PROPRIETARY

REQUEST: Please provide (i) the percentage of loops within each BellSouth wire center in Florida that exceed 17,500 feet in length and (ii) the percentage of the loops used to provision xDSL service to BellSouth's retail customers within each BellSouth wire center in Florida that exceed 17,500 feet in length.

RESPONSE: BellSouth objects to this Interrogatory to the extent it seeks information concerning the cost of BellSouth's retail services, which is not relevant to any issue in this proceeding nor reasonably calculated to lead to the discovery of admissible evidence.

However, subject to this objection, and without waiving this objection, BellSouth provides the following:

(i) BellSouth does not maintain the requested percentage of loops exceeding 17, 500, but is providing the percentage of loops that exceeds 18, 000. This information if proprietary and is being provided subject to the terms of the protective agreement executed by the parties.

RESPONSE PROVIDED BY:

Robert McKnight
Director
3535 Colonnade Pkwy
Birmingham, AL 35243

3/6/07 (entire document)
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appeal

Florida ADSL Comparison

All Lenghts		< 18kft			
Sum of ServiceCount		Sum of ServiceCount			
CLLI	Total	CLLI	Total	Col B - Col D	% > 18kft
ARCHFLMARS0	3162	ARCHFLMARS0	1140	2022	63.95%
BCRTFLBTDS0	37427	BCRTFLBTDS0	23024	14403	38.48%
BCRTFLMADS1	81553	BCRTFLMADS1	17756	63797	78.23%
BCRTFLSADS0	70358	BCRTFLSADS0	15426	54932	78.07%
BGPIFLMARS0	5889	BGPIFLMARS0	2630	3259	55.34%
BKVLFLJFDS0	23605	BKVLFLJFDS0	8432	15173	64.28%
BLDWFLMARS0	2436	BLDWFLMARS0	1427	1009	41.42%
BLGLFLMADS0	10661	BLGLFLMADS0	8021	2640	24.76%
BNNLFLMARS0	7147	BNNLFLMARS0	2285	4862	68.03%
BRSNFLMARS0	3471	BRSNFLMARS0	1209	2262	65.17%
BYBHFLMADS0	73259	BYBHFLMADS0	6991	66268	90.46%
CCBHFLMADS0	24942	CCBHFLMADS0	13028	11914	47.77%
CDKYFLMARS0	1294	CDKYFLMARS0	895	399	30.83%
CFLDFLMARS0	5058	CFLDFLMARS0	1788	3270	64.65%
CHPLFLJADS0	6342	CHPLFLJADS0	3626	2716	42.83%
CNTMFLLEDS1	8898	CNTMFLLEDS1	2485	6413	72.07%
COCOFLMADS0	48550	COCOFLMADS0	7668	40882	84.21%
COCOFLMEDS0	27307	COCOFLMEDS0	10301	17006	62.28%
CSCYFLBARS0	3790	CSCYFLBARS0	1704	2086	55.04%
DBRYFLDLDS0	14960	DBRYFLDLDS0	5591	9369	62.63%
DBRYFLMARS1	7693	DBRYFLMARS1	5378	2315	30.09%
DELDFLMADS0	29828	DELDFLMADS0	11129	18699	62.69%
DLBHFLKPDS0	43485	DLBHFLKPDS0	7755	35730	82.17%
DLBHFLMADS0	46281	DLBHFLMADS0	24583	21698	46.88%
DLSPFLMARS0	2582	DLSPFLMARS0	1903	679	26.30%
DNLNFLWMRS0	13410	DNLNFLWMRS0	2435	10975	81.84%
DRBHFLMADS0	67657	DRBHFLMADS0	21449	46208	68.30%
DYBHFLFNRS0	2693	DYBHFLFNRS0	2693	0	0.00%
DYBHFLMADS0	48824	DYBHFLMADS0	22075	26749	54.79%
DYBHFLOBDS0	35209	DYBHFLOBDS0	9713	25496	72.41%
DYBHFLOSDS0	8212	DYBHFLOSDS0	4286	3926	47.81%
DYBHFLPODS0	55066	DYBHFLPODS0	13185	41881	76.06%
EGLLFLBGDS0	46907	EGLLFLBGDS0	11099	35808	76.34%
EGLLFLIHDS0	21478	EGLLFLIHDS0	12381	9097	42.35%
EORNFLMARS0	5708	EORNFLMARS0	1040	4668	81.78%
FLBHFLMARS0	4999	FLBHFLMARS0	3633	1366	27.33%
FRBHFLFPDS0	18783	FRBHFLFPDS0	7505	11278	60.04%
FTGRFLMARS0	620	FTGRFLMARS0	235	385	62.10%
FTLDFLAPRS0	2147	FTLDFLAPRS0	936	1211	56.40%
FTLDFLCRDS0	52044	FTLDFLCRDS0	27464	24580	47.23%
FTLDFLCYDS0	47897	FTLDFLCYDS0	20674	27223	56.84%
FTLDFLJADS0	73312	FTLDFLJADS0	8066	65246	89.00%
FTLDFLMRDS0	78375	FTLDFLMRDS0	34289	44086	56.25%
FTLDFLOADS0	67706	FTLDFLOADS0	42778	24928	36.82%
FTLDFLPLDS0	64545	FTLDFLPLDS0	11791	52754	81.73%
FTLDFLSGDS0	7106	FTLDFLSGDS0	4968	2138	30.09%

Florida ADSL Comparison

All Lenghts		< 18kft			
Sum of ServiceCount		Sum of ServiceCount			
CLLI	Total	CLLI	Total	Col B - Col D	% > 18kft
FTLDFLSUDS0	50674	FTLDFLSUDS0	23311	27363	54.00%
FTLDFLWNDS0	29811	FTLDFLWNDS0	3091	26720	89.63%
FTPRFLMADS0	55056	FTPRFLMADS0	14208	40848	74.19%
GCSPFLCNDS0	9316	GCSPFLCNDS0	3780	5536	59.42%
GCVLFLMARS0	3579	GCVLFLMARS0	2132	1447	40.43%
GENVFLMARS0	2729	GENVFLMARS0	1171	1558	57.09%
GLBRFLMCDS0	18366	GLBRFLMCDS0	4900	13466	73.32%
GSVLFLMADS0	96034	GSVLFLMADS0	19641	76393	79.55%
GSVLFLNW33E	14038	GSVLFLNW33E	9606	4432	31.57%
HAVNFLMADS0	5289	HAVNFLMADS0	2519	2770	52.37%
HBSDFLMADS0	11398	HBSDFLMADS0	6767	4631	40.63%
HLNVFLMADS1	11422	HLNVFLMADS1	2627	8795	77.00%
HLWDFLHADS0	32710	HLWDFLHADS0	30846	1864	5.70%
HLWDFLMADS0	54967	HLWDFLMADS0	12017	42950	78.14%
HLWDFLPEDS0	112907	HLWDFLPEDS0	13537	99370	88.01%
HLWDFLWHDS0	93178	HLWDFLWHDS0	14881	78297	84.03%
HMSTFLAFRS0	7726	HMSTFLAFRS0	2936	4790	62.00%
HMSTFLEARS0	1153	HMSTFLEARS0	267	886	76.84%
HMSTFLHMDS0	33838	HMSTFLHMDS0	13902	19936	58.92%
HTISFLMADS0	19474	HTISFLMADS0	6354	13120	67.37%
HWTHFLMARS0	3891	HWTHFLMARS0	1674	2217	56.98%
ISLMFLMARS0	5310	ISLMFLMARS0	2567	2743	51.66%
JAY-FLMARS0	2782	JAY-FLMARS0	904	1878	67.51%
JCBHFLABRS0	13656	JCBHFLABRS0	7654	6002	43.95%
JCBHFLMADS0	34941	JCBHFLMADS0	12209	22732	65.06%
JCBHFLSPRS0	13039	JCBHFLSPRS0	10906	2133	16.36%
JCVLFLARDS0	32094	JCVLFLARDS0	10511	21583	67.25%
JCVLFLBWDS0	39305	JCVLFLBWDS0	12176	27129	69.02%
JCVLFLCLDS0	41263	JCVLFLCLDS0	13877	27386	66.37%
JCVLFLFCDS0	21837	JCVLFLFCDS0	7769	14068	64.42%
JCVLFLIARS0	1526	JCVLFLIARS0	1406	120	7.86%
JCVLFLJTRS0	6339	JCVLFLJTRS0	6339	0	0.00%
JCVLFLLFDS0	33883	JCVLFLLFDS0	5661	28222	83.29%
JCVLFLNODS0	33286	JCVLFLNODS0	7002	26284	78.96%
JCVLFLOWDS0	18740	JCVLFLOWDS0	5919	12821	68.42%
JCVLFLRVDS0	33234	JCVLFLRVDS0	13765	19469	58.58%
JCVLFLSJ73E	44636	JCVLFLSJ73E	15483	29153	65.31%
JCVLFLSMDS0	22271	JCVLFLSMDS0	16763	5508	24.73%
JCVLFLWCDS0	41154	JCVLFLWCDS0	12578	28576	69.44%
JPTRFLMADS0	54719	JPTRFLMADS0	15420	39299	71.82%
KYHGFLMARS0	6679	KYHGFLMARS0	3108	3571	53.47%
KYLRFLLSRS0	8962	KYLRFLLSRS0	4982	3980	44.41%
KYLRFLMARS0	9945	KYLRFLMARS0	3705	6240	62.75%
KYWSFLMADS0	29557	KYWSFLMADS0	15764	13793	46.67%
LKCYFLMADS0	26836	LKCYFLMADS0	12008	14828	55.25%
LKMRFLMADS0	9814	LKMRFLMADS0	474	9340	95.17%

Florida ADSL Comparison

All Lenghts		< 18kft			
Sum of ServiceCount		Sum of ServiceCount			
CLLI	Total	CLLI	Total	Col B - Col D	% > 18kft
LYHNFLOHDS0	12553	LYHNFLOHDS0	5653	6900	54.97%
MCNPFLMARS0	1771	MCNPFLMARS0	647	1124	63.47%
MDBGFLPMDS0	13943	MDBGFLPMDS0	2617	11326	81.23%
MIAMFLAEDS0	67872	MIAMFLAEDS0	39197	28675	42.25%
MIAMFLALDS0	32083	MIAMFLALDS0	15214	16869	52.58%
MIAMFLAPDS0	10390	MIAMFLAPDS0	7923	2467	23.74%
MIAMFLBADS0	35733	MIAMFLBADS0	35451	282	0.79%
MIAMFLBCDS0	15136	MIAMFLBCDS0	13417	1719	11.36%
MIAMFLBRDS0	54090	MIAMFLBRDS0	46321	7769	14.36%
MIAMFLCADS0	104257	MIAMFLCADS0	17129	87128	83.57%
MIAMFLDBRS1	2322	MIAMFLDBRS1	2322	0	0.00%
MIAMFLFLDS0	32960	MIAMFLFLDS0	20570	12390	37.59%
MIAMFLGRDS0	32272	MIAMFLGRDS0	32272	0	0.00%
MIAMFLHLDS0	119620	MIAMFLHLDS0	18131	101489	84.84%
MIAMFLICDS0	43281	MIAMFLICDS0	30813	12468	28.81%
MIAMFLKEDS0	11102	MIAMFLKEDS0	10831	271	2.44%
MIAMFLMEDS0	17129	MIAMFLMEDS0	11174	5955	34.77%
MIAMFLNMDS0	28920	MIAMFLNMDS0	12385	16535	57.17%
MIAMFLNSDS0	33696	MIAMFLNSDS0	11780	21916	65.04%
MIAMFLOLDS0	35047	MIAMFLOLDS0	12498	22549	64.34%
MIAMFLPBDS0	47092	MIAMFLPBDS0	22950	24142	51.27%
MIAMFLPLDS0	65285	MIAMFLPLDS0	10417	54868	84.04%
MIAMFLRRDS0	59174	MIAMFLRRDS0	23619	35555	60.09%
MIAMFLSHDS0	40557	MIAMFLSHDS0	17383	23174	57.14%
MIAMFLSODS0	66149	MIAMFLSODS0	35989	30160	45.59%
MIAMFLWDDS0	60409	MIAMFLWDDS0	14761	45648	75.56%
MIAMFLWMDS0	46609	MIAMFLWMDS0	22816	23793	51.05%
MICCFLBBRS0	6584	MICCFLBBRS0	4234	2350	35.69%
MLBRFLMADS0	91737	MLBRFLMADS0	14222	77515	84.50%
MLTNFLRADS0	20123	MLTNFLRADS0	6234	13889	69.02%
MNDRFLAVDS0	7385	MNDRFLAVDS0	5988	1397	18.92%
MNDRFLLODS0	40749	MNDRFLLODS0	11441	29308	71.92%
MNDRFLLWRS0	7601	MNDRFLLWRS0	3777	3824	50.31%
MNSNFLMARS0	619	MNSNFLMARS0	148	471	76.09%
MRTHFLVERS0	12447	MRTHFLVERS0	3281	9166	73.64%
MXVLFLMARS0	1423	MXVLFLMARS0	433	990	69.57%
NDADFLACDS0	46660	NDADFLACDS0	30696	15964	34.21%
NDADFLBRDS0	48778	NDADFLBRDS0	7158	41620	85.33%
NDADFLGGDS0	36141	NDADFLGGDS0	17544	18597	51.46%
NDADFLOLDS0	46895	NDADFLOLDS0	27521	19374	41.31%
NKLRFLMARS0	3222	NKLRFLMARS0	3098	124	3.85%
NSBHFLMADS0	36693	NSBHFLMADS0	13190	23503	64.05%
NWBYFLMARS0	4453	NWBYFLMARS0	1302	3151	70.76%
OKHLFLMARS0	2305	OKHLFLMARS0	1075	1230	53.36%
OLTWFLLNRS0	4180	OLTWFLLNRS0	338	3842	91.91%
ORLDFLAPDS0	98933	ORLDFLAPDS0	5365	93568	94.58%

Florida ADSL Comparison

All Lenghts		< 18kft			
Sum of ServiceCount		Sum of ServiceCount			
CLLI	Total	CLLI	Total	Col B - Col D	% > 18kft
ORLDFLCLDS0	36538	ORLDFLCLDS0	15373	21165	57.93%
ORLDFLMADS1	59001	ORLDFLMADS1	22928	36073	61.14%
ORLDFLPCDS0	76653	ORLDFLPCDS0	9617	67036	87.45%
ORLDFLPHDS0	102526	ORLDFLPHDS0	14934	87592	85.43%
ORLDFLSADS0	34804	ORLDFLSADS0	5968	28836	82.85%
ORPKFLMADS0	26889	ORPKFLMADS0	9835	17054	63.42%
ORPKFLRWDS0	17397	ORPKFLRWDS0	9236	8161	46.91%
OVIDFLCADS0	32186	OVIDFLCADS0	10616	21570	67.02%
PACEFLPV99E	12085	PACEFLPV99E	4791	7294	60.36%
PAHKFLMARS0	3511	PAHKFLMARS0	2963	548	15.61%
PCBHFLNTDS0	29114	PCBHFLNTDS0	3833	25281	86.83%
PLCSFLMADS0	19156	PLCSFLMADS0	4298	14858	77.56%
PLTKFLMADS0	19943	PLTKFLMADS0	6892	13051	65.44%
PMBHFLCSDS0	80603	PMBHFLCSDS0	6034	74569	92.51%
PMBHFLFEDS0	79107	PMBHFLFEDS0	19096	60011	75.86%
PMBHFLMADS0	85621	PMBHFLMADS0	21195	64426	75.25%
PMBHFLTADS0	41099	PMBHFLTADS0	16065	25034	60.91%
PMPKFLMARS0	3187	PMPKFLMARS0	891	2296	72.04%
PNCYFLCA87E	8332	PNCYFLCA87E	5045	3287	39.45%
PNCYFLMADS0	43959	PNCYFLMADS0	11452	32507	73.95%
PNSCFLBLDS0	44172	PNSCFLBLDS0	10876	33296	75.38%
PNSCFLFPDS0	55324	PNSCFLFPDS0	4691	50633	91.52%
PNSCFLHCDS0	10282	PNSCFLHCDS0	3950	6332	61.58%
PNSCFLPBDS0	7643	PNSCFLPBDS0	4777	2866	37.50%
PNSCFLWADS0	34456	PNSCFLWADS0	4664	29792	86.46%
PNVDFLMADS0	22069	PNVDFLMADS0	12772	9297	42.13%
PRRNFLMADS0	108302	PRRNFLMADS0	4778	103524	95.59%
PRSNFLFDRS0	2856	PRSNFLFDRS0	1105	1751	61.31%
PTSLFLMADS0	40875	PTSLFLMADS0	6499	34376	84.10%
PTSLFLSOCG0	17024	PTSLFLSOCG0	5889	11135	65.41%
SBSTFLFERS0	1538	SBSTFLFERS0	1375	163	10.60%
SBSTFLMADS0	15921	SBSTFLMADS0	4625	11296	70.95%
SGKYFLMARS0	4454	SGKYFLMARS0	1019	3435	77.12%
SNFRFLMADS0	56829	SNFRFLMADS0	6614	50215	88.36%
STAGFLBSRS0	13056	STAGFLBSRS0	4006	9050	69.32%
STAGFLMADS0	24990	STAGFLMADS0	10058	14932	59.75%
STAGFLSHRS0	10863	STAGFLSHRS0	5586	5277	48.58%
STAGFLWGRS0	1328	STAGFLWGRS0	301	1027	77.33%
STRTFLMADS0	64349	STRTFLMADS0	13070	51279	79.69%
SYHSFLCCRS0	1749	SYHSFLCCRS0	30	1719	98.28%
TRENFLMARS0	4137	TRENFLMARS0	1403	2734	66.09%
TTVLFLMADS0	36120	TTVLFLMADS0	9738	26382	73.04%
VERNFLMARS0	2076	VERNFLMARS0	729	1347	64.88%
VRBHFLBERS0	15033	VRBHFLBERS0	8233	6800	45.23%
VRBHFLMADS0	50702	VRBHFLMADS0	14259	36443	71.88%
WELKFLMARS0	2613	WELKFLMARS0	796	1817	69.54%

Florida ADSL Comparison

All Lenghts		< 18kft			
Sum of ServiceCount		Sum of ServiceCount			
CLLI	Total	CLLI	Total	Col B - Col D	% > 18kft
WPBHFLANDS0	41045	WPBHFLANDS0	26570	14475	35.27%
WPBHFLGADS0	99653	WPBHFLGADS0	27696	71957	72.21%
WPBHFLGRDS0	62470	WPBHFLGRDS0	14326	48144	77.07%
WPBHFLHHDS0	74975	WPBHFLHHDS0	20621	54354	72.50%
WPBHFLLEDS0	47517	WPBHFLLEDS0	24801	22716	47.81%
WPBHFLRBDS0	49411	WPBHFLRBDS0	17986	31425	63.60%
WPBHFLRPDS0	53687	WPBHFLRPDS0	10283	43404	80.85%
WWSPFLHIDS0	16290	WWSPFLHIDS0	2758	13532	83.07%
WWSPFLSHDS0	36300	WWSPFLSHDS0	4520	31780	87.55%
YNFNFLMARS0	3515	YNFNFLMARS0	455	3060	87.06%
YNTWFLMARS0	2549	YNTWFLMARS0	1811	738	28.95%
YULEFLMARS0	4222	YULEFLMARS0	1488	2734	64.76%
Grand Total	6124526	Grand Total	2005532	4118994	

BSTLM
RService: A.6.1. (2-WIRE ASYMMETRICAL DIGITAL SUBSCRIDER LINE (ADSL) COMPATIBLE LOOP)
Geographical Unit: FL - all available
Quantity: 6124526

Services Reported: a	b	c	d	e	j
Services Returned: a	b	c	d	e	j

Scenario: Copper Only-Fl-Ref
Options: Local loop only CU fed only

CLLI	ServiceCode	All Lenghts ServiceCount
ARCHFLMARS0	a-LOCAL POTS	3145
ARCHFLMARS0	b-PBX	4
ARCHFLMARS0	d-COIN SMART	1
ARCHFLMARS0	e-COIN REGUL	12
BCRTFLBTDS0	a-LOCAL POTS	34772
BCRTFLBTDS0	A-2WG UV	8
BCRTFLBTDS0	b-PBX	1395
BCRTFLBTDS0	c-CENTREX	804
BCRTFLBTDS0	d-COIN SMART	3
BCRTFLBTDS0	e-COIN REGUL	286
BCRTFLBTDS0	j-SLV ANALOG	159
BCRTFLMADS1	a-LOCAL POTS	76654
BCRTFLMADS1	b-PBX	1196
BCRTFLMADS1	c-CENTREX	2087
BCRTFLMADS1	d-COIN SMART	2
BCRTFLMADS1	e-COIN REGUL	579
BCRTFLMADS1	j-SLV ANALOG	1035
BCRTFLSADS0	a-LOCAL POTS	69108
BCRTFLSADS0	b-PBX	329
BCRTFLSADS0	c-CENTREX	373
BCRTFLSADS0	d-COIN SMART	142
BCRTFLSADS0	e-COIN REGUL	232
BCRTFLSADS0	j-SLV ANALOG	174
BGPIFLMARS0	a-LOCAL POTS	5773
BGPIFLMARS0	b-PBX	13
BGPIFLMARS0	d-COIN SMART	7
BGPIFLMARS0	e-COIN REGUL	72
BGPIFLMARS0	j-SLV ANALOG	24
BKVLFLJFDS0	a-LOCAL POTS	22626
BKVLFLJFDS0	b-PBX	294
BKVLFLJFDS0	c-CENTREX	116
BKVLFLJFDS0	d-COIN SMART	50
BKVLFLJFDS0	e-COIN REGUL	234
BKVLFLJFDS0	j-SLV ANALOG	285
BLDWFLMARS0	a-LOCAL POTS	2323
BLDWFLMARS0	A-2WG UV	2
BLDWFLMARS0	b-PBX	29
BLDWFLMARS0	d-COIN SMART	7
BLDWFLMARS0	e-COIN REGUL	70

BLDWFLMARS0	j-SLV ANALOG	5
BLGLFLMADS0	a-LOCAL POTS	9350
BLGLFLMADS0	b-PBX	312
BLGLFLMADS0	c-CENTREX	512
BLGLFLMADS0	d-COIN SMART	2
BLGLFLMADS0	e-COIN REGUL	322
BLGLFLMADS0	j-SLV ANALOG	163
BNNLFLMARS0	a-LOCAL POTS	6422
BNNLFLMARS0	b-PBX	168
BNNLFLMARS0	c-CENTREX	444
BNNLFLMARS0	d-COIN SMART	1
BNNLFLMARS0	e-COIN REGUL	75
BNNLFLMARS0	j-SLV ANALOG	37
BRSNFLMARS0	a-LOCAL POTS	3057
BRSNFLMARS0	c-CENTREX	370
BRSNFLMARS0	d-COIN SMART	3
BRSNFLMARS0	e-COIN REGUL	35
BRSNFLMARS0	j-SLV ANALOG	6
BYBHFLMADS0	a-LOCAL POTS	71363
BYBHFLMADS0	b-PBX	357
BYBHFLMADS0	c-CENTREX	819
BYBHFLMADS0	e-COIN REGUL	513
BYBHFLMADS0	j-SLV ANALOG	207
CCBHFLMADS0	a-LOCAL POTS	23262
CCBHFLMADS0	b-PBX	624
CCBHFLMADS0	c-CENTREX	401
CCBHFLMADS0	d-COIN SMART	23
CCBHFLMADS0	e-COIN REGUL	443
CCBHFLMADS0	j-SLV ANALOG	189
CDKYFLMARS0	a-LOCAL POTS	1258
CDKYFLMARS0	b-PBX	10
CDKYFLMARS0	d-COIN SMART	7
CDKYFLMARS0	e-COIN REGUL	12
CDKYFLMARS0	j-SLV ANALOG	7
CFLDFLMARS0	a-LOCAL POTS	4793
CFLDFLMARS0	b-PBX	41
CFLDFLMARS0	c-CENTREX	151
CFLDFLMARS0	d-COIN SMART	4
CFLDFLMARS0	e-COIN REGUL	61
CFLDFLMARS0	j-SLV ANALOG	8
CHPLFLJADS0	a-LOCAL POTS	5741
CHPLFLJADS0	b-PBX	100
CHPLFLJADS0	c-CENTREX	383
CHPLFLJADS0	e-COIN REGUL	77
CHPLFLJADS0	j-SLV ANALOG	41
CNTMFLLEDS1	a-LOCAL POTS	8670
CNTMFLLEDS1	b-PBX	144
CNTMFLLEDS1	e-COIN REGUL	54
CNTMFLLEDS1	j-SLV ANALOG	30

COCOFLMADS0	a-LOCAL POTS	46340
COCOFLMADS0	b-PBX	306
COCOFLMADS0	c-CENTREX	970
COCOFLMADS0	d-COIN SMART	48
COCOFLMADS0	e-COIN REGUL	620
COCOFLMADS0	j-SLV ANALOG	266
COCOFLMEDS0	a-LOCAL POTS	26144
COCOFLMEDS0	b-PBX	374
COCOFLMEDS0	c-CENTREX	440
COCOFLMEDS0	d-COIN SMART	28
COCOFLMEDS0	e-COIN REGUL	265
COCOFLMEDS0	j-SLV ANALOG	56
CSCYFLBARS0	a-LOCAL POTS	3461
CSCYFLBARS0	b-PBX	11
CSCYFLBARS0	c-CENTREX	235
CSCYFLBARS0	d-COIN SMART	7
CSCYFLBARS0	e-COIN REGUL	61
CSCYFLBARS0	j-SLV ANALOG	15
DBRYFLDLDS0	a-LOCAL POTS	14535
DBRYFLDLDS0	b-PBX	24
DBRYFLDLDS0	c-CENTREX	346
DBRYFLDLDS0	e-COIN REGUL	52
DBRYFLDLDS0	j-SLV ANALOG	3
DBRYFLMARS1	a-LOCAL POTS	7532
DBRYFLMARS1	b-PBX	13
DBRYFLMARS1	c-CENTREX	87
DBRYFLMARS1	d-COIN SMART	12
DBRYFLMARS1	e-COIN REGUL	42
DBRYFLMARS1	j-SLV ANALOG	7
DELDFLMADS0	a-LOCAL POTS	28569
DELDFLMADS0	b-PBX	284
DELDFLMADS0	c-CENTREX	400
DELDFLMADS0	e-COIN REGUL	361
DELDFLMADS0	j-SLV ANALOG	214
DLBHFLKPDS0	a-LOCAL POTS	42609
DLBHFLKPDS0	b-PBX	254
DLBHFLKPDS0	c-CENTREX	314
DLBHFLKPDS0	d-COIN SMART	1
DLBHFLKPDS0	e-COIN REGUL	223
DLBHFLKPDS0	j-SLV ANALOG	84
DLBHFLMADS0	a-LOCAL POTS	44152
DLBHFLMADS0	b-PBX	778
DLBHFLMADS0	c-CENTREX	537
DLBHFLMADS0	d-COIN SMART	1
DLBHFLMADS0	e-COIN REGUL	396
DLBHFLMADS0	j-SLV ANALOG	417
DLSPFLMARS0	a-LOCAL POTS	2459
DLSPFLMARS0	b-PBX	15
DLSPFLMARS0	c-CENTREX	47

DLSPFLMARS0	d-COIN SMART	1
DLSPFLMARS0	e-COIN REGUL	28
DLSPFLMARS0	j-SLV ANALOG	32
DNLNFLWMRS0	a-LOCAL POTS	13296
DNLNFLWMRS0	b-PBX	16
DNLNFLWMRS0	d-COIN SMART	11
DNLNFLWMRS0	e-COIN REGUL	66
DNLNFLWMRS0	j-SLV ANALOG	21
DRBHFLMADS0	a-LOCAL POTS	64658
DRBHFLMADS0	b-PBX	996
DRBHFLMADS0	c-CENTREX	1121
DRBHFLMADS0	d-COIN SMART	90
DRBHFLMADS0	e-COIN REGUL	451
DRBHFLMADS0	j-SLV ANALOG	341
DYBHFLFNRS0	a-LOCAL POTS	2210
DYBHFLFNRS0	b-PBX	103
DYBHFLFNRS0	c-CENTREX	350
DYBHFLFNRS0	e-COIN REGUL	25
DYBHFLFNRS0	j-SLV ANALOG	5
DYBHFLMADS0	a-LOCAL POTS	43946
DYBHFLMADS0	A-2WG UV	39
DYBHFLMADS0	b-PBX	1986
DYBHFLMADS0	c-CENTREX	563
DYBHFLMADS0	e-COIN REGUL	1390
DYBHFLMADS0	j-SLV ANALOG	900
DYBHFLOBDS0	a-LOCAL POTS	34056
DYBHFLOBDS0	A-2WG UV	2
DYBHFLOBDS0	b-PBX	581
DYBHFLOBDS0	c-CENTREX	125
DYBHFLOBDS0	e-COIN REGUL	362
DYBHFLOBDS0	j-SLV ANALOG	83
DYBHFLOSDS0	a-LOCAL POTS	8157
DYBHFLOSDS0	b-PBX	15
DYBHFLOSDS0	e-COIN REGUL	28
DYBHFLOSDS0	j-SLV ANALOG	12
DYBHFLPODS0	a-LOCAL POTS	53900
DYBHFLPODS0	A-2WG UV	30
DYBHFLPODS0	b-PBX	374
DYBHFLPODS0	c-CENTREX	269
DYBHFLPODS0	e-COIN REGUL	411
DYBHFLPODS0	j-SLV ANALOG	82
EGLLFLBGDS0	a-LOCAL POTS	45360
EGLLFLBGDS0	A-2WG UV	2
EGLLFLBGDS0	b-PBX	534
EGLLFLBGDS0	c-CENTREX	659
EGLLFLBGDS0	d-COIN SMART	40
EGLLFLBGDS0	e-COIN REGUL	275
EGLLFLBGDS0	j-SLV ANALOG	37
EGLLFLIHDS0	a-LOCAL POTS	21041

EGLLFLIHDS0	b-PBX	129
EGLLFLIHDS0	c-CENTREX	111
EGLLFLIHDS0	d-COIN SMART	14
EGLLFLIHDS0	e-COIN REGUL	143
EGLLFLIHDS0	j-SLV ANALOG	40
EORNFLMARS0	a-LOCAL POTS	5661
EORNFLMARS0	b-PBX	1
EORNFLMARS0	d-COIN SMART	1
EORNFLMARS0	e-COIN REGUL	44
EORNFLMARS0	j-SLV ANALOG	1
FLBHFLMARS0	a-LOCAL POTS	4768
FLBHFLMARS0	b-PBX	18
FLBHFLMARS0	c-CENTREX	125
FLBHFLMARS0	e-COIN REGUL	79
FLBHFLMARS0	j-SLV ANALOG	9
FRBHFLFPDS0	a-LOCAL POTS	18118
FRBHFLFPDS0	A-2WG UV	6
FRBHFLFPDS0	b-PBX	245
FRBHFLFPDS0	c-CENTREX	148
FRBHFLFPDS0	e-COIN REGUL	197
FRBHFLFPDS0	j-SLV ANALOG	69
FTGRFLMARS0	a-LOCAL POTS	577
FTGRFLMARS0	b-PBX	9
FTGRFLMARS0	c-CENTREX	17
FTGRFLMARS0	e-COIN REGUL	17
FTLDFLAPRS0	a-LOCAL POTS	1376
FTLDFLAPRS0	b-PBX	126
FTLDFLAPRS0	c-CENTREX	363
FTLDFLAPRS0	d-COIN SMART	27
FTLDFLAPRS0	e-COIN REGUL	207
FTLDFLAPRS0	j-SLV ANALOG	48
FTLDFLCRDS0	a-LOCAL POTS	49393
FTLDFLCRDS0	A-2WG UV	43
FTLDFLCRDS0	b-PBX	1086
FTLDFLCRDS0	c-CENTREX	739
FTLDFLCRDS0	d-COIN SMART	2
FTLDFLCRDS0	e-COIN REGUL	609
FTLDFLCRDS0	j-SLV ANALOG	172
FTLDFLCYDS0	a-LOCAL POTS	43206
FTLDFLCYDS0	A-2WG UV	255
FTLDFLCYDS0	b-PBX	1820
FTLDFLCYDS0	c-CENTREX	1784
FTLDFLCYDS0	d-COIN SMART	45
FTLDFLCYDS0	e-COIN REGUL	582
FTLDFLCYDS0	j-SLV ANALOG	205
FTLDFLJADS0	a-LOCAL POTS	70511
FTLDFLJADS0	b-PBX	1006
FTLDFLJADS0	c-CENTREX	947
FTLDFLJADS0	d-COIN SMART	61

FTLDFLJADS0	e-COIN REGUL	604
FTLDFLJADS0	j-SLV ANALOG	183
FTLDFLMRDS0	a-LOCAL POTS	70676
FTLDFLMRDS0	A-2WG UV	242
FTLDFLMRDS0	b-PBX	1970
FTLDFLMRDS0	c-CENTREX	1809
FTLDFLMRDS0	e-COIN REGUL	1761
FTLDFLMRDS0	j-SLV ANALOG	1917
FTLDFLOADS0	a-LOCAL POTS	65070
FTLDFLOADS0	A-2WG UV	27
FTLDFLOADS0	b-PBX	700
FTLDFLOADS0	c-CENTREX	1154
FTLDFLOADS0	d-COIN SMART	89
FTLDFLOADS0	e-COIN REGUL	517
FTLDFLOADS0	j-SLV ANALOG	149
FTLDFLPLDS0	a-LOCAL POTS	61682
FTLDFLPLDS0	A-2WG UV	41
FTLDFLPLDS0	b-PBX	664
FTLDFLPLDS0	c-CENTREX	1038
FTLDFLPLDS0	d-COIN SMART	3
FTLDFLPLDS0	e-COIN REGUL	901
FTLDFLPLDS0	j-SLV ANALOG	216
FTLDFLSGDS0	a-LOCAL POTS	6357
FTLDFLSGDS0	b-PBX	359
FTLDFLSGDS0	c-CENTREX	243
FTLDFLSGDS0	e-COIN REGUL	121
FTLDFLSGDS0	j-SLV ANALOG	26
FTLDFLSUDS0	a-LOCAL POTS	49020
FTLDFLSUDS0	b-PBX	241
FTLDFLSUDS0	c-CENTREX	932
FTLDFLSUDS0	d-COIN SMART	1
FTLDFLSUDS0	e-COIN REGUL	378
FTLDFLSUDS0	j-SLV ANALOG	102
FTLDFLWNDS0	a-LOCAL POTS	28683
FTLDFLWNDS0	b-PBX	526
FTLDFLWNDS0	c-CENTREX	426
FTLDFLWNDS0	d-COIN SMART	35
FTLDFLWNDS0	e-COIN REGUL	137
FTLDFLWNDS0	j-SLV ANALOG	4
FTPRFLMADS0	a-LOCAL POTS	52219
FTPRFLMADS0	b-PBX	719
FTPRFLMADS0	c-CENTREX	462
FTPRFLMADS0	d-COIN SMART	1
FTPRFLMADS0	e-COIN REGUL	1064
FTPRFLMADS0	j-SLV ANALOG	591
GCSPFLCNDS0	a-LOCAL POTS	8551
GCSPFLCNDS0	b-PBX	31
GCSPFLCNDS0	c-CENTREX	407
GCSPFLCNDS0	d-COIN SMART	2

GCSPFLCNDS0	e-COIN REGUL	138
GCSPFLCNDS0	j-SLV ANALOG	187
GCVLFLMARS0	a-LOCAL POTS	3476
GCVLFLMARS0	b-PBX	42
GCVLFLMARS0	e-COIN REGUL	42
GCVLFLMARS0	j-SLV ANALOG	19
GENVFLMARS0	a-LOCAL POTS	2712
GENVFLMARS0	b-PBX	4
GENVFLMARS0	d-COIN SMART	2
GENVFLMARS0	e-COIN REGUL	7
GENVFLMARS0	j-SLV ANALOG	4
GLBRFLMCDS0	a-LOCAL POTS	17647
GLBRFLMCDS0	b-PBX	194
GLBRFLMCDS0	c-CENTREX	331
GLBRFLMCDS0	e-COIN REGUL	173
GLBRFLMCDS0	j-SLV ANALOG	21
GSVLFLMADS0	a-LOCAL POTS	91913
GSVLFLMADS0	b-PBX	1504
GSVLFLMADS0	c-CENTREX	1135
GSVLFLMADS0	d-COIN SMART	100
GSVLFLMADS0	e-COIN REGUL	1006
GSVLFLMADS0	j-SLV ANALOG	376
GSVLFLNW33E	a-LOCAL POTS	13196
GSVLFLNW33E	b-PBX	272
GSVLFLNW33E	c-CENTREX	411
GSVLFLNW33E	d-COIN SMART	11
GSVLFLNW33E	e-COIN REGUL	146
GSVLFLNW33E	j-SLV ANALOG	2
HAVNFLMADS0	a-LOCAL POTS	5213
HAVNFLMADS0	b-PBX	24
HAVNFLMADS0	e-COIN REGUL	43
HAVNFLMADS0	j-SLV ANALOG	9
HBSDFLMADS0	a-LOCAL POTS	11107
HBSDFLMADS0	b-PBX	88
HBSDFLMADS0	c-CENTREX	79
HBSDFLMADS0	d-COIN SMART	27
HBSDFLMADS0	e-COIN REGUL	52
HBSDFLMADS0	j-SLV ANALOG	45
HLNVFLMADS1	a-LOCAL POTS	11286
HLNVFLMADS1	b-PBX	53
HLNVFLMADS1	e-COIN REGUL	72
HLNVFLMADS1	j-SLV ANALOG	11
HLWDFLHADS0	a-LOCAL POTS	31392
HLWDFLHADS0	b-PBX	322
HLWDFLHADS0	c-CENTREX	567
HLWDFLHADS0	d-COIN SMART	1
HLWDFLHADS0	e-COIN REGUL	368
HLWDFLHADS0	j-SLV ANALOG	60
HLWDFLMADS0	a-LOCAL POTS	51586

HLWDFLMADS0	A-2WG UV	78
HLWDFLMADS0	b-PBX	1005
HLWDFLMADS0	c-CENTREX	628
HLWDFLMADS0	d-COIN SMART	64
HLWDFLMADS0	e-COIN REGUL	896
HLWDFLMADS0	j-SLV ANALOG	710
HLWDFLPEDS0	a-LOCAL POTS	109724
HLWDFLPEDS0	b-PBX	684
HLWDFLPEDS0	c-CENTREX	1666
HLWDFLPEDS0	d-COIN SMART	51
HLWDFLPEDS0	e-COIN REGUL	655
HLWDFLPEDS0	j-SLV ANALOG	127
HLWDFLWHDS0	a-LOCAL POTS	89643
HLWDFLWHDS0	A-2WG UV	14
HLWDFLWHDS0	b-PBX	636
HLWDFLWHDS0	c-CENTREX	1611
HLWDFLWHDS0	d-COIN SMART	84
HLWDFLWHDS0	e-COIN REGUL	972
HLWDFLWHDS0	j-SLV ANALOG	218
HMSTFLAFRS0	a-LOCAL POTS	7342
HMSTFLAFRS0	b-PBX	20
HMSTFLAFRS0	c-CENTREX	268
HMSTFLAFRS0	d-COIN SMART	6
HMSTFLAFRS0	e-COIN REGUL	82
HMSTFLAFRS0	j-SLV ANALOG	8
HMSTFLEARS0	a-LOCAL POTS	1122
HMSTFLEARS0	b-PBX	5
HMSTFLEARS0	d-COIN SMART	18
HMSTFLEARS0	e-COIN REGUL	8
HMSTFLHMDS0	a-LOCAL POTS	31960
HMSTFLHMDS0	b-PBX	373
HMSTFLHMDS0	c-CENTREX	868
HMSTFLHMDS0	d-COIN SMART	35
HMSTFLHMDS0	e-COIN REGUL	465
HMSTFLHMDS0	j-SLV ANALOG	137
HTISFLMADS0	a-LOCAL POTS	19097
HTISFLMADS0	b-PBX	145
HTISFLMADS0	c-CENTREX	10
HTISFLMADS0	d-COIN SMART	1
HTISFLMADS0	e-COIN REGUL	138
HTISFLMADS0	j-SLV ANALOG	83
HWTHFLMARS0	a-LOCAL POTS	3804
HWTHFLMARS0	b-PBX	9
HWTHFLMARS0	c-CENTREX	25
HWTHFLMARS0	d-COIN SMART	5
HWTHFLMARS0	e-COIN REGUL	34
HWTHFLMARS0	j-SLV ANALOG	14
ISLMFLMARS0	a-LOCAL POTS	4935
ISLMFLMARS0	b-PBX	168

ISLMFLMARS0	c-CENTREX	60
ISLMFLMARS0	d-COIN SMART	3
ISLMFLMARS0	e-COIN REGUL	124
ISLMFLMARS0	j-SLV ANALOG	20
JAY-FLMARS0	a-LOCAL POTS	2755
JAY-FLMARS0	b-PBX	3
JAY-FLMARS0	e-COIN REGUL	14
JAY-FLMARS0	j-SLV ANALOG	10
JCBHFLABRS0	a-LOCAL POTS	13528
JCBHFLABRS0	A-2WG UV	10
JCBHFLABRS0	c-CENTREX	77
JCBHFLABRS0	d-COIN SMART	3
JCBHFLABRS0	e-COIN REGUL	38
JCBHFLMADS0	a-LOCAL POTS	33580
JCBHFLMADS0	A-2WG UV	39
JCBHFLMADS0	b-PBX	248
JCBHFLMADS0	c-CENTREX	404
JCBHFLMADS0	e-COIN REGUL	520
JCBHFLMADS0	j-SLV ANALOG	150
JCBHFLSPRS0	a-LOCAL POTS	12649
JCBHFLSPRS0	A-2WG UV	22
JCBHFLSPRS0	b-PBX	133
JCBHFLSPRS0	c-CENTREX	172
JCBHFLSPRS0	d-COIN SMART	4
JCBHFLSPRS0	e-COIN REGUL	54
JCBHFLSPRS0	j-SLV ANALOG	5
JCVLFLARDS0	a-LOCAL POTS	29561
JCVLFLARDS0	A-2WG UV	18
JCVLFLARDS0	b-PBX	442
JCVLFLARDS0	c-CENTREX	1632
JCVLFLARDS0	d-COIN SMART	11
JCVLFLARDS0	e-COIN REGUL	304
JCVLFLARDS0	j-SLV ANALOG	126
JCVLFLBWDS0	a-LOCAL POTS	37764
JCVLFLBWDS0	A-2WG UV	45
JCVLFLBWDS0	b-PBX	460
JCVLFLBWDS0	c-CENTREX	694
JCVLFLBWDS0	d-COIN SMART	16
JCVLFLBWDS0	e-COIN REGUL	295
JCVLFLBWDS0	j-SLV ANALOG	31
JCVLFLCLDS0	a-LOCAL POTS	32993
JCVLFLCLDS0	A-2WG UV	56
JCVLFLCLDS0	b-PBX	935
JCVLFLCLDS0	c-CENTREX	2430
JCVLFLCLDS0	d-COIN SMART	1
JCVLFLCLDS0	e-COIN REGUL	1264
JCVLFLCLDS0	j-SLV ANALOG	3584
JCVLFLFCDS0	a-LOCAL POTS	21378
JCVLFLFCDS0	A-2WG UV	19

JCVLFLFCDS0	b-PBX	28
JCVLFLFCDS0	c-CENTREX	242
JCVLFLFCDS0	d-COIN SMART	1
JCVLFLFCDS0	e-COIN REGUL	156
JCVLFLFCDS0	j-SLV ANALOG	13
JCVLFLIARS0	a-LOCAL POTS	1196
JCVLFLIARS0	A-2WG UV	8
JCVLFLIARS0	b-PBX	246
JCVLFLIARS0	e-COIN REGUL	73
JCVLFLIARS0	j-SLV ANALOG	3
JCVLFLJTRS0	a-LOCAL POTS	4825
JCVLFLJTRS0	A-2WG UV	24
JCVLFLJTRS0	b-PBX	858
JCVLFLJTRS0	c-CENTREX	528
JCVLFLJTRS0	d-COIN SMART	19
JCVLFLJTRS0	e-COIN REGUL	62
JCVLFLJTRS0	j-SLV ANALOG	23
JCVLFLLFDS0	a-LOCAL POTS	32196
JCVLFLLFDS0	A-2WG UV	16
JCVLFLLFDS0	b-PBX	203
JCVLFLLFDS0	c-CENTREX	868
JCVLFLLFDS0	e-COIN REGUL	515
JCVLFLLFDS0	j-SLV ANALOG	85
JCVLFLNODS0	a-LOCAL POTS	30736
JCVLFLNODS0	A-2WG UV	60
JCVLFLNODS0	b-PBX	755
JCVLFLNODS0	c-CENTREX	1151
JCVLFLNODS0	d-COIN SMART	2
JCVLFLNODS0	e-COIN REGUL	470
JCVLFLNODS0	j-SLV ANALOG	112
JCVLFLOWDS0	a-LOCAL POTS	17540
JCVLFLOWDS0	A-2WG UV	17
JCVLFLOWDS0	b-PBX	390
JCVLFLOWDS0	c-CENTREX	495
JCVLFLOWDS0	d-COIN SMART	4
JCVLFLOWDS0	e-COIN REGUL	267
JCVLFLOWDS0	j-SLV ANALOG	27
JCVLFLRVDS0	a-LOCAL POTS	31517
JCVLFLRVDS0	A-2WG UV	52
JCVLFLRVDS0	b-PBX	314
JCVLFLRVDS0	c-CENTREX	777
JCVLFLRVDS0	e-COIN REGUL	328
JCVLFLRVDS0	j-SLV ANALOG	246
JCVLFLSJ73E	a-LOCAL POTS	42066
JCVLFLSJ73E	A-2WG UV	84
JCVLFLSJ73E	b-PBX	1112
JCVLFLSJ73E	c-CENTREX	873
JCVLFLSJ73E	d-COIN SMART	2
JCVLFLSJ73E	e-COIN REGUL	373

JCVLFLSJ73E	j-SLV ANALOG	126
JCVLFLSMDS0	a-LOCAL POTS	20118
JCVLFLSMDS0	A-2WG UV	75
JCVLFLSMDS0	b-PBX	677
JCVLFLSMDS0	c-CENTREX	828
JCVLFLSMDS0	d-COIN SMART	3
JCVLFLSMDS0	e-COIN REGUL	269
JCVLFLSMDS0	j-SLV ANALOG	301
JCVLFLWCDS0	a-LOCAL POTS	39068
JCVLFLWCDS0	A-2WG UV	48
JCVLFLWCDS0	b-PBX	536
JCVLFLWCDS0	c-CENTREX	806
JCVLFLWCDS0	d-COIN SMART	13
JCVLFLWCDS0	e-COIN REGUL	597
JCVLFLWCDS0	j-SLV ANALOG	86
JPTRFLMADS0	a-LOCAL POTS	53159
JPTRFLMADS0	b-PBX	369
JPTRFLMADS0	c-CENTREX	627
JPTRFLMADS0	e-COIN REGUL	311
JPTRFLMADS0	j-SLV ANALOG	253
KYHGFLMARS0	a-LOCAL POTS	6517
KYHGFLMARS0	b-PBX	88
KYHGFLMARS0	c-CENTREX	17
KYHGFLMARS0	d-COIN SMART	9
KYHGFLMARS0	e-COIN REGUL	38
KYHGFLMARS0	j-SLV ANALOG	10
KYLRFLLSRS0	a-LOCAL POTS	8506
KYLRFLLSRS0	b-PBX	93
KYLRFLLSRS0	c-CENTREX	134
KYLRFLLSRS0	d-COIN SMART	9
KYLRFLLSRS0	e-COIN REGUL	163
KYLRFLLSRS0	j-SLV ANALOG	57
KYLRFLMARS0	a-LOCAL POTS	9482
KYLRFLMARS0	b-PBX	146
KYLRFLMARS0	c-CENTREX	178
KYLRFLMARS0	d-COIN SMART	10
KYLRFLMARS0	e-COIN REGUL	89
KYLRFLMARS0	j-SLV ANALOG	40
KYWSFLMADS0	a-LOCAL POTS	26574
KYWSFLMADS0	b-PBX	798
KYWSFLMADS0	c-CENTREX	800
KYWSFLMADS0	d-COIN SMART	44
KYWSFLMADS0	e-COIN REGUL	704
KYWSFLMADS0	j-SLV ANALOG	637
LKCYFLMADS0	a-LOCAL POTS	24497
LKCYFLMADS0	b-PBX	579
LKCYFLMADS0	c-CENTREX	939
LKCYFLMADS0	d-COIN SMART	2
LKCYFLMADS0	e-COIN REGUL	482

LKCYFLMADS0	j-SLV ANALOG	337
LKMRFLMADS0	a-LOCAL POTS	8854
LKMRFLMADS0	A-2WG UV	155
LKMRFLMADS0	b-PBX	456
LKMRFLMADS0	c-CENTREX	213
LKMRFLMADS0	e-COIN REGUL	89
LKMRFLMADS0	j-SLV ANALOG	47
LYHNFLOHDS0	a-LOCAL POTS	12325
LYHNFLOHDS0	b-PBX	91
LYHNFLOHDS0	c-CENTREX	60
LYHNFLOHDS0	e-COIN REGUL	71
LYHNFLOHDS0	j-SLV ANALOG	6
MCNPFLMARS0	a-LOCAL POTS	1744
MCNPFLMARS0	b-PBX	6
MCNPFLMARS0	d-COIN SMART	2
MCNPFLMARS0	e-COIN REGUL	18
MCNPFLMARS0	j-SLV ANALOG	1
MDBGFLPMDS0	a-LOCAL POTS	13728
MDBGFLPMDS0	A-2WG UV	3
MDBGFLPMDS0	b-PBX	16
MDBGFLPMDS0	c-CENTREX	135
MDBGFLPMDS0	e-COIN REGUL	56
MDBGFLPMDS0	j-SLV ANALOG	5
MIAMFLAEDS0	a-LOCAL POTS	63340
MIAMFLAEDS0	A-2WG UV	98
MIAMFLAEDS0	b-PBX	1280
MIAMFLAEDS0	c-CENTREX	1934
MIAMFLAEDS0	d-COIN SMART	28
MIAMFLAEDS0	e-COIN REGUL	760
MIAMFLAEDS0	j-SLV ANALOG	432
MIAMFLALDS0	a-LOCAL POTS	29914
MIAMFLALDS0	b-PBX	637
MIAMFLALDS0	c-CENTREX	689
MIAMFLALDS0	d-COIN SMART	2
MIAMFLALDS0	e-COIN REGUL	719
MIAMFLALDS0	j-SLV ANALOG	122
MIAMFLAPDS0	a-LOCAL POTS	6577
MIAMFLAPDS0	b-PBX	641
MIAMFLAPDS0	c-CENTREX	1062
MIAMFLAPDS0	e-COIN REGUL	1864
MIAMFLAPDS0	j-SLV ANALOG	246
MIAMFLBADS0	a-LOCAL POTS	34337
MIAMFLBADS0	A-2WG UV	1
MIAMFLBADS0	b-PBX	358
MIAMFLBADS0	c-CENTREX	603
MIAMFLBADS0	d-COIN SMART	1
MIAMFLBADS0	e-COIN REGUL	352
MIAMFLBADS0	j-SLV ANALOG	81
MIAMFLBCDS0	a-LOCAL POTS	13978

MIAMFLBCDS0	b-PBX	198
MIAMFLBCDS0	c-CENTREX	569
MIAMFLBCDS0	e-COIN REGUL	260
MIAMFLBCDS0	j-SLV ANALOG	131
MIAMFLBRDS0	a-LOCAL POTS	50174
MIAMFLBRDS0	A-2WG UV	12
MIAMFLBRDS0	b-PBX	1476
MIAMFLBRDS0	c-CENTREX	1015
MIAMFLBRDS0	d-COIN SMART	49
MIAMFLBRDS0	e-COIN REGUL	1240
MIAMFLBRDS0	j-SLV ANALOG	124
MIAMFLCADS0	a-LOCAL POTS	101779
MIAMFLCADS0	b-PBX	408
MIAMFLCADS0	c-CENTREX	1092
MIAMFLCADS0	d-COIN SMART	1
MIAMFLCADS0	e-COIN REGUL	804
MIAMFLCADS0	j-SLV ANALOG	173
MIAMFLDBRS1	a-LOCAL POTS	1755
MIAMFLDBRS1	b-PBX	161
MIAMFLDBRS1	c-CENTREX	358
MIAMFLDBRS1	e-COIN REGUL	40
MIAMFLDBRS1	j-SLV ANALOG	8
MIAMFLFLDS0	a-LOCAL POTS	31109
MIAMFLFLDS0	b-PBX	254
MIAMFLFLDS0	c-CENTREX	833
MIAMFLFLDS0	d-COIN SMART	19
MIAMFLFLDS0	e-COIN REGUL	655
MIAMFLFLDS0	j-SLV ANALOG	90
MIAMFLGRDS0	a-LOCAL POTS	22543
MIAMFLGRDS0	A-2WG UV	110
MIAMFLGRDS0	b-PBX	1289
MIAMFLGRDS0	c-CENTREX	1317
MIAMFLGRDS0	d-COIN SMART	33
MIAMFLGRDS0	e-COIN REGUL	1037
MIAMFLGRDS0	j-SLV ANALOG	5943
MIAMFLHLDS0	a-LOCAL POTS	114609
MIAMFLHLDS0	b-PBX	1446
MIAMFLHLDS0	c-CENTREX	2154
MIAMFLHLDS0	d-COIN SMART	71
MIAMFLHLDS0	e-COIN REGUL	1071
MIAMFLHLDS0	j-SLV ANALOG	269
MIAMFLICDS0	a-LOCAL POTS	41616
MIAMFLICDS0	b-PBX	561
MIAMFLICDS0	c-CENTREX	563
MIAMFLICDS0	e-COIN REGUL	381
MIAMFLICDS0	j-SLV ANALOG	160
MIAMFLKEDS0	a-LOCAL POTS	10319
MIAMFLKEDS0	b-PBX	346
MIAMFLKEDS0	c-CENTREX	244

MIAMFLKEDS0	d-COIN SMART	10
MIAMFLKEDS0	e-COIN REGUL	126
MIAMFLKEDS0	j-SLV ANALOG	57
MIAMFLMEDS0	a-LOCAL POTS	14909
MIAMFLMEDS0	b-PBX	475
MIAMFLMEDS0	c-CENTREX	593
MIAMFLMEDS0	d-COIN SMART	3
MIAMFLMEDS0	e-COIN REGUL	997
MIAMFLMEDS0	j-SLV ANALOG	152
MIAMFLNMDS0	a-LOCAL POTS	28083
MIAMFLNMDS0	b-PBX	176
MIAMFLNMDS0	c-CENTREX	206
MIAMFLNMDS0	e-COIN REGUL	401
MIAMFLNMDS0	j-SLV ANALOG	54
MIAMFLNSDS0	a-LOCAL POTS	31619
MIAMFLNSDS0	A-2WG UV	6
MIAMFLNSDS0	b-PBX	219
MIAMFLNSDS0	c-CENTREX	1101
MIAMFLNSDS0	d-COIN SMART	45
MIAMFLNSDS0	e-COIN REGUL	639
MIAMFLNSDS0	j-SLV ANALOG	67
MIAMFLOLDS0	a-LOCAL POTS	32696
MIAMFLOLDS0	A-2WG UV	1
MIAMFLOLDS0	b-PBX	335
MIAMFLOLDS0	c-CENTREX	1226
MIAMFLOLDS0	d-COIN SMART	1
MIAMFLOLDS0	e-COIN REGUL	690
MIAMFLOLDS0	j-SLV ANALOG	98
MIAMFLPBDS0	a-LOCAL POTS	43923
MIAMFLPBDS0	A-2WG UV	1
MIAMFLPBDS0	b-PBX	960
MIAMFLPBDS0	c-CENTREX	1232
MIAMFLPBDS0	d-COIN SMART	2
MIAMFLPBDS0	e-COIN REGUL	750
MIAMFLPBDS0	j-SLV ANALOG	224
MIAMFLPLDS0	a-LOCAL POTS	58747
MIAMFLPLDS0	A-2WG UV	181
MIAMFLPLDS0	b-PBX	3304
MIAMFLPLDS0	c-CENTREX	1571
MIAMFLPLDS0	d-COIN SMART	84
MIAMFLPLDS0	e-COIN REGUL	1106
MIAMFLPLDS0	j-SLV ANALOG	292
MIAMFLRRDS0	a-LOCAL POTS	56732
MIAMFLRRDS0	b-PBX	593
MIAMFLRRDS0	c-CENTREX	1039
MIAMFLRRDS0	d-COIN SMART	32
MIAMFLRRDS0	e-COIN REGUL	555
MIAMFLRRDS0	j-SLV ANALOG	223
MIAMFLSHDS0	a-LOCAL POTS	38131

MIAMFLSHDS0	b-PBX	218
MIAMFLSHDS0	c-CENTREX	1321
MIAMFLSHDS0	d-COIN SMART	2
MIAMFLSHDS0	e-COIN REGUL	794
MIAMFLSHDS0	j-SLV ANALOG	91
MIAMFLSODS0	a-LOCAL POTS	63818
MIAMFLSODS0	b-PBX	402
MIAMFLSODS0	c-CENTREX	1355
MIAMFLSODS0	e-COIN REGUL	489
MIAMFLSODS0	j-SLV ANALOG	85
MIAMFLWDDS0	a-LOCAL POTS	59651
MIAMFLWDDS0	b-PBX	94
MIAMFLWDDS0	c-CENTREX	356
MIAMFLWDDS0	e-COIN REGUL	285
MIAMFLWDDS0	j-SLV ANALOG	23
MIAMFLWMDS0	a-LOCAL POTS	44134
MIAMFLWMDS0	A-2WG UV	2
MIAMFLWMDS0	b-PBX	641
MIAMFLWMDS0	c-CENTREX	1104
MIAMFLWMDS0	d-COIN SMART	3
MIAMFLWMDS0	e-COIN REGUL	551
MIAMFLWMDS0	j-SLV ANALOG	174
MICCFLBBRS0	a-LOCAL POTS	6554
MICCFLBBRS0	c-CENTREX	1
MICCFLBBRS0	d-COIN SMART	3
MICCFLBBRS0	e-COIN REGUL	18
MICCFLBBRS0	j-SLV ANALOG	8
MLBRFLMADS0	a-LOCAL POTS	87818
MLBRFLMADS0	A-2WG UV	8
MLBRFLMADS0	b-PBX	1101
MLBRFLMADS0	c-CENTREX	1333
MLBRFLMADS0	d-COIN SMART	75
MLBRFLMADS0	e-COIN REGUL	718
MLBRFLMADS0	j-SLV ANALOG	684
MLTNFLRADS0	a-LOCAL POTS	19476
MLTNFLRADS0	b-PBX	261
MLTNFLRADS0	c-CENTREX	32
MLTNFLRADS0	e-COIN REGUL	273
MLTNFLRADS0	j-SLV ANALOG	81
MNDRFLAVDS0	a-LOCAL POTS	6564
MNDRFLAVDS0	b-PBX	475
MNDRFLAVDS0	c-CENTREX	258
MNDRFLAVDS0	e-COIN REGUL	42
MNDRFLAVDS0	j-SLV ANALOG	46
MNDRFLLODS0	a-LOCAL POTS	39686
MNDRFLLODS0	b-PBX	270
MNDRFLLODS0	c-CENTREX	484
MNDRFLLODS0	d-COIN SMART	16
MNDRFLLODS0	e-COIN REGUL	245

MNDRFLLODS0	j-SLV ANALOG	48
MNDRFLLWRS0	a-LOCAL POTS	7532
MNDRFLLWRS0	b-PBX	43
MNDRFLLWRS0	d-COIN SMART	5
MNDRFLLWRS0	e-COIN REGUL	16
MNDRFLLWRS0	j-SLV ANALOG	5
MNSNFLMARS0	a-LOCAL POTS	613
MNSNFLMARS0	e-COIN REGUL	6
MRTHFLVERS0	a-LOCAL POTS	11388
MRTHFLVERS0	b-PBX	229
MRTHFLVERS0	c-CENTREX	442
MRTHFLVERS0	d-COIN SMART	21
MRTHFLVERS0	e-COIN REGUL	196
MRTHFLVERS0	j-SLV ANALOG	171
MXVLFLMARS0	a-LOCAL POTS	1412
MXVLFLMARS0	e-COIN REGUL	10
MXVLFLMARS0	j-SLV ANALOG	1
NDADFLACDS0	a-LOCAL POTS	44336
NDADFLACDS0	b-PBX	662
NDADFLACDS0	c-CENTREX	925
NDADFLACDS0	e-COIN REGUL	613
NDADFLACDS0	j-SLV ANALOG	124
NDADFLBRDS0	a-LOCAL POTS	46140
NDADFLBRDS0	b-PBX	594
NDADFLBRDS0	c-CENTREX	1371
NDADFLBRDS0	e-COIN REGUL	572
NDADFLBRDS0	j-SLV ANALOG	101
NDADFLGGDS0	a-LOCAL POTS	34528
NDADFLGGDS0	A-2WG UV	4
NDADFLGGDS0	b-PBX	303
NDADFLGGDS0	c-CENTREX	867
NDADFLGGDS0	e-COIN REGUL	374
NDADFLGGDS0	j-SLV ANALOG	65
NDADFLOLDS0	a-LOCAL POTS	45266
NDADFLOLDS0	b-PBX	571
NDADFLOLDS0	c-CENTREX	540
NDADFLOLDS0	d-COIN SMART	1
NDADFLOLDS0	e-COIN REGUL	381
NDADFLOLDS0	j-SLV ANALOG	136
NKLRFLMARS0	a-LOCAL POTS	2863
NKLRFLMARS0	b-PBX	96
NKLRFLMARS0	e-COIN REGUL	24
NKLRFLMARS0	j-SLV ANALOG	239
NSBHFLMADS0	a-LOCAL POTS	35631
NSBHFLMADS0	b-PBX	151
NSBHFLMADS0	c-CENTREX	424
NSBHFLMADS0	d-COIN SMART	3
NSBHFLMADS0	e-COIN REGUL	294
NSBHFLMADS0	j-SLV ANALOG	190

NWBYFLMARS0	a-LOCAL POTS	4394
NWBYFLMARS0	c-CENTREX	36
NWBYFLMARS0	d-COIN SMART	4
NWBYFLMARS0	e-COIN REGUL	16
NWBYFLMARS0	j-SLV ANALOG	3
OKHLFLMARS0	a-LOCAL POTS	2255
OKHLFLMARS0	c-CENTREX	26
OKHLFLMARS0	e-COIN REGUL	22
OKHLFLMARS0	j-SLV ANALOG	2
OLTWFLLNRS0	a-LOCAL POTS	4116
OLTWFLLNRS0	b-PBX	33
OLTWFLLNRS0	d-COIN SMART	2
OLTWFLLNRS0	e-COIN REGUL	24
OLTWFLLNRS0	j-SLV ANALOG	5
ORLDFLAPDS0	a-LOCAL POTS	96688
ORLDFLAPDS0	A-2WG UV	533
ORLDFLAPDS0	b-PBX	586
ORLDFLAPDS0	c-CENTREX	321
ORLDFLAPDS0	d-COIN SMART	6
ORLDFLAPDS0	e-COIN REGUL	749
ORLDFLAPDS0	j-SLV ANALOG	50
ORLDFLCLDS0	a-LOCAL POTS	34438
ORLDFLCLDS0	A-2WG UV	340
ORLDFLCLDS0	b-PBX	610
ORLDFLCLDS0	c-CENTREX	455
ORLDFLCLDS0	d-COIN SMART	5
ORLDFLCLDS0	e-COIN REGUL	530
ORLDFLCLDS0	j-SLV ANALOG	160
ORLDFLMADS1	a-LOCAL POTS	52608
ORLDFLMADS1	A-2WG UV	759
ORLDFLMADS1	b-PBX	1792
ORLDFLMADS1	c-CENTREX	730
ORLDFLMADS1	e-COIN REGUL	1349
ORLDFLMADS1	j-SLV ANALOG	1763
ORLDFLPCDS0	a-LOCAL POTS	72224
ORLDFLPCDS0	A-2WG UV	112
ORLDFLPCDS0	b-PBX	2183
ORLDFLPCDS0	c-CENTREX	685
ORLDFLPCDS0	d-COIN SMART	25
ORLDFLPCDS0	e-COIN REGUL	1021
ORLDFLPCDS0	j-SLV ANALOG	403
ORLDFLPHDS0	a-LOCAL POTS	99632
ORLDFLPHDS0	A-2WG UV	41
ORLDFLPHDS0	b-PBX	1020
ORLDFLPHDS0	c-CENTREX	355
ORLDFLPHDS0	d-COIN SMART	8
ORLDFLPHDS0	e-COIN REGUL	937
ORLDFLPHDS0	j-SLV ANALOG	533
ORLDFLSADS0	a-LOCAL POTS	30902

ORLDFLSADS0	A-2WG UV	392
ORLDFLSADS0	b-PBX	1722
ORLDFLSADS0	c-CENTREX	480
ORLDFLSADS0	d-COIN SMART	5
ORLDFLSADS0	e-COIN REGUL	1099
ORLDFLSADS0	j-SLV ANALOG	204
ORPKFLMADS0	a-LOCAL POTS	25967
ORPKFLMADS0	A-2WG UV	76
ORPKFLMADS0	b-PBX	221
ORPKFLMADS0	c-CENTREX	422
ORPKFLMADS0	d-COIN SMART	1
ORPKFLMADS0	e-COIN REGUL	178
ORPKFLMADS0	j-SLV ANALOG	24
ORPKFLRWDS0	a-LOCAL POTS	16900
ORPKFLRWDS0	A-2WG UV	27
ORPKFLRWDS0	b-PBX	78
ORPKFLRWDS0	c-CENTREX	126
ORPKFLRWDS0	e-COIN REGUL	168
ORPKFLRWDS0	j-SLV ANALOG	98
OVIDFLCADS0	a-LOCAL POTS	31553
OVIDFLCADS0	b-PBX	124
OVIDFLCADS0	c-CENTREX	319
OVIDFLCADS0	d-COIN SMART	13
OVIDFLCADS0	e-COIN REGUL	158
OVIDFLCADS0	j-SLV ANALOG	19
PACEFLPV99E	a-LOCAL POTS	11848
PACEFLPV99E	b-PBX	70
PACEFLPV99E	c-CENTREX	98
PACEFLPV99E	e-COIN REGUL	59
PACEFLPV99E	j-SLV ANALOG	10
PAHKFLMARS0	a-LOCAL POTS	3250
PAHKFLMARS0	b-PBX	39
PAHKFLMARS0	c-CENTREX	24
PAHKFLMARS0	d-COIN SMART	1
PAHKFLMARS0	e-COIN REGUL	121
PAHKFLMARS0	j-SLV ANALOG	76
PCBHFLNTDS0	a-LOCAL POTS	27047
PCBHFLNTDS0	b-PBX	997
PCBHFLNTDS0	c-CENTREX	325
PCBHFLNTDS0	e-COIN REGUL	662
PCBHFLNTDS0	j-SLV ANALOG	83
PLCSFLMADS0	a-LOCAL POTS	18099
PLCSFLMADS0	b-PBX	236
PLCSFLMADS0	c-CENTREX	691
PLCSFLMADS0	e-COIN REGUL	106
PLCSFLMADS0	j-SLV ANALOG	24
PLTKFLMADS0	a-LOCAL POTS	18891
PLTKFLMADS0	b-PBX	183
PLTKFLMADS0	c-CENTREX	381

PLTKFLMADS0	d-COIN SMART	31
PLTKFLMADS0	e-COIN REGUL	224
PLTKFLMADS0	j-SLV ANALOG	233
PMBHFLCSDS0	a-LOCAL POTS	78611
PMBHFLCSDS0	b-PBX	442
PMBHFLCSDS0	c-CENTREX	940
PMBHFLCSDS0	d-COIN SMART	38
PMBHFLCSDS0	e-COIN REGUL	415
PMBHFLCSDS0	j-SLV ANALOG	157
PMBHFLFEDS0	a-LOCAL POTS	75325
PMBHFLFEDS0	A-2WG UV	61
PMBHFLFEDS0	b-PBX	891
PMBHFLFEDS0	c-CENTREX	1290
PMBHFLFEDS0	d-COIN SMART	4
PMBHFLFEDS0	e-COIN REGUL	828
PMBHFLFEDS0	j-SLV ANALOG	708
PMBHFLMADS0	a-LOCAL POTS	82473
PMBHFLMADS0	A-2WG UV	32
PMBHFLMADS0	b-PBX	968
PMBHFLMADS0	c-CENTREX	964
PMBHFLMADS0	d-COIN SMART	150
PMBHFLMADS0	e-COIN REGUL	839
PMBHFLMADS0	j-SLV ANALOG	195
PMBHFLTADS0	a-LOCAL POTS	40260
PMBHFLTADS0	A-2WG UV	6
PMBHFLTADS0	b-PBX	152
PMBHFLTADS0	c-CENTREX	345
PMBHFLTADS0	d-COIN SMART	78
PMBHFLTADS0	e-COIN REGUL	216
PMBHFLTADS0	j-SLV ANALOG	42
PMPKFLMARS0	a-LOCAL POTS	3130
PMPKFLMARS0	c-CENTREX	43
PMPKFLMARS0	d-COIN SMART	3
PMPKFLMARS0	e-COIN REGUL	10
PMPKFLMARS0	j-SLV ANALOG	1
PNCYFLCA87E	a-LOCAL POTS	8261
PNCYFLCA87E	b-PBX	19
PNCYFLCA87E	e-COIN REGUL	42
PNCYFLCA87E	j-SLV ANALOG	10
PNCYFLMADS0	a-LOCAL POTS	41396
PNCYFLMADS0	b-PBX	835
PNCYFLMADS0	c-CENTREX	636
PNCYFLMADS0	e-COIN REGUL	733
PNCYFLMADS0	j-SLV ANALOG	359
PNSCFLBLDS0	a-LOCAL POTS	41360
PNSCFLBLDS0	A-2WG UV	1
PNSCFLBLDS0	b-PBX	967
PNSCFLBLDS0	c-CENTREX	865
PNSCFLBLDS0	d-COIN SMART	1

PNSCFLBLDS0	e-COIN REGUL	631
PNSCFLBLDS0	j-SLV ANALOG	347
PNSCFLFPDS0	a-LOCAL POTS	52787
PNSCFLFPDS0	b-PBX	1334
PNSCFLFPDS0	c-CENTREX	506
PNSCFLFPDS0	e-COIN REGUL	617
PNSCFLFPDS0	j-SLV ANALOG	80
PNSCFLHCDS0	a-LOCAL POTS	10142
PNSCFLHCDS0	b-PBX	37
PNSCFLHCDS0	e-COIN REGUL	96
PNSCFLHCDS0	j-SLV ANALOG	7
PNSCFLPBDS0	a-LOCAL POTS	7580
PNSCFLPBDS0	b-PBX	12
PNSCFLPBDS0	e-COIN REGUL	47
PNSCFLPBDS0	j-SLV ANALOG	4
PNSCFLWADS0	a-LOCAL POTS	33384
PNSCFLWADS0	b-PBX	303
PNSCFLWADS0	c-CENTREX	259
PNSCFLWADS0	e-COIN REGUL	459
PNSCFLWADS0	j-SLV ANALOG	51
PNVDFLMADS0	a-LOCAL POTS	21402
PNVDFLMADS0	A-2WG UV	15
PNVDFLMADS0	b-PBX	301
PNVDFLMADS0	c-CENTREX	207
PNVDFLMADS0	d-COIN SMART	13
PNVDFLMADS0	e-COIN REGUL	80
PNVDFLMADS0	j-SLV ANALOG	51
PRRNFLMADS0	a-LOCAL POTS	105057
PRRNFLMADS0	b-PBX	795
PRRNFLMADS0	c-CENTREX	1423
PRRNFLMADS0	e-COIN REGUL	840
PRRNFLMADS0	j-SLV ANALOG	187
PRSNFLFDRS0	a-LOCAL POTS	2688
PRSNFLFDRS0	b-PBX	25
PRSNFLFDRS0	c-CENTREX	95
PRSNFLFDRS0	e-COIN REGUL	31
PRSNFLFDRS0	j-SLV ANALOG	17
PTSLFLMADS0	a-LOCAL POTS	40016
PTSLFLMADS0	b-PBX	126
PTSLFLMADS0	c-CENTREX	417
PTSLFLMADS0	d-COIN SMART	32
PTSLFLMADS0	e-COIN REGUL	166
PTSLFLMADS0	j-SLV ANALOG	118
PTSLFLSOCG0	a-LOCAL POTS	16169
PTSLFLSOCG0	b-PBX	154
PTSLFLSOCG0	c-CENTREX	518
PTSLFLSOCG0	d-COIN SMART	18
PTSLFLSOCG0	e-COIN REGUL	136
PTSLFLSOCG0	j-SLV ANALOG	29

SBSTFLFERS0	a-LOCAL POTS	1443
SBSTFLFERS0	c-CENTREX	67
SBSTFLFERS0	d-COIN SMART	10
SBSTFLFERS0	e-COIN REGUL	17
SBSTFLFERS0	j-SLV ANALOG	1
SBSTFLMADS0	a-LOCAL POTS	15564
SBSTFLMADS0	b-PBX	129
SBSTFLMADS0	c-CENTREX	10
SBSTFLMADS0	e-COIN REGUL	140
SBSTFLMADS0	j-SLV ANALOG	78
SGKYFLMARS0	a-LOCAL POTS	4401
SGKYFLMARS0	b-PBX	18
SGKYFLMARS0	d-COIN SMART	1
SGKYFLMARS0	e-COIN REGUL	28
SGKYFLMARS0	j-SLV ANALOG	6
SNFRFLMADS0	a-LOCAL POTS	55025
SNFRFLMADS0	b-PBX	543
SNFRFLMADS0	c-CENTREX	174
SNFRFLMADS0	d-COIN SMART	65
SNFRFLMADS0	e-COIN REGUL	678
SNFRFLMADS0	j-SLV ANALOG	344
STAGFLBSRS0	a-LOCAL POTS	12712
STAGFLBSRS0	b-PBX	107
STAGFLBSRS0	c-CENTREX	107
STAGFLBSRS0	d-COIN SMART	8
STAGFLBSRS0	e-COIN REGUL	102
STAGFLBSRS0	j-SLV ANALOG	20
STAGFLMADS0	a-LOCAL POTS	23098
STAGFLMADS0	A-2WG UV	4
STAGFLMADS0	b-PBX	621
STAGFLMADS0	c-CENTREX	424
STAGFLMADS0	d-COIN SMART	53
STAGFLMADS0	e-COIN REGUL	518
STAGFLMADS0	j-SLV ANALOG	272
STAGFLSHRS0	a-LOCAL POTS	10690
STAGFLSHRS0	b-PBX	72
STAGFLSHRS0	d-COIN SMART	9
STAGFLSHRS0	e-COIN REGUL	86
STAGFLSHRS0	j-SLV ANALOG	6
STAGFLWGRS0	a-LOCAL POTS	1268
STAGFLWGRS0	b-PBX	22
STAGFLWGRS0	e-COIN REGUL	38
STRTFLMADS0	a-LOCAL POTS	62107
STRTFLMADS0	b-PBX	532
STRTFLMADS0	c-CENTREX	618
STRTFLMADS0	d-COIN SMART	108
STRTFLMADS0	e-COIN REGUL	505
STRTFLMADS0	j-SLV ANALOG	479
SYHSFLCCRS0	a-LOCAL POTS	1592

SYHSFLCCRS0	c-CENTREX	149
SYHSFLCCRS0	e-COIN REGUL	6
SYHSFLCCRS0	j-SLV ANALOG	2
TRENFLMARS0	a-LOCAL POTS	4040
TRENFLMARS0	b-PBX	8
TRENFLMARS0	d-COIN SMART	14
TRENFLMARS0	e-COIN REGUL	57
TRENFLMARS0	j-SLV ANALOG	18
TTVLFLMADS0	a-LOCAL POTS	34881
TTVLFLMADS0	b-PBX	266
TTVLFLMADS0	c-CENTREX	448
TTVLFLMADS0	d-COIN SMART	37
TTVLFLMADS0	e-COIN REGUL	334
TTVLFLMADS0	j-SLV ANALOG	154
VERNFLMARS0	a-LOCAL POTS	2044
VERNFLMARS0	b-PBX	8
VERNFLMARS0	d-COIN SMART	1
VERNFLMARS0	e-COIN REGUL	21
VERNFLMARS0	j-SLV ANALOG	2
VRBHFLBERS0	a-LOCAL POTS	14570
VRBHFLBERS0	b-PBX	268
VRBHFLBERS0	e-COIN REGUL	63
VRBHFLBERS0	j-SLV ANALOG	132
VRBHFLMADS0	a-LOCAL POTS	47786
VRBHFLMADS0	b-PBX	762
VRBHFLMADS0	c-CENTREX	970
VRBHFLMADS0	d-COIN SMART	87
VRBHFLMADS0	e-COIN REGUL	549
VRBHFLMADS0	j-SLV ANALOG	548
WELKFLMARS0	a-LOCAL POTS	2588
WELKFLMARS0	d-COIN SMART	5
WELKFLMARS0	e-COIN REGUL	16
WELKFLMARS0	j-SLV ANALOG	4
WPBHFLANDS0	a-LOCAL POTS	35329
WPBHFLANDS0	A-2WG UV	34
WPBHFLANDS0	b-PBX	1188
WPBHFLANDS0	c-CENTREX	1516
WPBHFLANDS0	e-COIN REGUL	553
WPBHFLANDS0	j-SLV ANALOG	2425
WPBHFLGADS0	a-LOCAL POTS	97154
WPBHFLGADS0	b-PBX	357
WPBHFLGADS0	c-CENTREX	1268
WPBHFLGADS0	d-COIN SMART	113
WPBHFLGADS0	e-COIN REGUL	630
WPBHFLGADS0	j-SLV ANALOG	131
WPBHFLGRDS0	a-LOCAL POTS	59919
WPBHFLGRDS0	b-PBX	852
WPBHFLGRDS0	c-CENTREX	1004
WPBHFLGRDS0	e-COIN REGUL	477

WPBHFLGRDS0	j-SLV ANALOG	218
WPBHFLHHDS0	a-LOCAL POTS	70214
WPBHFLHHDS0	b-PBX	1255
WPBHFLHHDS0	c-CENTREX	1997
WPBHFLHHDS0	d-COIN SMART	104
WPBHFLHHDS0	e-COIN REGUL	1104
WPBHFLHHDS0	j-SLV ANALOG	301
WPBHFLLEDS0	a-LOCAL POTS	45730
WPBHFLLEDS0	b-PBX	410
WPBHFLLEDS0	c-CENTREX	773
WPBHFLLEDS0	d-COIN SMART	1
WPBHFLLEDS0	e-COIN REGUL	471
WPBHFLLEDS0	j-SLV ANALOG	132
WPBHFLRBDS0	a-LOCAL POTS	46615
WPBHFLRBDS0	b-PBX	954
WPBHFLRBDS0	c-CENTREX	833
WPBHFLRBDS0	d-COIN SMART	3
WPBHFLRBDS0	e-COIN REGUL	637
WPBHFLRBDS0	j-SLV ANALOG	369
WPBHFLRPDS0	a-LOCAL POTS	52145
WPBHFLRPDS0	b-PBX	296
WPBHFLRPDS0	c-CENTREX	647
WPBHFLRPDS0	e-COIN REGUL	472
WPBHFLRPDS0	j-SLV ANALOG	127
WWSPFLHIDS0	a-LOCAL POTS	15909
WWSPFLHIDS0	b-PBX	163
WWSPFLHIDS0	c-CENTREX	75
WWSPFLHIDS0	d-COIN SMART	15
WWSPFLHIDS0	e-COIN REGUL	100
WWSPFLHIDS0	j-SLV ANALOG	28
WWSPFLSHDS0	a-LOCAL POTS	35531
WWSPFLSHDS0	b-PBX	321
WWSPFLSHDS0	c-CENTREX	278
WWSPFLSHDS0	d-COIN SMART	16
WWSPFLSHDS0	e-COIN REGUL	126
WWSPFLSHDS0	j-SLV ANALOG	28
YNFNFLMARS0	a-LOCAL POTS	3489
YNFNFLMARS0	e-COIN REGUL	21
YNFNFLMARS0	j-SLV ANALOG	5
YNTWFLMARS0	a-LOCAL POTS	2499
YNTWFLMARS0	b-PBX	4
YNTWFLMARS0	d-COIN SMART	4
YNTWFLMARS0	e-COIN REGUL	24
YNTWFLMARS0	j-SLV ANALOG	18
YULEFLMARS0	a-LOCAL POTS	4093
YULEFLMARS0	b-PBX	31
YULEFLMARS0	c-CENTREX	15
YULEFLMARS0	e-COIN REGUL	78
YULEFLMARS0	j-SLV ANALOG	5

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Research Report

Cahners IN-STAT GROUP

Report No. TX00-02SP

Clash of the Broadband Titans: Cable vs. DSL

February 2000

Advanced Carrier Strategies

version of this report

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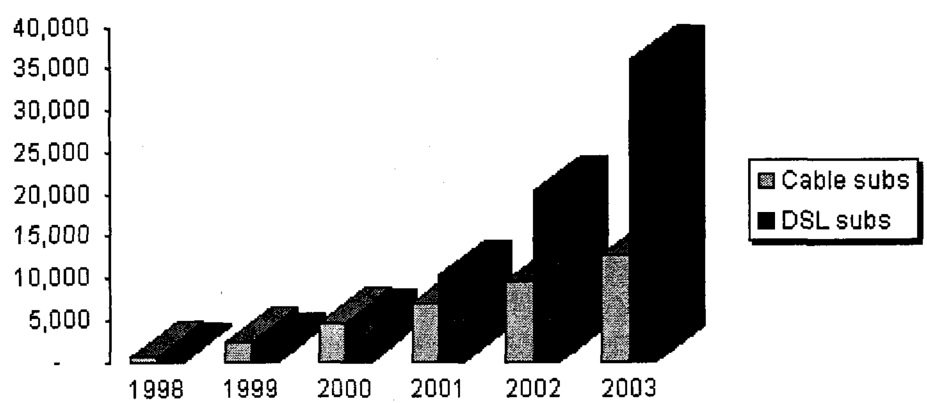
Executive Summary

The installed base of Broadband subscribers is expected to reach almost 9 million worldwide by the end of 2000, and almost 49 million by the end of 2003. This phenomenal growth is a direct result of increasing reliance on the Internet as an information, communications, business and entertainment tool. At the same time, new bandwidth intensive applications are being introduced that make the argument for broadband services very compelling.

In many of the early markets where broadband services are being deployed, cable and DSL are competing head to head for the same customers. Although In-Stat believes that there will be plenty of customers to go around for both types of broadband access, our research demonstrates that DSL will become the most prominent broadband access technology worldwide during the forecast period.

Figure 1 Worldwide Cable vs. DSL Market Forecast



Source: Cahners In-Stat Group

Both services are facing hurdles to deployment, many of them are technical issues. However, the deep pockets of the telco's and the comparatively lower infrastructure investment required to deliver DSL services, will play a prominent role in who wins the battle for the broadband subscriber. In addition, our comparison includes residential and business subscribers, and copper penetration to the business enables DSL to approach a broader total available market.

Regulatory environments within both industries are relaxing, allowing for greater competition. Recent FCC rulings in the telecom industry open up the opportunity for competitive carriers to rapidly offer DSL services, dramatically increasing the momentum behind these services.

In-Stat expects that the installed base of worldwide DSL subscribers will surpass cable subscribers in 2001. In the North American residential market, where the competition will be the fiercest, cable modems will remain the dominant access technology through 2002, being surpassed by DSL subscribers in 2002.

Methodology

Primary and secondary sources of information were used in the development of this report. An In-Stat survey of businesses was used to determine the buying and implementation behavior of IT managers. A separate survey was conducted of consumers to determine service provider preference, Internet adoption trends, and price sensitivity. In-Stat surveys are based on a statistically valid sample of a cross section of end users.

Also incorporated in the assumptions are the results of a survey of cable MSOs about the availability and their future plans for cable modem services. Additional research was conducted through direct interviews with hardware vendors and service providers in both the cable and DSL markets.

In-Stat's subscriber installed base forecasts are also based on information collected from proprietary In-Stat databases that are part of the Multimedia and WAN research practices.

The following major trends were evaluated in developing the forecast:

- Silicon integration, availability, and pricing trends
- Hardware reliability, availability, and pricing trends
- Service Provider deployment plans, business models, marketing strategies, and pricing trends
- Geographic economic conditions, Internet penetration rates, and the installed base of coax and copper networks
- End user demographics including basic psychographics

The data in this report is calculated at a higher level of precision than shown, as a result, not all numbers add due to rounding.

Delivery of Broadband Data Services

Residential Internet and online usage has grown tremendously despite the glacial speeds available through existing dial-up telephone modem connections, typically limited to 33.6 Kbps or less. Touted as an interactive extravaganza, surfing the World Wide Web more typically offers narrowband users a click-and-wait experience. The growing frustration of existing online users is driving demand for higher-speed connections.

Table 1 Characteristics of Broadband Data Services

Service Type	Max Downstream Data Rate	Max Upstream Data Rate	Number of Wire Pairs
Symmetrical			
HDSL-US	1.544 Mbps	1.544 Mbps	two
HDSL-Europe	2.048 Mbps	2.048 Mbps	three
SDSL	1.5Mbps	1.5 Mbps	one
IDSL	144 kbps	144 kbps	one
Asymmetrical			
ADSL	6 Mbps	640 kbps	one
ADSL lite	1 Mbps	128 kbps	one
RADSL	1-12 Mbps	128k-1Mbps	one
VDSL	55.2 Mbps	6 Mbps	one
Cable			
Cable data	10 Mbps	144kbps	coax

Source: Cahners In-Stat Group

How it Works: The Cable Data Network

Cable modems provide two-way, high-speed access between The Internet and a consumer or business user who is connected to a local Cable TV system. To deliver on this high speed data the traffic is routed through this TV network. One television channel (in the 50 - 750 MHz range) is typically allocated for downstream traffic to homes, and another channel (in the 5 - 42 MHz band) is used to carry upstream signals.

A headend cable modem termination system (CMTS) communicates through these channels with cable modems located in subscriber homes to create a virtual local area network (LAN) connection. A single downstream 6 MHz television channel may support up to 27 Mbps of downstream data throughput from the cable headend using 64 QAM (quadrature amplitude modulation) transmission technology. Speeds can be boosted to 36 Mbps using 256 QAM. Upstream channels may deliver 500 Kbps to 10 Mbps from homes using 16QAM or QPSK (quadrature phase shift key) modulation techniques, depending on the amount of spectrum allocated for service.

This upstream and downstream bandwidth is shared by the active data subscribers connected to a given cable network segment. An individual cable modem subscriber may experience access speeds from 500 Kbps to 1.5 Mbps or more -- depending on the network architecture and traffic load. Performance can be affected by Internet backbone congestion.

The cable modem access network operates at the physical layer, Layer 1 and the logical link layer, Layer 2 of the Open System Interconnect (OSI) Reference Model. This enables Layer 3 network protocols, such as IP traffic, to be seamlessly delivered over the cable modem platform to end users.

How the Cable Network Delivers Data

It all starts at the Cable TV headend. The headend is a building that contains all the specialized equipment and power management systems to operate an entire Cable TV system. Within the Headend building are multiple, standard 19-inch sized racks, loaded with the electronics gear that de-modulates the incoming signals,

assigns these signals to the appropriate channel for distribution, and modulators that send both video and data signals out into the rest of the Cable TV system's wired infrastructure. It is at the headend that the CMTS is located, routing data to the appropriate network node and ultimately the end user.

A telecommunications satellite delivers high speed video and data to the Headend, to a receiver dish that downloads the data to the headend signal router. At this point the CMTS is the final link to the HFC and Coaxial network.

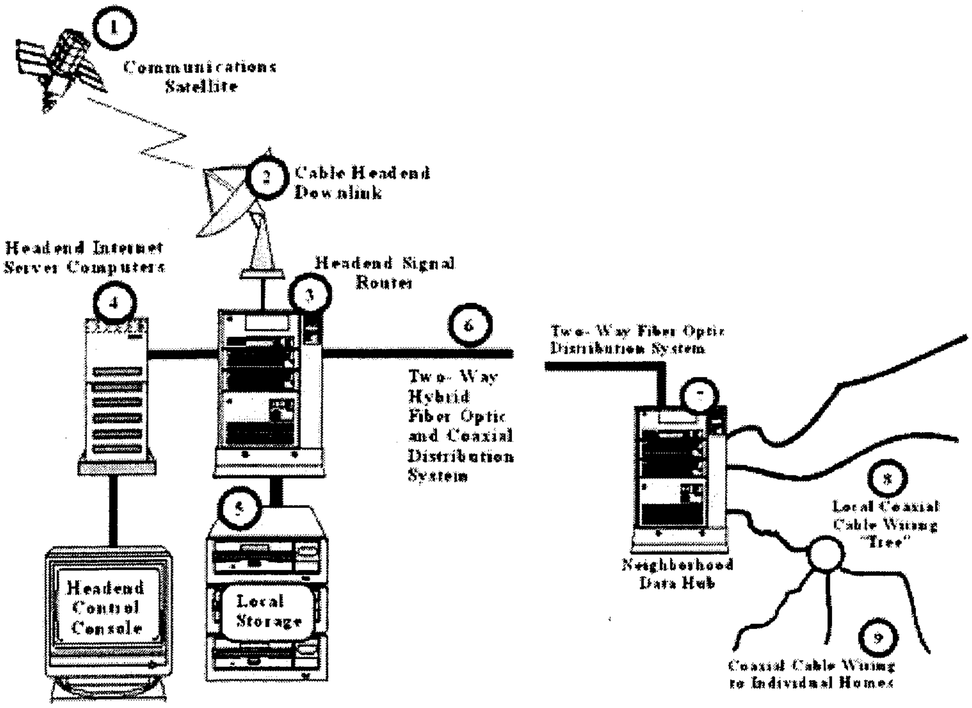
Typically, the Fiber Optic cable extends from the Headend out to a Neighborhood Data Hub, which segments the data streams coming in from the Headend for delivery into the last part of the connection, which is provided by a coaxial cable.

The passive local cable wiring delivers all the signals within a very small area. Typically, each branch connects to no more that 512 end-users of cable modem service. Note that one

TOP

Neighborhood Data Hub can support up to four branches, so one Neighborhood Data Hub can control up to 2,048 cable Modem end users.

Figure 2 Typical Configuration of a Cable Network



Source: Cahners In-Stat Group

Delivering Data to the Cable Modem Subscriber

In the case of the residential subscriber, coaxial cable comes out of the Neighborhood Data Hub, and is connected to the local distribution wiring. One line from a branch is run into the yard and physically connected to a junction box that provides Ingress and Egress to the customer's premises. Once the data has been delivered to the residence through a splitter, it is distributed by running several RG-58 coaxial wires through the walls or ceilings to the appropriate locations that contain TV sets or personal computers.

In the case of a business subscriber, the data is delivered to a cable router, equipped with a 10/100 Mbps interface that links to a hub or switch within the business. The hub or switch enables multiple PCs to access the cable network, and distributes the data to the appropriate end user.

Cable TV system operators do not want to troubleshoot hundreds of different types and configurations of personal computers, so they are leveraging Ethernet technology to connect to LANs and personal computers. An inexpensive and virtually ubiquitous technology, Ethernet is an ideal topology for delivering the data over the final link.

How it Works: The DSL Network

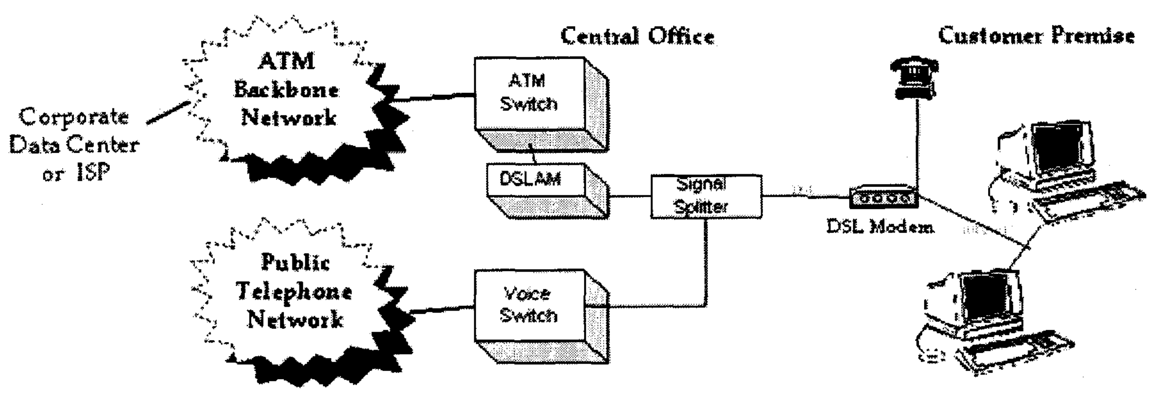
Digital subscriber line (DSL) provides a transmission link typically at the edge of an ATM, Frame Relay or IP network. DSL signifies a modem pair, which when applied to an existing single pair of twisted copper wire, creates a digital subscriber line. DSL and the associated DSL equipment is deployed in the local access network. The access network consists of the local loops and associated equipment that connect the service user location to the telephone company's central office (CO). This network typically consists of cable bundles carrying thousands of twisted wire pairs to Feeder Distribution Interfaces (FDIs). FDIs are points where dedicated cable is extended out to the individual service users.

An estimated 725 million copper wire access lines connect homes and business customers to the Public Switched Telephone Network (PSTN) worldwide. Approximately 95 percent of the local access loops consist of a single twisted pair wire, supporting plain old telephone service (POTS). POTS is designed to carry a voice conversation, which requires the lines to handle frequencies from 0 Hertz up to about 3,400 Hertz (1 Hertz = 1 cycle per second). POTS has historically supported only voice calls or analog modem transmissions at speeds commonly ranging from 9.6 to 33.6 kbps. The highest achievable information rate using the 3,400 Hertz frequency spectrum is less than 56 kbps.

The copper wire between a user's site and a carrier's central office can support transmissions over frequencies up to about 1MHz for wire lengths of between about 12,000 and 18,000 feet, or about 2.2 to 3.4 miles. The way DSL is able to take advantage of the available frequency and achieve considerably higher data rates over the same POTS line is that DSL, much like traditional T1 or E1, is by using a much broader range of frequencies than the voice channel. This type of implementation requires transmission of information over a wide range of frequencies from one DSL modem at the end of the copper wire loop to another complementary device which receives the wide frequency signal at the far end of the copper loop.

A typical DSL configuration includes a customer premise modem, a CO telco modem and a concentrator, which aggregates traffic from multiple modems for delivery to a data network while routing voice traffic to a voice switch. In the case of asymmetric DSL, voice and high-speed data can be transmitted through the same line at the same time without interference. First, the high-speed data is transmitted through the Customer Premise Equipment (CPE). DSL CPE modems usually come in one of two forms, internal PC cards or external bridge/routers. The connection is typically 10Base-T, V.35, ATM-25 or T1/E1. The POTS channel is split off from the digital modem by filters, guaranteeing uninterrupted POTS, even if DSL fails. Please see Figure 3.

Figure 3 Typical configuration of a DSL system



Source: Cahners In-Stat Group

DSL modems divide the available bandwidth of a telephone line through Frequency Division Multiplexing (FDM) or Echo Cancellation. FDM assigns one band for upstream data and another band for downstream data. The downstream path is divided by time division multiplexing into one or more high-speed channels and one or more low-speed channels. The upstream path is multiplexed into corresponding low-speed channels. Echo Cancellation assigns the upstream band to overlap the downstream band and separates the two by local echo cancellation, a technique also utilized in V.32 and V.34 modems. With either technique, DSL splits off a 4 kHz region for POTS, retaining higher frequencies for upstream and downstream data transmission.

When the data reaches the CO, it bypasses the voice switch altogether. The data is concentrated

by a Digital Subscriber Line Access Multiplexer (DSLAM). The DSLAM integrates the required telco modem and concentrator functions. It provides back-haul services for packet, cell and/or circuit based applications through concentration of the DSL lines onto 10Base-T, 100Base-T, T1/E1, T3/E3 or ATM outputs. Upon receiving the data, the DSLAM combines all of the unrelated data streams onto a common medium for transport across the CO's existing ATM or Frame Relay network.

Under controlled conditions, xDSL equipment operates near top rate speed when linked over a short length of twisted pair cable. However, in reality, it is not easy to get a clean pair of copper wires. Many ISPs rely on local-area data service circuits they acquire from LECs, also known as dry copper or an unbundled local loop. The wire pairs may be old, in need of repair or susceptible to cross talk. It is typical for the service provider to have to install several different pairs of wires to customer sites before finding one that works well enough to carry the DSL signal. The quality of the wire and its gauge can therefore affect whether DSL reaches its potential speeds.

Broadband Market Drivers and Hurdles

An often heard debate from skeptics of strong adoption for high speed access technologies is "what do consumers possibly need all of that bandwidth for?" There are several applications that are driving the demand today, and several that will emerge in the future. The result will be continued end user demand for more bandwidth

Applications Driving Broadband Deployment Today

Internet Access is clearly the primary driver for broadband subscriptions today. Exponential growth in Internet access, as well as the increase in convenient, easy to navigate content has made the Internet a central part of the lives of early adopters, and is rapidly becoming a mainstream communication and reference tool.

E-commerce is a natural outcropping of the increasing use of the Internet as a supplement to in-store and catalog shopping. Although consumer e-commerce dollars were relatively low compared to business to business e-commerce in 1999, consumer purchases over the Internet are expected to increase exponentially. A high-speed pipe is a tremendous enabler for interactive shopping over the net.

IP Telephony is a much-hyped application that broadband services are poised to deliver. Cable companies have been threatening to encroach on telephone companies cash cow of voice services for the last 10 years. IP telephony finally enables cable companies to deliver on their threat. At the same time, Voice over DSL has emerged to enable traditional copper pairs to deliver megabits of high speed data and several lines of voice traffic.

Video conferencing over IP may prove to be another lucrative application for broadband services. Video conferencing could support distance learning as well as group collaboration, or "whiteboarding."

Webcasting is so bandwidth hungry that many companies have outlawed it among their employees. Popular examples include Pointcast and Headliner, both of which automatically push information from server to client over IP based on the users' pre-determined filters. The convenience of having specified information pushed to users has proven attractive as a time saver, and over a high-speed pipe that is always on, webcasting becomes a very interesting application.

Telecommuting and Virtual Private Networks offer a compelling revenue stream for service providers, and address the immediate demand of end users requiring a high speed pipe for remote access, LAN to LAN and LAN to Internet connectivity.

Applications Driving Broadband Deployment Tomorrow

Distance learning and educational networks are expected to become an important part of our education system over the next five years. Connecting libraries and local schools, educational LANs allow the best teachers and programs to be leveraged regardless of geography, making it possible to provide equal education despite location.

Unified Messaging enables an end user to access voice mail, email and fax from a single device, typically the PC. Unified Messaging has not even begun to find success in the residential market, because users do not want to wait to log on and download their voice mail messages, when they can more quickly pick up the phone. However, a high speed, always on connection, eliminates the wait, and offers a much more compelling proposition for unified messaging to the residence.

Multicasting will be an important enabler of applications driving demand for cable modems in the future, in addition to being a compelling application in and of itself. Multicasting is the automatic transmission of files or streaming audio and video to pre-selected multiple users. Information is uploaded by the provider to a server, and users automatically download that information or a pre-selected portion of that information. Standards are still being developed for IP based multicasting.

Multiplayer Gaming and MUD (Multi-user Dimensions) are a much touted application for broadband because they require a great deal of bandwidth. Multiplayer gaming and its partner, Multi-user Dimension groups (which allow you to see yourself and other companion users as a cartoon in a location like a labyrinth, castle, etc.) will become a reality only as service availability broadens, in turn broadening the user base. Sony has been an early innovator in this space, and has already committed to include a cable modem in its Playstation.

Utilities Management can be supported by the broadband infrastructure enabling energy management by local utilities, simplifying billing, meter reading and monitoring by allowing utility companies to check these measures remotely.

Home Networking through a residential gateway will allow the broadband network to be used to monitor homes for fires, break-ins, and medical emergencies. The available bandwidth of a broadband network combined with the system's "always on" characteristic is ideal for delivering emergency information.

Telemedicine will be an emerging opportunity. The medical industry has urgent requirements

for the use of broadband technology in sharing patient information, research, and leveraging physicians' expertise across geographies. A broadband service supports quick transfer of very large files aiding in treatment, diagnosis and education.

Cable Market Drivers and Hurdles

More than 95 million homes in North America are passed by broadband coaxial cable plant and more than 67 million homes currently subscribe to cable TV services. With near-ubiquitous coverage, coaxial cable connections provide a potentially powerful platform for providing residences and small business with high-speed data access. This represents a very large target market for data services.

IP Telephony. Delivering telephony over the cable network completely changes the value proposition for the cable operator, and has been a major goal among MSO's for years. However, the standards, infrastructure and business models are developing very slowly. Comcast recently announced that it deployed Lucent's CableConnect System (which uses Motorola's CMTS) to test a PacketCable based VoIP service in Union, NJ, among 25 participants. The service supports local and long distance calls, both on and off network calls and standard and CLASS phone features. Other VoIP cable trials are being conducted in Canada by Videotron and in Texas by Chambers, both have Cisco as the primary vendor.

Shared Network Platform Performance. Cable modem systems rely on a shared access platform. Unlike circuit-switched telephone networks where a caller is allocated a dedicated connection, cable modem users do not occupy a fixed amount of bandwidth during their online session. Instead, they share the network with other active users and use the network's resources only when they actually send or receive data in quick bursts. As a result, shared access can result in a deterioration of performance as more users access the network.

To avoid this type of congestion, a cable operator can subdivide the physical cable network by running fiber-optic lines deeper into neighborhoods, which reduces the number of homes on a shared link. However, this can be a significant investment. The other alternative is to allocate an additional 6 MHz video channel for high-speed data, doubling the downstream bandwidth available to users.

Security. Cable modem services present security challenges because of two primary problems. First, since cable modems are connected full time, they use the same IP address. This provides (in theory, at least) a constant and inviting target to hackers. In contrast, a PC connecting through a dial-up Internet service provider is assigned a different IP address every time it connects to the Internet.

The second problem for cable modem subscribers is that users share bandwidth on a single cable. In theory, this presents a more inviting target to hackers trying to inset a "Trojan Horse" type of program (Back Orifice and Net Bus are the most common) onto a PC that uses a cable modem. The simplest solution to this problem is to turn off the file and print sharing options on your PC, and leave them off. In fact, almost all cable broadband ISPs strongly recommend this preventative measure. The one drawback to this solution is that once you turn off these options, you can no longer network multiple machines in the home.

Service providers are currently in the process of developing firewalls and other security upgrades to alleviate this problem. Although most cable modems sold to date don't have security, the new standards-based breed of cable modems supports security capabilities.

Standards. DOCSIS (Data Over Cable Systems Interface Specifications) is a standard interface for □cable modems. DOCSIS certified cable modems are identifiable by a "CableLabs " seal. This seal will inform consumers and cable operators that a□Certified modem complies with the CableLabs' DOCSIS cable modem specification. It also assures the modem will communicate (interoperate) with qualified cable system headends.

DOCSIS 1.0 was ratified by the International Telecommunication Union (ITU) in March of 1998. Initial cable modem certifications were awarded in early 1999, with the most recent certifications awarded on December 9, 1999 to Best Data and Com21.

DOCSIS 1.1 adds key enhancements to the original standard, such as improved quality of service (QoS) and hardware-based packet- fragmentation capabilities, to support IP telephony and other constant-bit-rate services. In short, DOCSIS 1.1 provides the bandwidth and latency guarantees required to offer toll-quality voice and business-class data services. As a result, cable operators are eager to deploy the technology. CableLabs does not plan to begin certifying cable modems for DOCSIS 1.1 compliance until April 2000. However, vendors are trying to create a smooth migration path by obtaining 1.0 certification for their 1.1-capable modems. The expectation is that these modems could be upgraded to the 1.1 standard via software once formal certification begins, helping cable operators and consumers preserve their hardware investments.

The "Open Access" Debate. Perhaps the hottest issue facing cable modem service today is the "Open Access/Forced Access" debate. The point of contention centers on the fact that cable broadband customers have no choice of Internet service providers. Currently, AT&T cable data subscribers are automatically signed up for Excite@Home's Internet service. Other Internet service providers have protested this practice. And with AT&T's proposed purchase of MediaOne, the issue has exploded into an interesting fight between the cable industry and the dial-up ISPs.

On one side are the cable companies trying to build, upgrade, and operate proprietary networks with lines accessible only to their own or partner ISPs. On the other side are ISPs, some consumer groups, and the phone companies, all of which want broadband cable lines open to any provider willing to pay line usage fees, just like the phone company/dial-up ISP model.

Identification of the opposing sides is relatively easy: just pay attention to the buzzwords. The dial-up ISPs (America Online, Mindspring, US West, etc.) are members of the "OpenNet Coalition." They refer to the issue as "Open Access." On the cable side of the argument, the issue is termed "Forced Access."

In early December 1999, AT&T formally agreed to eventually allow rival Internet services to use its cable lines to provide high-speed computer connections. AT&T struck an agreement in principle with MindSpring, the nation's second-largest Internet service provider (and a key member of the OpenNet coalition) formally committing itself to a new "open access" policy.

The key word in the agreement is "eventually." The announcement stated that AT&T would allow subscribers to use the ISP of their choice "once technical issues are addressed and after AT&T's current exclusivity contract with mailto:Excite@Home

Excite@Home expires in mid-2002." The open access debate will be a two year battle in the cable industry, ultimately presenting a hurdle to the markets progress.

Since the January 2000 merger announcement of America Online and Time Warner, AOL has toned down its rhetoric about Open Access and is "further examining" the issue. While AOL publicly claimed it still supported the OpenNet Coalition and its stance on Open Access, the fact it may soon have 13 million cable subscribers has made it imperative that it mend some fences with the cable industry and find some common ground about the issue.

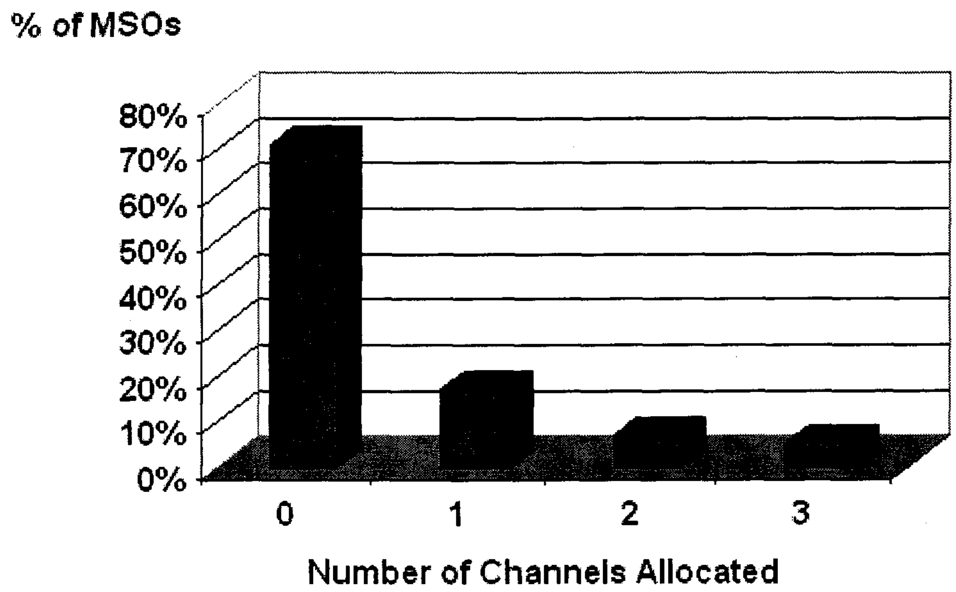
MSO infrastructure and data access availability. An In-Stat survey of cable MSO's in the US revealed that the status of their digital cable services deployments and investments are not progressing as rapidly as initially expected.

In effect, the survey results pointed out two trends about cable broadband service in the United States that we had previously only suspected.

The first trend is that cable modem services are still not widely available. Since most Cahners In-Stat Group employees live in major metropolitan areas and cannot get cable broadband service, we already knew this from anecdotal evidence. However, we were still a little surprised that two-thirds of the MSOs did not offer cable modem services in their area of operation.

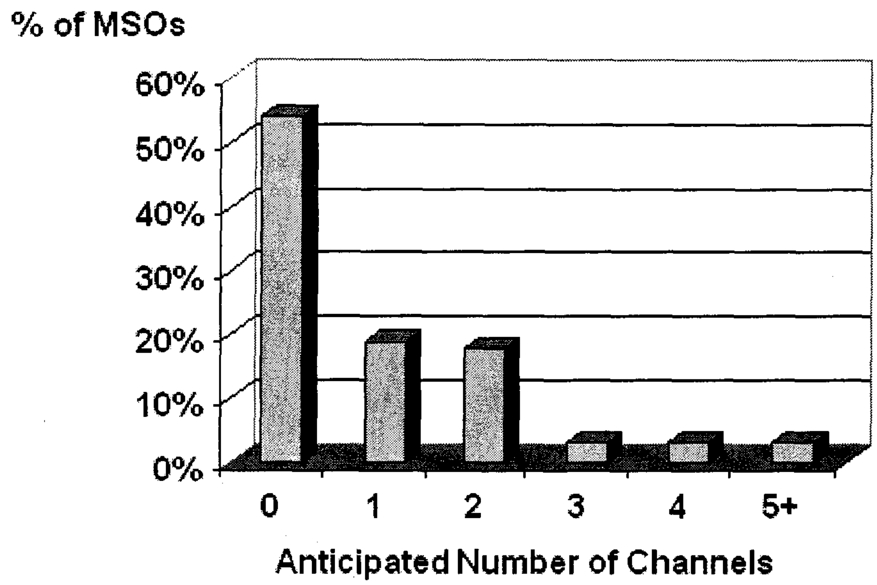
The second trend is that future rollouts of cable broadband data service in the U.S. will be relatively slow. By mid-year 2001, only half of the MSOs polled were planning to offer cable modem service.

Table 2 Current Number of 6 Mhz Channels Allocated for Cable Modem Services



Source: Cahners In-Stat Group

Table 3 Anticipated Number of 6 Mhz Channels Available for Cable Modem Services in 24 Months



Source: Cahners In-Stat Group

DSL Market Drivers and Hurdles

An estimated 725 million copper wire access lines connect homes and business customers to the Public Switched Telephone Network (PSTN) worldwide. Approximately 95 percent of the local access loops consist of a single twisted pair wire supporting plain old telephone service (POTS). Telephone service penetration is virtually 100 percent in the US. As a result, the market opportunity for DSL services is tremendous. Much like cable services, infrastructure and standards have to be in place to enable widespread penetration of these services.

Standards. There are a myriad of standards for xDSL technologies. Most recently g.light, a sub rate version of ADSL, was standardized, with the ultimate goal of enabling more rapid deployment of DSL services by eliminating some of the technical issues associated with full rate ADSL. By and large, DSL standardization has moved very quickly. Unfortunately, there is no one version of standardized DSL that will be the right flavor for all markets. As a result, standardized g.light and g.dmt are being deployed to residential users. G.dmt and ultimately HDSL2 and g.shdsl will be deployed to business users. The variety in DSL flavors, ADSL, RADSL, ADSL lite, SDSL, g.shdsl, HDL2, VDSL to name a few, continues to generate some confusion in the market.

Pricing. In 1998 and early 1999, pricing for DSL services, specifically residential services, was a major issue in being able to win customers that had the alternative of a cable modem. However, aggressive pricing iniatives by major telco's lowered average pricing of DSL services from $70 per month to $50 per month in 1999. Services are available for as low as $29 per month. Recently, several ISPs announced initiatives to provide free DSL services as a way to develop targeted marketing campaigns.

Technical Issues: Copper Pair. Despite how quickly the DSL standards processes have moved and how adeptly vendors have been able to provide affordable and flexible DSL equipment, the infamous copper wire still remains a major mystery in the DSL equation.

Standard twisted pair wiring rapidly attenuates frequencies much higher than 1MHz. (Attenuation is a function of distance, shorter the distance – less the attenuation – higher the speed). Over 24 gauge wire and within 18,000 feet ADSL can transmit downstream at 1.5 Mbps or greater. Within shorter distances the downstream throughput can reach as high as 8Mbps.

These limitations of the copper pair created the demand for DSL lite (maximum speed of 1.5 Mbps) which offered the flexibility of higher speeds than analog modems and ISDN without limiting the customer base to those next door to the central office. It is estimated that only about 1/3 of the installed lines in the US are 12,000 feet or less from the CO, while internationally, the number is even more uncertain.

Beyond the distance issue, two other line characteristics affect ADSL: the bridge tap and the loading coil. Telco's are not certain which lines are impacted by either, and loading coils and bridge taps have the ability to render an ADSL connection impossible. Several vendors have introduced sophisticated testing equipment over the last year to make the process of customer line qualification much simpler.

Technical Issues: Spectral Compatibility Various types of DSL in the same bundle can cause interference with each other, and almost always degrade the performance of other services within the same bundle. The culprit is cross talk, which becomes an issue when the power level of the cross talk signal becomes comparable to the power level of the primary signal. Higher frequency transmissions are generally more susceptible. Cross talk from existing services will generally reduce the performance of other services that occupy the same frequency spectrum.

Cross talk results in reducing the loop reach and/or speed of DSL, specifically full rate DSL. However, sub rate DSLs are virtually unimpaired by T1 services in the same bundle. Additional challenges in the residential environment are cross talk from 2B1Q based ISDN, HDSL and DAML.

Technical Issues: The DLC. DLCs move the termination points for local loop subscribers into the neighborhood. These pedestals reduce the length of the local loop. As many as one third of US loops are estimated to be served by DLCs.

The two problems ADSL systems encounter with DLCs are:

1) the fact that ADSL termination equipment is required in these space limited pedestals. DSL services cannot pass through DLCs passively, DSL line cards must be integrated to terminate and convert the transmission to standard services for back haul with voice. Vendors are now offering specialized solutions for DLCs including line cards that integrate with existing DLC equipment.

2) Existing DLCs were not designed to support power intensive technologies like ADSL. For example, a DLC can support about 1W per line card while full rate ADSL requires 3-4 Watts or more in many cases. Sub rate DSL will reduce power slightly, but not enough for most DLCs. Next generation DLCs are expected to support higher power, and next generation ADSL products are expected to decrease power consumption, but this is still a limiting factor in initial DSL market growth in the near term.

Voice over DSL. While there are still technical hurdles to DSL deployment, there is no lull in technology innovation to enable the delivery of DSL and services that take advantage of the fat pipe.

VoDSL has tremendous untapped potential, especially among competitive local exchange carriers (CLECs), because the technology permits them to provision multi-line telephone service to small businesses at a price point that is significantly less than what incumbent local exchange carriers (ILECs) are charging for the same type of service. This does not mean, however, that

VoDSL is not of ILEC interest. On the contrary, ILECs that choose to deploy VoDSL will find they have a new and powerful way to avoid the massive costs of provisioning new copper.

Cahners In-Stat Group believes that voice over DSL (VoDSL) will emerge as the first "killer" application to propel the widespread usage of DSL. Small businesses will be the primary target market for VoDSL services.

Broadband Market Forecast

Worldwide Broadband Access Forecast

The following dynamics are driving the demand for broadband access services:

- Increasing Internet Penetration
- Increase in small businesses' reliance on the Internet
- Increase in telecommuting, driving demand for corporate subsidized high speed access
- Increased Awareness of Broadband Access Alternatives
- Increased Availability of Broadband Access Alternatives
- Declining Costs of Broadband Access Alternatives
- Growing number of bandwidth hungry applications

Table 4 Worldwide Installed Base of Broadband Access Subscribers

(K)	1998	1999	2000	2001	2002	2003	CAGR 99-03
BB subscribers	945	3,657	8,916	16,977	29,934	48,808	91.1%
% change		287%	144%	90%	76%	63%	

Source: Cahners In-Stat Group

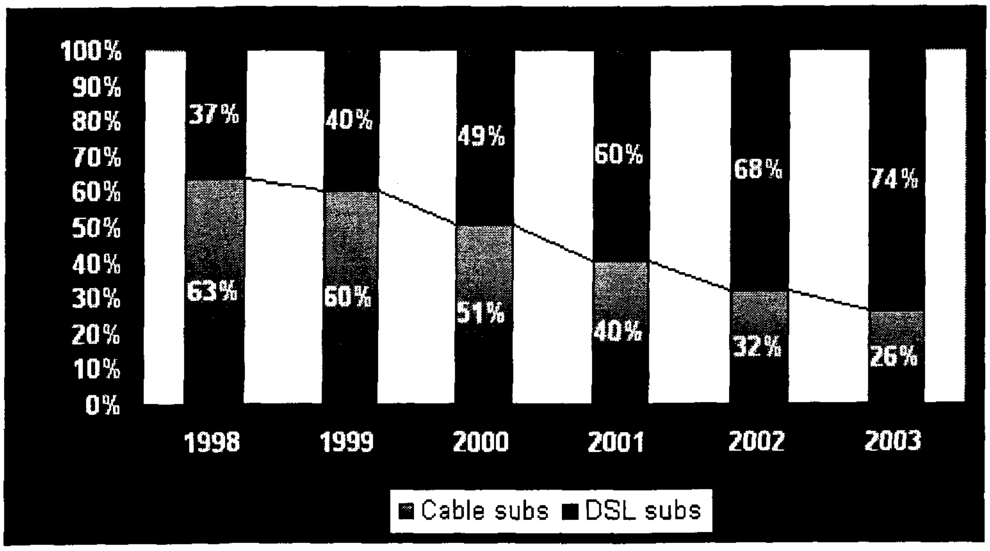
These drivers will result in growth of both DSL and cable subscribers through the forecast period. However, competition is heating up. Telco's have been more rapidly rolling out DSL services in areas served by cable modem services. As a result, the technologies are beginning to compete head to head in many cities for the same customer. In any battle, there is usually only one winner. In-Stat believes both cable and DSL access services will find plenty of customers during the forecast period, essentially making both services winners, however, In-Stat forecasts DSL to reach the highest penetration rates beginning in 2001 through 2003. Please see Table 5.

Table 5 Worldwide Installed Base of Cable vs. DSL subscribers

(K)	1998	1999	2000	2001	2002	2003	CAGR 99-03
Cable subs	600	2,210	4,530	6,814	9,515	12,696	54.8%
% change		268%	105%	50%	40%	33%	
DSL subs	345	1,447	4,386	10,163	20,419	36,112	123.5%
% change		319%	203%	132%	101%	77%	
Total subs	945	3,657	8,916	16,977	29,934	48,808	91.1%
% change		287%	144%	90%	76%	63%	

Source: Cahners In-Stat Group

Figure 4 Worldwide Cable vs. DSL Market Share Forecast



Source: Cahners In-Stat Group

Factors impacting the growth of worldwide cable modem subscribers include:

- Upgrades to existing cable infrastructure: The continuing upgrade of most cable plants to bi-directional, 750 Mhz hybrid fiber/coaxial (HFC) systems is expensive and time-consuming.
- Continued standardization to ensure the interoperability of cable data equipment.
- Relatively slow worldwide growth rate of cable TV subscriptions. The worldwide growth rate will be 7% per year through the year 2002, and the bulk of this growth will be limited to one country: China.
- In several countries, like Italy and Portugal, most of the cable infrastructure is owned by the incumbent telephone company, which just happens to be a state monopoly. For the most part, these telcos are pushing broadband services like DSL.
- Fragmentation of the local cable market. In many countries, especially in Asia and Latin America, cable service is divided between many "mom-and-pop" cable operators. This fragmentation denies many areas the economies of scale needed to introduce broadband cable data services.
- Factors impacting the growth of worldwide DSL subscribers include:

- Declining prices for DSL services
- The Emergence of PC OEMs as a channel
- Real pressure on ILECs from competing technologies/services from Cable Companies and Wireless Internet Service Providers
- Aggressive Roll outs by CLECs of inexpensive business data services as a foot in the door of business customers
- Increased investment by carriers in DSL infrastructure. In 1999 alone, carriers invested in enough infrastructure to support almost 3 million DSL lines.
- Voice over DSL will fundamentally change the value proposition for carriers deploying DSL

North American Broadband Access Market

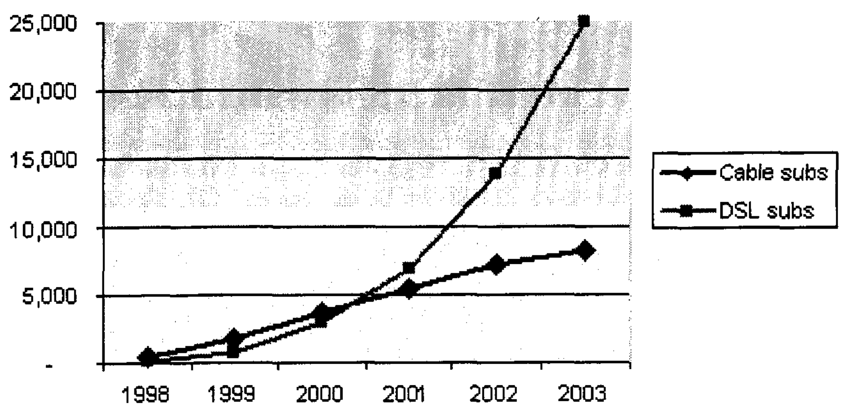
The most significant opportunity for broadband services over the next five years, North America will experience a stronger penetration rate of DSL services during the forecast period.

Table 6 North American Cable vs. DSL Subscriber Installed Base

(K)	1998	1999	2000	2001	2002	2003	CAGR 99-03
Cable subs	440	1,780	3,632	5,431	7,184	8,251	46.7%
% change		305%	104%	50%	32%	15%	
DSL subs	205	715	2,886	6,877	13,887	24,933	143.0%
% change		248%	303%	138%	102%	80%	
Total subs	645	2,495	6,518	12,308	21,071	33,184	91.0%
% change		287%	161%	89%	71%	57%	

Source: Cahners In-Stat Group

Figure 5 North American Cable vs. DSL Forecast



Source: Cahners In-Stat Group

Factors impacting the growth of North American cable modem subscribers and revenues include:

- The outcome of the "open access" debate
- The rate of MSO infrastructure investment for cable data services
- The availability of DOCSIS 1.1 products and then voice enabled services, changing the revenue model for the MSO.
- Increasing competition from other broadband data services. These include the rapid growth of DSL services and moderate growth in satellite and fixed wireless broadband data services.

Factors impacting the growth of North American DSL subscribers include:

- Although it is generally agreed that US residential demand for entertainment and other services will provide a mass market for DSL based service deployments, small businesses also represent a tremendous growth opportunity.
- A survey of small businesses in the US indicated that over half expect to be connected by a DSL pipe by 2001.
- The presence and penetration of competitive carriers continues to increase as the regulatory environment improves.
- Voice over DSL will fundamentally change the value proposition for CLECs and ILECs deploying DSL.
- Government rulings on line sharing considerably improve CLEC's business model for delivering ADSL services.

The Real Battleground: Residential Broadband Access

Because of the low penetration rates and adoption rates expected for cable modems in the enterprise, the residential market will be the real battleground between the broadband access alternatives. While cable penetration has outpaced DSL in the early stages, the renewed efforts of the telecom carriers to market to, and provide services for residential users has stepped up availability considerably.

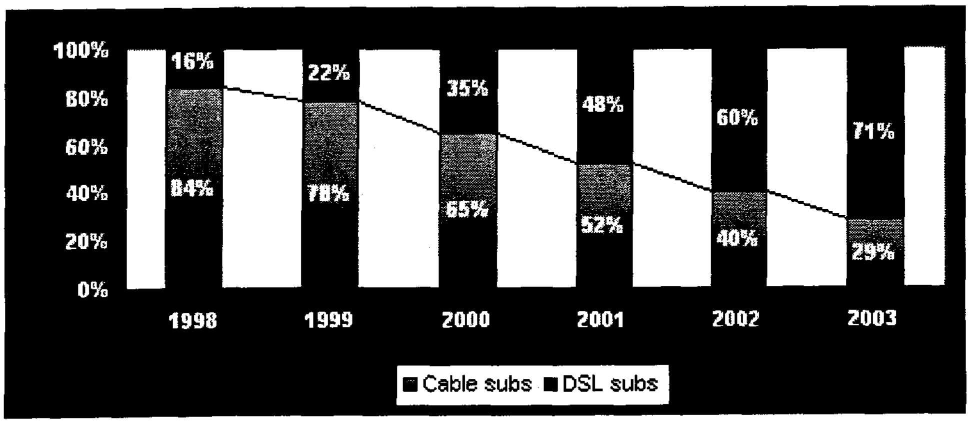
Price drops have also fostered customers as cable and DSL access begin to experience more pricing parity. In many areas, end users are more comfortable relying on their telco than their cable providers. All of these factors, as well as the drivers discussed above result in a higher penetration of DSL in the North American residential market by 2002.

Table 7 North American Residential Broadband Access Forecast

(k)	1998	1999	2000	2001	2002	2003	CAGR 99-03
Cable subs	440	1,709	3,450	5,051	6,537	7,343	44.0%
% change		288%	102%	46%	29%	12%	
DSL subs	84	473	1,857	4,605	9,810	18,057	148.5%
% change		461%	292%	148%	113%	84%	
Total subs	524	2,182	5,307	9,656	16,347	25,400	84.7%
% change		316%	143%	82%	69%	55%	

Source: Cahners In-Stat Group

Figure 6 North American Residential Broadband Services Market Share Forecast



Source: Cahners In-Stat Group

Broadband Access @ Home: Survey of Broadband Users in Four MSAs

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Disclaimer

Parks Associates has made every reasonable effort to ensure that all information in this report is correct. We assume no responsibility for any inadvertent errors.

Table of Contents

1.0 Executive Summary

This report analyzes the results from a survey of 599 broadband users in four MSAs (metropolitan statistical areas). It is part of a multiclient study entitled *Broadband Access @ Home*. Chapter 10 also includes results from a short survey of over 6,000 dial-up users in the same four markets.

1.1 Sampling

Parks Associates selected the four MSAs listed in Figure 1-1 for sampling. These four MSAs represent the four RBOCs and the two dominant cable ISPs (Excite@Home and Road Runner). Both cable modem service and DSL were available in these MSAs when the survey was conducted. As head-on competition between DSL and cable modem service is becoming intense, surveying broadband users in markets where both services are available would provide strategic insight into various implications of competition in the broadband marketplace.

Survey of Broadband Users: the Sample

MSA	*Total Mail-out*	*Qualified Cable Modem Users*	*Qualified DSL Users*	*Total Qualified Respondents*
Atlanta:	27,807	105	51	156
San Jose:	23,546	51	102	153
New York:	53,841	50	42	92
Phoenix:	25,334	147	51	198
Total	130,528	353	246	599*

* After removing 21 unqualified respondents.

Figure 1-1

The survey was conducted online in January 2000. A total of 9,063 online users responded to the survey. Among them, 599 are qualified respondents (broadband users AND household decision-makers).

In addition to the four RBOCs, Excite@Home, Road Runner, and a few other broadband service providers are represented in the survey, as illustrated in Figures 1-2 and 1-3. This survey is not intended to represent all broadband users and all broadband service providers. Findings from the survey apply only to the four MSAs. Nonetheless, Parks Associates feels confident that this survey can be used to make inferences about the broadband marketplace in general.

1.2 Hardware, Installation, and Service Plans

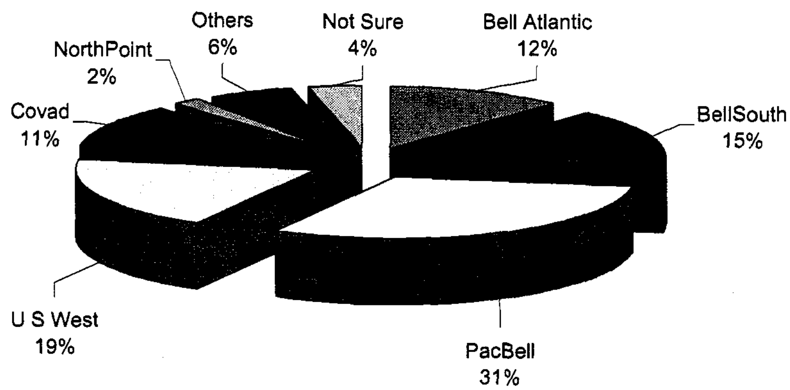
The brands of hardware do not appear to be an important issue, at least to the current broadband users. First of all, 32% of cable modem users and 14% of DSL users do not even know the brand of the high-speed modems that they have been using. Secondly, 90% of the broadband users were not even given choices about brands of hardware when they signed up for broadband services.

Thirty-two percent of the respondents reported leasing their high-speed modems. Virtually all of such respondents are cable modem users. Only 3% of DSL users reported leasing a modem, compared with 53% of cable modem users, mainly because few DSL providers have given their customers a lease option.

Only a small number of broadband users (14% of cable modem users and 4% of DSL users) reported a typical downstream speed of 1.5 Mbps or more). Many (44% of cable modem users and 18% of DSL users) do not even know the typical downstream speed they get. These findings suggest that majority of broadband users only get sub-Mbps speed downstream.

Most of the cable modem users (84%) do not have a term contract for service, compared with 54% of DSL users without a term contract. This is because more DSL providers than cable

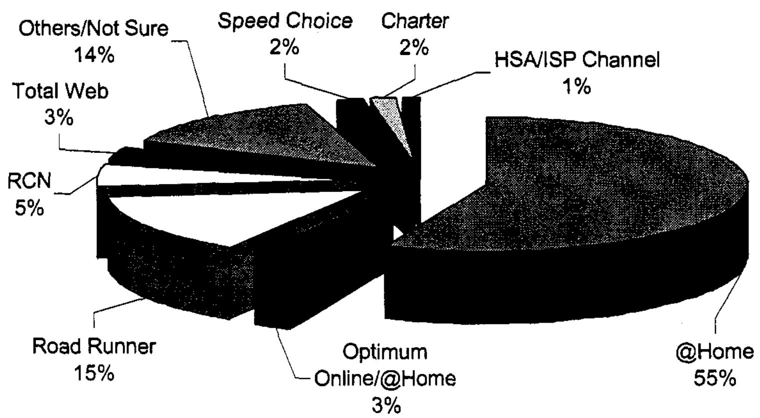
Providers of DSL Lines
(n=246)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 1-2

ISPs for Cable Modem Service
(n=353)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 1-3

modem ISPs require subscribers to make a choice between a month-to-month rate plan or a term-contract rate plan (with a lower monthly charge). So it appears that a term contract with a lower monthly fee is more attractive than the opposite. Among those who have a term contract, most (87%) are obliged to keep their service for one year.

There is no significant difference between DSL and cable modem service in terms of the time needed for service installation. The average number of hours spent on installation is 3 hours and 26 minutes. More DSL users (34%) than cable modem users (14%) reported self-installation.

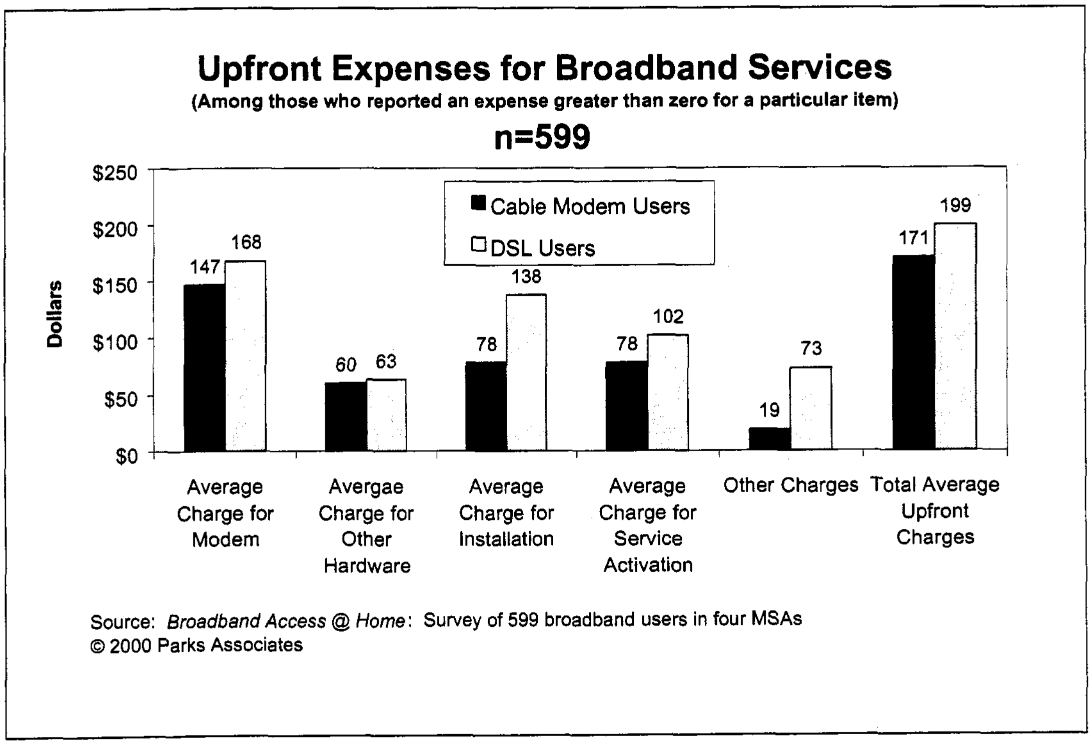


Figure 1-4

The average monthly charge reported by cable modem users is $36, compared with $60 reported by DSL users (including ISP charge). On average, DSL users paid $199 on hardware, installation, and service activation. Cable modem subscribers, on the other hand, paid $171.

Although cable modem service has had a price advantage over DSL, Parks Associates expects the price difference to diminish soon.

1.3 Online Usage

On average, the respondents used the Internet at home for four years before adopting broadband. When the survey was conducted, cable modem users had been using broadband for an average of 12 months, while DSL subscribers had been using the service for an average of six months.

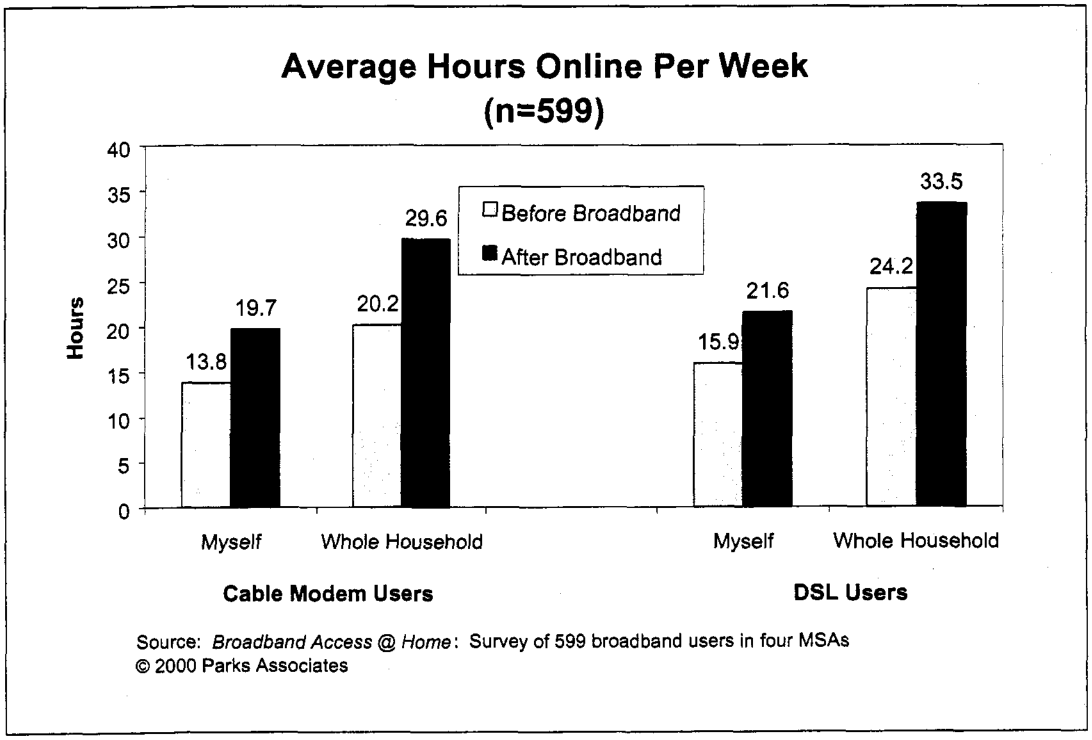


Figure 1-5

Both DSL and cable modem users spend almost six hours more online per week because of the usage of broadband connections. Their whole households have increased online usage by about 9 hours per week. Overall, broadband users now spend more than 20 hours online a week, while their whole households spend at least 30 hours online per week.

Other than e-mail, the most frequent activities online include using search engines/directories, checking/trading stocks, and banking online. The least frequent online activities include making Internet phone calls, accessing business computer network, and creating/updating personal Web pages.

1.4 Decision-Making

Most of the broadband users became aware of the availability of broadband services through their own research, direct mail, and media advertising. On average, it took most broadband users (79%) two months or less to decide to adopt broadband services.

Benefits related to speed are perceived as the most important to the purchase decision. High downstream speed and constant/instant connections to the Internet (related to speed) are perceived to be more important than freeing up phone lines, saving the cost of using a separate line for voice, or broadband content. Of course, all of these benefits are important, as they are all mentioned by at least 50% of the broadband users as being important to the purchase decision. There are no significant differences between DSL users and cable modem subscribers in terms of the perceived importance of the key benefits of using broadband services.

Two other significant factors in the decision-making process are family members requesting broadband services and business related use. Twenty-nine percent of the broadband users said that requests from family members played an "extremely important" or "somewhat important" role in the decision to adopt broadband services. As to business-related use, 38% rated it as either "extremely important" or "somewhat important."

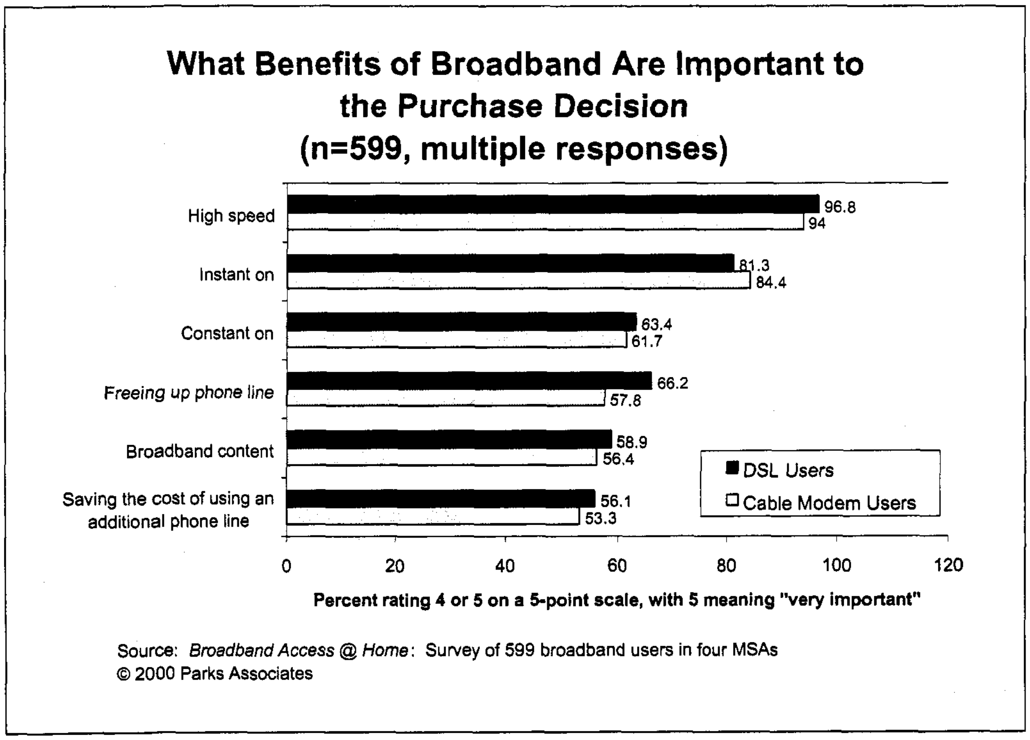


Figure 1-6

1.5 Satisfaction

Seventy percent of the respondents are satisfied with their broadband services (rating of 5 or 4 on a 5-point scale, with 5 meaning "very satisfied"). There is no difference between DSL users' satisfaction and cable modem subscribers' satisfaction. Close to 10% are NOT satisfied (rating of 1 or 2 on a 5-point scale, with 1 meaning "very dissatisfied").

Broadband users are more intolerant of service outages than the high monthly fees they have to pay. Fifty-four percent of the broadband users selected service outages as their number-one complaint, while a smaller number of respondents (42%) reported a high monthly fee as what they dislike most. Other things they dislike include variance of speed, troubleshooting after installation, speed slower than expected, having to schedule professional installation, worries about hacking/security, having to change their ISP and email address, and paying for professional installation.

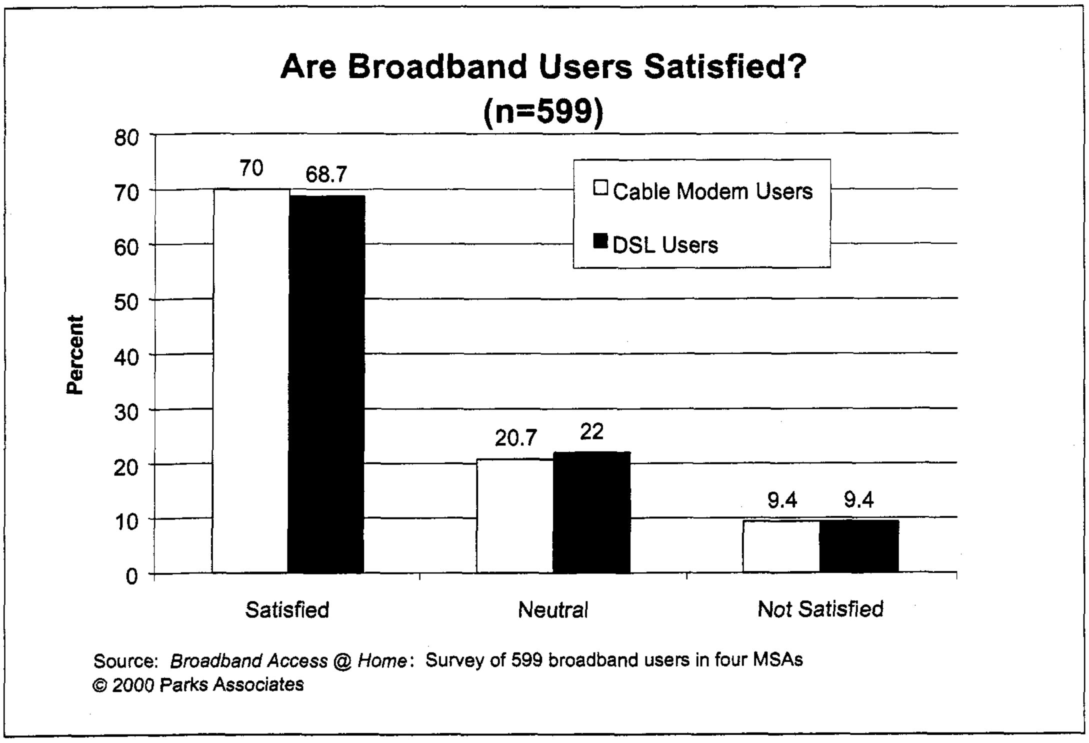


Figure 1-7

1.6 Consideration of Alternative Services

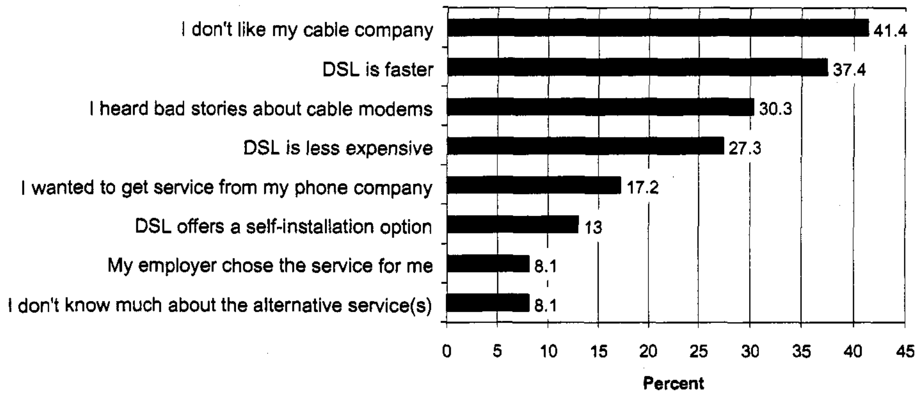
In total, 40% of all the DSL users surveyed were aware of the availability of cable modem service when they signed up for DSL. As to cable modem users surveyed, 26% knew of DSL's availability. So why did they pick one over the other? The number one reason for DSL users is that they don't like their cable company, while the number one reason for cable modem users is their perception that cable modems are faster.

Awareness of the availability of DirecPC and broadband fixes wireless is low at 31.6% and 17.7%, respectively. The most important reason why the broadband users surveyed did not sign up for DirecPC or broadband fixed wireless services is that they do not like the idea of having to use a dish/antenna for downstream data and a phone modem for upstream data.

Why Didn't DSL Subscribers Choose Cable Modem Service?

(Among DSL Users Aware of Cable Modem Availability When Signing up for DSL)

(n=99)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
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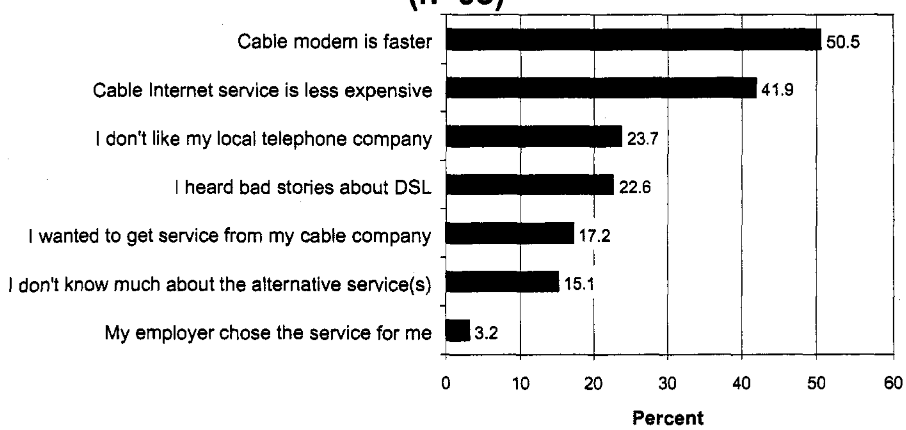
Figure 1-8

Why Didn't Cable Modem Users Choose DSL?

(Among Those Aware of DSLAvailability When Signing up for Cable Modem Service)

(n=93)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 1-9

1.7 Additional Phone Lines

More than half (53%) of the broadband subscribers currently have additional phone lines at home. However, 59% used to have a separate phone line dedicated for Internet access. This indicates that the adoption of broadband services has somewhat decreased the usage of additional phone lines. Among those who used to have a separate line for dial-up Internet access, 42% have already stopped using that line. However, more than half are still using that line today. The top-three reasons for keeping that line are faxing, dial-up access to the Internet in case of broadband service outage, and usage by someone else in the household.

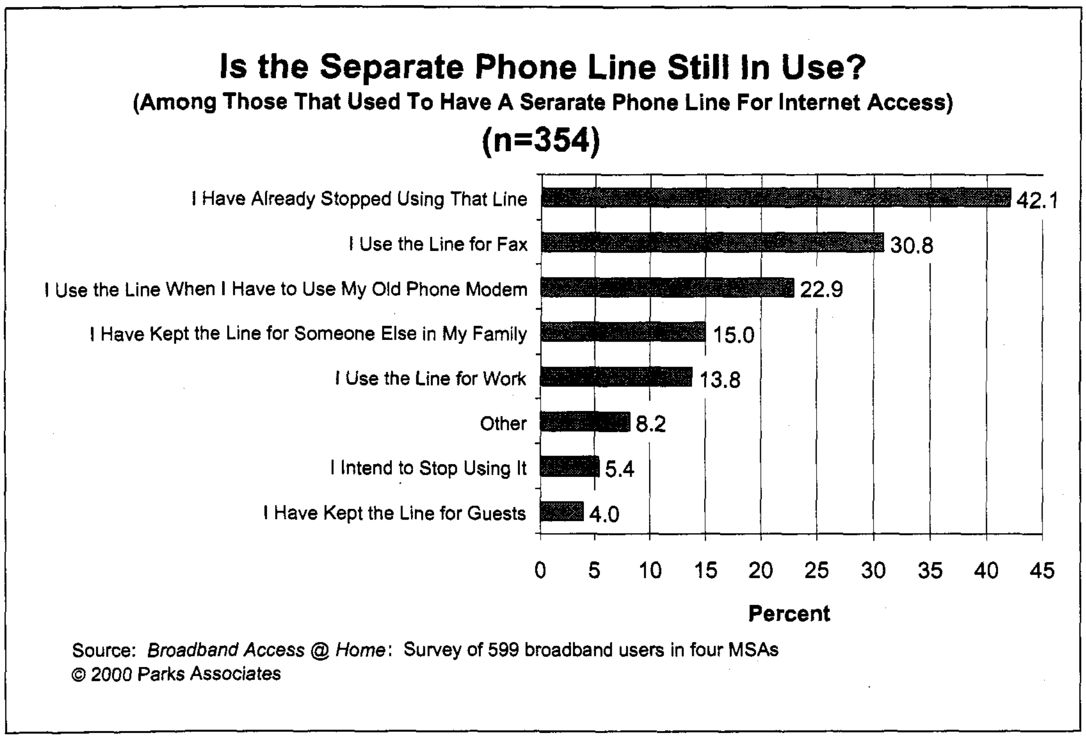


Figure 1-10

Nearly half (46%) indicated that they do not need any additional lines, and the average monthly fee that broadband users (excluding those who responded with a zero) are willing to pay is only $9.90 per additional line. This suggests that Voice-over-DSL (VoDSL) and multi-line IP-based cable telephony may not meet with very strong consumer demand.

1.8 Home Networking

Sixty-six percent of the broadband users have two or more PCs. Among them, 55% have a computer network. The applications used most frequently are shared Internet access (88%), file sharing/transfer (86%), and printer sharing (80%). Ethernet accounts for 89% of all the computer networks installed. Among the broadband users without a computer network, 35% feel a need for one.

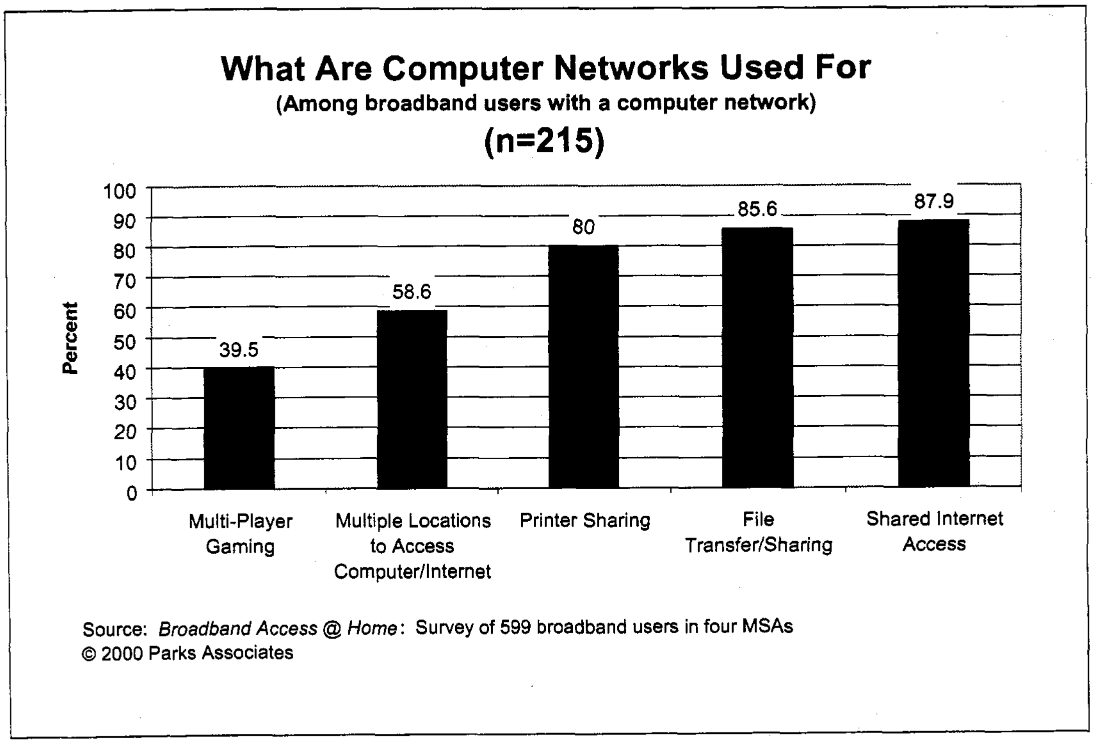


Figure 1-11

1.9 Demographics

Comparison Between Broadband Users and the Average Consumer

	Broadband Users	*National Average*
Medium household income	\$75,000-\$99,999	\$38,885[1]
Attained college degree or more	63%	24.4%[2]
Have at least one work-at-homer in household	77%	42%[3]
Own a home theater	32%	21%[4]
Own a fax machine	41%	11%[5]
Subscribe to a premium channel	45%	35%[6]
Use a mobile phone	81%	51%[7]
Use a pager	45%	37%[8]
Have a DVD player	24%	5%[9]
Use a PDA	32%	5%[10]

Figure 1-12

The broadband users clearly represent the most attractive consumer segment to service providers. They generally have attained a high level of education, earn a high household income, subscribe to numerous services, and are the early adopters of various emerging technology-based products. Figure 1-12 is a comparison between broadband users and the average consumer.

[1] 1998 data from US Census Bureau
[2] Ibid.
[3] Based on several surveys Parks Associates conducted in 1998 and 1999
[4] January 2000 data from CEA
[5] Based on Parks Associates' own consumer research
[6] Based on data from the FCC
[7] January 2000 data from CEA
[8] Ibid.
[9] Ibid.
[10] Based on Parks Associates' own consumer research

2.0 Methodology

This chapter discusses how Parks Associates designed and executed the survey of broadband users. Topics include the selection of target markets for the survey, major topics covered, sampling, and survey reporting.

2.1 Selection of Target Markets for the Survey

Although the availability of broadband Internet services is still limited, Parks Associates estimates that there were at least 20 major markets where both DSL and cable modem service were available at the end of 1999. Head-on competition between the two major platforms for broadband Internet services is becoming intense. Thus, surveying broadband users in markets where both services are available provides early insight into what will be a fierce battle in the broadband marketplace. Thus, Parks Associates selected four MSAs, or metropolitan statistical areas (Figure 2-1), that represent the four RBOCs and the two dominant cable ISPs (Excite@Home and Road Runner); both cable modem service and DSL were available in the four MSAs when Parks Associates conducted the survey.

MSAs Selected for the Survey of Broadband Users

MSA	RBOCs Represented	Major Cable ISPs Represented
Atlanta:	BellSouth	@Home, Road Runner
San Jose:	PacBell (SBC)	@Home
New York:	Bell Atlantic	Road Runner
Phoenix:	U S West	@Home

Figure 2-1

2.2 Major Topics Covered

The survey covers the following major topics:

- The benefits of broadband services and the importance of each to respondents' purchase decision-making process.
- Influence of different marketing approaches on decision-making.
- Other factors that influence decision-making.
- Level of satisfaction with high-speed Internet service.
- What is liked best.
- What is liked least.
- Changes in computer and online usage.
- Awareness and consideration of alternative high-speed services.
- Likelihood of switching to an alternative service.
- Conditions that may make broadband users switch to alternative services.
- Impact of broadband adoption on usage of additional phone lines.
- Usage of home networking.
- Demographic profiles.

2.3 Sampling and Reporting

In December 1999, Parks Associates contracted Harris Interactive, which has a panel of several million online users, to conduct the survey online. The questionnaire was e-mailed to a total of 130,528 online users in the four MSAs selected for the survey. A total of 9,063 online users (7%) responded to the survey. Among them, 7,445 completed the whole survey (82% completion rate). The respondents who completed survey fall under three categories:

- 620 online users who identified themselves as both broadband subscribers and decision-makers.
- 149 online users who identified themselves as broadband subscribers but NOT decision-makers (unqualified).

- 6,676 online users who identified themselves as dial-up Internet subscribers (unqualified). Among them, however, 31 reported using a cable modem in the middle of the survey. Parks Associates removed them from the data file while conducting analysis.

Due to a very low market penetration rate of satellite-based DirecPC service (less than 100,000 users in the US at the end of 1999), Parks Associates only surveyed cable modem and DSL users. The survey was fielded on January 7, 2000, and completed on February 14, 2000.

After scanning the responses from the 620 respondents who identified themselves as broadband subscribers, Parks Associates identified 21 respondents who either provided extremely abnormal/conflicting responses to multiple questions or mistakenly identified themselves as cable modem users at the beginning of the survey and indicated later that they were not. These respondents have been removed from the SPSS file used for the creation of the data tab and analysis in this report. Thus, a total of 599 respondents are considered qualified for the survey.

Survey of Broadband Users: the Sample

MSA	*Total Mail-out*	*Qualified Cable Modem Users*	*Qualified DSL Users*	*Total Qualified Respondents*
Atlanta:	27,807	105	51	156
San Jose:	23,546	51	102	153
New York:	53,841	50	42	92
Phoenix:	25,334	147	51	198
Total	130,528	353	246	599*

* After removing 21 unqualified respondents.

Figure 2-2

Parks Associates initially set a quota of 50 DSL users and 50 cable modem users per MSA, with a total sample size of 400 broadband users. Due to the nature of an online survey and the actual status of broadband deployment in these four MSAs, Parks Associates has obtained a larger sample size. From the New York MSA, however, only 42 DSL users responded. Parks Associates and the fielding company were unable to solicit more DSL respondents prior to the closing of the survey. In fact, Parks Associates extended the closing of the survey for three weeks in an attempt to get more DSL respondents from New York. Parks Associates believes that primarily because Bell Atlantic did not start deploying DSL in New York City until the summer of 1999, not many panelists of the fielding company are DSL subscribers living in New York.

The detailed results of the survey are available in the data tab, which includes multiple categories for cross-tabulations. This report will not follow a question-by-question format or restate the numbers in the data tab. Instead, it will focus on a few key subject areas and integrate multiple questions together while analyzing survey results. Each chapter consists of text-based analysis and numerous charts that illustrate the major findings from the survey.

The unqualified dial-up users who participated in the survey filled out a much shorter questionnaire that mainly consists of the screening and demographic questions. However, Parks Associates did ask them to answer four questions related to their awareness of broadband services and intentions of modem/service upgrades. Responses to these questions will be discussed in the last chapter of this report.

3.0 Service Providers

3.1 Representation of Service Providers

Because the survey was conducted in four MSAs rather than throughout the nation, it does not represent all providers of DSL and cable modem services are represented in the study. In addition, the survey is not meant to reveal the actual market share of each service provider that operates in the four MSAs selected. For example, Figure 3-4 is not a representation of the service providers' nationwide market share. Rather, it summarizes the percentage of each service provider's DSL customers that participated in the survey.

However, the survey does reflect the competitive strengths of the broadband service providers. For example, SBC and U S West are the two largest providers of DSL in the US, and they are indeed represented in the survey as the two largest DSL players (Figure 3-4). In fact, SBC's estimated market share of DSL services nationwide is exactly the same as the percentage of respondents using DSL who reported Pacific Bell (a subsidiary of SBC) as the provider of DSL lines: 31%[11]. Similarly, @Home and Road Runner are represented as the two major cable modem ISPs in the survey (Figure 3-3).

Finally, the survey provides a good representation of broadband service providers in the sense that it allows the reader to compare different sub-groups of broadband subscribers on the basis of the service providers they use. For example, the reader can compare Pacific Bell's DSL users in San Jose with U S West's DSL users in Phoenix or @Home users in San Jose. The reader can also compare DSL users as a group with cable modem users as a group.

[11] SBC reported 155,000 DSL subscribers for the fourth quarter of 1999, accounting for 31% of approximately 500,000 DSL subscribers nationwide at the end of 1999, according to DSLprime.com's estimate.

3.2 Providers of Local Telephone and Cable TV Services

Figures 3-1 and 3-2 indicate that broadband subscribers in each MSA may use different providers for local telephone and cable TV services. For example, some cable modem users get telephone, cable TV, and high-speed Internet services all from the same cable company (e.g., Cox Communications in Phoenix and MediaOne in Atlanta). Similarly, there are some DSL subscribers that get both telephone and subscription TV services from BellSouth (in Atlanta) or U S West (in Phoenix).

However, the variation in service providers is not as significant as Figures 3-1 and 3-2 may suggest on the surface. Two factors have caused the big variations in the service-provider figures. First, except in New York, the number of DSL users surveyed is very different from the number of cable modem users surveyed. In San Jose, for example, there are two respondents using DSL for each respondent using a cable modem. Secondly, within each category of broadband subscribers (DSL vs. cable modem), the number of respondents from each MSA varies. For example, 102 DSL users from San Jose that participated in the survey, whereas in each of the other three MSAs, the number of DSL users ranges from 42 to 51.

The impact of these two factors is most obviously reflected in the big difference between the percentage of cable modem users reporting Pacific Bell as their local telephone provider and the percentage of DSL users who also use Pacific Bell's local telephone service (Figure 3-1). Cable modem users in San Jose only account for 14% of all the cable modem users that participated in the survey. Seventy-nine percent of them (the cable modem users in San Jose) reported Pacific Bell as their local telephone company[12], and they only account for 11% of all the cable modem users in the sample. DSL users in San Jose, on the other hand, account for 41% of all DSL users surveyed. Thus, 41% of DSL users reported Pacific Bell as their local telephone company.

[12] The rest of the cable modem users in San Jose use an alternative local telephone company.

3.3 DSL and Cable Modem Providers

Most of the DSL subscribers get DSL lines from the four RBOCs. Among them, the majority also subscribe to ISP service from the same providers (Figures 3-4 and 3-5). The survey provides a good illustration of the dominance of the RBOCs in the DSL arena. The main competitive local exchange carriers (CLECs) represented in the survey are Covad Communications Group Inc. and NorthPoint Communications Group Inc.

Although Excite@Home and RoadRunner are the two dominant players of cable modem service in the US, there are a few independent cable modem ISPs (Figure 3-3), including RCN Corp., the ISP Channel, High-speed Access Corp. (HSA), Charter Pipeline, and Adelphia Communications (not represented in the survey). CableVision's local franchise in Atlanta uses its own ISP service (Total-Web), even though CableVision is an affiliate of the @Home service. Thus, Total-Web is also reported as an independent cable modem ISP in the survey.

It is noteworthy that a traditional dial-up ISP may also serve as a cable modem ISP, although there are few of them. The companies that work with cable companies as cable modem ISPs in the four MSAs include Prodigy Inc., EarthLink Network Inc., Planetsoft Inc., Erols Internet (via RCN), etc. America Online (AOL) members can keep their AOL account but use a cable company for access.[13] This is perhaps why 12 respondents who identified themselves as cable modem users reported AOL as their cable modem ISP. Although Parks Associates cannot rule out the possibility that some of these respondents may have mistakenly identified themselves as cable modem users, Parks Associates did not remove them from the sample.

A small percent of cable modem users (6% of @Home users and 4% of Road Runner users surveyed) do not seem to recognize the cable modem ISP they are using. While answering the question on cable Internet service used, these respondents did not choose Excite@Home or Road

---

[13] Excite@Home affiliates launched a promotion called "You Get. You Keep. We Pay." in 1999 that targeted AOL users. The promotion says that if an AOL user chooses to use a cable company's @Home service to access his/her AOL account, the cable company will pay AOL's Bring-Your-Own-Access monthly charge of $9.95 for a certain period of time.

Runner. Instead, they checked "Other" and then specified "Other" as, say, Cox@Home or MediaOne. While compiling the data, however, Parks Associates put these respondents into the category of @Home or Road Runner users. So the number of @Home and Road Runner subscribers in Figure 3-3 already include these respondents.

It is noteworthy that Speed Choice is a wireless cable modem service that uses multichannel multipoint distribution service (MMDS). Although Parks Associates did not intend to cover MMDS in this study, six Speed Choice subscribers in Phoenix participated in the survey. Parks Associates has chosen to keep them in the sample.

3.4 ISPs Used Before Adopting Broadband

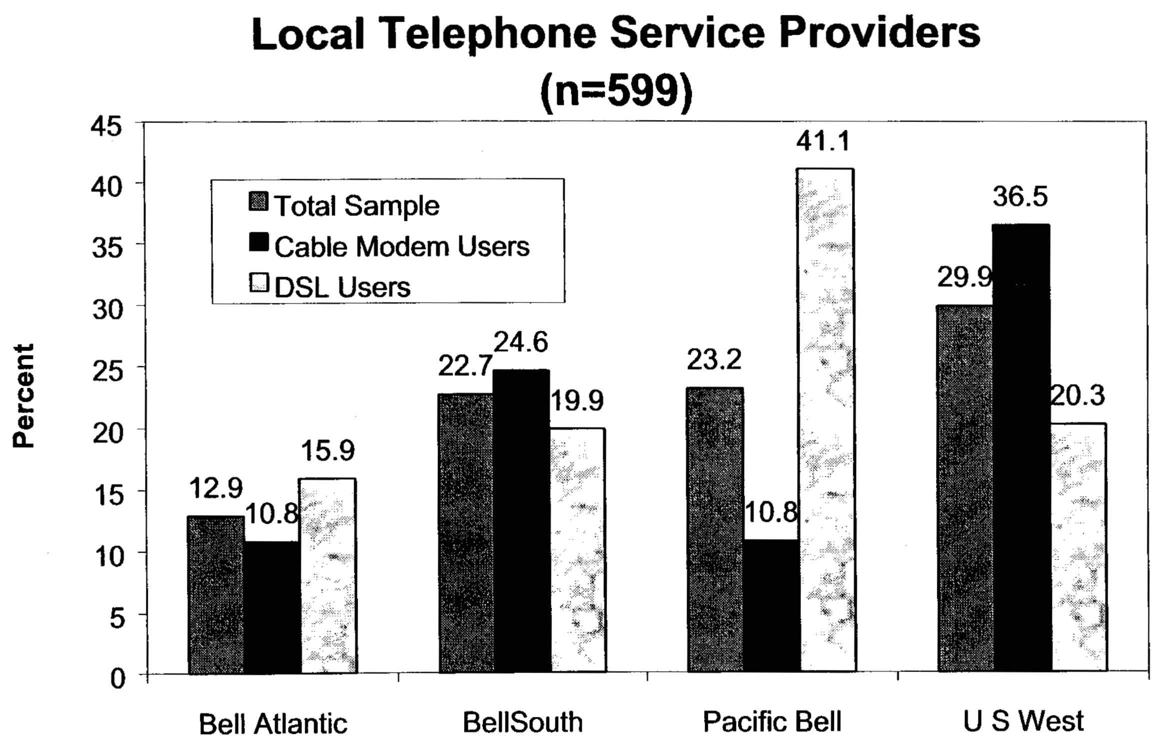
Because broadband users adopted broadband services at different times and because the survey targeted just four MSAs, Figure 3-6 should not be read as a chart that reflects dial-up ISPs' market share. However, the chart does indicate who the major players are. A larger percent of cable modem subscribers used to use AOL's service, compared with DSL subscribers (25.8% vs. 14.6%). Parks Associates believes that this is partially the RBOCs have been targetting their existing dial-up ISP customers for DSL services. Indeed, the survey indicates that more DSL users subscribed to the RBOCs' dial-up services than cable modem users (13% vs. 7.9%).

Almost 9% of the respondents did not specify a dial-up ISP. However, this does not necessarily mean that they did not use dial-up service before adopting broadband services. A separate question on online usage before adopting broadband services indicates that only 2.7 percent of the respondents did not use the Internet at home before adopting broadband (Figure 5-1).

3.5 Current Usage of Dial-up Accounts and Free Web-Based E-mail Accounts

Nearly half of the cable modem users do not have a dial-up account, compared with 37.5% of DSL subscribers. This is partially because many DSL customers can get a free dial-up account if they subscribe to both a DSL line and ISP service from the same provider.[14] Cable companies, on the other hand, mostly do not provide dial-up Internet service. However, things are changing rapidly. Excite@Home has already started offering a free dial-up Internet service. Cable modem subscribers can also get free dial-up Internet from various independent ISPs, such as NetZero, 1stup.com, freeweb.com, Bluelight.com, etc. As to free Web-based e-mail services, such as Hotmail and Yahoo!mail, more than 71% of the respondents use at least one of these services (Figure 3-8). There is no significant difference between DSL and cable modem users in terms of subscription to free e-mail services.

[14] Based on Parks Associates' interviews with various DSL providers.



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-1

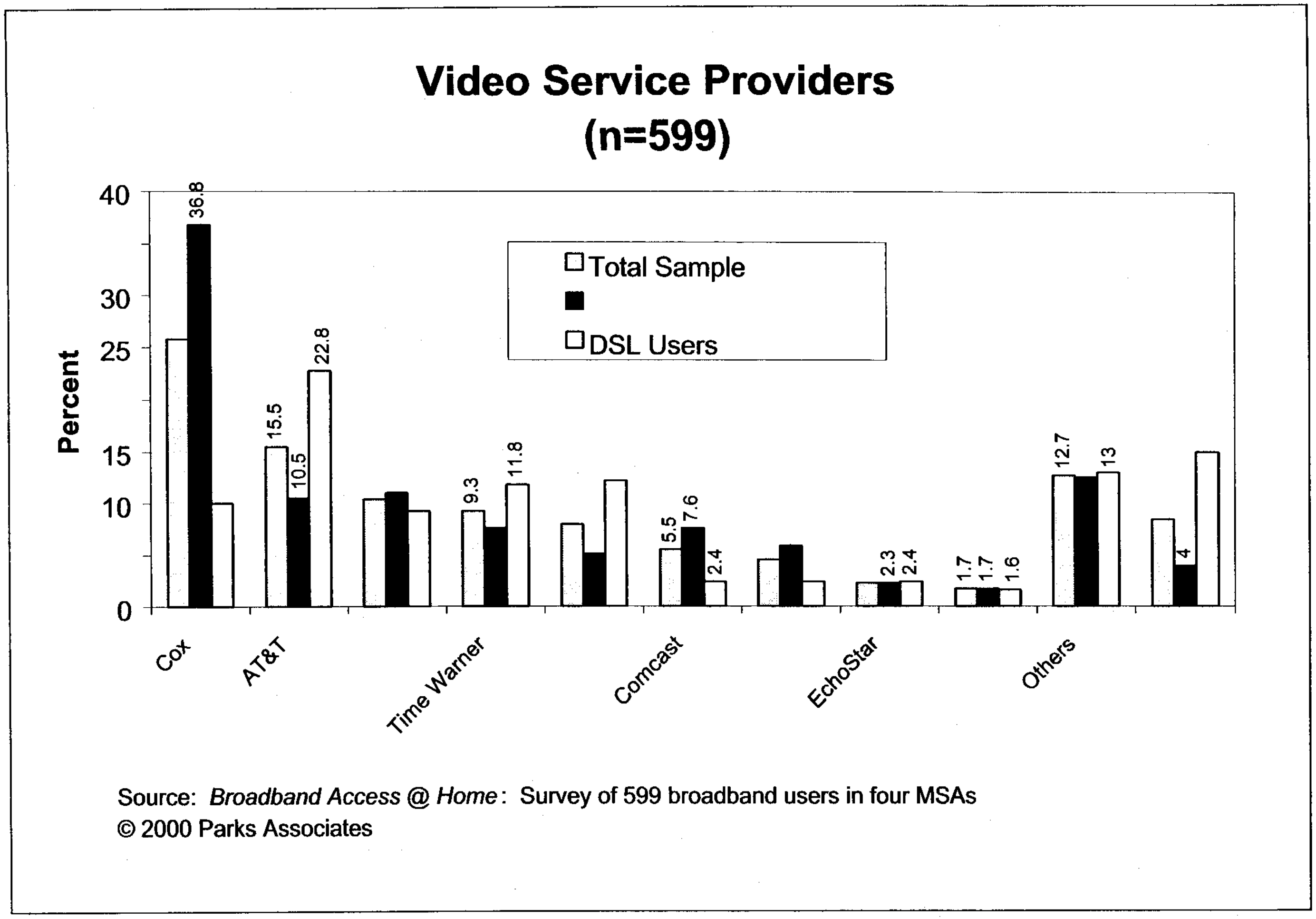
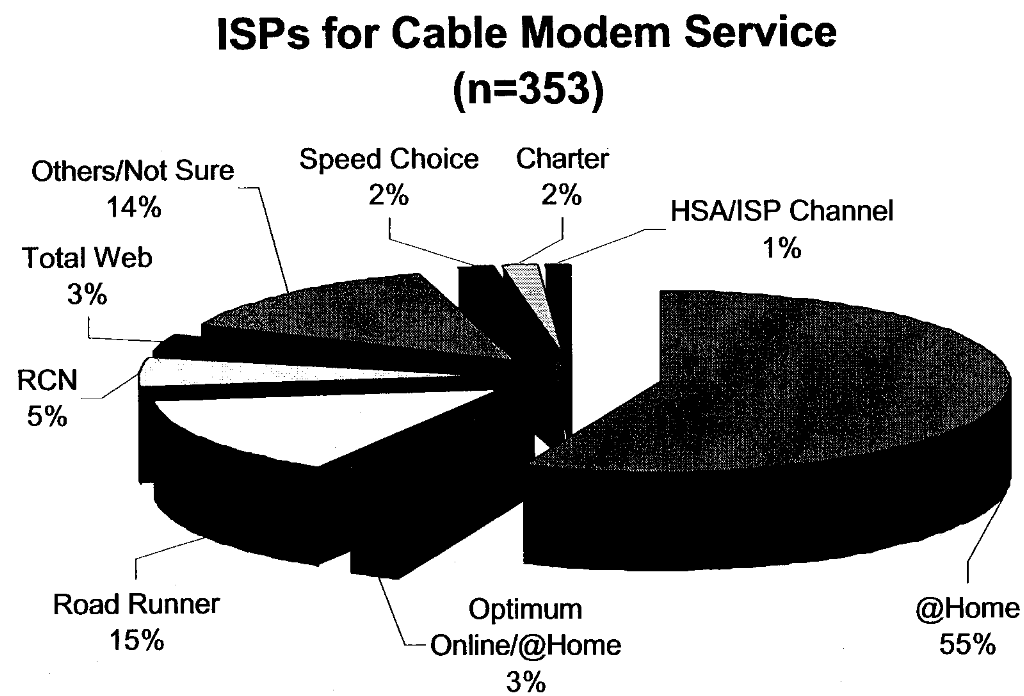
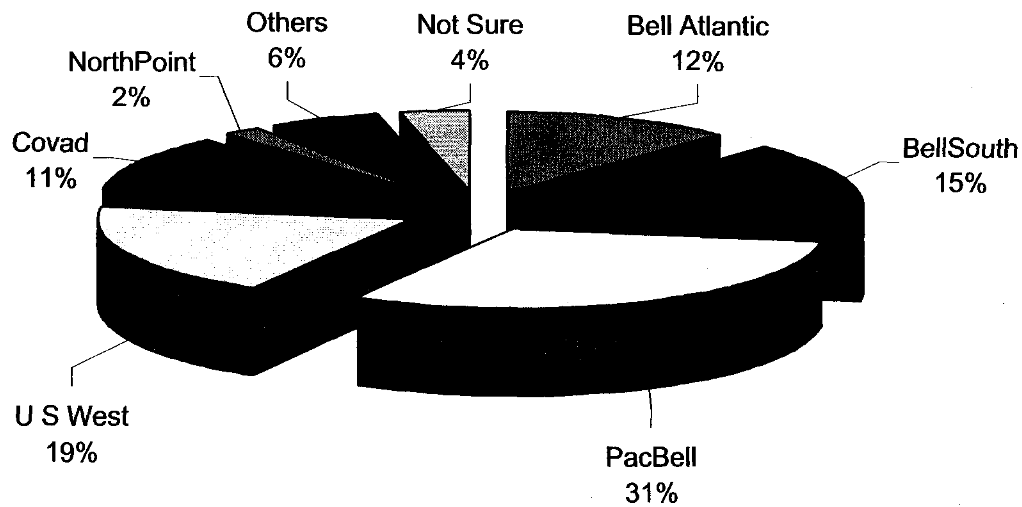

Video Service Providers
(n=599)
Percent
40
30
25
15
10
0
36.8
15.5
10.5
22.8
9.3
11.8
5.5
7.6
2.4
2.3
2.4
1.7
1.7
1.6
12.7
13
4
Total Sample
DSL Users
Cox
AT&T
Time Warner
Comcast
EchoStar
Others
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-2



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Providers of DSL Lines
(n=246)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
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Figure 3-4

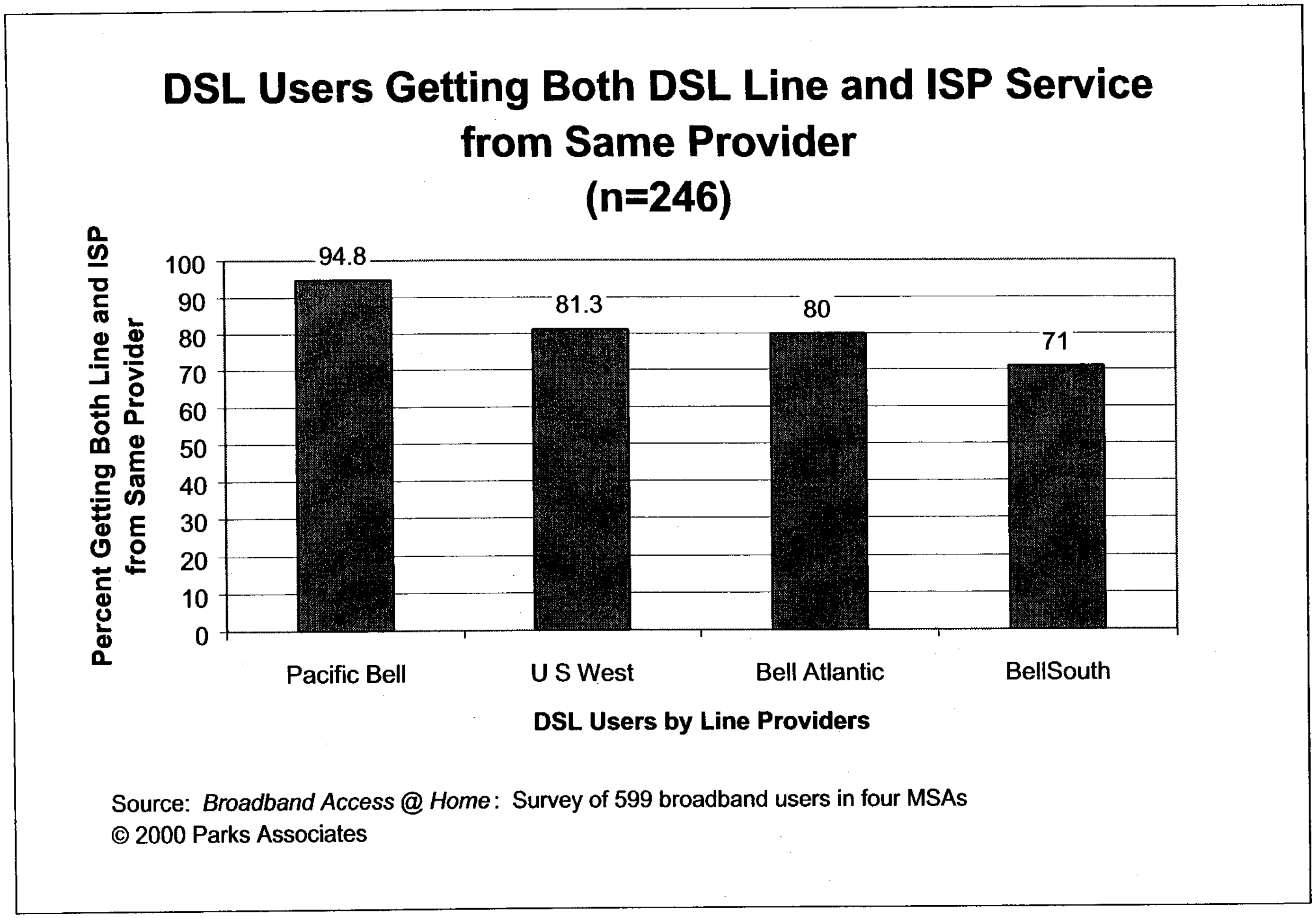
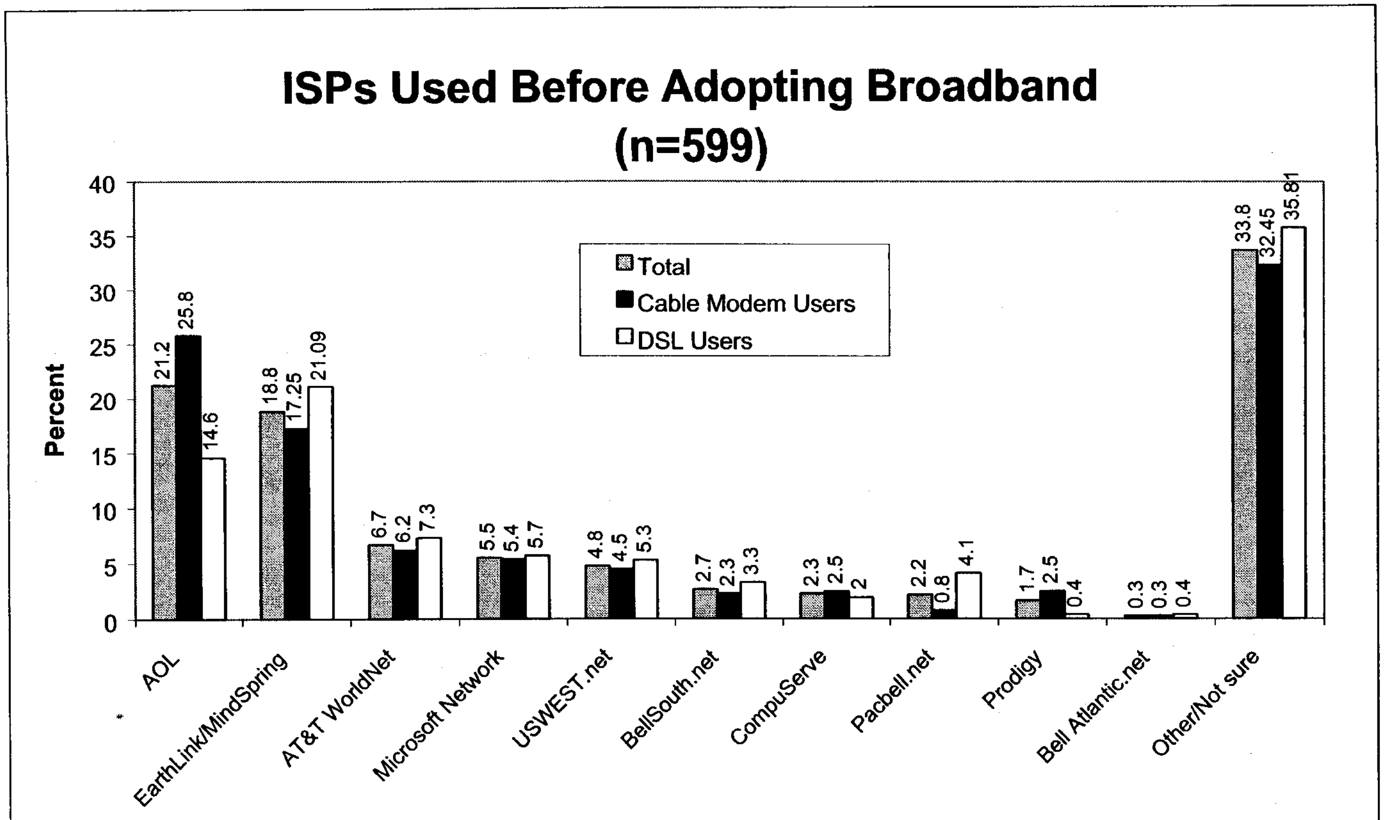
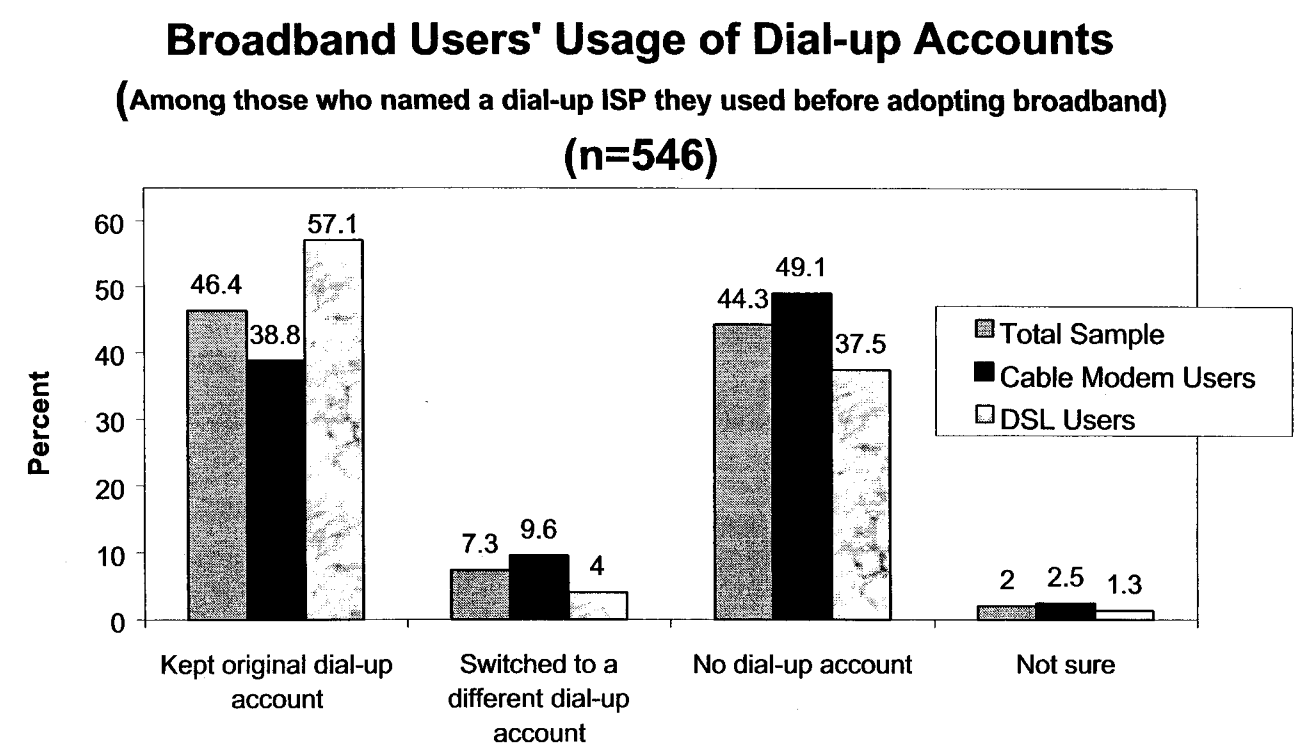

DSL Users Getting Both DSL Line and ISP Service from Same Provider
(n=246)
Percent Getting Both Line and ISP from Same Provider
100
90
80
70
60
50
40
30
20
10
0
94.8
81.3
80
71
Pacific Bell
U S West
Bell Atlantic
BellSouth
DSL Users by Line Providers
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-5



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-6



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-7

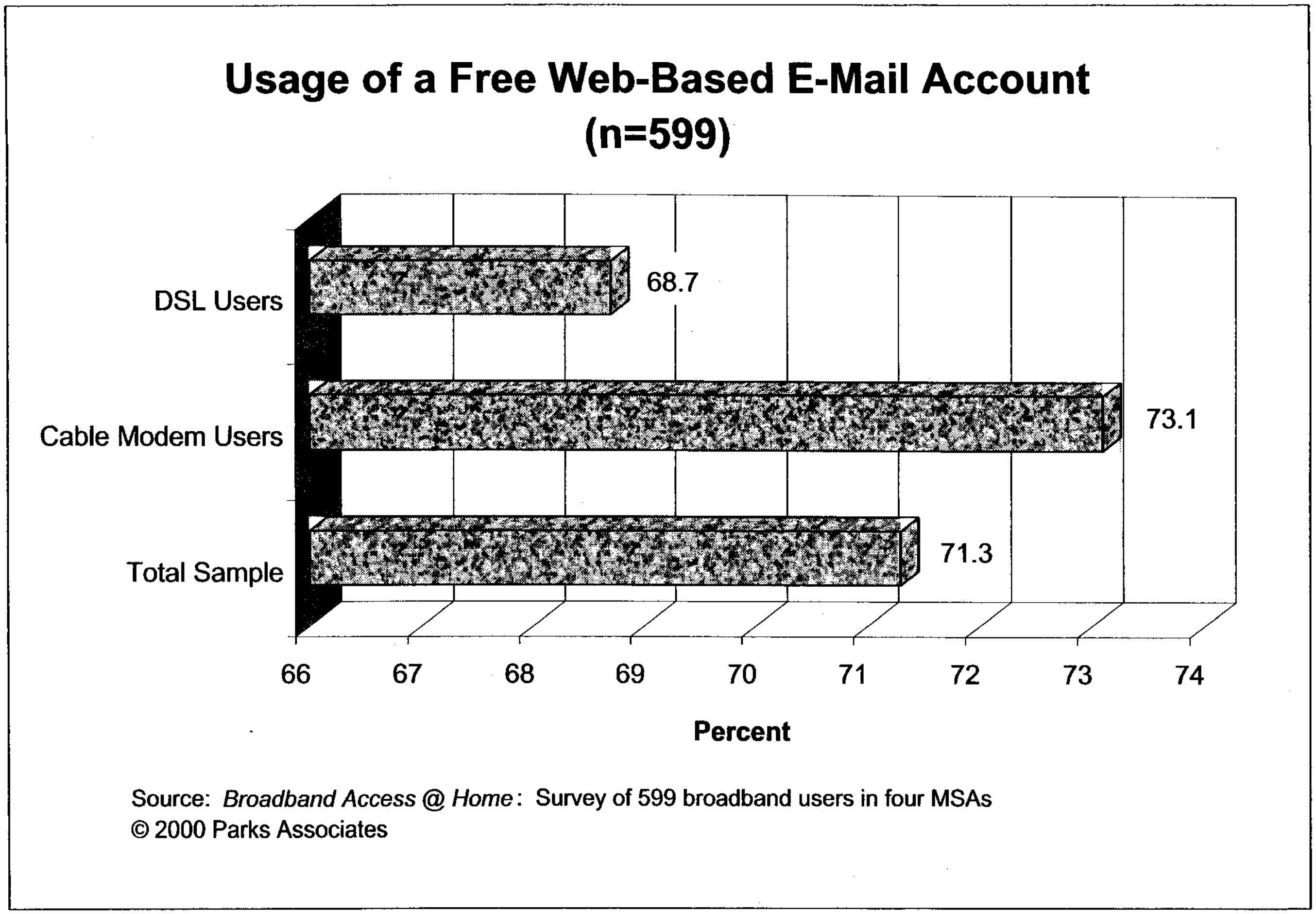

Usage of a Free Web-Based E-Mail Account
(n=599)
DSL Users
Cable Modem Users
Total Sample
68.7
73.1
71.3
66
67
68
69
70
71
72
73
74
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 3-8

4.0 Hardware, Installation, and Service Plans

4.1 Importance of Hardware Brands

Hardware/modem brands do not appear to be an important issue to the respondents. First of all, 32% of cable modem users and 14% of DSL users do not even know the brand of the high-speed modems they have been using (Figure 4-1). Secondly, 90% of the broadband users were not even given a choice about hardware when they signed up for broadband services (Figure 4-2).

When interoperable high-speed modems become widely available at retail, consumers will be able to make their choices. When that happens, the importance of hardware brands will become more obvious. Such increase of importance, however, may be limited if high-speed modems are sold not as external stand-alone devices but as internal components of new PCs (the same way as virtually all dial-up modems are sold today). Preliminary results from a survey of 600 dial-up users indicate that 43% of the dial-up users do not even know the brand of the modem they use.

4.2 Downstream Speed of Broadband Services

Although the theoretical downstream speed of DSL or cable modems is very high (typically a few megabits per second or more), the actual speed is typically slower. Various factors affect the actual downstream speed. Examples include the distance between the DSL user and the telcos' central office and the number of cable modem users sharing the same cable node.

Parks Associates' survey indicates that DSL users have a better idea of the actual speed they can get. Forty-four percent of the cable modem users cannot tell the typical downstream speed they get from their modems, compared with just 18% of DSL users (Figure 4-3). Parks Associates believes that this is partially because DSL provides a dedicated connection, which generally does not cause speed to fluctuate. Cable modem service, on the other hand, provides shared access, and end users can experience big variations of access speed. Another reason is that many DSL providers offer a tiered service plan, charging different prices for different access speeds. Thus, DSL subscribers must select a particular service that is based on access speed, making it easier for them to recall the downstream speed they can actually get.

Cable modem service, however, does seem to enjoy an advantage in access speed. Fourteen percent of the cable modem users reported a typical speed of 1.5 Mbps or more, compared with just 4% of DSL users. Parks Associates believes that because DSL services offering 1.5 Mbps or more typically cost more than $60 a month, most DSL subscribers have chosen a lower-priced (and hence lower-speed) service. Another viable reason is that DSL's current distance limit makes it impossible for many subscribers to get more than 1.5 Mbps.

4.3 Service Installation

The survey indicates that modem installation and network configuration usually takes less than four hours. The average time spent on installation is 3 hours and 26 minutes (Figure 4-4). Overall, there is no significant difference between DSL and cable modem service in terms of installation time.

More DSL users reported self-installation than cable modem users (34% vs. 14%). Most of the DSL users who self-installed services are in Phoenix (76.5%) and New York (40.5%). According to Parks Associates' research, about 90% of U S West's DSL customers have chosen a self-installation option; of those, 86% could complete the installation without requiring professional assistance.[15] This explains why 76.5% of the DSL respondents in Phoenix reported self-installation. As to New York, the relatively high-percentage of self-installed DSL service is attributed to Bell Atlantic's introduction of a self-installation version of its DSL service in New York in June. Most of the other DSL providers have yet to make self-installable services widely available. Among the respondents whose broadband services were professionally installed,

[15] Interview with a U S West executive at the end of 1999.

more than half (52%) would be interested in a self-installation option if they were to subscribe to their broadband services today (Figure 4-6).

4.4 Broadband Modems Leased vs. Purchased

Thirty-six percent of the respondents were given the option of leasing their high-speed modems (Figure 4-2), and of those, 89% (or 32% of all the respondents) said that they lease their high-speed modems (Figure 4-7). Virtually all of them are cable modem users. Because few DSL providers have given their customers a lease option, only 2.9% of the DSL users reported leasing a modem, compared with 53% of cable modem users.

Forty-three percent of the respondents did not indicate whether their high-speed modems were leased or purchased. Parks Associates believes that these respondents either failed to check the word "purchased" while filling out the survey online or got their modem free of charge. While answering the question on upfront costs of high-speed services, 31% of the respondents entered the number "zero" for modem (Q.351)[16].

4.5 Term Contract of Broadband Services

Most of the cable modem users (84%) do not have a term contract for service, which contrasts with 54% of DSL users without a term contract (Figure 4-8). More DSL providers than cable modem ISPs require subscribers to make a choice between a month-to-month rate plan or a term-contract rate plan (with a lower monthly charge). Among those who have a term contract, most (87%) are obliged to keep their service for one year.

[16] Some of the respondents entered the number zero because they leased their modem or were charged a single amount for modem, installation, and service activation combined. For more information, see Section 4.6 on upfront expenses.

4.6 Pricing of Broadband Services

Cable modem subscribers generally enjoy a lower monthly charge than DSL users (Figure 4-9). Two factors have contributed to a higher average price of DSL service. First, DSL users not only need to pay a monthly fee for a DSL line but also an ISP charge, which is often separate. Cable modem service involves just a single fee for both line access and ISP charge. Second, most DSL providers have a tiered service plan, charging different fees for different downstream speeds. For example, the RBOCs (except BellSouth, which has a single rate plan) charge $100 or more for services that deliver downstream speeds in the megabit range. Cable companies, on the hand, generally do not offer tiered service plans with different rates. However, Parks Associates expects the gap to diminish. The RBOCs are lowering DSL service charges, and U S West even offers a dial-up version of its DSL service that costs only $19.95 per month (excluding ISP charge).

DSL users also appear to pay more on up-front expenses than cable modem subscribers (Figure 4-10). On average, DSL users paid an average of $199 on hardware, installation, and service activation. Cable modem subscribers, on the other hand, paid $171. However, Parks Associates believes that the difference will also diminish soon. DSL providers are lowering upfront charges with discounts and other types of promotions. In the end, the only upfront cost for DSL and cable modem services will perhaps be the cost of a high-speed modem that is sold at retail or comes with a new PC. Parks Associates expects to see comparable price tags for cable modems and DSL modems.

It is noteworthy that in the data tab, zeros are included in the calculation of all the averages (Figure 4-11). Figure 4-10 only includes respondents who reported an expense greater than zero for a particular item.

More DSL users (13.4%) than cable modem subscribers (5.6%) have their employers pay for their broadband services either completely or partially (Figure 4-12). Parks Associates believes that this difference is due to two factors. One is that DSL is probably the preferred choice for corporate telecommuters and/or spillovers. One example is a deal between SBC Communications and IBM Corp. (announced in October 1999): SBC will provide 15,000 IBM telecommuters with remote access to IBM's corporate network via DSL throughout SBC's region. The second factor is that among the DSL users who reported complete employer coverage of DSL service charges, 57% are in San Jose, which accounts for 41% of all the respondents using DSL.

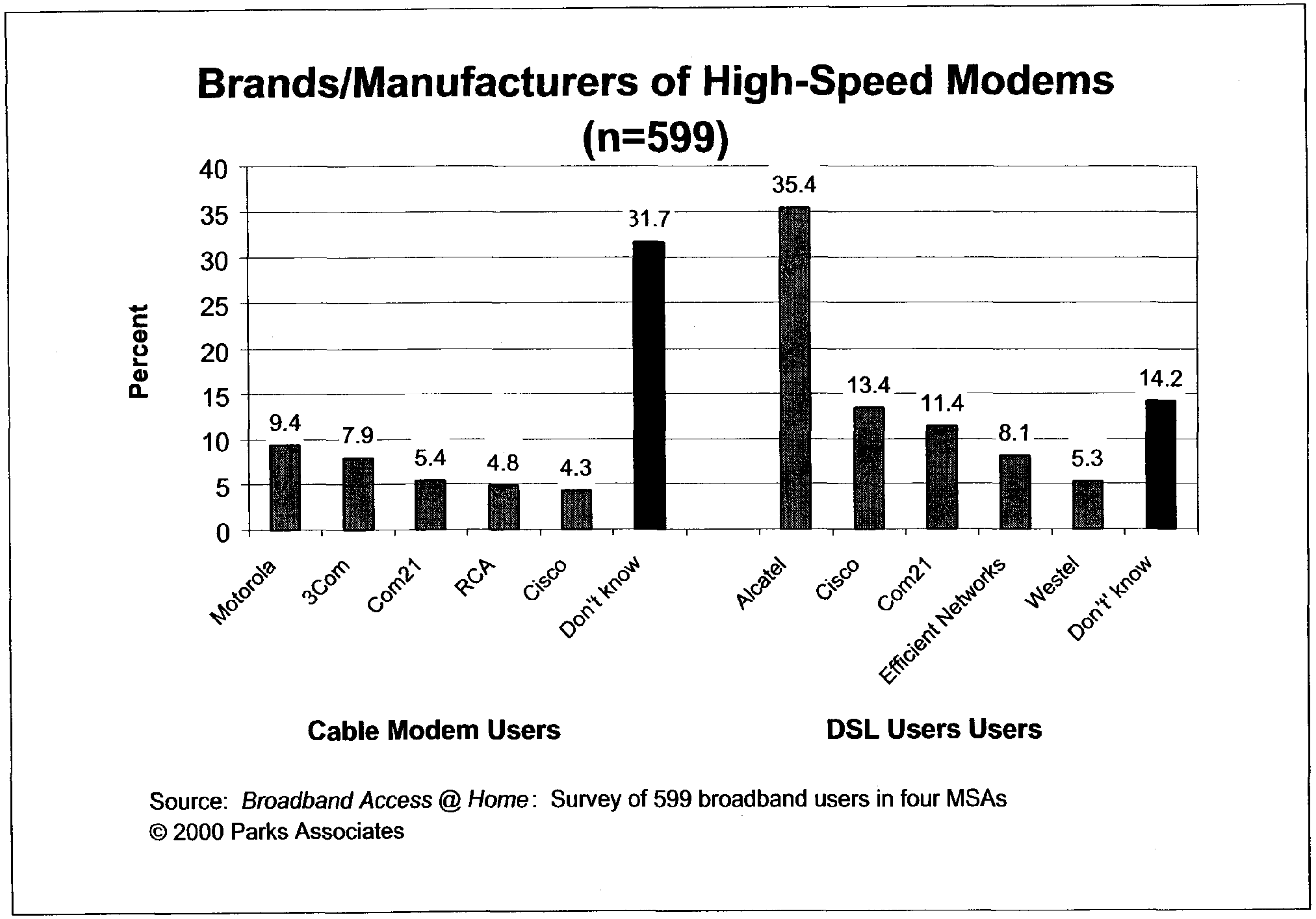

Brands/Manufacturers of High-Speed Modems
(n=599)
Percent
40
35
30
25
20
15
10
5
0
9.4
7.9
5.4
4.8
4.3
31.7
35.4
13.4
11.4
8.1
5.3
14.2
Motorola
3Com
Com21
RCA
Cisco
Don't know
Alcatel
Cisco
Com21
Efficient Networks
Westel
Don't' know
Cable Modem Users
DSL Users Users
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-1

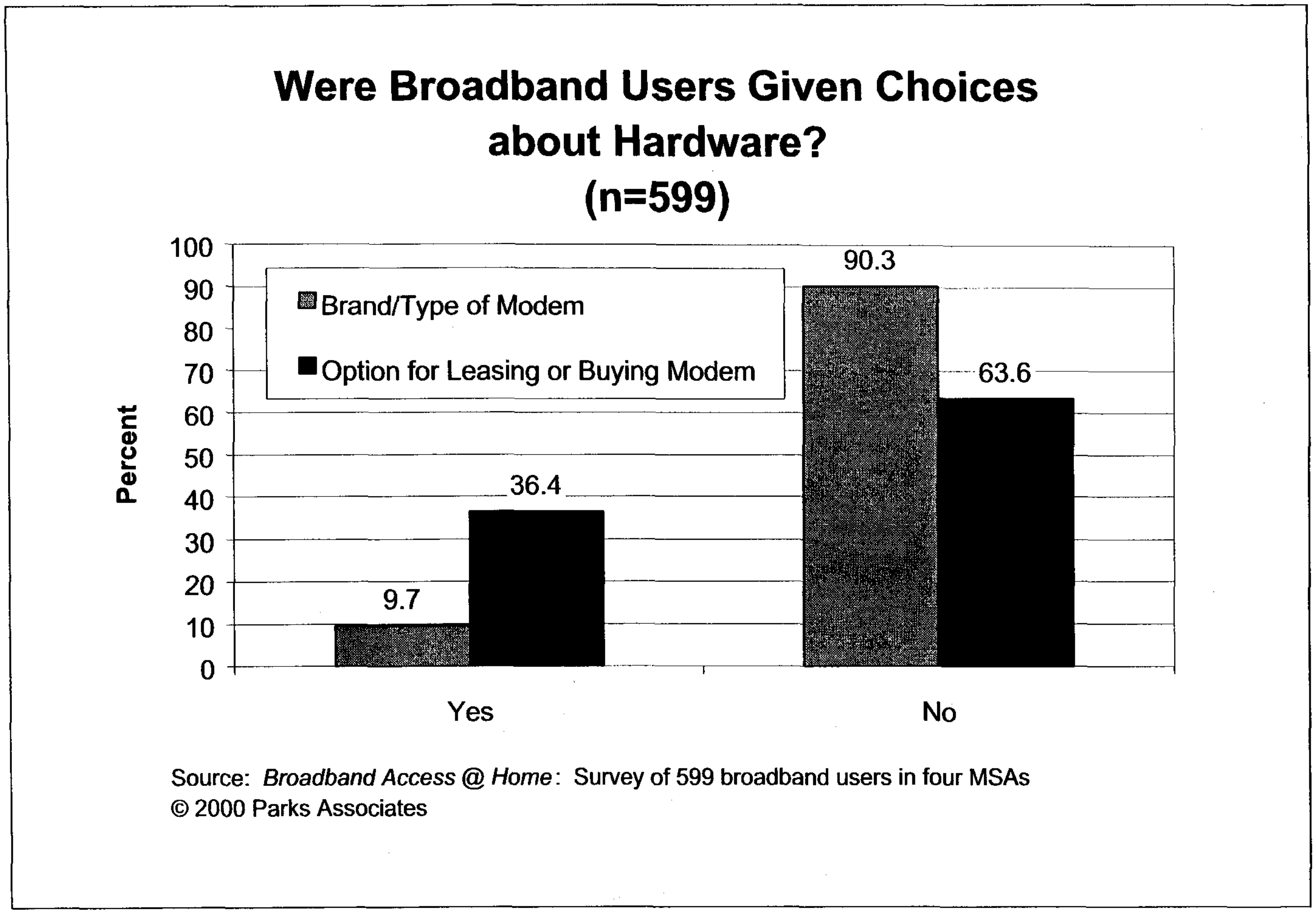

Were Broadband Users Given Choices about Hardware?
(n=599)
Percent
100
90
80
70
60
50
40
30
20
10
0
Brand/Type of Modem
Option for Leasing or Buying Modem
9.7
36.4
90.3
63.6
Yes
No
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
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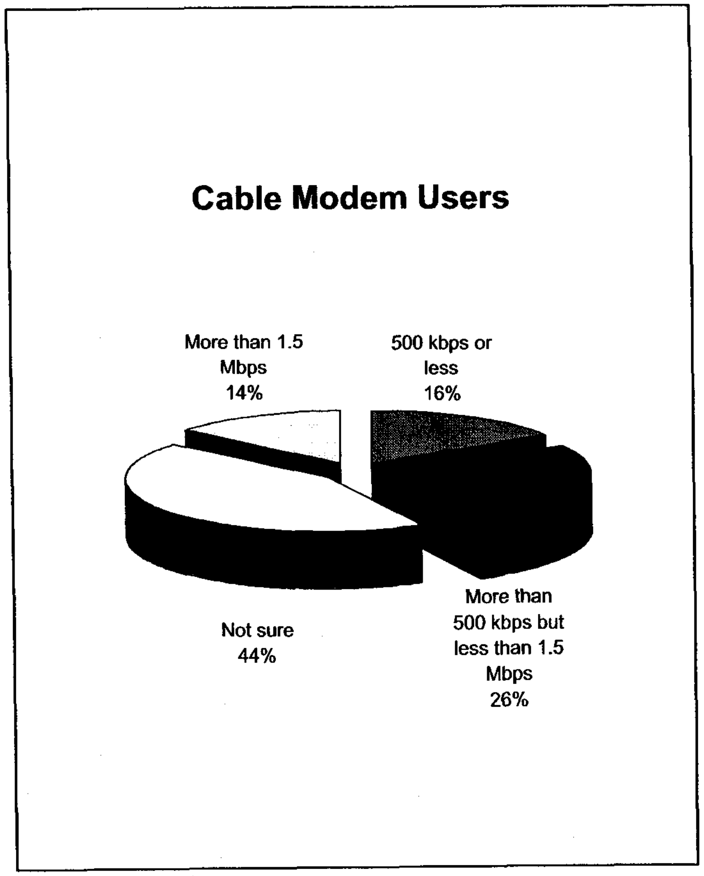
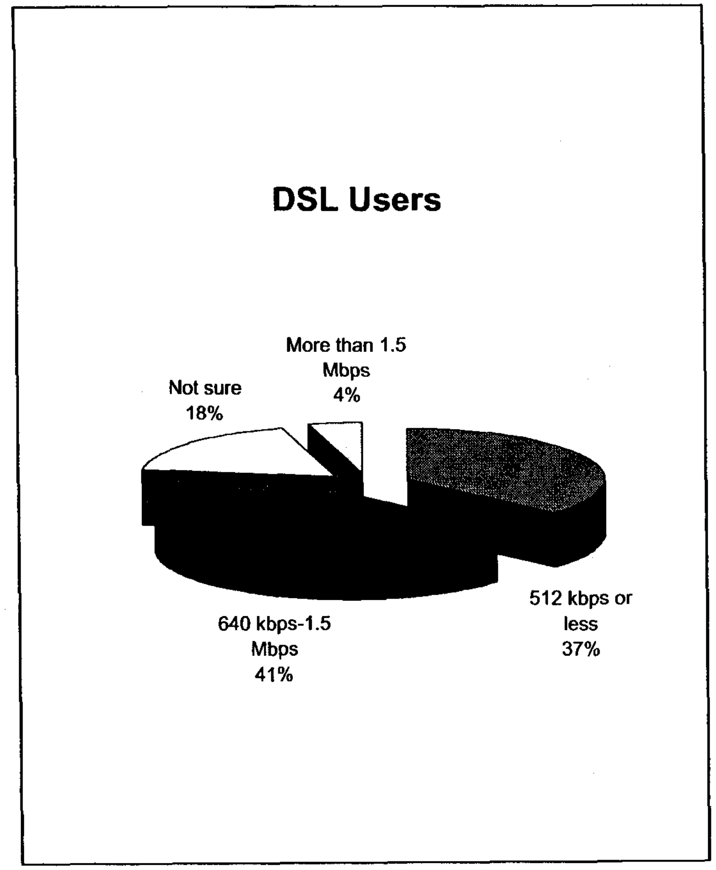
Figure 4-2

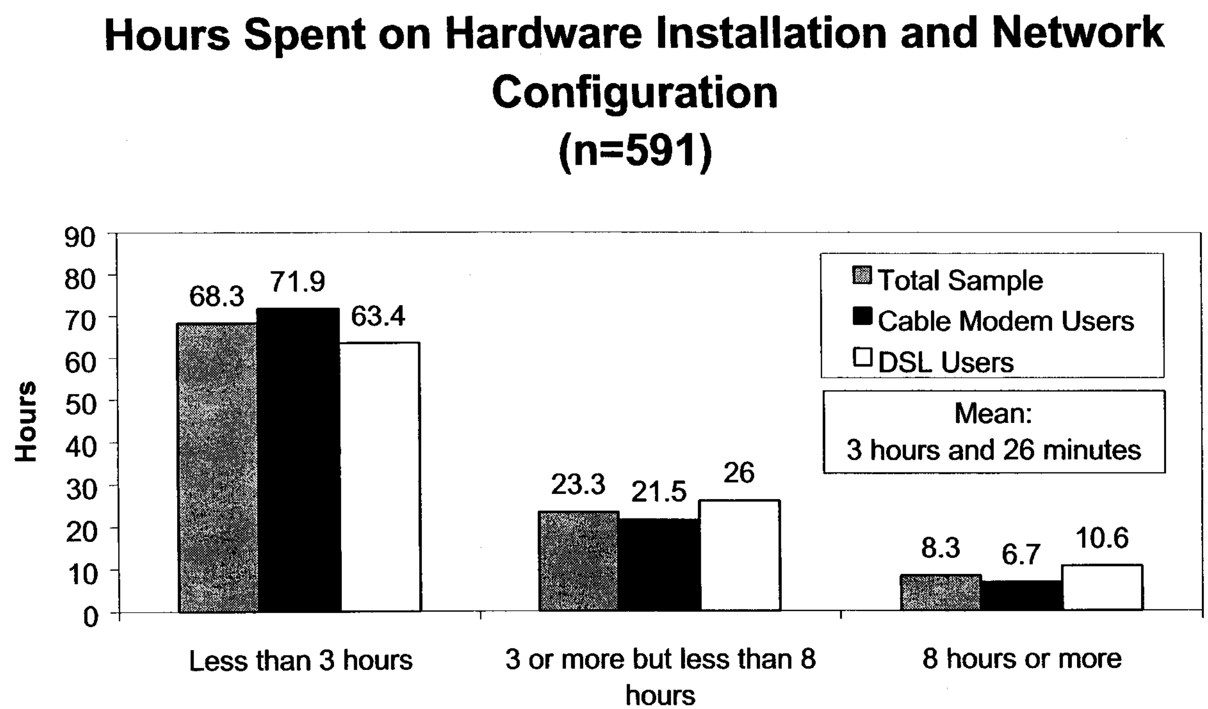
What Downstream Speed Do Broadband Users Typically Get?





Source: *Broadband Access @ Home* : Survey of 599 broadband users in four MSAs

Figure 4-3



Note: Eight respondents who reported zero hours are excluded from the calculation.

Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 4-4

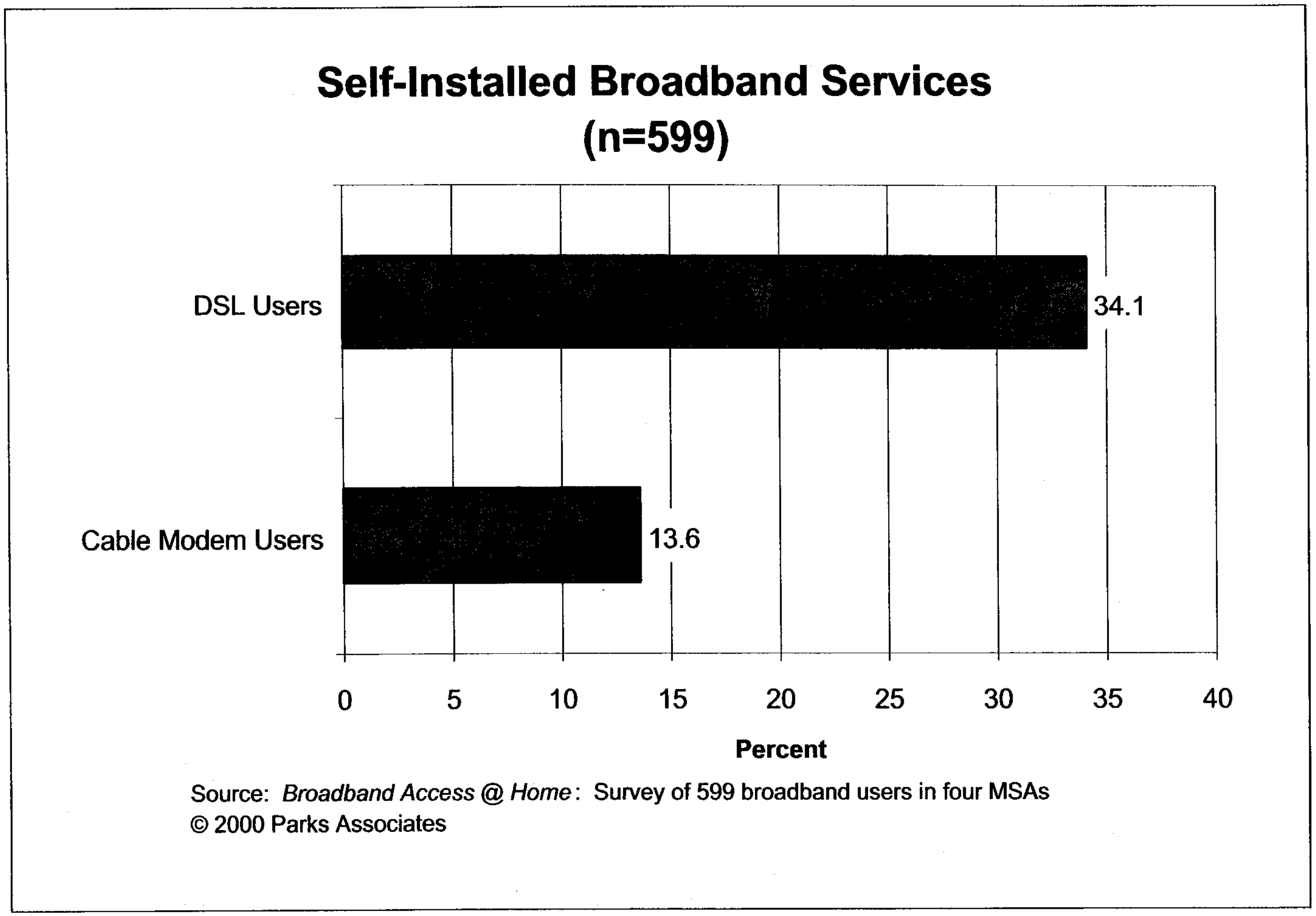

Self-Installed Broadband Services
(n=599)
DSL Users
34.1
Cable Modem Users
13.6
0
5
10
15
20
25
30
35
40
Percent
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-5

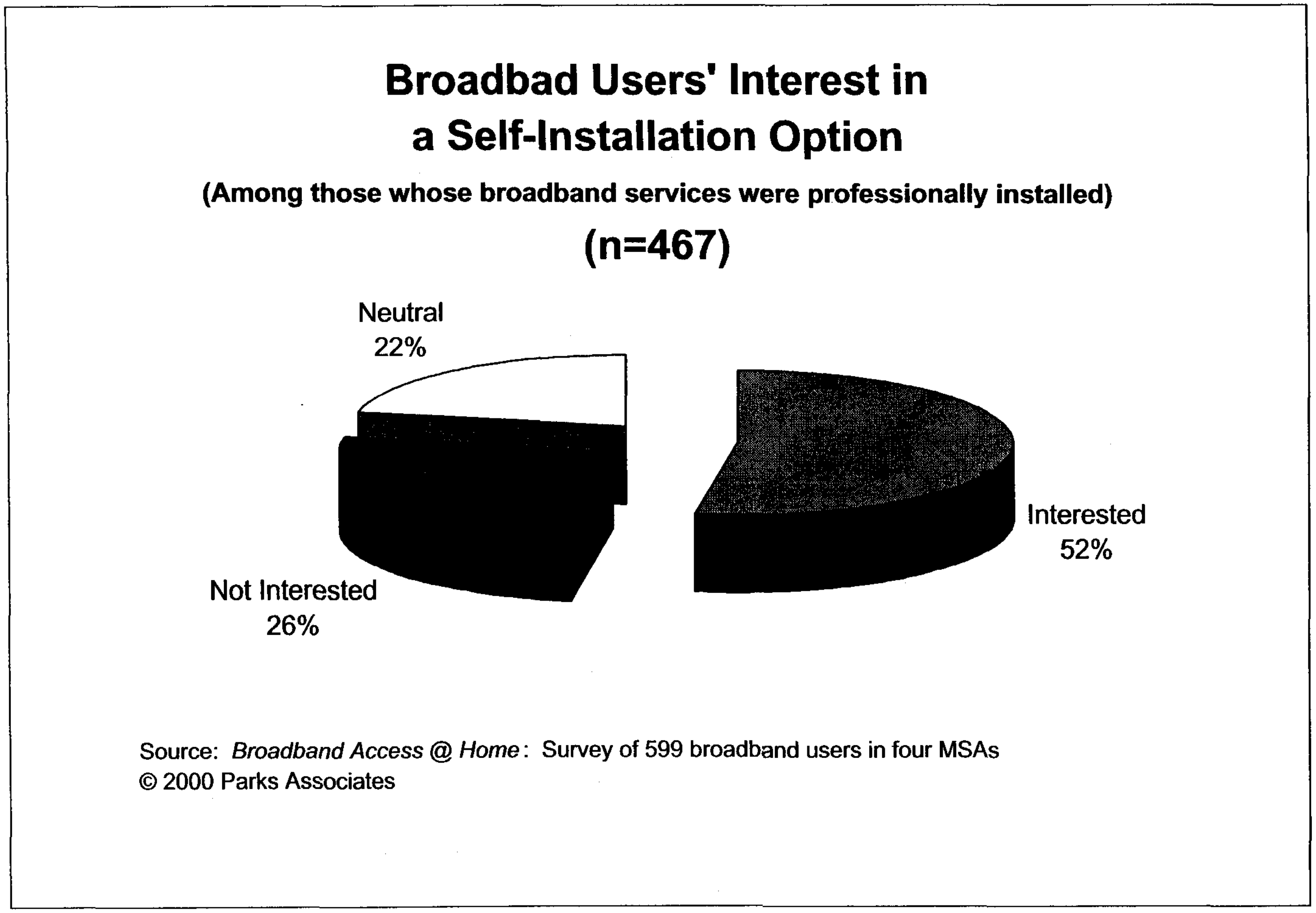

Broadbad Users' Interest in a Self-Installation Option
(Among those whose broadband services were professionally installed)
(n=467)
Neutral 22%
Interested 52%
Not Interested 26%
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-6

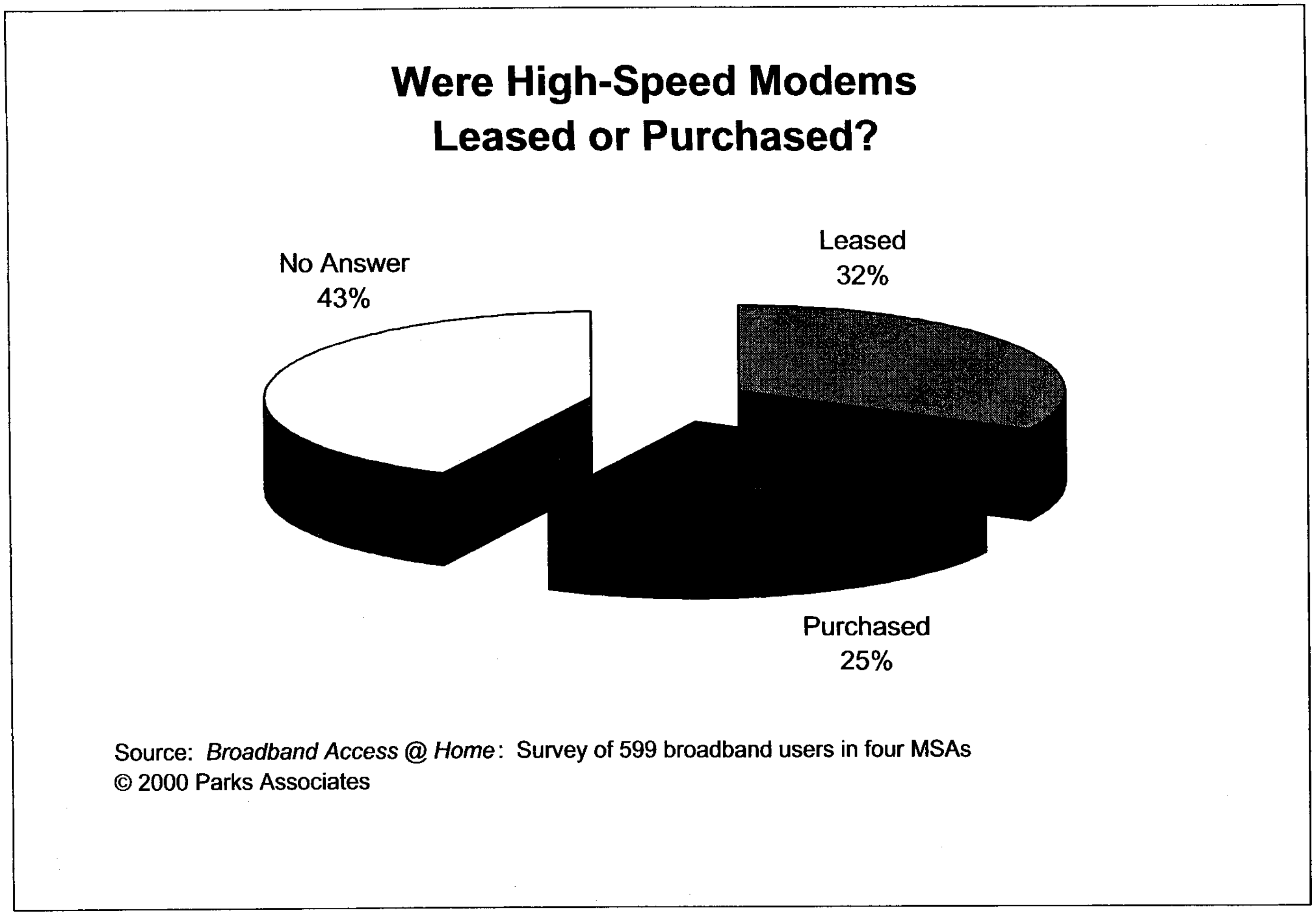

Were High-Speed Modems Leased or Purchased?
No Answer 43%
Leased 32%
Purchased 25%
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-7

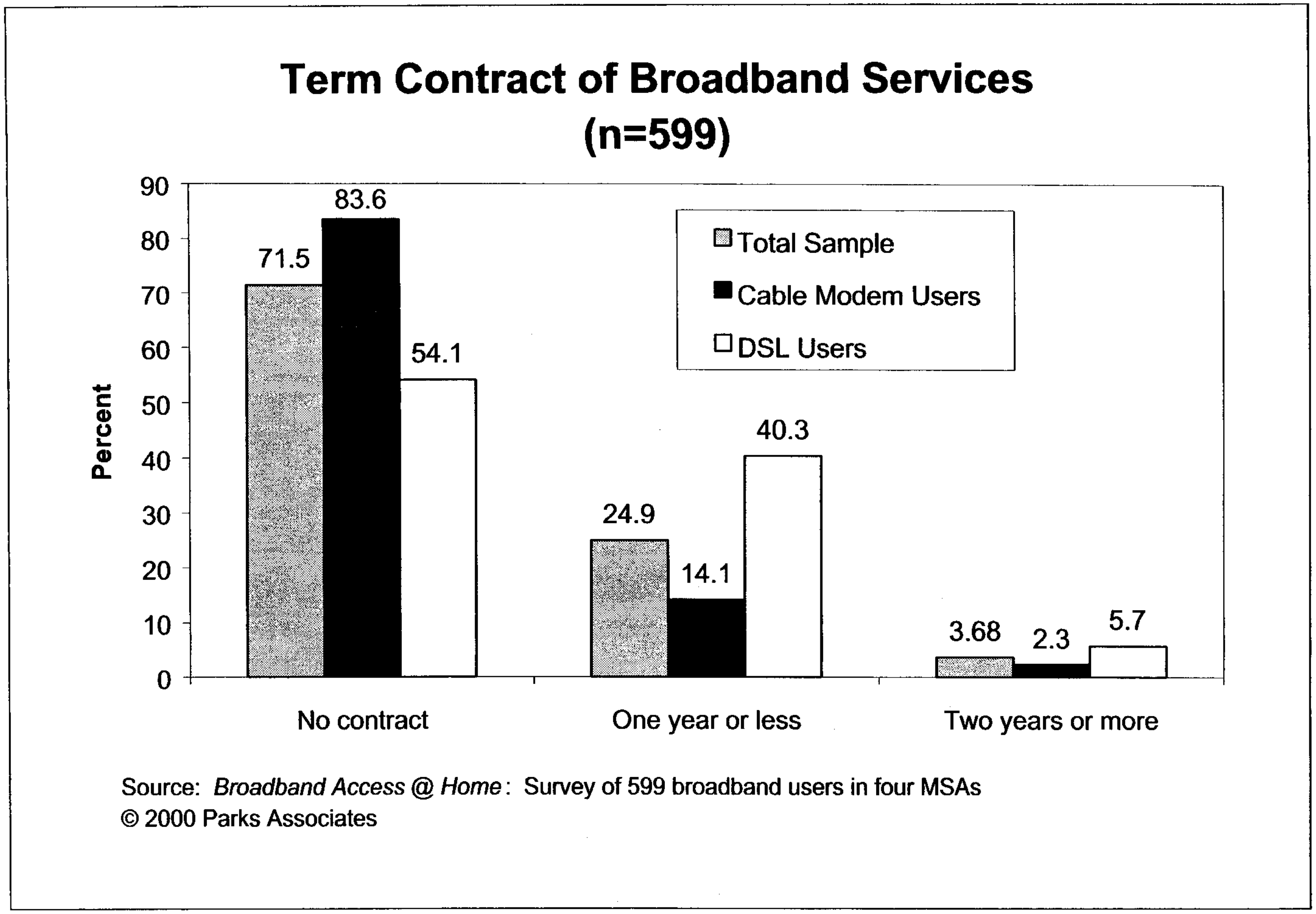
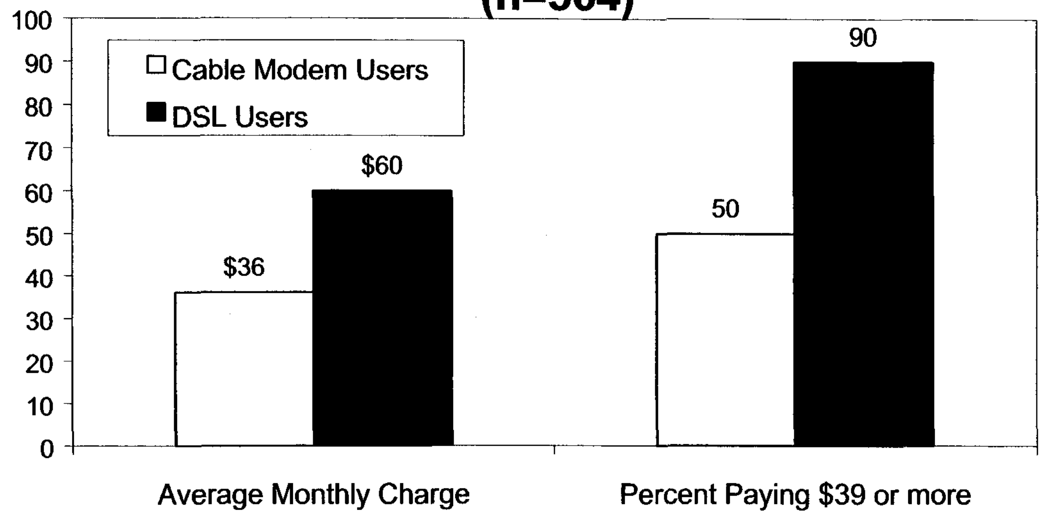

Term Contract of Broadband Services
(n=599)
Percent
90
80
70
60
50
40
30
20
10
0
71.5
83.6
54.1
24.9
14.1
40.3
3.68
2.3
5.7
Total Sample
Cable Modem Users
DSL Users
No contract
One year or less
Two years or more
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-8

Monthly Charge for Broadband Services, Including ISP Charge (n=564)



Note: respondents who reported less than $19 per month are excluded.

Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 4-9

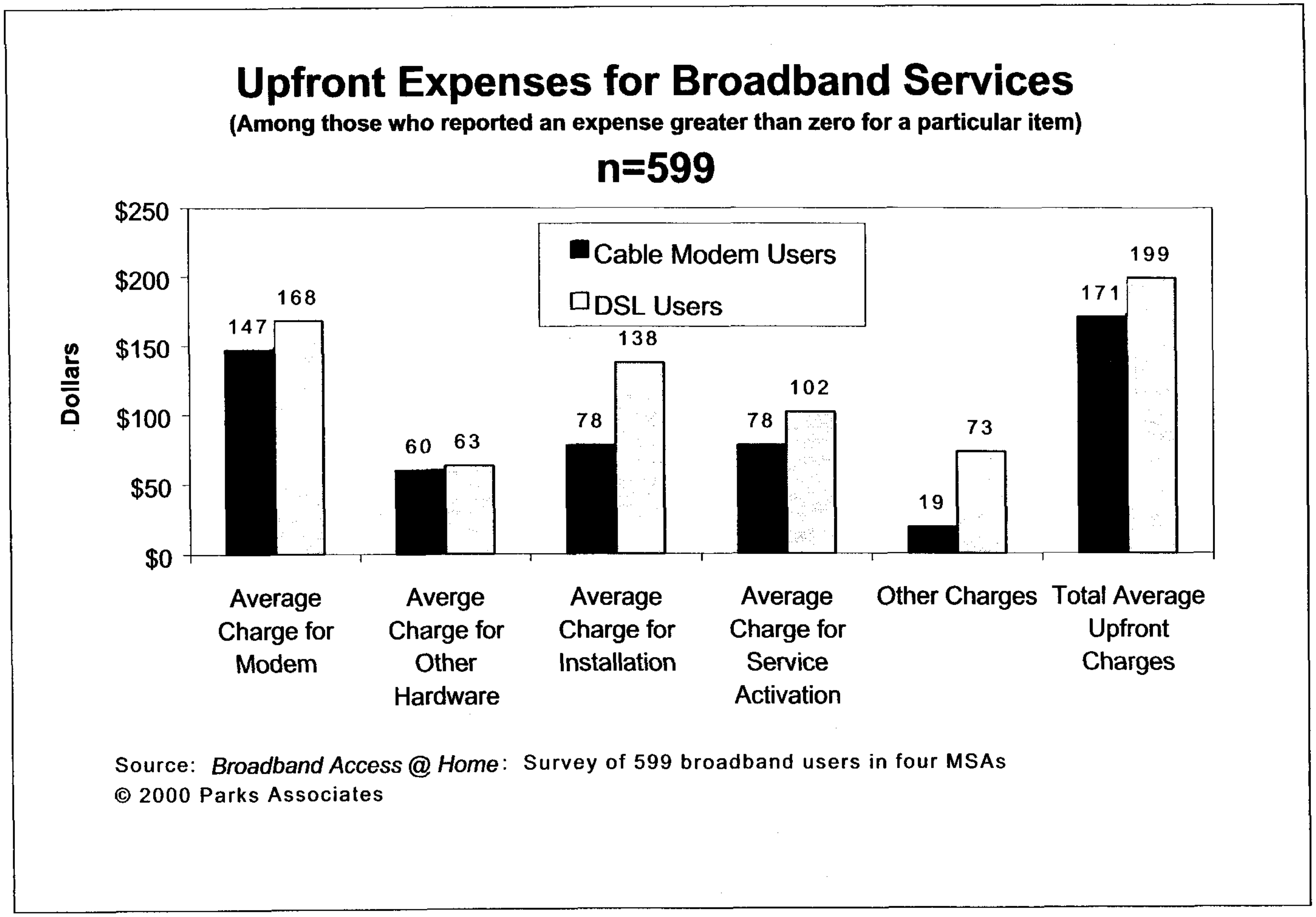

Upfront Expenses for Broadband Services
(Among those who reported an expense greater than zero for a particular item)
n=599
$250
$200
$150
$100
$50
$0
Dollars
Cable Modem Users
DSL Users
147
168
60
63
78
138
78
102
19
73
171
199
Average Charge for Modem
Averge Charge for Other Hardware
Average Charge for Installation
Average Charge for Service Activation
Other Charges
Total Average Upfront Charges
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-10

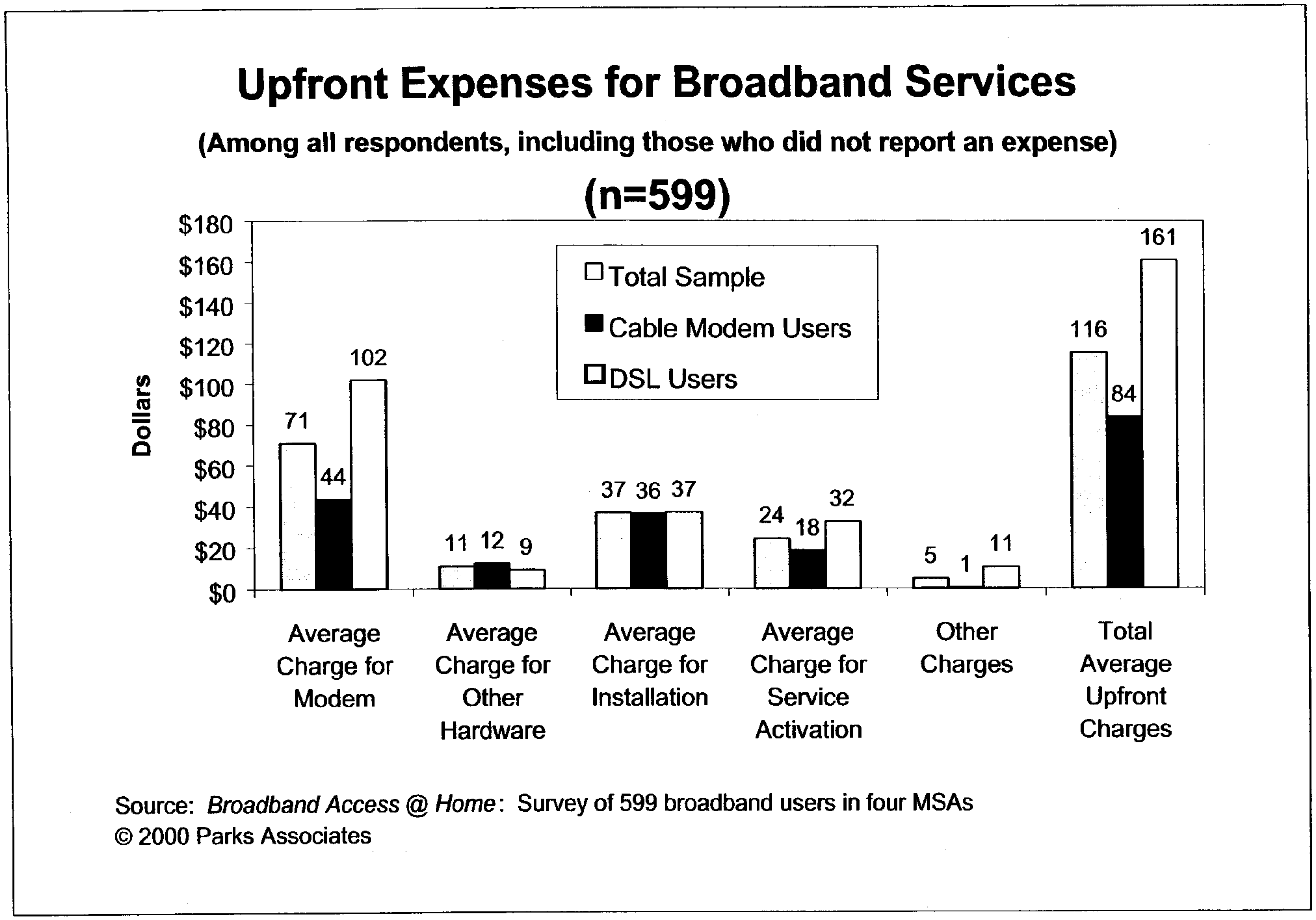

Upfront Expenses for Broadband Services
(Among all respondents, including those who did not report an expense)
(n=599)
Total Sample
Cable Modem Users
DSL Users
Dollars
$180
$160
$140
$120
$100
$80
$60
$40
$20
$0
71
44
102
11
12
9
37
36
37
24
18
32
5
1
11
116
84
161
Average Charge for Modem
Average Charge for Other Hardware
Average Charge for Installation
Average Charge for Service Activation
Other Charges
Total Average Upfront Charges
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-11

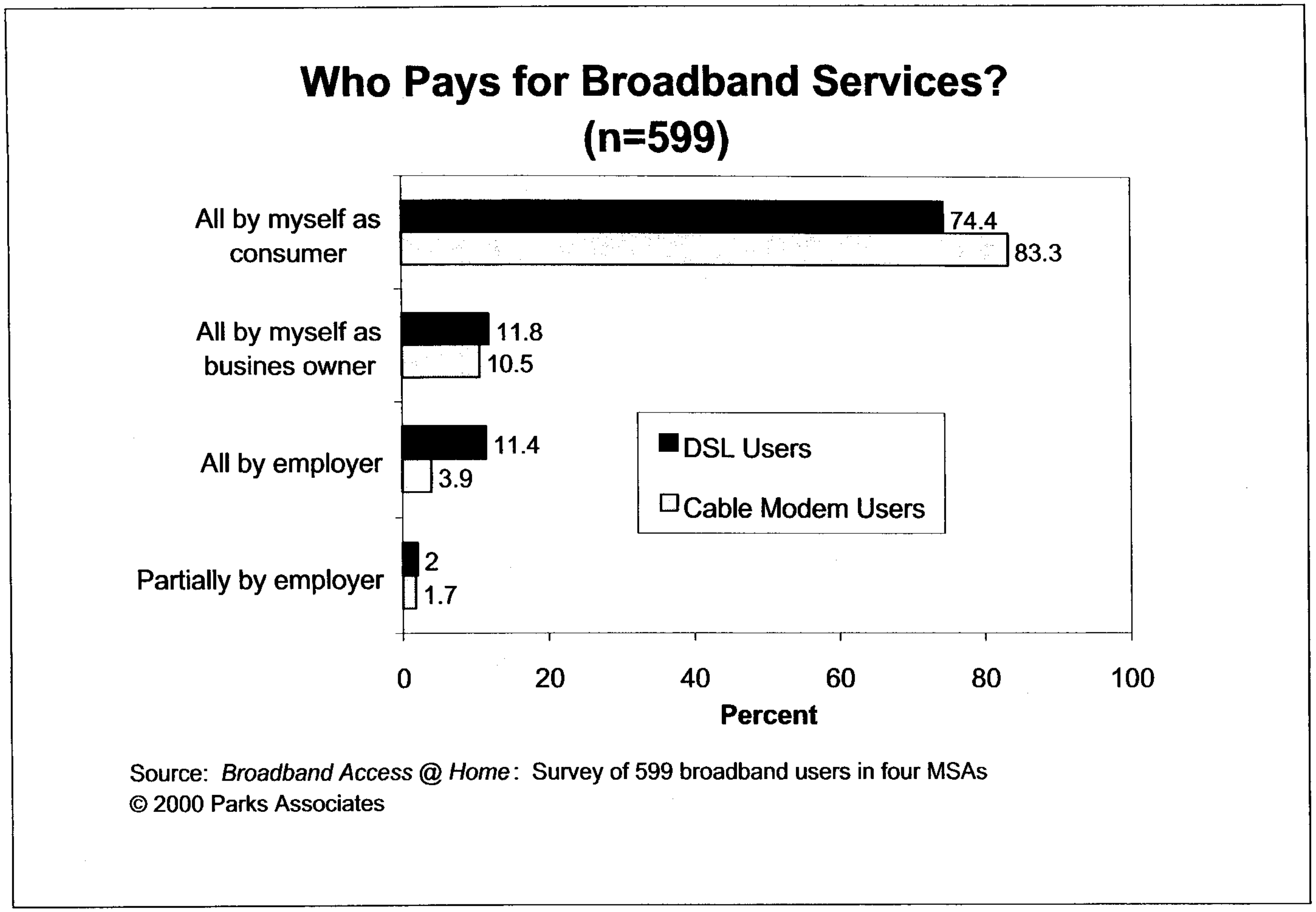

Who Pays for Broadband Services?
(n=599)
All by myself as consumer
74.4
83.3
All by myself as busines owner
11.8
10.5
All by employer
11.4
3.9
Partially by employer
2
1.7
DSL Users
Cable Modem Users
0
20
40
60
80
100
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 4-12

5.0 Online Usage Before and After Adoption of Broadband

5.1 Years Online

On average, the respondents had used the Internet at home for four years before adopting broadband (Figure 5-1). DSL users appear to have a longer history of using the Internet at home than cable modem users (four years and six months versus three years and 11 months). Only 2.7% of the broadband users said that they did not use the Internet at home before subscribing to broadband services. However, it does not mean that they did not use the Internet somewhere else (at work, at school, etc.). It is Parks Associates' belief that these early adopters all had substantial online experience before starting to use broadband services at home.

On average, the respondents have been using broadband services at home for 10 months (Figure 5-2). However, that number for cable modem users is 12 months, while DSL users have been using the service for an average of six months. This is due to the fact that in general, cable modem service has been available longer than DSL.

5.2 Hours Online and Computer Usage

Broadband services do get users hooked to the Internet for longer hours. Both DSL and cable modem users spend almost six hours more online per week because of the usage of broadband services. Their whole households have increased online usage by about 9 hours per week (Figure 5-3). Overall, broadband users now spend more than 20 hours online per week, while their whole households spend 30 hours or more online per week.

Broadband services provide instant-on/constant-on connections to the Internet. So how long do broadband users leave their computers on per day? Almost half (48%) leave on their computer (or the one directly connected to the Internet) 24 hours a day. Only 27% leave their computers on only when they are being used (Figure 5-4). Parks Associates believes that if a computer is always on with a constant Internet connection, it will enable various new services to the home, such as remote home control and remote access to data stored at a home computer. Broadband services will prompt more consumers to leave their computers on all day long and will become a driver to the deployment of new services for the home.

5.3 Online Activities

Other than e-mailing, the most frequent activities online include using search engines/directories, checking/trading stocks, and banking online. The least frequent online activities are making Internet phone calls, accessing business computer network, and creating/updating personal Web pages (Figure 5-5). Bandwidth-intensive activities, such as downloading/watching Internet video, are not quite frequent yet. However, Parks Associates believes that as more and better content becomes available, broadband users will spend more time on Internet-based entertainment activities.

5.4 Who Else Uses the Internet at Home

Close to half (45.2%) of the respondents reported spouses using the Internet at home (Figure 5-6). If we only look at those who have a spouse, the percentage becomes much higher at 81% (Figure 5-7). About two-thirds (66%) of the respondents with at least one child said that their children also use the Internet at home.

The high percentage of spouses/children using the Internet at home indicates that family members can play an important role in the decision-making process on acquiring broadband services. Indeed, 29% of the respondents considered family members' requests for broadband services important to the decision to adopt broadband services (see Chapter Six).

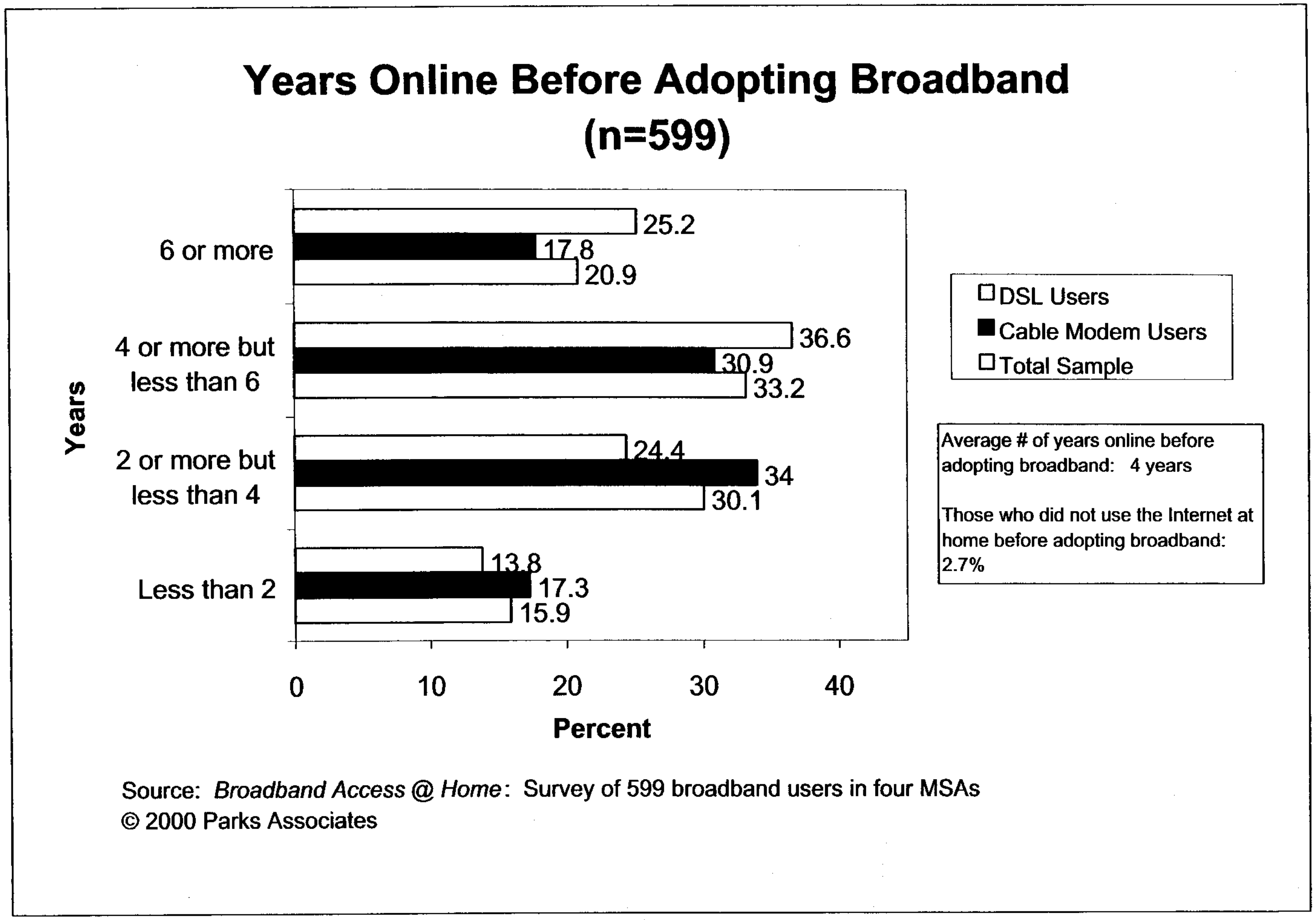
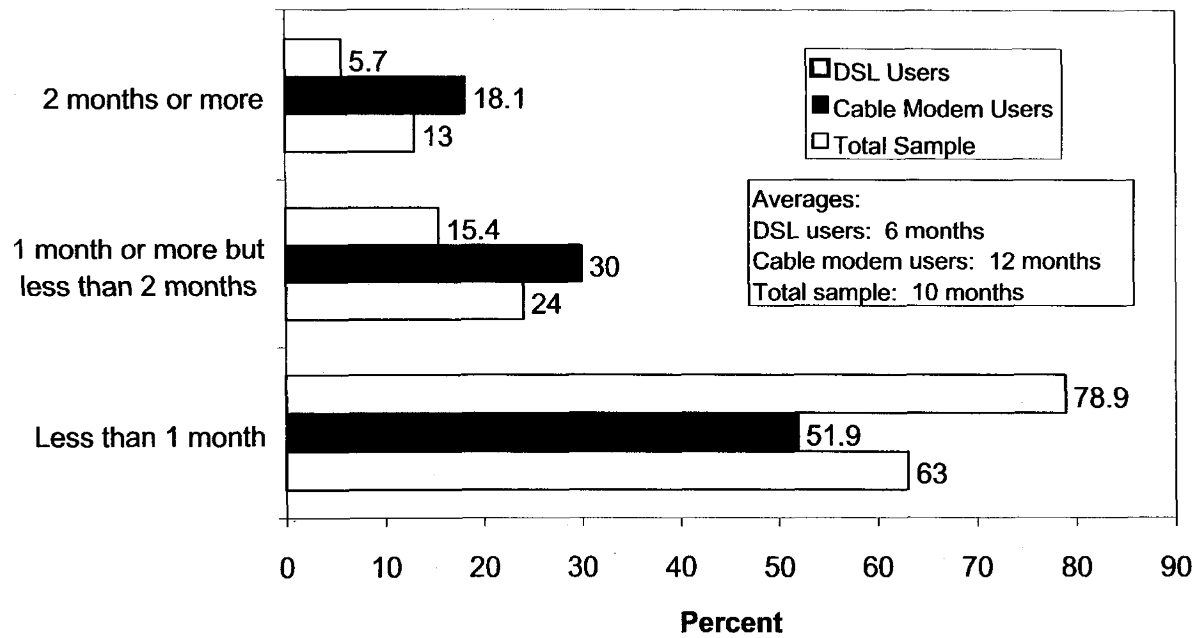

Years Online Before Adopting Broadband
(n=599)
6 or more
4 or more but less than 6
2 or more but less than 4
Less than 2
Years
25.2
17.8
20.9
36.6
30.9
33.2
24.4
34
30.1
13.8
17.3
15.9
0
10
20
30
40
Percent
DSL Users
Cable Modem Users
Total Sample
Average # of years online before adopting broadband: 4 years
Those who did not use the Internet at home before adopting broadband: 2.7%
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 5-1

Years of Using Broadband Services at Home (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 5-2

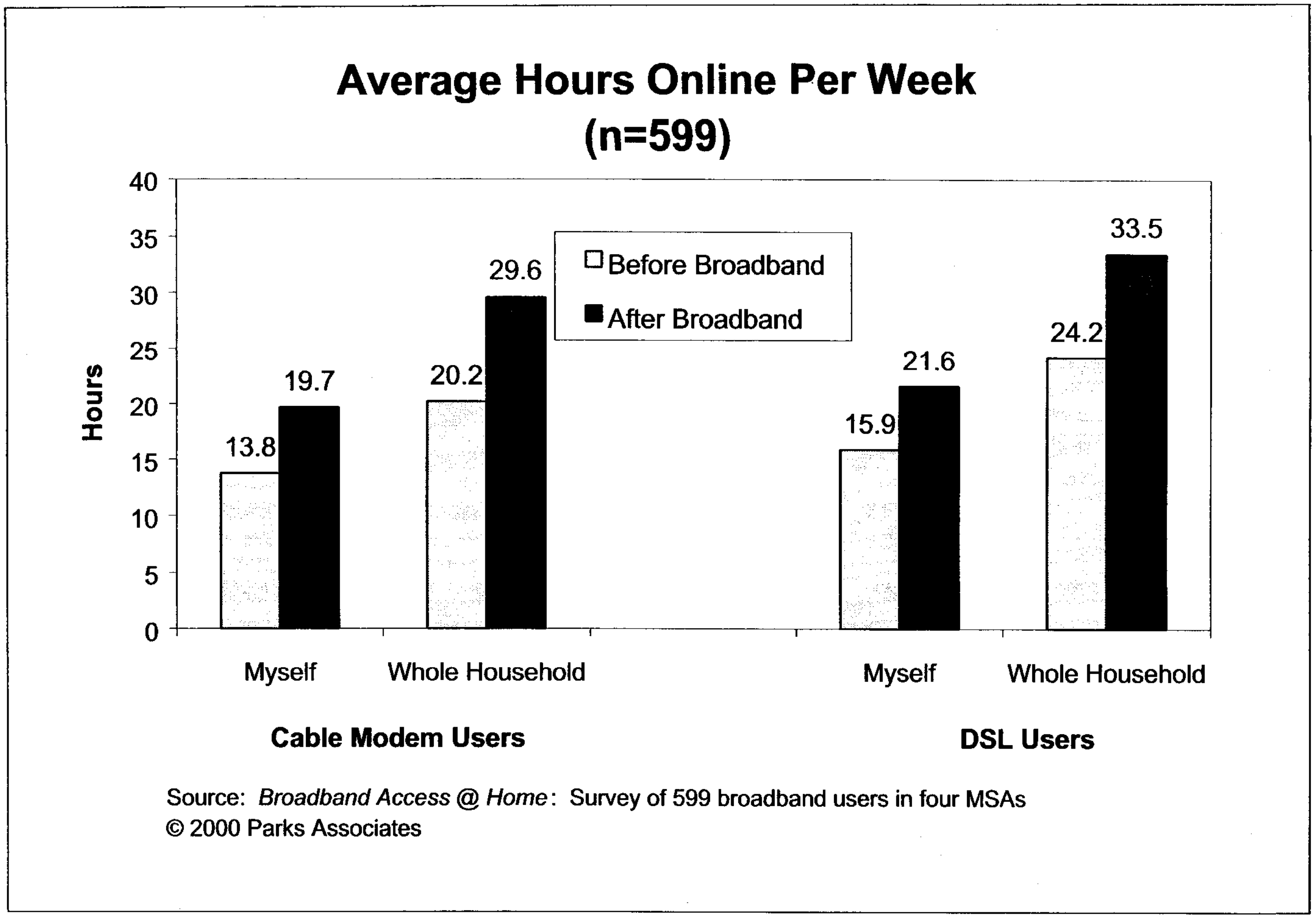
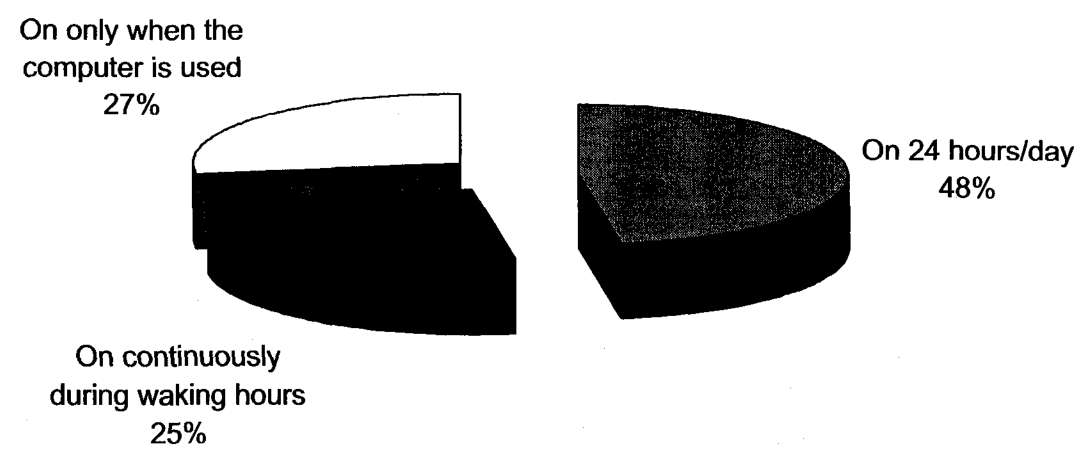

Average Hours Online Per Week
(n=599)
Hours
40
35
30
25
20
15
10
5
0
Before Broadband
After Broadband
13.8
19.7
20.2
29.6
15.9
21.6
24.2
33.5
Myself
Whole Household
Myself
Whole Household
Cable Modem Users
DSL Users
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 5-3

How Long Are Broadband Users' Computers On? (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 5-4

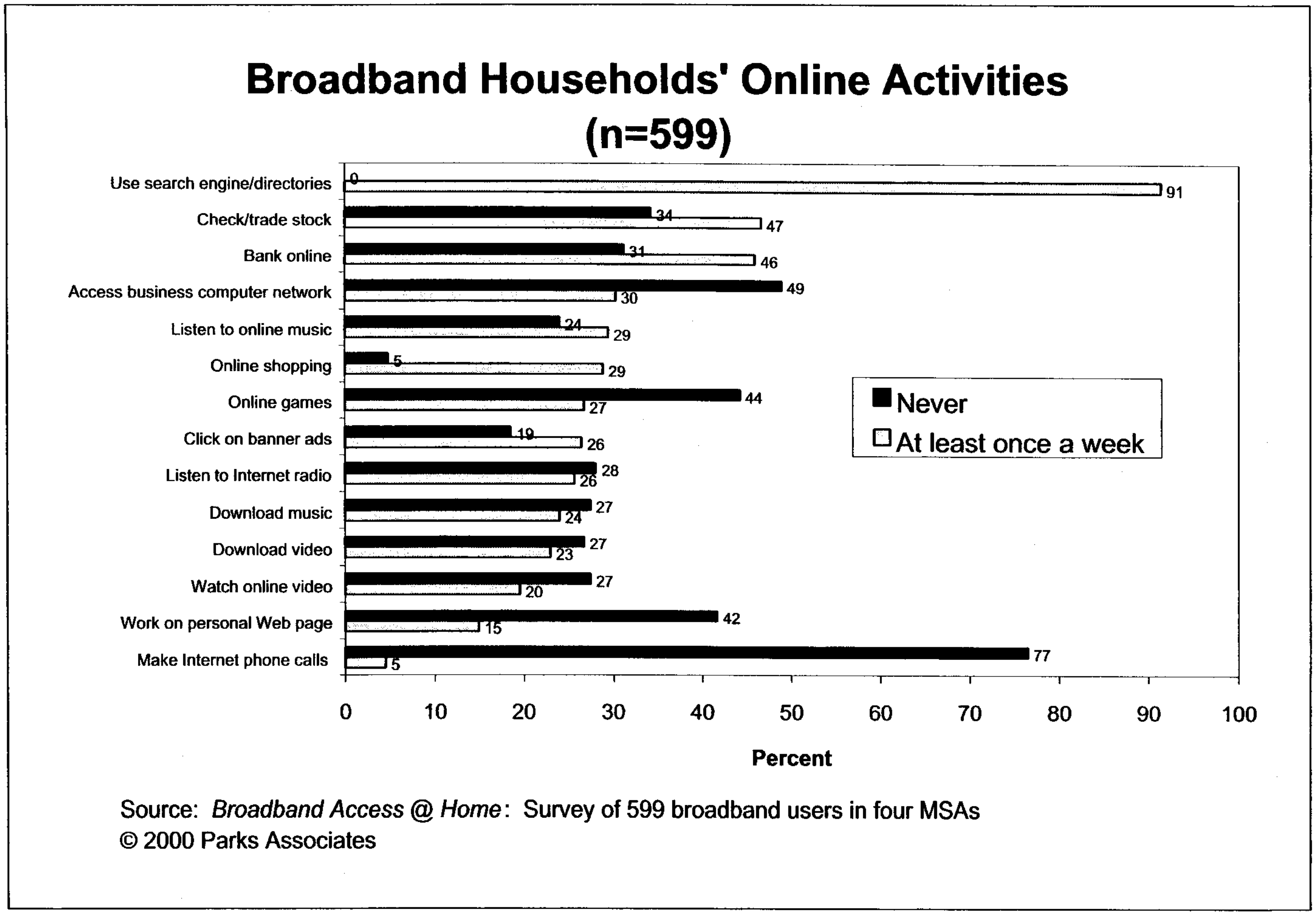

Broadband Households' Online Activities
(n=599)
Use search engine/directories
Check/trade stock
Bank online
Access business computer network
Listen to online music
Online shopping
Online games
Click on banner ads
Listen to Internet radio
Download music
Download video
Watch online video
Work on personal Web page
Make Internet phone calls
0
91
34
47
31
46
49
30
24
29
5
29
44
27
19
26
28
26
27
24
27
23
27
20
42
15
77
5
Never
At least once a week
0 10 20 30 40 50 60 70 80 90 100
Percent
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 5-5

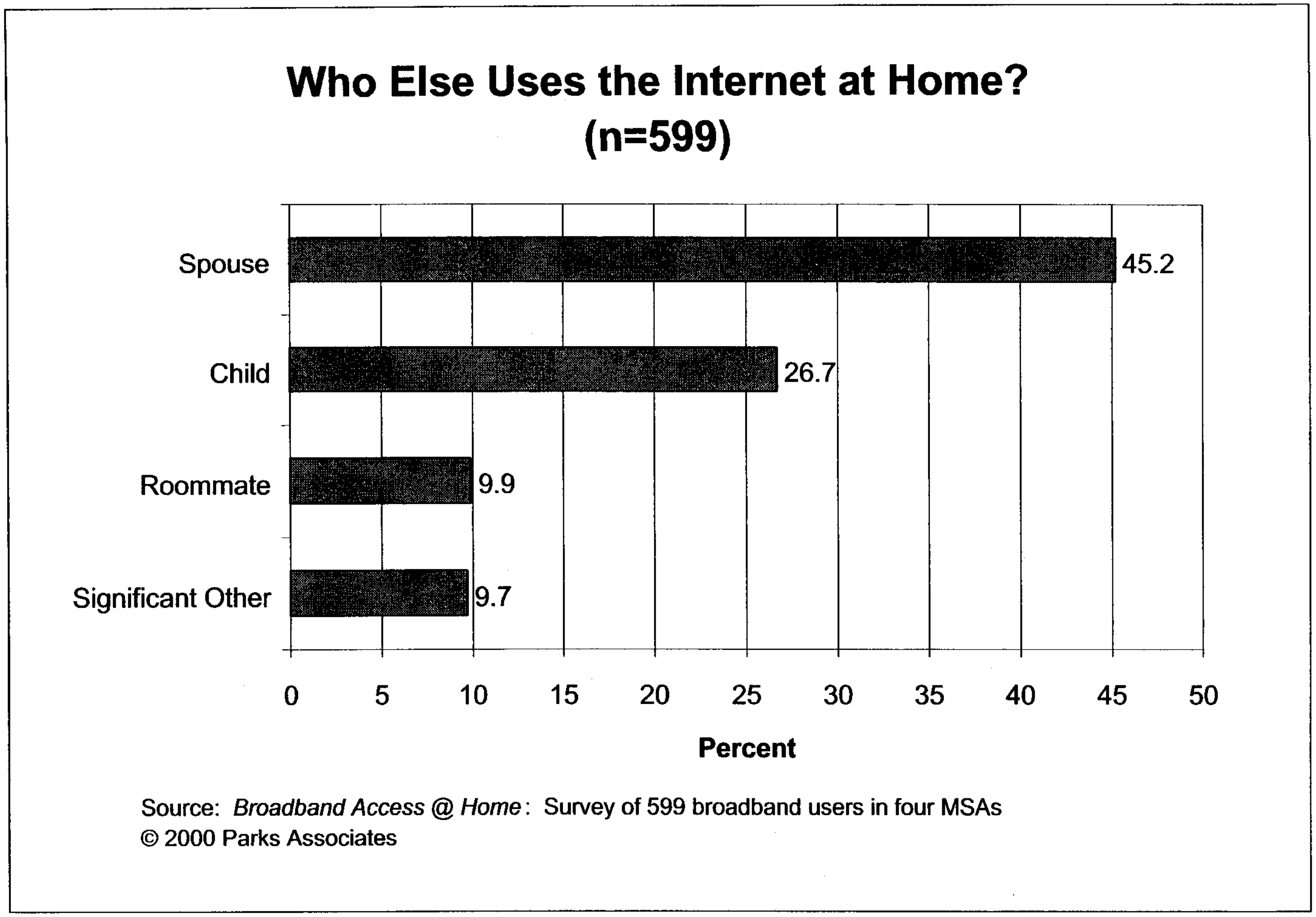
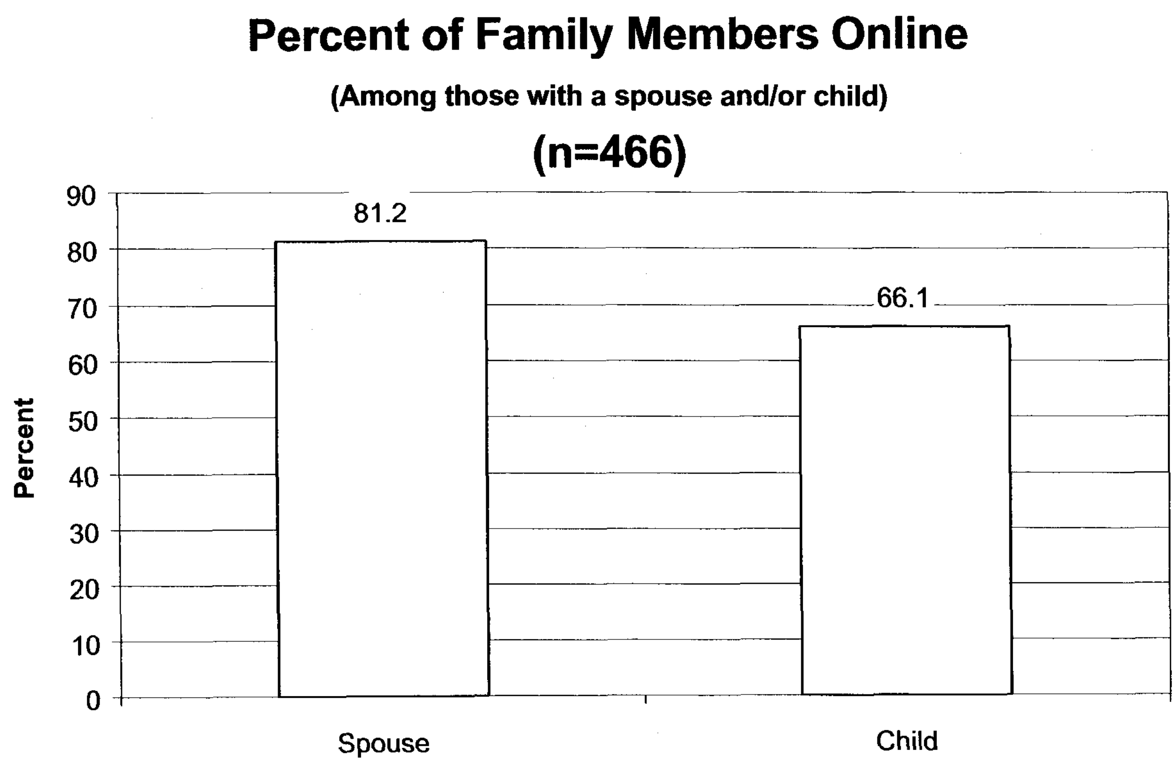

Who Else Uses the Internet at Home?
(n=599)
Spouse
Child
Roommate
Significant Other
45.2
26.7
9.9
9.7
0
5
10
15
20
25
30
35
40
45
50
Percent
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 5-6



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 5-7

6.0 Decision Making, Broadband Experience, and Preferences

6.1 Awareness of Service Availability and Influence of Different Marketing Efforts

DSL and cable modem providers have used many different approaches to create awareness of their broadband services. These techniques include direct mail, media advertising, referral, demos, and so on. However, these approaches have different levels of effectiveness.

When compared with DSL users, a much larger percent of cable modem users learned about service availability through direct mail (41.6% vs. 33.4%), TV advertising (29.5% vs. 11%), and live demos (9.4% vs. 1.6%) (Figure 6-1). This indicates that cable companies have been more aggressive in their marketing efforts than the telcos.

Forty percent of the DSL users learned about DSL availability through their own research. In fact, "own research" is reported as the number-one contributor to DSL users' awareness of service availability, beating out such marketing campaigns as direct mail and media advertising. "Own research" is also the number-two contributor to cable modem subscribers' awareness of service availability. This shows that the early adopters of broadband services take the initiative and have generally kept themselves abreast of high-tech products/services.

When it comes to what is "very influential" to the respondents' purchase decision, the top-three items to DSL users are their own research, referral, and direct mail. To cable modem users, the top three are the same, but the order is slightly different: own research, direct mail, and referral (Figure 6-2). The fourth most influential contributor to cable modem users is TV advertising (10.5%).

The least influential marketing techniques to DSL users include live demo, email advertising, and magazine advertising. To cable modem users, however, the least influential are magazine advertising, radio advertising, and Web site advertising (Figure 6-2).

6.2 Length of Decision Making

It took most broadband users (79%) two months or less to decide to adopt broadband after they first learned about service availability (Figure 6-3). This indicates that the decision-making process is relatively fast. As to why it took some broadband users three months or more to make a purchase decision, the most important reason is a perceived high price (60%). Most of the other reasons are related to the need to learn more about the broadband services. Only 4.7% reported security concerns as a reason (Figure 6-4). This indicates that few consumers are aware of a potential security problem: a constant Internet connection makes their computers and personal information vulnerable to hackers.

6.3 Which Benefit of Broadband Services Is the Most Important?

Not surprisingly, benefits related to speed are the most important to the purchase decision. High downstream speed and constant/instant connections to the Internet (related to speed) are more important than such benefits as freeing up phone lines, saving the cost of using a separate line for voice, or broadband content (Figure 6-5). Of course, all these benefits are important, as they are all mentioned by at least 50% of the broadband users as being important to the purchase decision. There are no significant differences between DSL users and cable modem subscribers in terms of the perceived importance of the benefits of using broadband services.

6.4 Importance of Family Member Requests and Business-Related Use to Purchase Decision

As Figure 6-6 indicates, family members requesting broadband services do play a role in the household adoption of broadband services. Twenty-nine percent of the broadband users said that requests from family members played an "extremely important" or "somewhat important" role in the decision to adopt broadband services. There is no significant difference between DSL and cable modem users regarding the importance of family member requests.

Business-related use is considered even more important than family member requests, as 42% of the DSL users and 34% of cable modem users reported business-related use as an important factor (Figure 6-7). The difference between the two groups of users confirms Parks Associates' previous statement that more DSL users use a broadband connection for work-related purposes than cable modem users.

6.5 Importance of Service Provider's Reputation to Subscription of Broadband services

It is no surprise that the reputation of service providers is considered very important to the subscribers of broadband services. Only 24% of the respondents consider it neutral or unimportant (Figure 6-8). However, the significance of the response to this question perhaps should not be overstated. The major providers of cable modem service (e.g., Excite@Home and Road Runner) and some data CLECs (e.g., Covad, NorthPoint, and Rhythms) are newly created organizations that have not been in business long enough to establish a strong reputation. Still, they have been able to sell their services to consumers. Parks Associates believes that the importance of service providers' reputations will become more obvious when two or more competing broadband services are available in all major markets nationwide. Everything else being equal, a company with a better reputation has a better chance to win over customers.

6.6 Satisfaction

More than two-thirds of the respondents are satisfied with the broadband services to which they subscribe (rating 4 or 5 on a 5-point scale, with 5 meaning "very satisfied"). There is no meaningful difference between DSL users' satisfaction and cable modem subscribers' satisfaction (Figure 6-9). It is noteworthy that close to 10% are NOT satisfied (rating 1 or 2 on a 5-point scale, with 1 meaning "very dissatisfied"). Perhaps because of this, 9.4% of cable modem subscribers and 2.9% of DSL users said that they would switch to a dial-up account using a 56K modem if that account is free (Figure 6-12). Parks Associates believes that these respondents indicated their intention to switch as a means to express their dissatisfaction. We don't believe that there will be many broadband users who will switch back to a dial-up account once they have experienced the benefits of using broadband.

6.7 What Broadband Users Dislike

The things broadband users dislike include a high monthly fee, service outages, variance of speed, troubleshooting after installation, speed slower than expected, scheduling of professional installation, worries about hacking/security, changing ISP and email address, and paying for professional installation (Figure 6-10).

Compared with DSL users, significantly more cable modem users dislike service outage (49.3% vs. 42.3%), variance of speed (43.9% vs. 34.6%), and speed slower than expected (29.5% vs. 22%). Parks Associates believes that these numbers reflect differences in perceived performances of DSL and cable modem services.

Broadband users are more intolerant of service outages than the high monthly fee that they have to pay (Figure 6-11). Fifty-four percent of the broadband users selected service outages as their top complaint, while a smaller number of respondents (42%) reported a high monthly fee as what they dislike the most. This shows the importance of service reliability to broadband users. As illustrated in Chapter 3, more than a third of the broadband users surveyed do not have a separate dial-up account. Thus, service outage would deny them access to the Internet.

6.8 Awareness of Competing Services During the Decision-Making Process

In the four MSAs Parks Associates selected for the survey, both DSL and cable modem services had been available for at least a few months at the time the survey was conducted. So were the respondents aware of alternative high-speed services when they signed up for the service they chose? It is no surprise that the number of DSL users aware of cable modem service is significantly higher (87%) than the number of cable modem users aware of DSL (62.3%) (Figure 6-13). Cable modem service was commercially launched earlier than DSL, hence more market awareness.

Forty-three percent of the DSL users aware of cable modem service reported its AVAILABILITY in their area when they signed for DSL. Among cable modem users aware of DSL, 32% said that DSL was actually AVAILABLE in their area when they signed up for cable modem service. Again, these numbers make sense because of cable modem's lead in terms of commercial rollout.

Although ISDN has been around for over a decade, more than 20% of the broadband users were not aware of it (Figure 6-14). This is perhaps because the telcos have not been aggressively marketing the service. As to two other major contenders for high-speed Internet services (DirecPC and broadband fixed wireless), market awareness is very low.

6.9 Why Not Subscribe to an Alternative Service?

In total, 40% of all the DSL users surveyed were aware of the availability of cable modem service when they signed up for DSL. As to cable modem users surveyed, 26% knew of DSL's availability. So why did they NOT subscribe to the alternative broadband service? The number one reason for DSL users is that they don't like their cable company, while the number one reason for cable modem users is their perception that cable modems are faster (Figures 6-15 and 6-16). Indeed, cable companies have generally lagged behind telcos in terms of reputation, and cable modems have been touted as "lightning fast" and part of a "cable Internet revolution," hence creating the perception that cable modems are faster than other broadband platforms. When we look at the elements in Figures 6-15 and 6-16, it seems that DSL is perceived to be more desirable than cable modem service. This signals a strong warning to cable companies despite cable modem's current lead over DSL.

The two most obvious disadvantages of the current DirecPC service and most fixed wireless Internet services are the need to have a dish or antenna for downstream data reception and the use of a phone modem for upstream signal transmission. Indeed, these two disadvantages are the two most important reasons why DSL or cable modem users did not sign up for DirecPC or broadband fixed wireless services (Figure 6-17). However, things are expected to change rapidly, as Hughes Network Systems (provider of DirecPC) is launching a two-way broadband satellite system that is scheduled to go into operation in 2002, and broadband fixed wireless players are deploying two-way digital systems. Thus, satellite-based and terrestrial broadband wireless systems will soon gain a stronger competitive edge.

6.10 Possible Churn and Preferred Providers of Bundled Services

Because of all the hassle of setting up a broadband Internet service, industry players and market analysts generally believe that once consumers have signed up for DSL or cable modem service, they will not switch to an alternative platform. However, Parks Associates' survey suggests that such a belief may be too simplistic. Figure 6-18 indicates that if the broadband users are given a good discount or offered more benefits for the same price, many of them may switch. Cable modem users expressed slightly stronger intentions to switch than DSL. Parks Associates believes that with the availability of plug-and-play high-speed modems sold at retail, switching a broadband service provider may become almost as easy as switching a dial-up ISP. Therefore, broadband service providers need to consider how to prevent churn.

The survey respondents suggested a strong intention to switch to a provider of bundled services (voice, video, and data) that can save $15 or more per month. All the major providers of communications services are attempting to become providers of bundled services. Who will likely be able to win over customers? Figure 6-20 indicates that DSL users are more interested in getting bundled services from a local telephone company (56.5% giving a rating of 4 or 5, with 5 meaning "extremely interested"). Only 19.5% of the DSL users showed interest in a cable company. Cable modem users, on the other hand, prefer a cable company (51.9% giving a rating of 4 or 5). However, 41.9% also showed interest in a local telco. Both groups expressed almost the same level of interest in AT&T (slightly more than 40%). Parks Associates believes that consumers' current preference is just one indicator of who may win over customers as a provider of bundled services. There are some other factors that are also important, including the timing of service rollout, marketing strategies, reliability of service, etc.

6.11 Tradeoffs

Overall, broadband users prefer service plans charging a lower monthly fee, even if it means a higher upfront cost, a term contract, and slower downstream speed (Figure 6-19). However, the survey respondents expressed willingness to pay for guaranteed speed, giving a much higher rating to "guaranteed speed at $10 more per month" than "no guaranteed speed at $10 less per month" (3.1 versus 1.83 average rating on a 5-point scale, with 5 meaning "very attractive").

Parks Associates would like to caution the reader that the difference between the average rating of "lower upfront charge and higher monthly fee" (1.68) and that of "higher upfront charge and lower monthly fee" (2.07) is not very significant, compared with the respondents' preferences on the other tradeoffs. This indicates that the attractiveness of either option is very similar overall.

6.12 Interest in Non-PC Internet Access Devices

More and more companies are developing/introducing Web pads, which serve as portable devices dedicated to Internet access at home. Not surprisingly, a Web pad is the number one non-PC device that broadband users want to use for Internet access. Thirty-seven percent of the respondents expressed interest in using a Web pad (Figure 6-21). Smart kitchen appliances and screen phones did not fare very well. Only 17% and 10%, respectively, of the respondents showed some interest in these two types of non-PC Internet devices.

It is interesting to note that a Web surfing device in a car is the number two non-PC device in which the respondents are interested (36.3%). These results indicate the appeal of a product/service that provides mobile access to the Internet and help explain why more broadband users are interested in using a mobile phone (28.5%) than a TV (22%) to access the Internet.

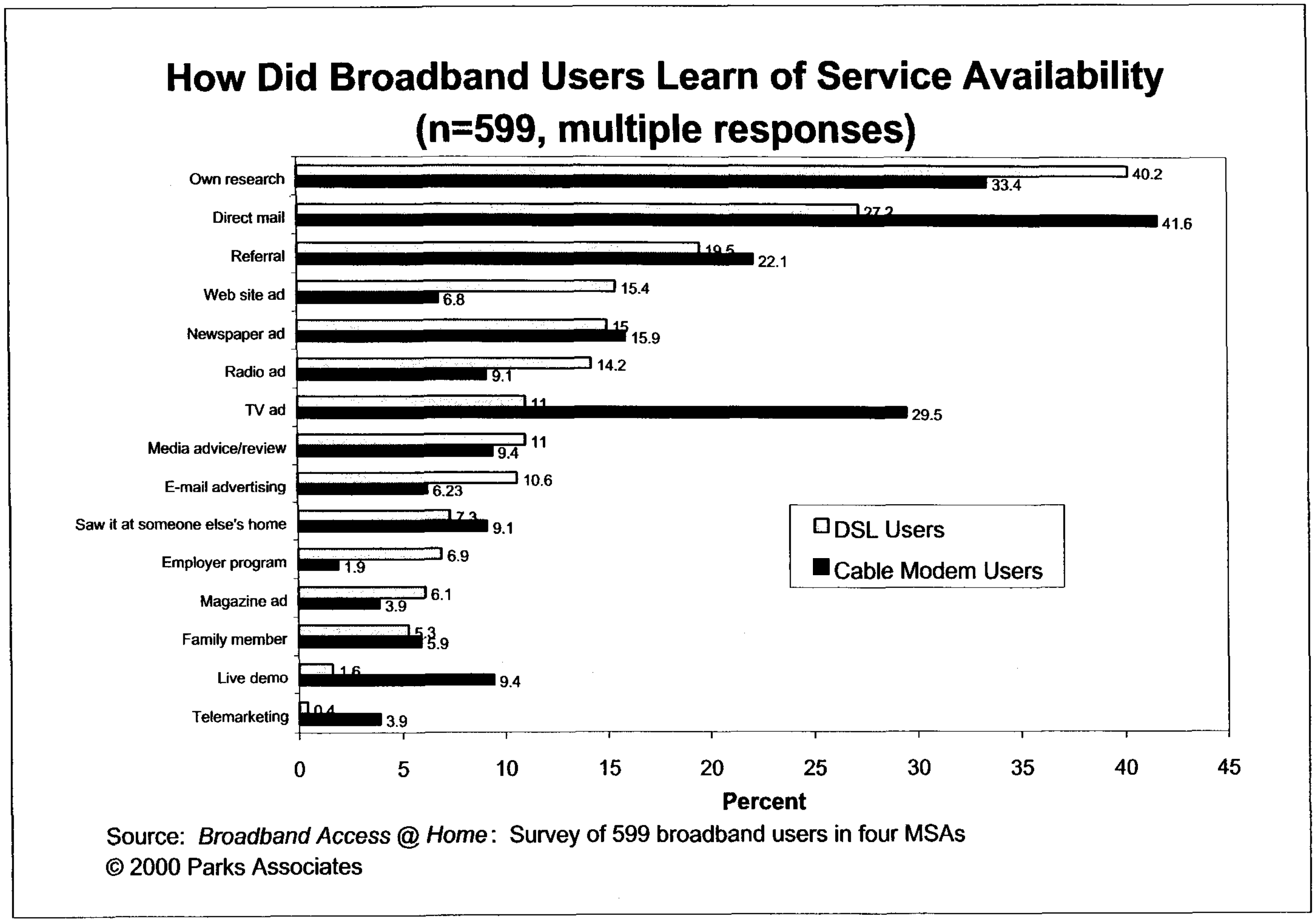
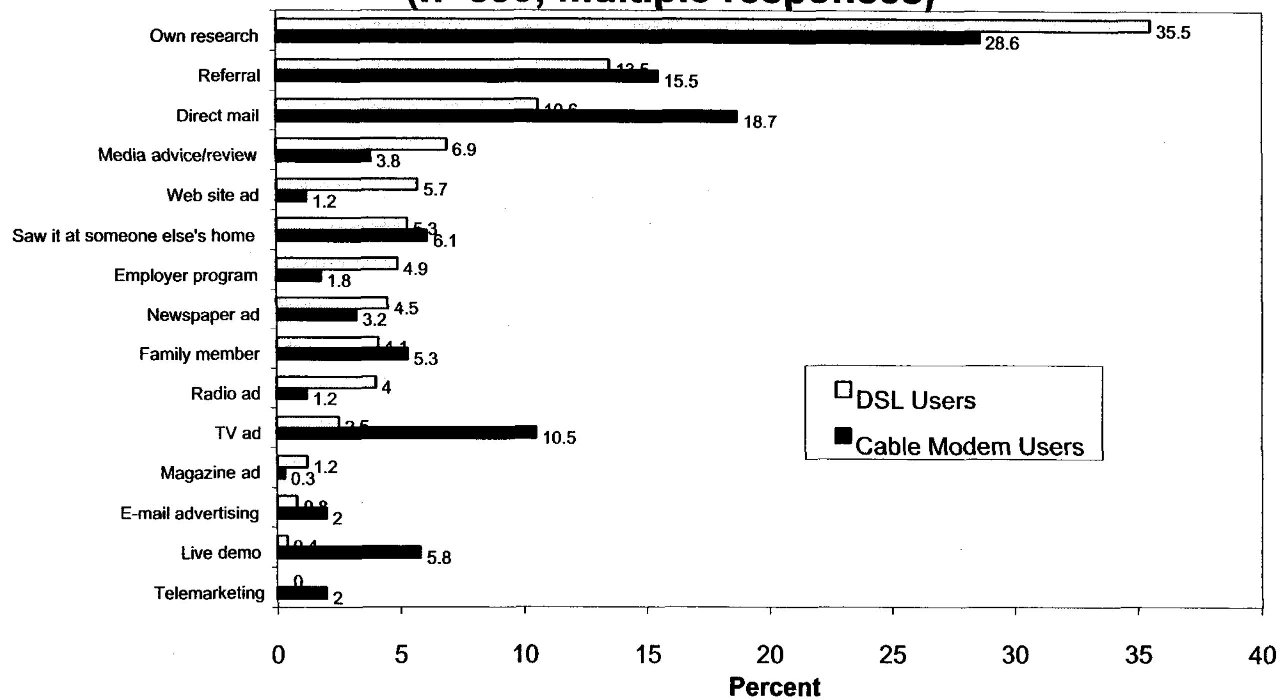

How Did Broadband Users Learn of Service Availability
(n=599, multiple responses)
Own research
Direct mail
Referral
Web site ad
Newspaper ad
Radio ad
TV ad
Media advice/review
E-mail advertising
Saw it at someone else's home
Employer program
Magazine ad
Family member
Live demo
Telemarketing
40.2
33.4
27.2
41.6
19.5
22.1
15.4
6.8
15
15.9
14.2
9.1
11
29.5
11
9.4
10.6
6.23
7.3
9.1
6.9
1.9
6.1
3.9
5.3
5.9
1.6
9.4
0.4
3.9
DSL Users
Cable Modem Users
0
5
10
15
20
25
30
35
40
45
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-1

What Is Very Influential to the Purchase Decision? (n=599, multiple responses)



Source: *Broadband Access @ Home* Survey of 599 broadband users in four MSAs
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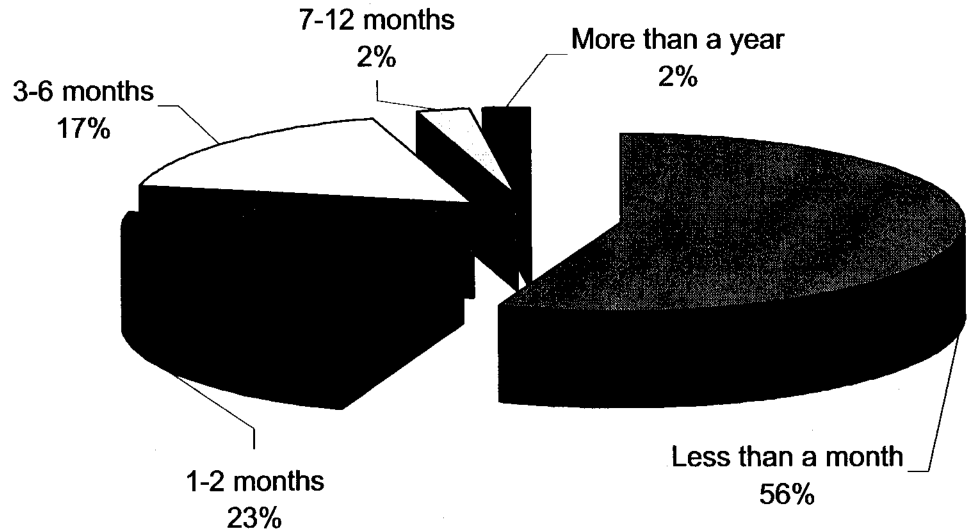
Figure 6-2

How Long Did the Purchase Decision Take (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 6-3

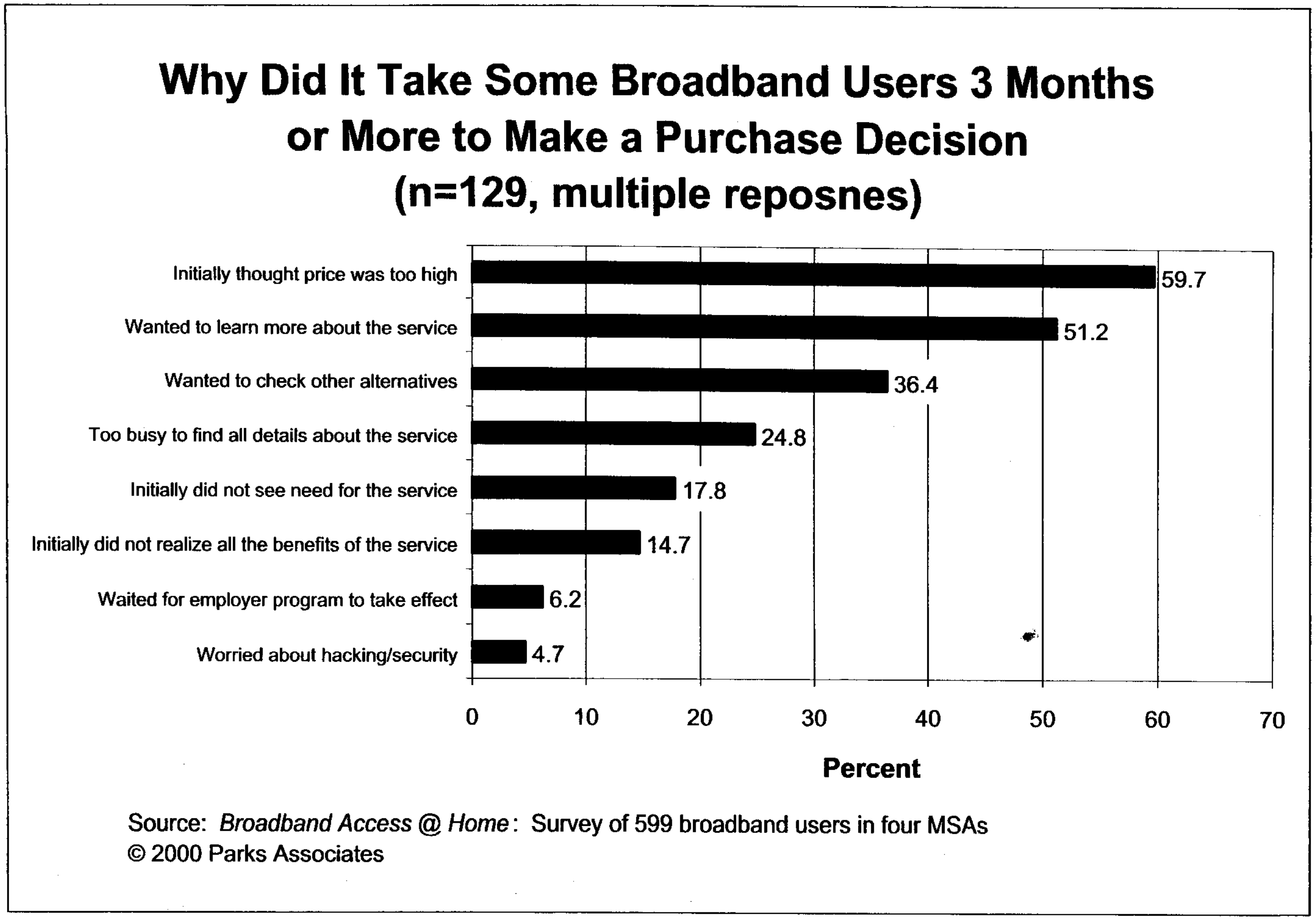

Why Did It Take Some Broadband Users 3 Months or More to Make a Purchase Decision
(n=129, multiple reposnes)
Initially thought price was too high
59.7
Wanted to learn more about the service
51.2
Wanted to check other alternatives
36.4
Too busy to find all details about the service
24.8
Initially did not see need for the service
17.8
Initially did not realize all the benefits of the service
14.7
Waited for employer program to take effect
6.2
Worried about hacking/security
4.7
0
10
20
30
40
50
60
70
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-4

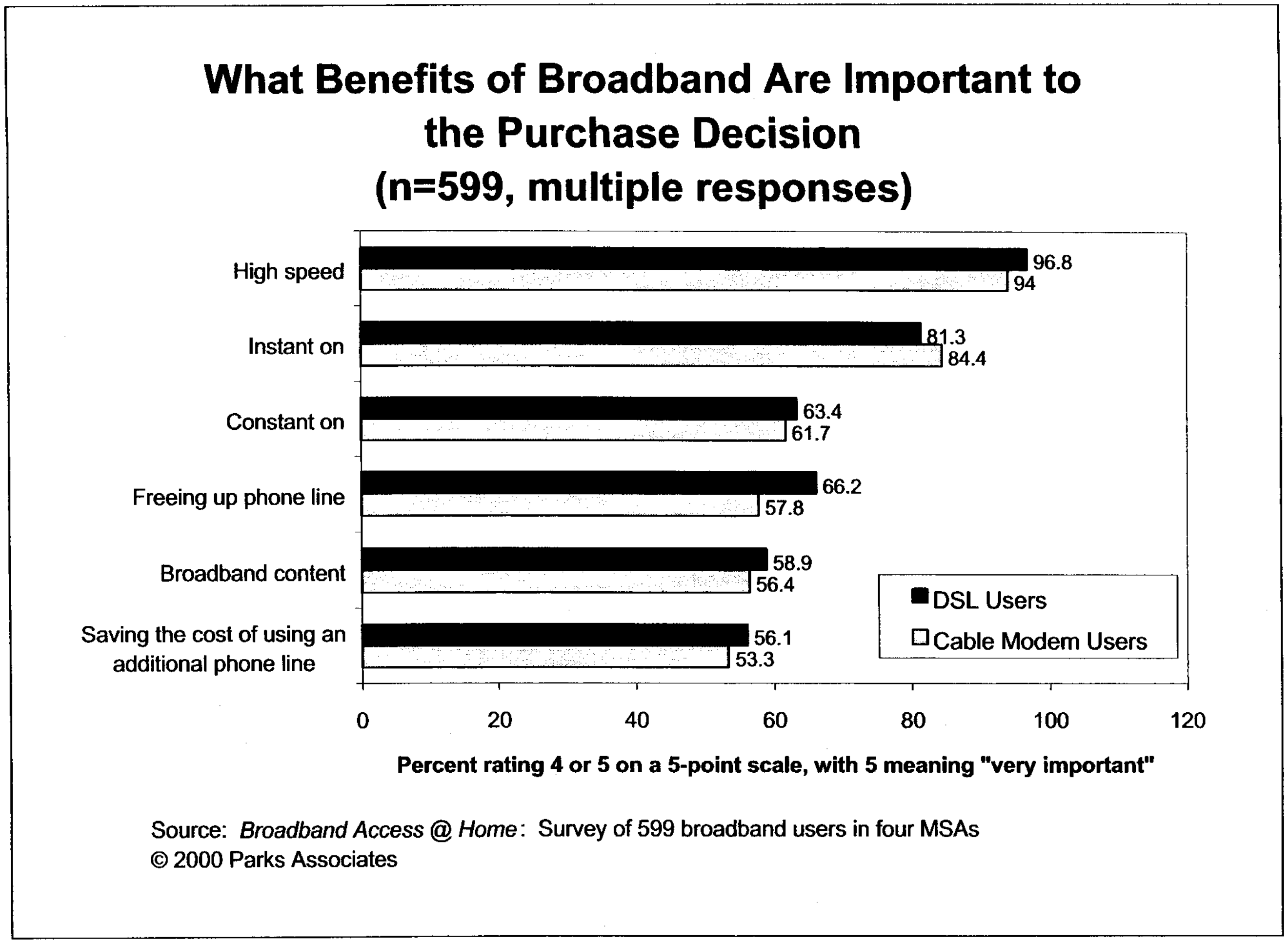
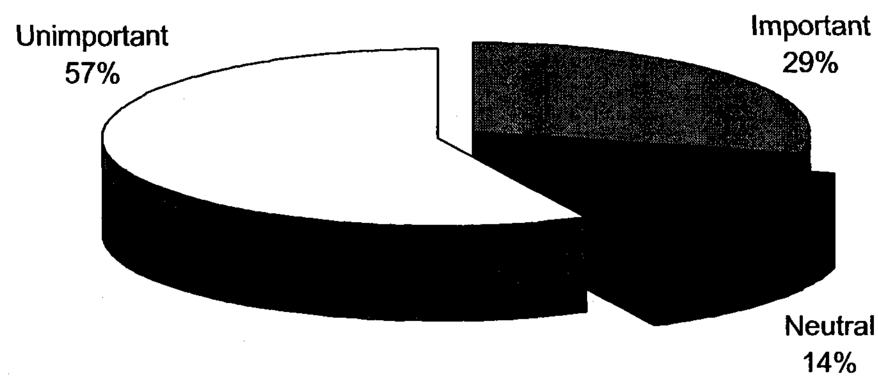

What Benefits of Broadband Are Important to the Purchase Decision (n=599, multiple responses)
High speed
Instant on
Constant on
Freeing up phone line
Broadband content
Saving the cost of using an additional phone line
96.8
94
81.3
84.4
63.4
61.7
66.2
57.8
58.9
56.4
56.1
53.3
DSL Users
Cable Modem Users
0
20
40
60
80
100
120
Percent rating 4 or 5 on a 5-point scale, with 5 meaning "very important"
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-5

Importance of Family Members' Request on Decision to Adopt Broadband

(Among Those Who Have at Least One Other Person Living in the Household)

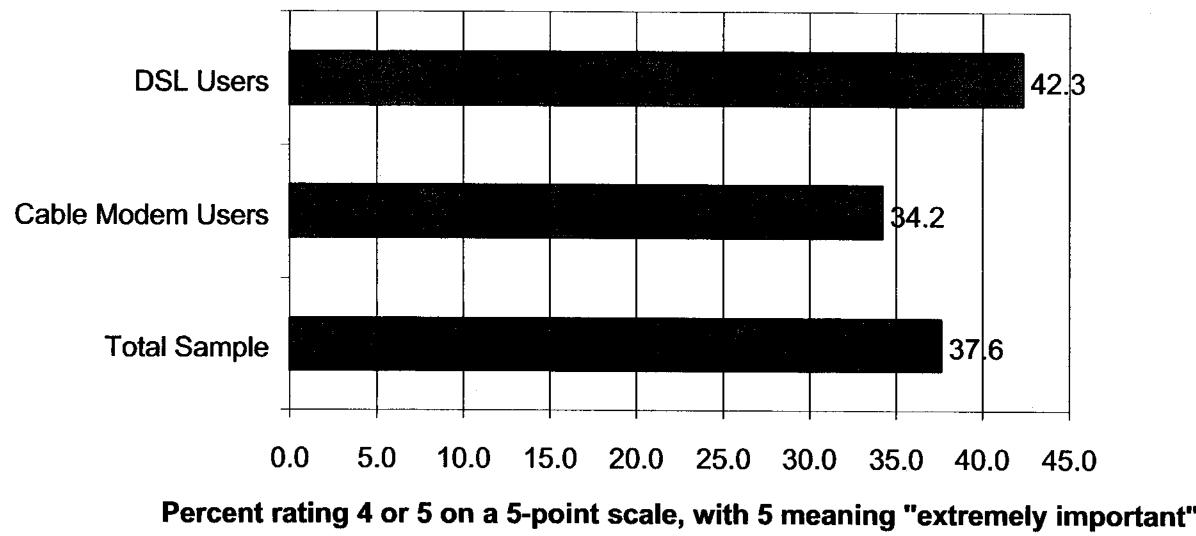
(n=490)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 6-6

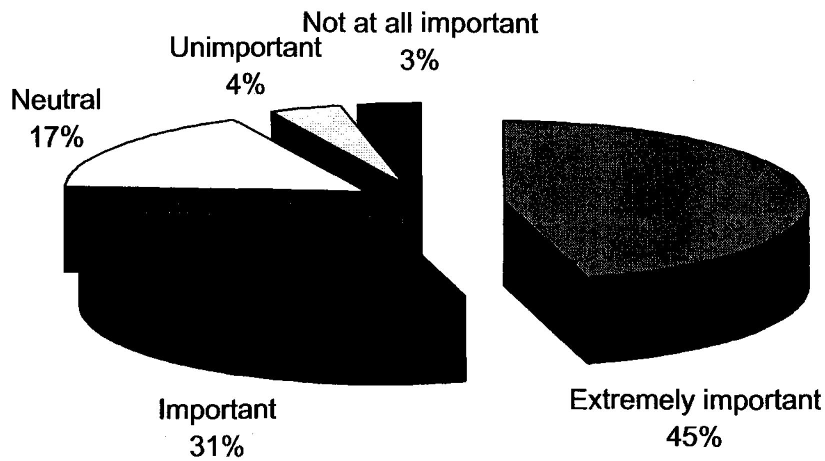
Importance of Business-Related Use to Broadband Purchase Decision (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-7

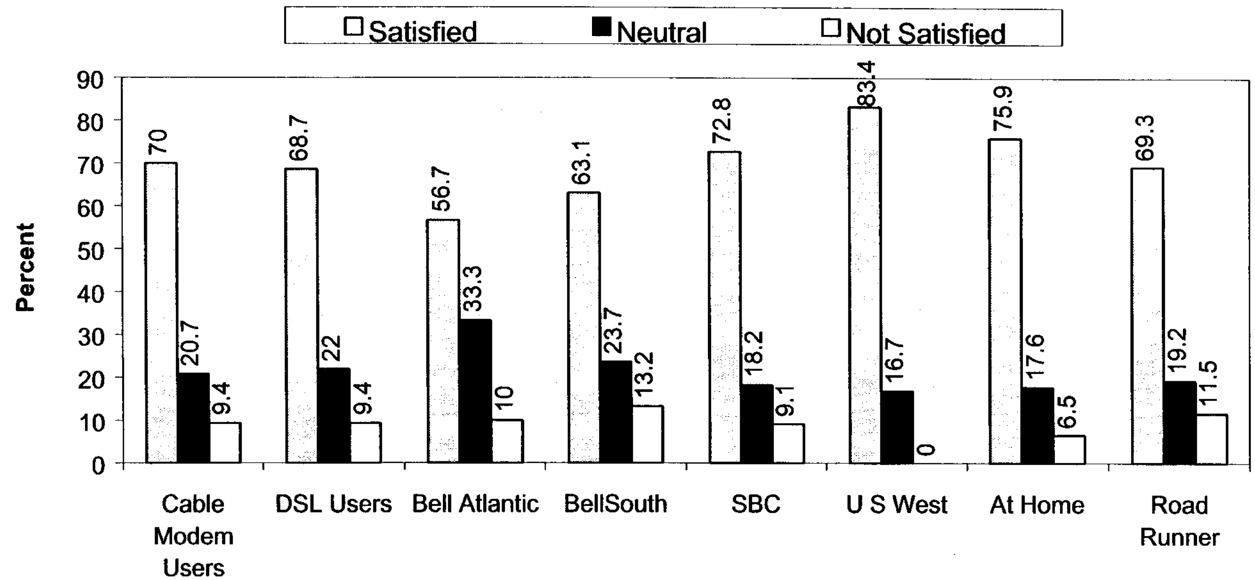
Importance of Service Provider's Reputation to Subscription of Broadband Services (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-8

Broadband Users' Satisfaction by User Type and Service Provider (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-9

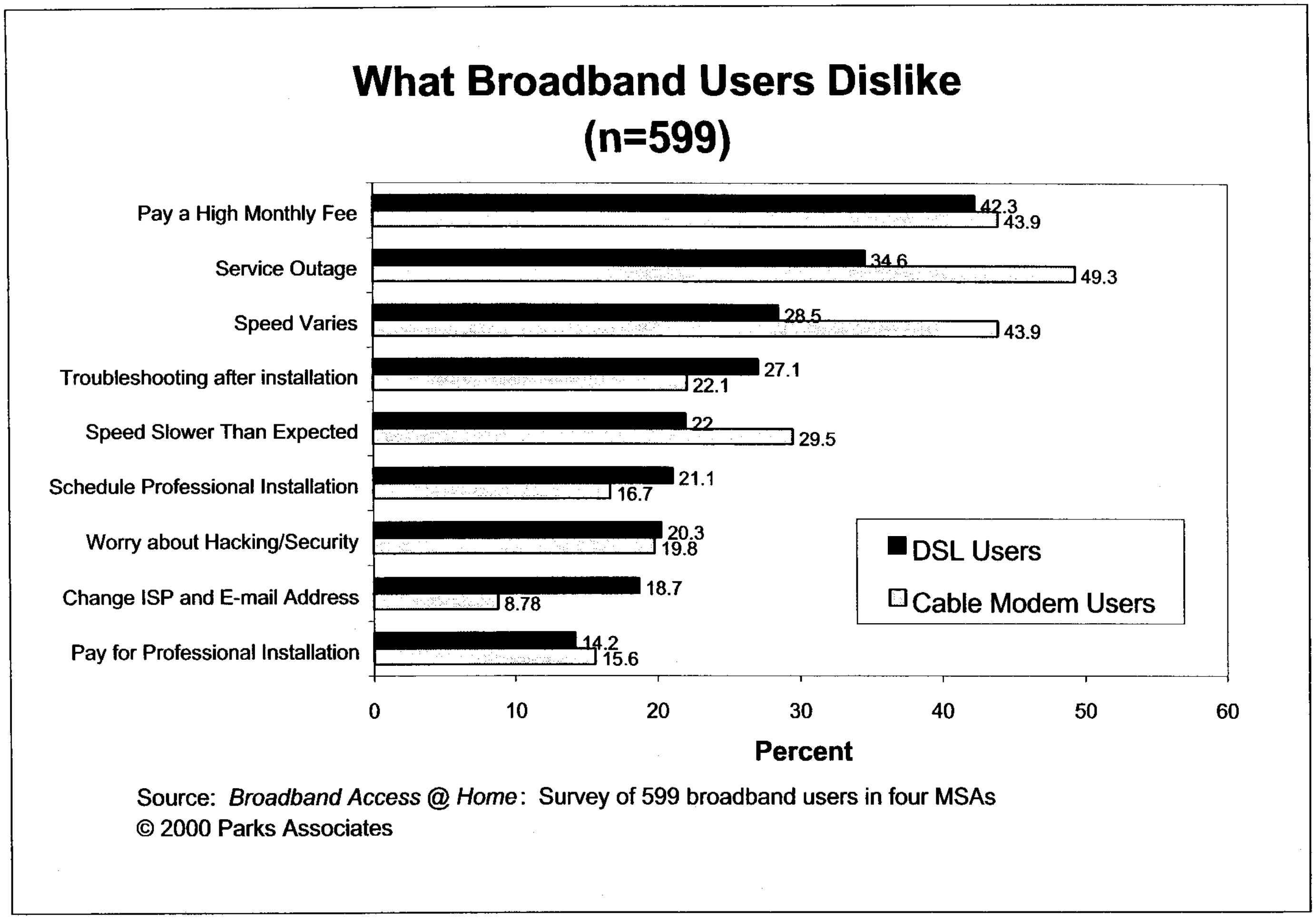

What Broadband Users Dislike
(n=599)
Pay a High Monthly Fee
Service Outage
Speed Varies
Troubleshooting after installation
Speed Slower Than Expected
Schedule Professional Installation
Worry about Hacking/Security
Change ISP and E-mail Address
Pay for Professional Installation
42.3
43.9
34.6
49.3
28.5
43.9
27.1
22.1
22
29.5
21.1
16.7
20.3
19.8
18.7
8.78
14.2
15.6
DSL Users
Cable Modem Users
0
10
20
30
40
50
60
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-10

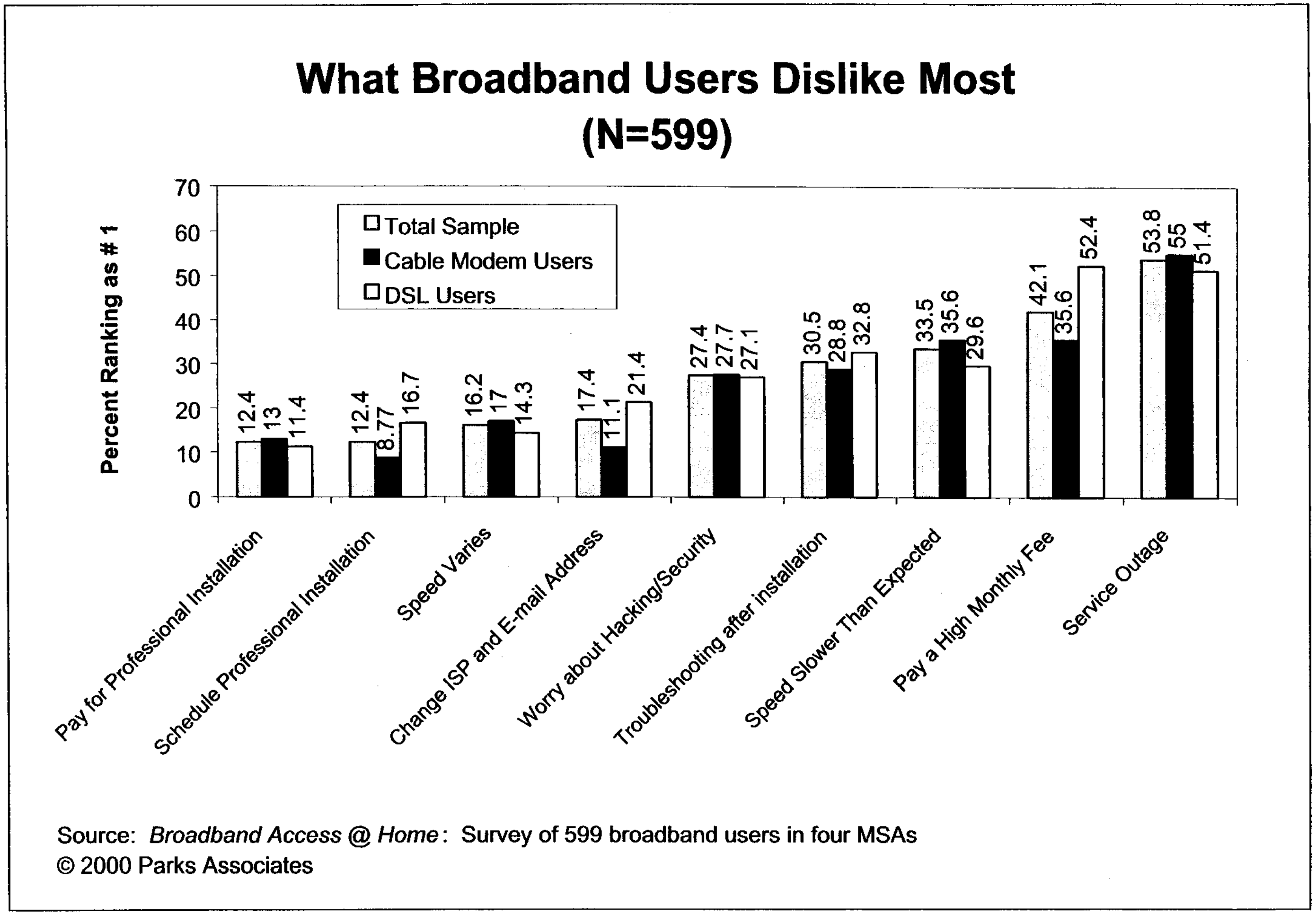

What Broadband Users Dislike Most
(N=599)
Percent Ranking as # 1
70
60
50
40
30
20
10
0
Total Sample
Cable Modem Users
DSL Users
12.4
13
11.4
12.4
8.77
16.7
16.2
17
14.3
17.4
11.1
21.4
27.4
27.7
27.1
30.5
28.8
32.8
33.5
35.6
29.6
42.1
35.6
52.4
53.8
55
51.4
Pay for Professional Installation
Schedule Professional Installation
Speed Varies
Change ISP and E-mail Address
Worry about Hacking/Security
Troubleshooting after installation
Speed Slower Than Expected
Pay a High Monthly Fee
Service Outage
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-11

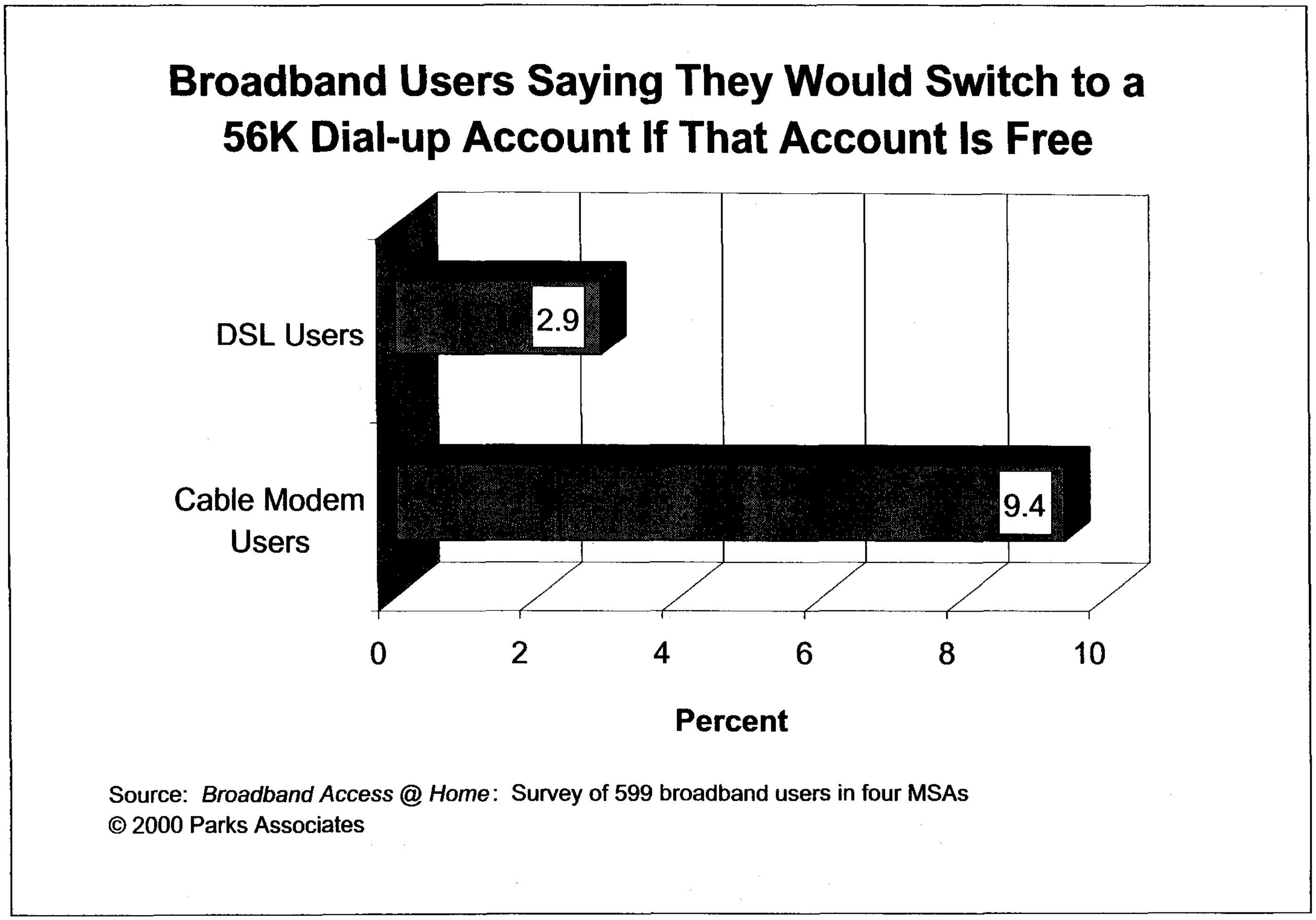
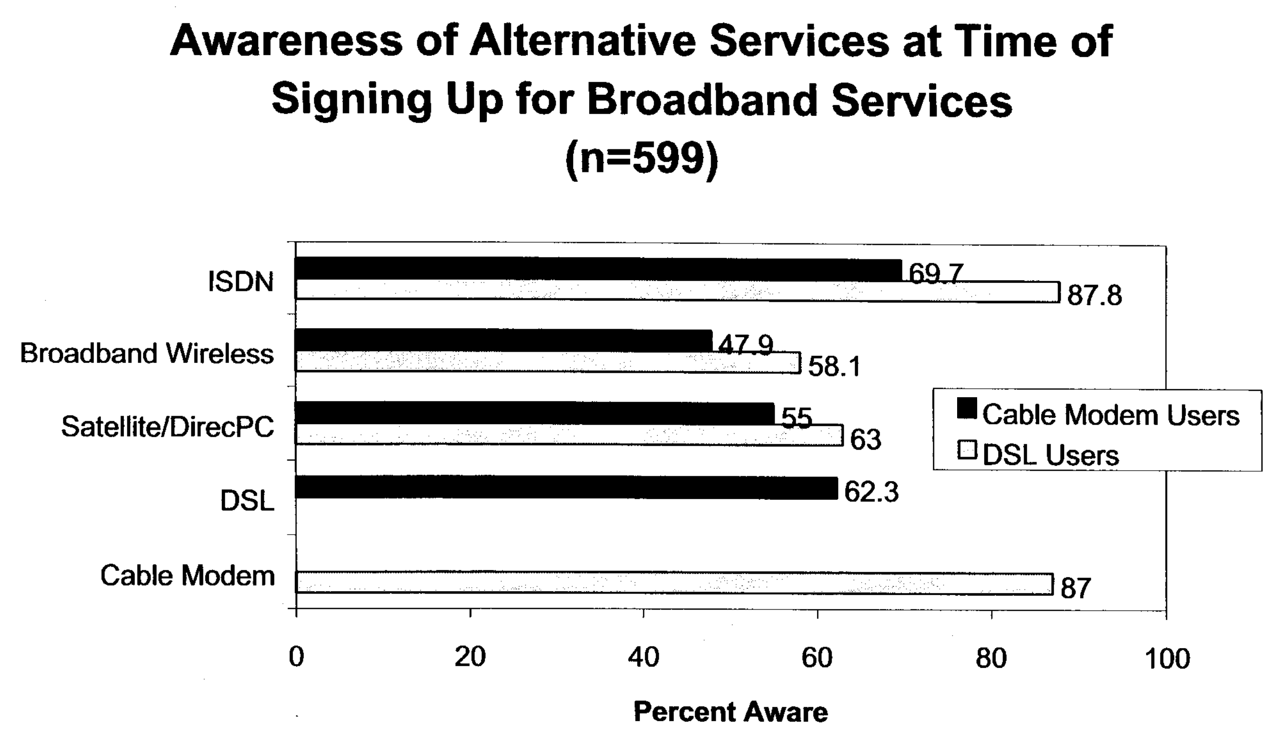

Broadband Users Saying They Would Switch to a 56K Dial-up Account If That Account Is Free
DSL Users
2.9
Cable Modem Users
9.4
0
2
4
6
8
10
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-12



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-13

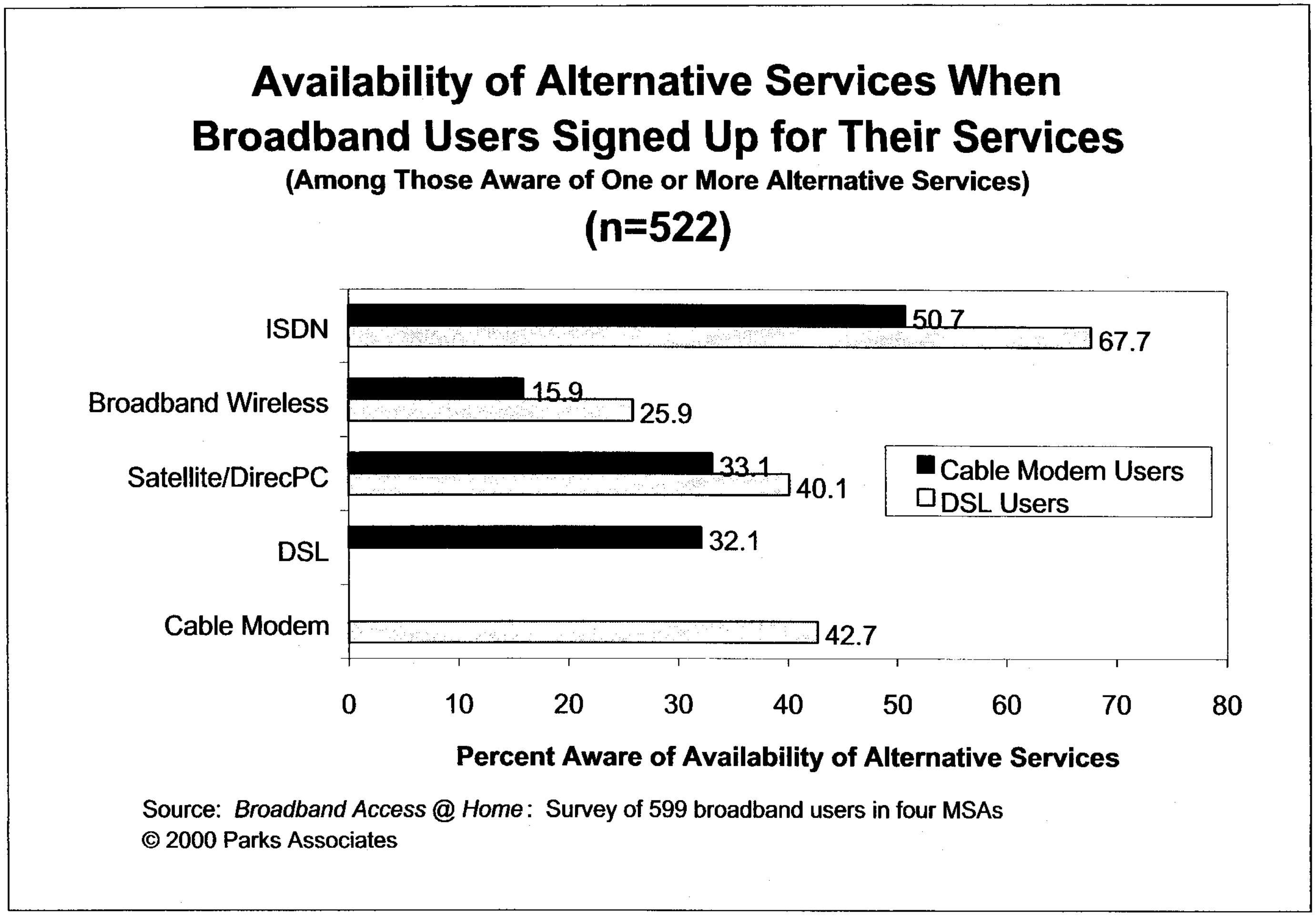
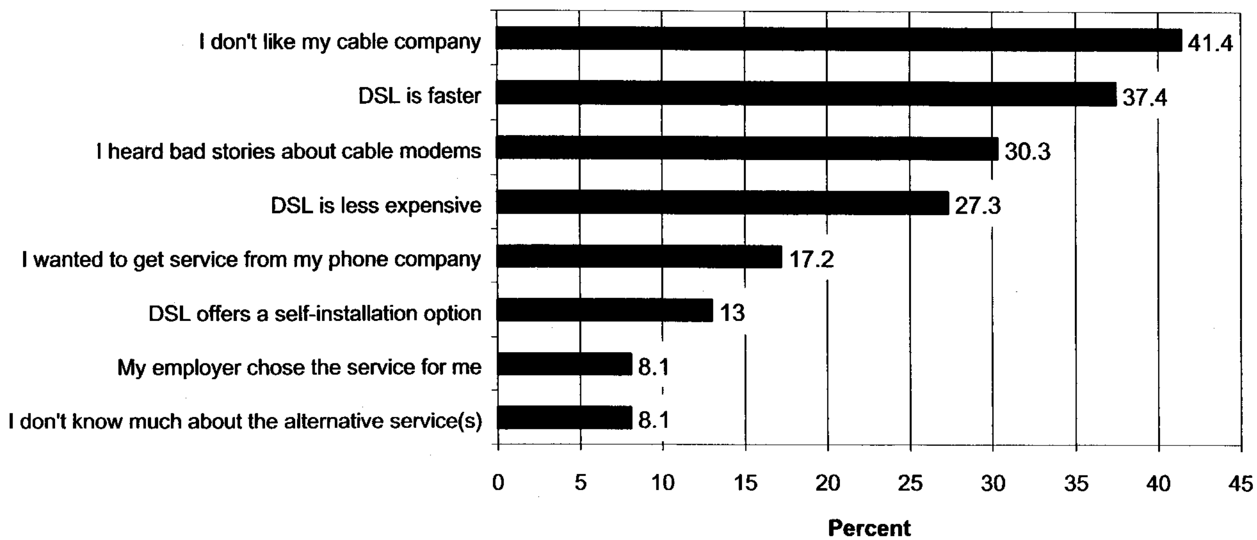

Availability of Alternative Services When Broadband Users Signed Up for Their Services
(Among Those Aware of One or More Alternative Services)
(n=522)
ISDN
Broadband Wireless
Satellite/DirecPC
DSL
Cable Modem
50.7
67.7
15.9
25.9
33.1
40.1
32.1
42.7
Cable Modem Users
DSL Users
0
10
20
30
40
50
60
70
80
Percent Aware of Availability of Alternative Services
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-14

Why Didn't DSL Subscribers Choose Cable Modem Service?

(Among DSL Users Aware of Cable Modem Availability When Signing Up for DSL)

(n=99)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 6-15

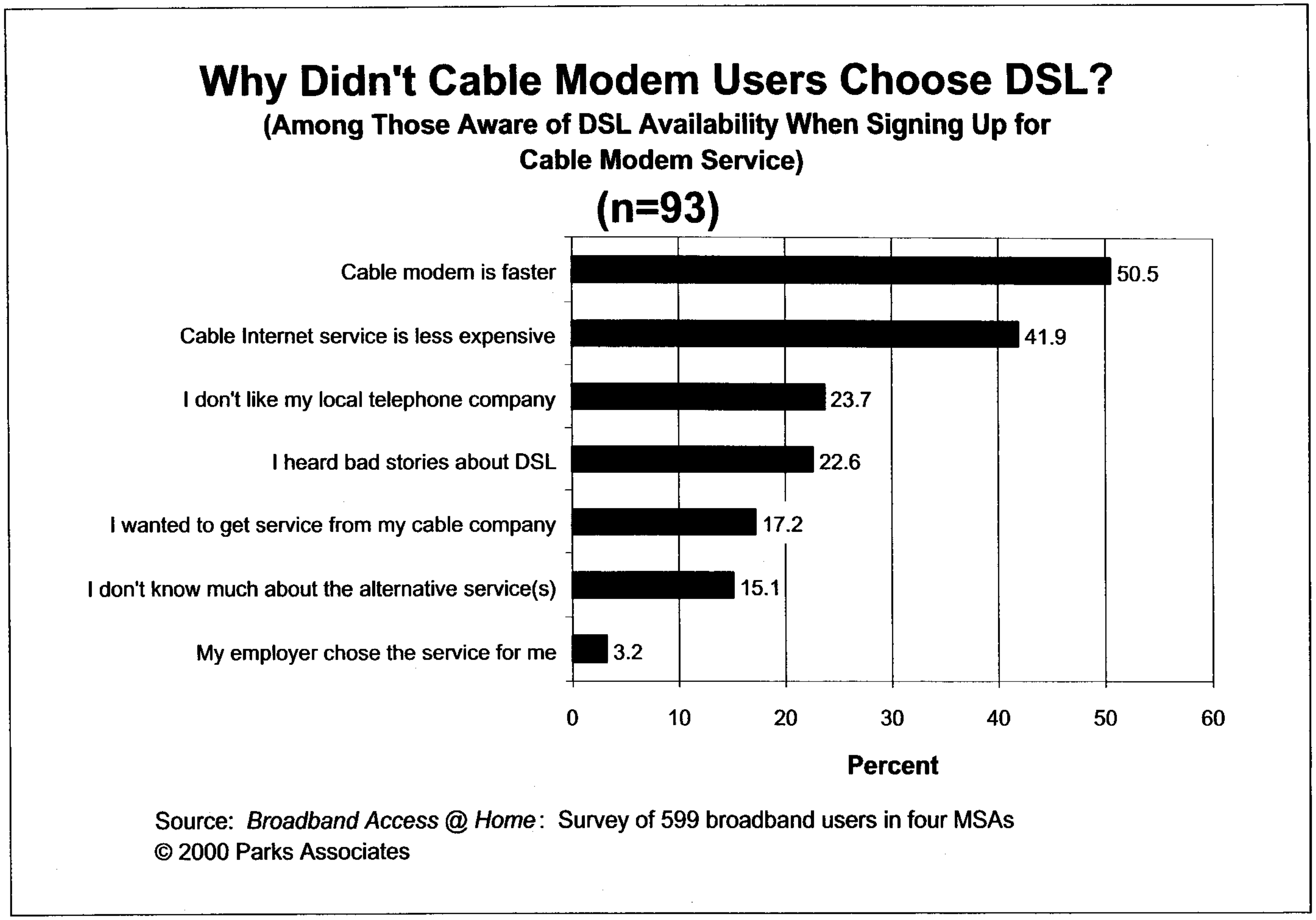

Why Didn't Cable Modem Users Choose DSL?
(Among Those Aware of DSL Availability When Signing Up for Cable Modem Service)
(n=93)
Cable modem is faster
50.5
Cable Internet service is less expensive
41.9
I don't like my local telephone company
23.7
I heard bad stories about DSL
22.6
I wanted to get service from my cable company
17.2
I don't know much about the alternative service(s)
15.1
My employer chose the service for me
3.2
0
10
20
30
40
50
60
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-16

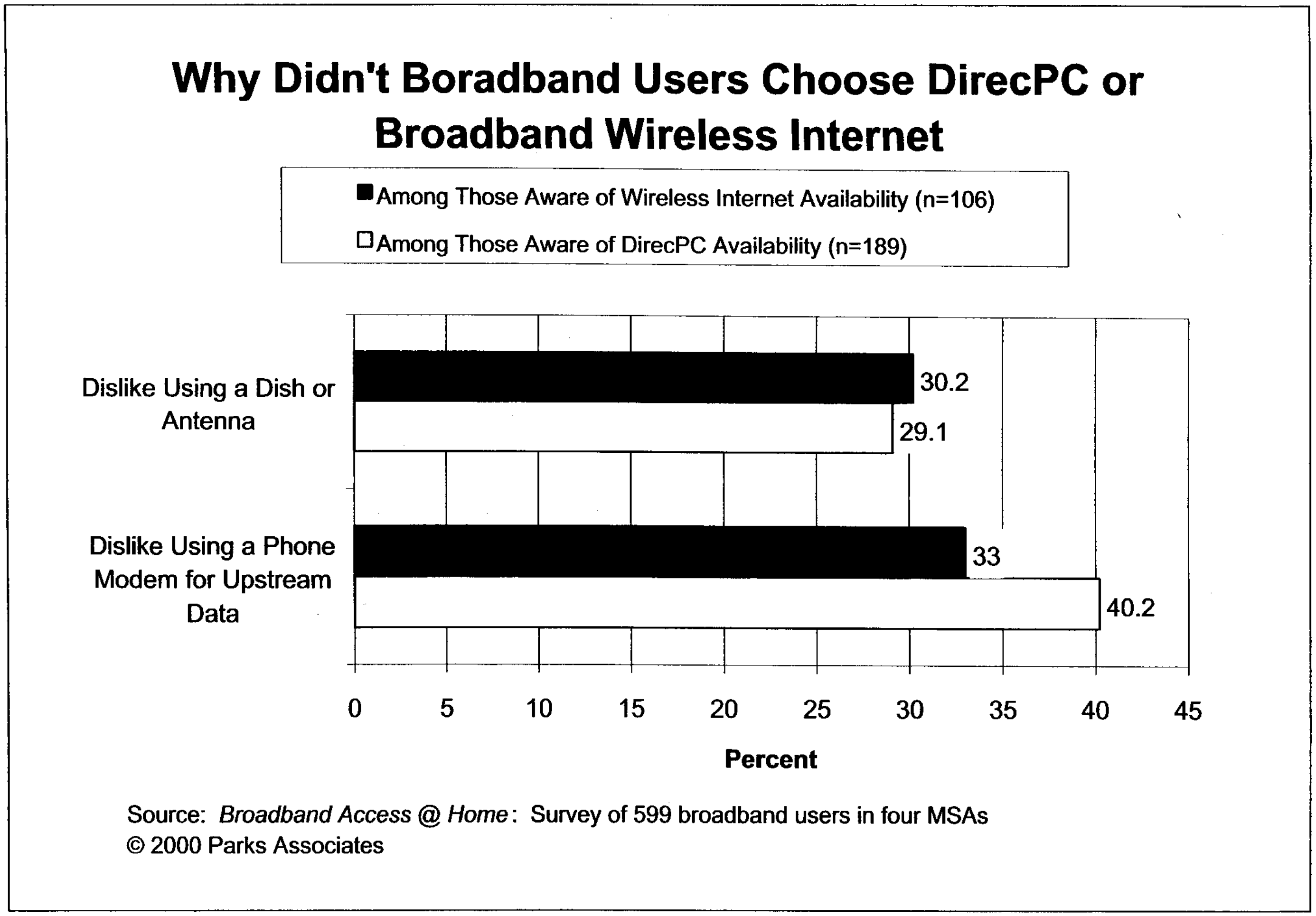

Why Didn't Boradband Users Choose DirecPC or Broadband Wireless Internet
Among Those Aware of Wireless Internet Availability (n=106)
Among Those Aware of DirecPC Availability (n=189)
Dislike Using a Dish or Antenna
30.2
29.1
Dislike Using a Phone Modem for Upstream Data
33
40.2
0
5
10
15
20
25
30
35
40
45
Percent
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-17

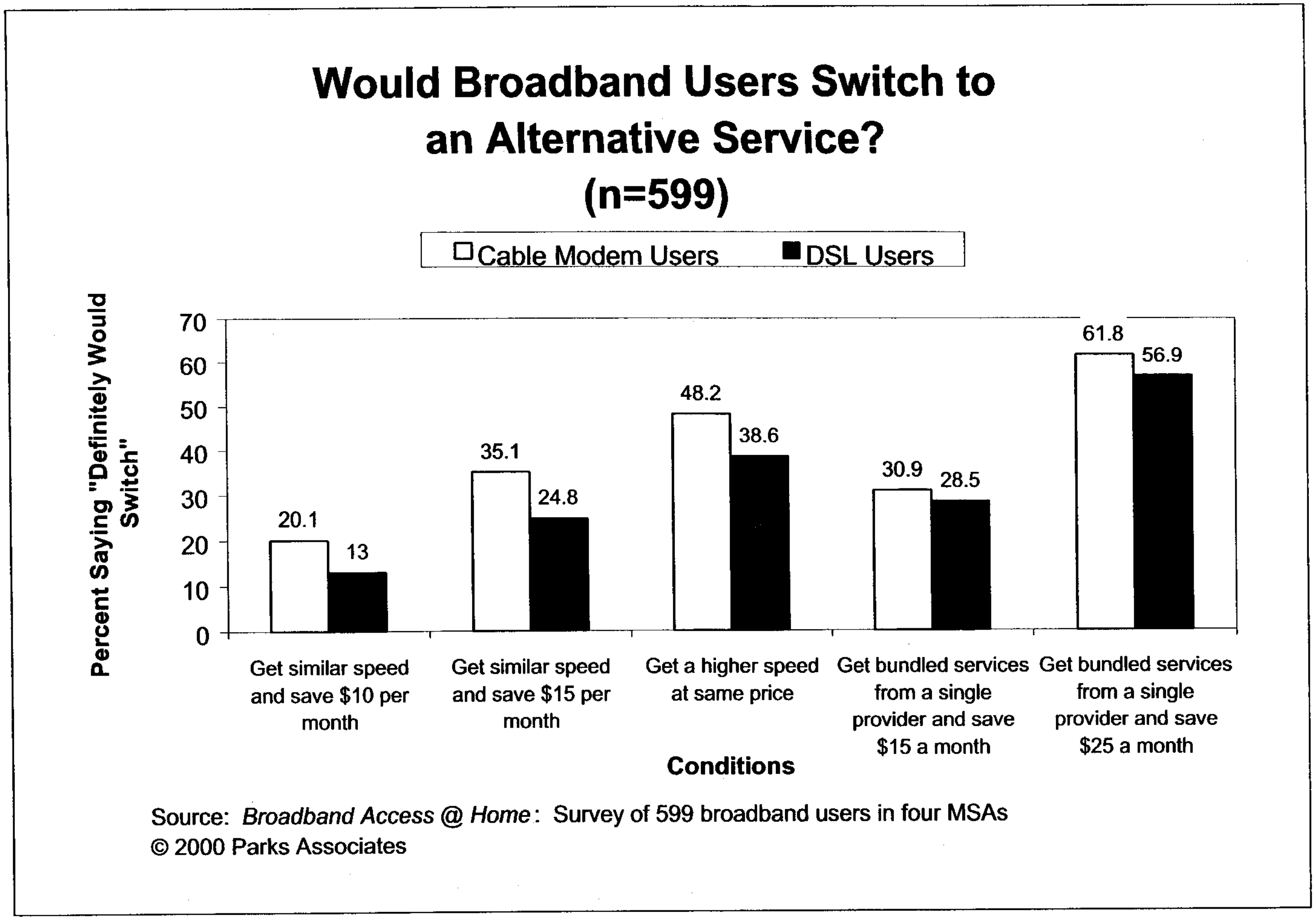
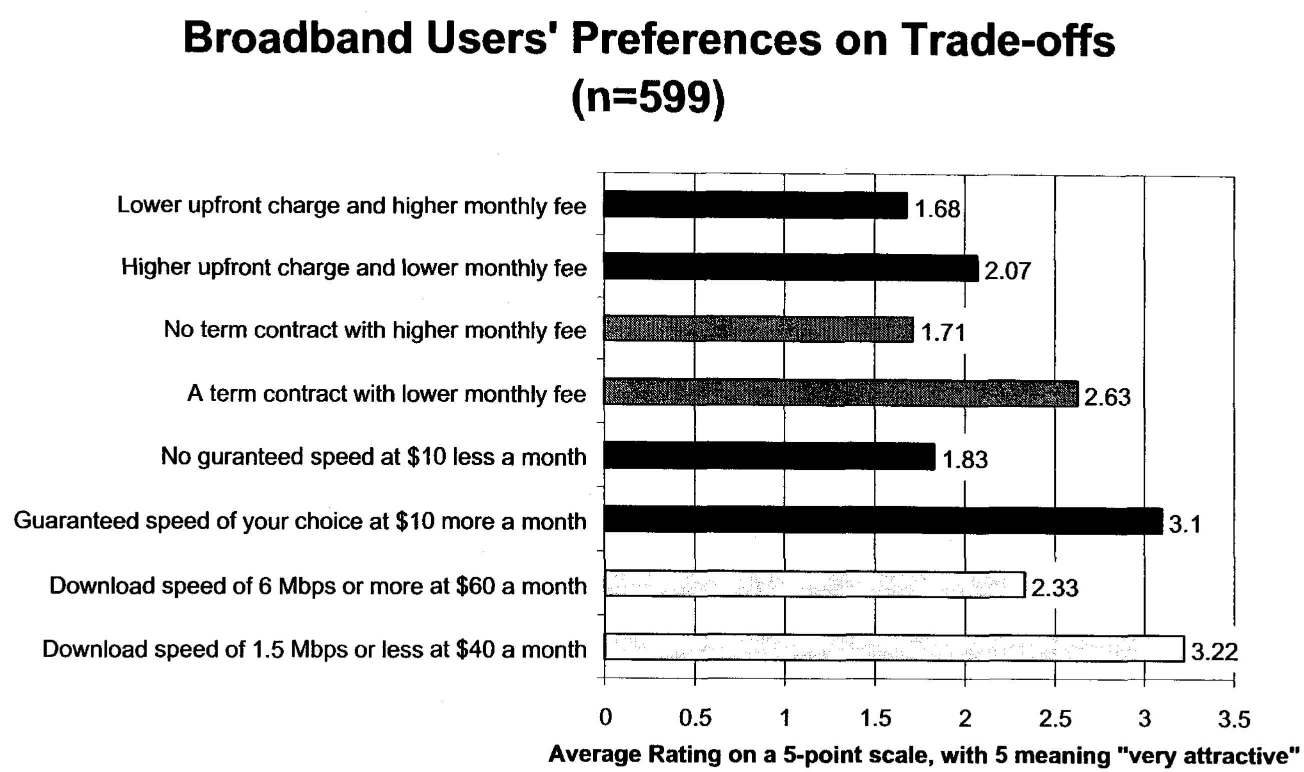

Would Broadband Users Switch to an Alternative Service? (n=599)
Cable Modem Users
DSL Users
Percent Saying "Definitely Would Switch"
70
60
50
40
30
20
10
0
20.1
13
35.1
24.8
48.2
38.6
30.9
28.5
61.8
56.9
Get similar speed and save $10 per month
Get similar speed and save $15 per month
Get a higher speed at same price
Get bundled services from a single provider and save $15 a month
Get bundled services from a single provider and save $25 a month
Conditions
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-18



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-19

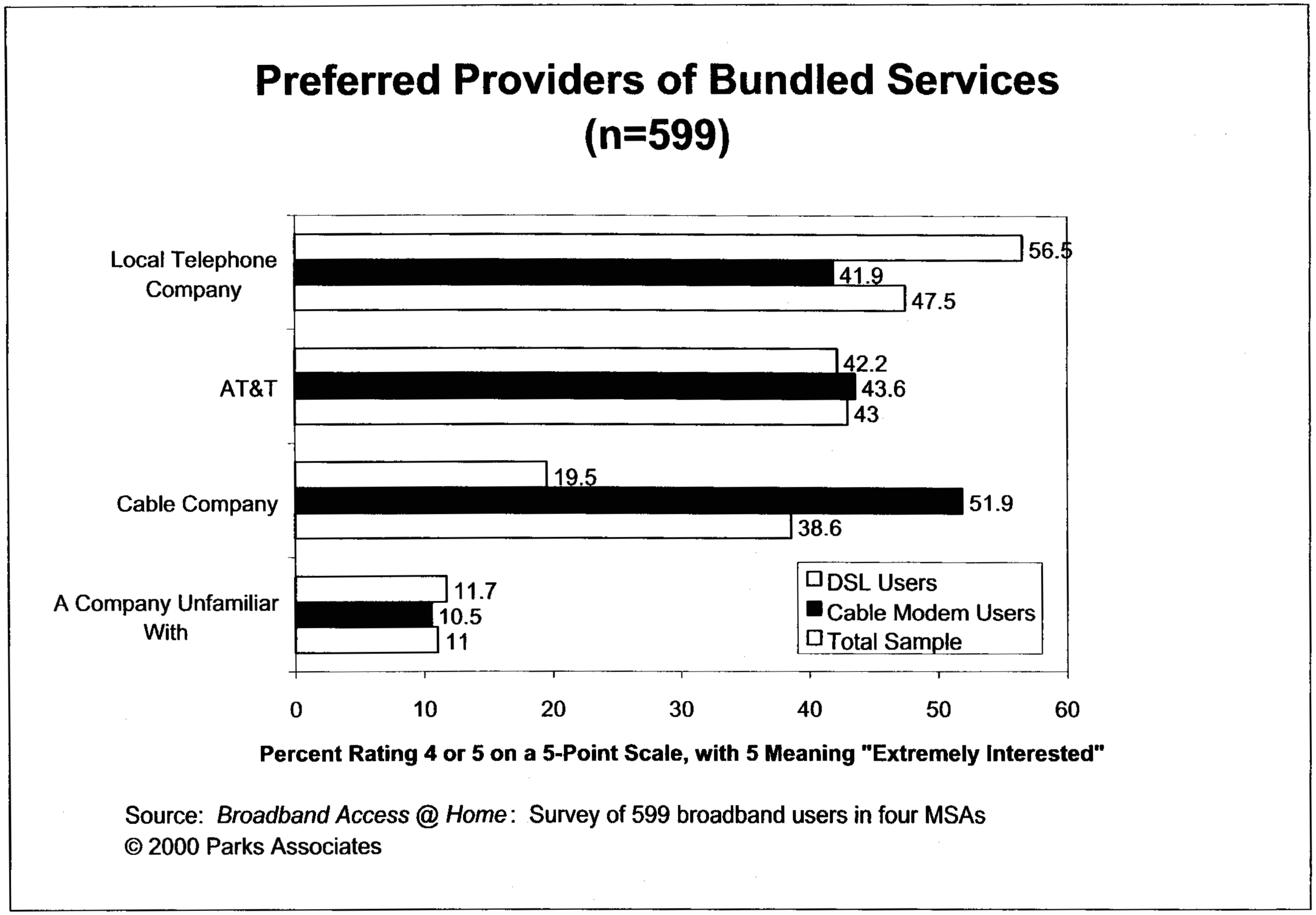

Preferred Providers of Bundled Services
(n=599)
Local Telephone Company
AT&T
Cable Company
A Company Unfamiliar With
56.5
41.9
47.5
42.2
43.6
43
19.5
51.9
38.6
11.7
10.5
11
DSL Users
Cable Modem Users
Total Sample
0
10
20
30
40
50
60
Percent Rating 4 or 5 on a 5-Point Scale, with 5 Meaning "Extremely Interested"
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-20

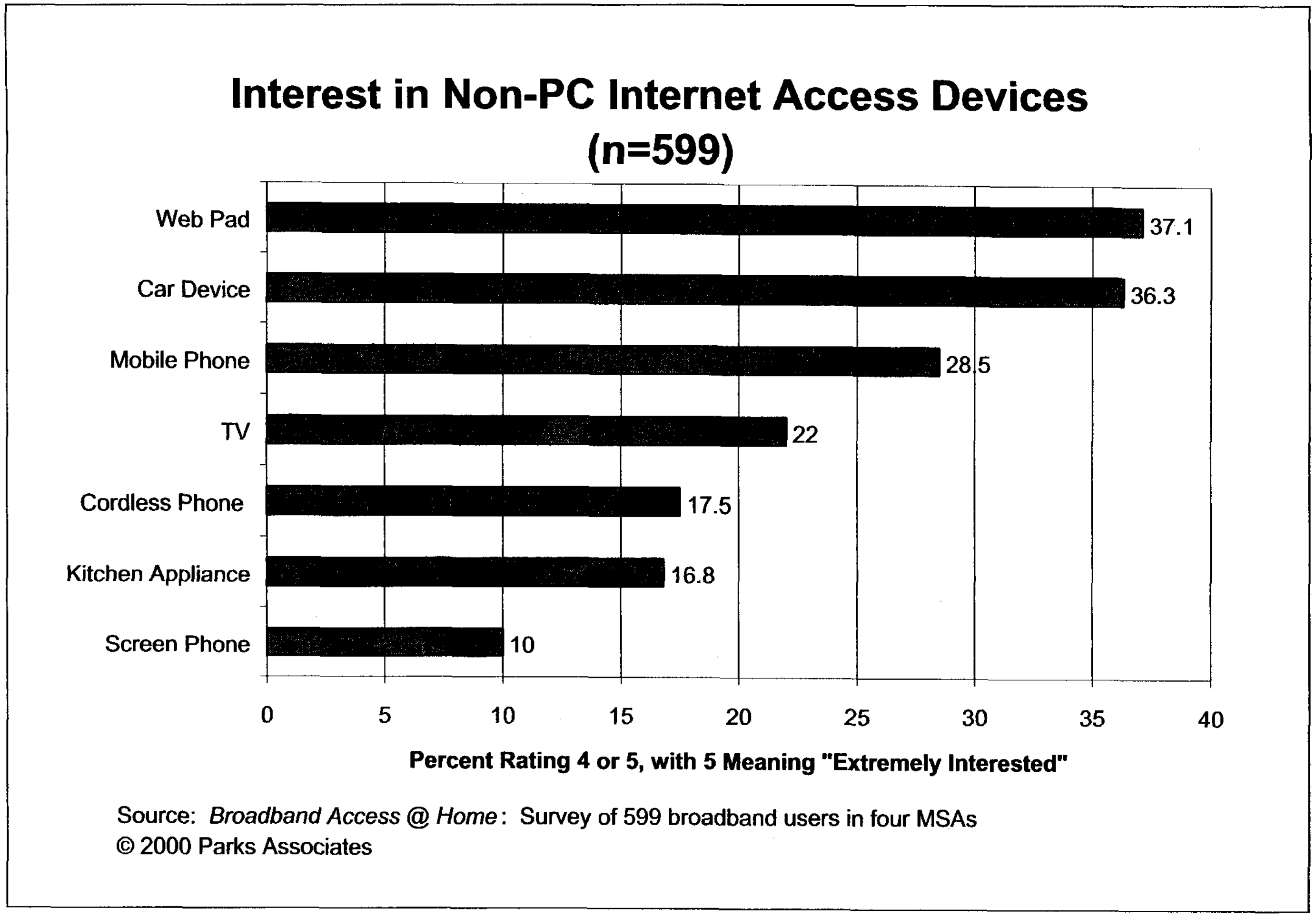

Interest in Non-PC Internet Access Devices
(n=599)
Web Pad
Car Device
Mobile Phone
TV
Cordless Phone
Kitchen Appliance
Screen Phone
37.1
36.3
28.5
22
17.5
16.8
10
0
5
10
15
20
25
30
35
40
Percent Rating 4 or 5, with 5 Meaning "Extremely Interested"
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 6-21

7.0 Additional Phone Lines

7.1 Usage of Additional Phone Lines Before and After Adopting Broadband

More than half (53%) of the broadband subscribers currently have additional phone lines at home (Figure 7-1). However, 59% used to have a separate phone line dedicated for Internet access (Figure 7-2). This indicates that the adoption of broadband services has somewhat decreased the usage of additional phone lines. Among those who used to have a separate line for dial-up Internet access, 42% have already stopped using that line (Figure 7-3), leaving more than half who are still using that line today. The top-three reasons for keeping that line are faxing, dial-up access to the Internet in case of broadband service outage, and usage by someone else in the household.

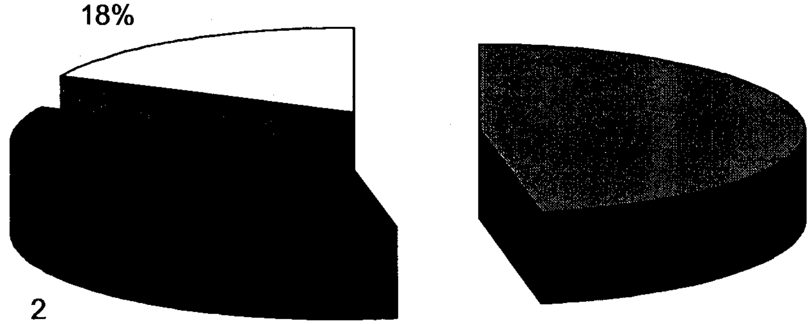
7.2 Will VoDSL or IP-Based Cable Telephony Take Off?

Voice-over-DSL (VoDSL) and packet-switched cable telephony promise multiple virtual phone lines over a single access network. But do consumers really need extra lines? Are they willing to pay the regular price for each additional line? Findings from the survey suggest that VoDSL players and cable telephony providers should not be overly optimistic about selling additional lines to consumers:

- Nearly half (46%) indicated that they do not need any additional lines.
- The average monthly fee the broadband users (excluding those who responded with a zero) are willing to pay is only $9.90 per additional line.

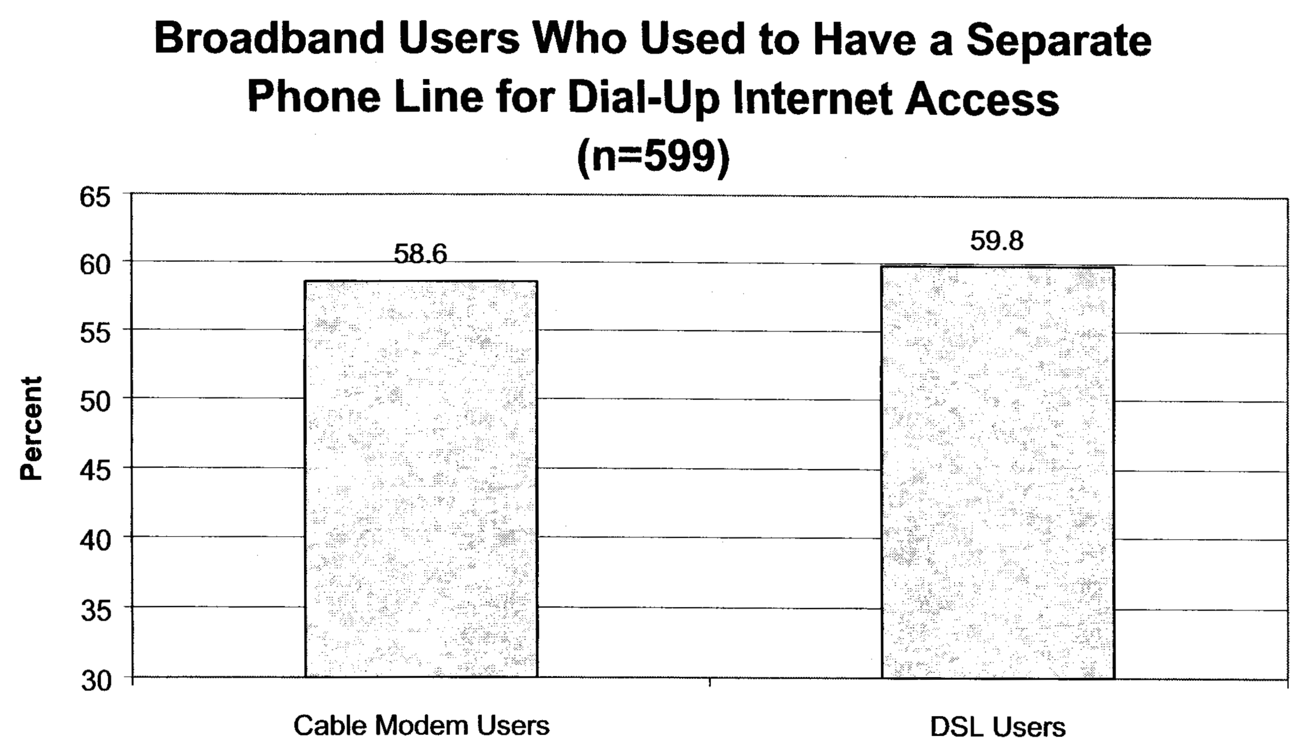
Another factor that may negatively impact consumer demand for additional phone lines at home is increased use of mobile phones. A small percent of mobile phone users have already stopped using their wireline phones at home. Parks Associates expects this number to increase steadily due to continuously falling prices of mobile phone handsets and monthly usage fees. Thus, VoDSL may be a killer app in the business market, but there is no strong evidence to suggest that it will be a killer app in the consumer market as well.

Number of Phone Lines Broadband Users Have at Home (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 7-1



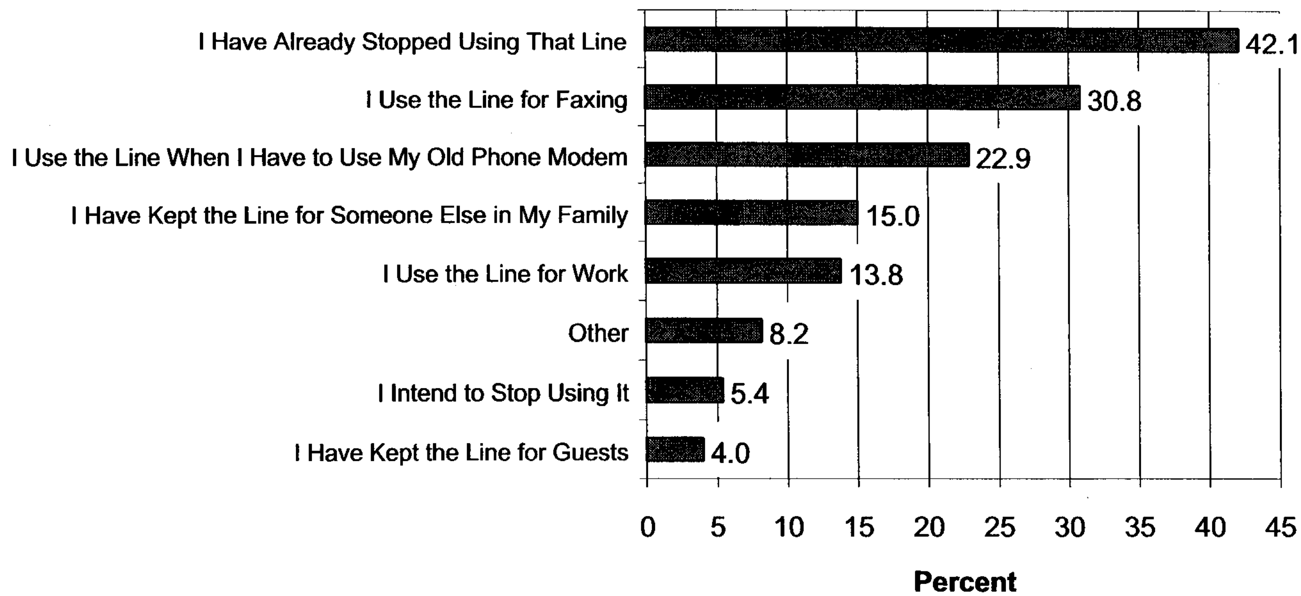
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 7-2

Is the Separate Phone Line Still in Use?

(Among Those That Used to Have a Serarate Phone Line for Internet Access)

(n=354)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 7-3

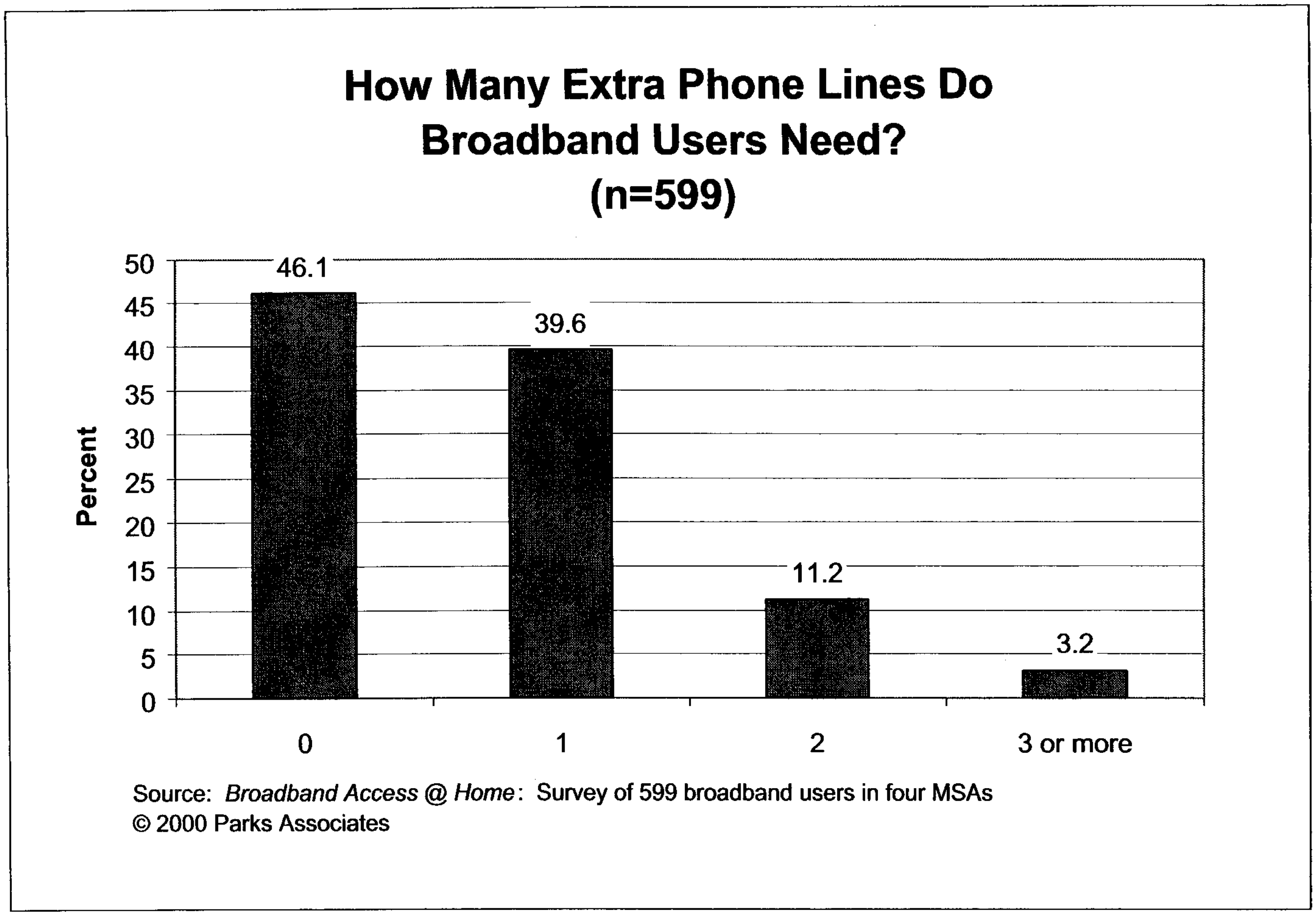
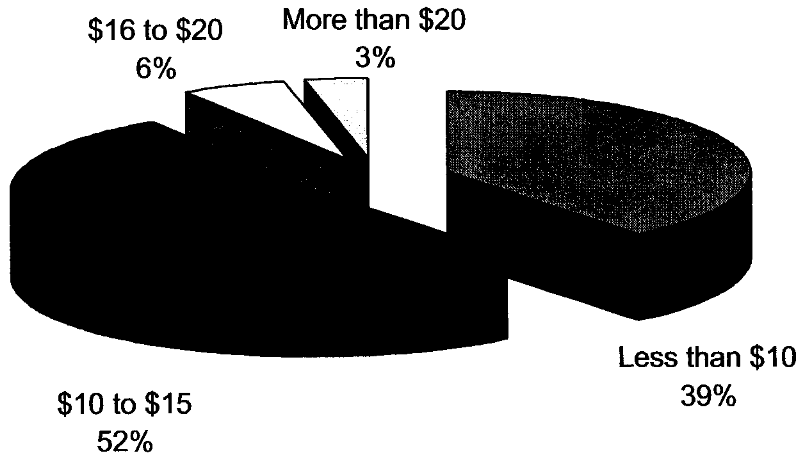

How Many Extra Phone Lines Do
Broadband Users Need?
(n=599)
Percent
50
45
40
35
30
25
20
15
10
5
0
46.1
39.6
11.2
3.2
0
1
2
3 or more
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 7-4

How Much Are Broadband Users Willing to Pay for Each Additional Phone Line?

(Among those who responded with a number other than zero)

(n=412)



Mean: $9.90

Source: *Broadband Access @ Home* Survey of 599 broadband users in four MSAs
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Figure 7-5

8.0 Computers and Home Networking

8.1 PC Ownership

Parks Associates estimates that at the end of 1999, about 18% of ALL households had two or more computers at home. The percentage of broadband users with multiple PCs is much higher at 65.6%. Among them, 59% have three or more PCs at home (Figure 8-2).

Most of the broadband uses have fairly new computers. Thirty-eight percent of the single-PC users acquired their computers in 1999 or at the beginning of 2000. As to the multi-PC users, 52% bought their newest computer in 1999-2000 (Figure 8-2). Overall, 47% of the broadband users purchased a new computer in the 1999-2000 time frame.

8.2 Characteristics of the PC Directly Connected to the Internet

Forty-eight percent of the computers directly connected to the Internet have a powerful processor: Pentium II or III (Figure 8-5). Over two-thirds of them have a USB port (Figure 8-6). However, only 28% have a DVD drive. Most of them (73.5%) are located either in a formal/informal home office or in a bedroom (Figure 8-4).

8.3 Broadband Users with a Computer Network

A survey Parks Associates conducted in April 1999 suggests that almost 30% of the multi-PC households have a computer network. Naturally, a much higher percent (55%) of the broadband users reported having a computer network at home (Figure 8-7).

The applications used most frequently are shared Internet access (88%), file sharing/transfer (86%), and printer sharing (80%) (Figure 8-8). Although file sharing is used more often than printer sharing, the latter is considered more important than file transfer/sharing (Figure 8-9).

Despite all the attention given to "no-new-wires" home networking solutions (HomePNA, HomeRF, ect.), the traditional Ethernet is still the dominant computer network installed in residences (Figure 8-10). However, Parks Associates does expect "no-new-wires" networking products to gain a larger share.

Although a computer network is generally perceived to be hard to install, two-thirds (77%) of the broadband users with a computer network said that they installed the network themselves (Figure 8-11). This is largely because the early adopters of broadband services are generally very technology-savvy. Will the percent of self-installed computer networks decrease in the future as more average consumers adopt the concept of home networking? Parks Associates does not think so, and the main reason for this is the anticipated wide availability of the "no new wires" networking products that are much easier to install than the traditional Ethernet.

Although more than half (60%) of the broadband users already had a computer network installed when they signed up for broadband services, 11% said that they obtained broadband and computer networking at the same time. This indicates that subscription to broadband services can be a good opportunity for the marketing of home networking products, as some venders/service providers are already doing.

8.4 Broadband Users Without a Computer Network

Among the broadband users with multiple PCs but not a computer network, 35% feel a need for a network (Figure 8-13). DSL users appear to be more receptive to home networking, as 44% of them indicated a need for a computer network, compared with 31% of cable modem users.

To those who feel a need for a computer network, shared Internet access is the number one application (Figures 8-14 and 8-15). Nearly one-fourth (23%) of them are interested in ordering computer networking services from their broadband service provider. Again, this is another indication that broadband services and home networking can be marketed together.

8.5 Interest in Certain Entertainment-Oriented Networking Applications

About half of the respondents are interested in the capability of sending DVD signals, Internet video, or music from a PC to a TV or a stereo system (Figure 8-17). As the percent of home PCs equipped with a DVD drive is expected to increase and because broadband services will turn the Internet into a medium for multimedia entertainment, products that can network PCs with traditional entertainment devices would have a strong appeal. The challenge, of course, is to make such networking products easy to install and cost-effective.

8.6 Number of Phone Jacks and Cable TV Outlets

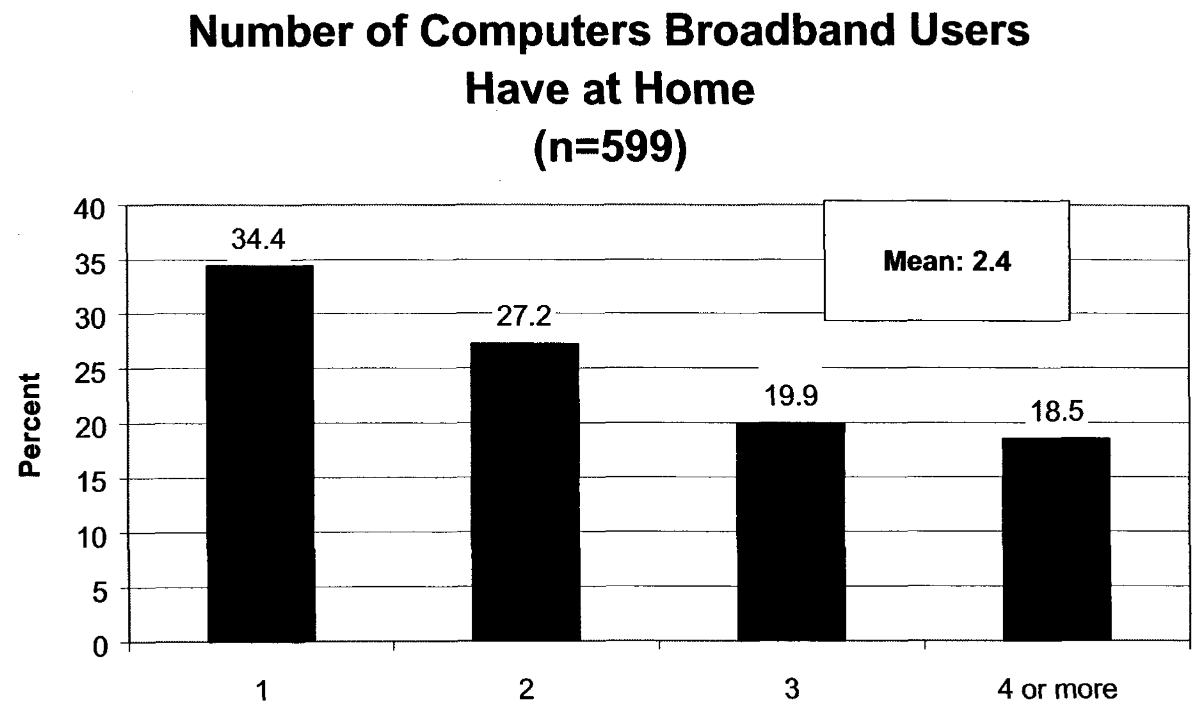
Phone jacks and cable TV outlets are significant to home networking because there are home networking solutions that require the use of existing telephone or cable TV wires in the home (e.g., HomePNA and Peracom Networks' *Avcast®*). The broadband users' homes have more telephone jacks/outlets than the national average: 5.1 vs. 3.4[17]. As to cable TV outlets, the average for broadband users is 3. (The national average is not available, but Parks Associates estimates that it is smaller than 3).

The number of telephone and cable TV outlets is typically related to the number of rooms in a residence. It is obvious that in virtually all residences, not every room has a phone or cable TV outlet. This puts a limitation to the networking solutions using existing telephone or cable TV

[17] A national survey Parks Associates conducted in early 1999 indicates that the average number of telephone outlets in the US is 3.4.

wires. Although powerline-based and RF networking solutions do not have such limitations, they have their own technical/business issues that need to be solved.[18]

[18] For more information about home networking solutions, please contact Parks Associates about its research in this area.



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-1

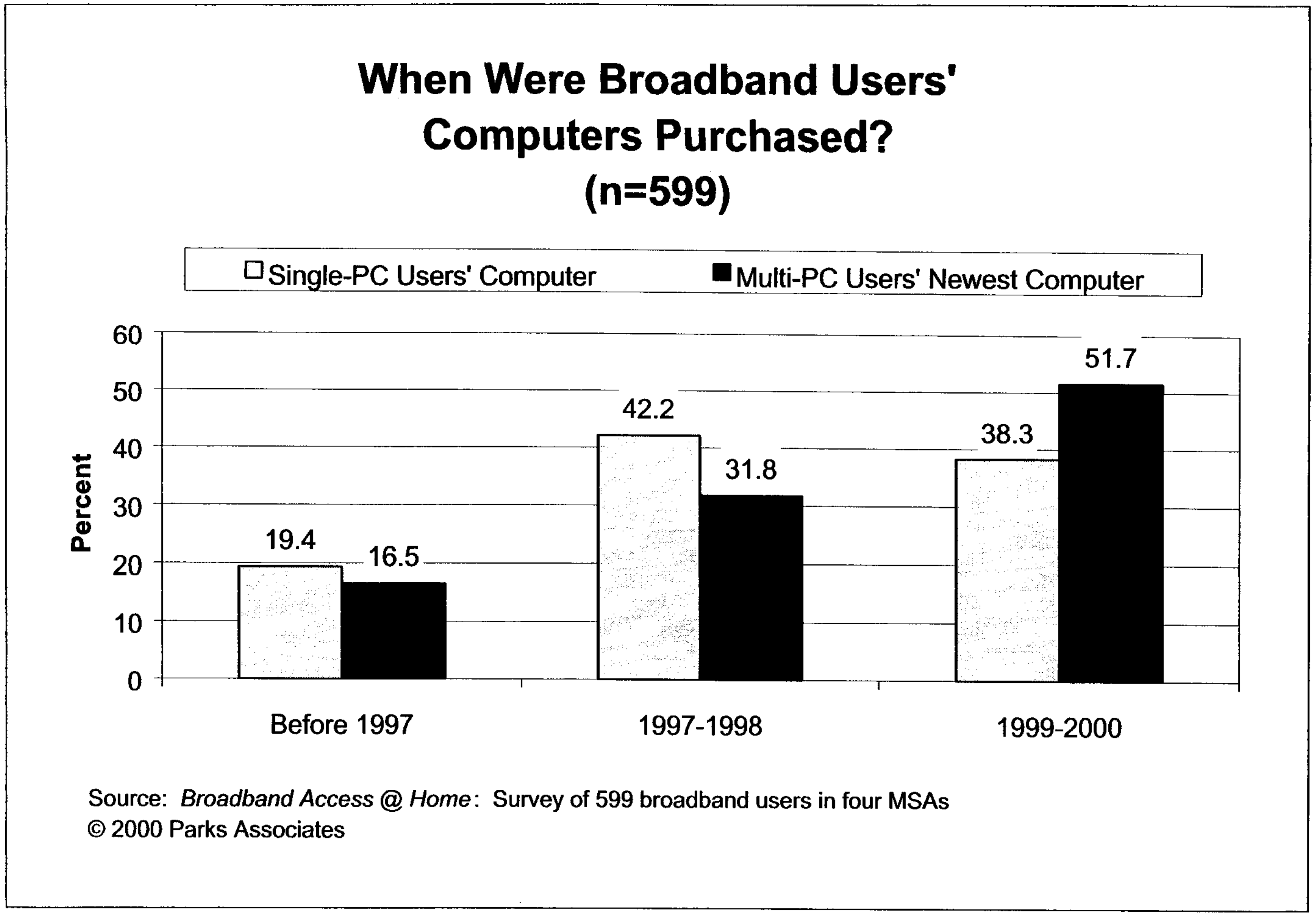
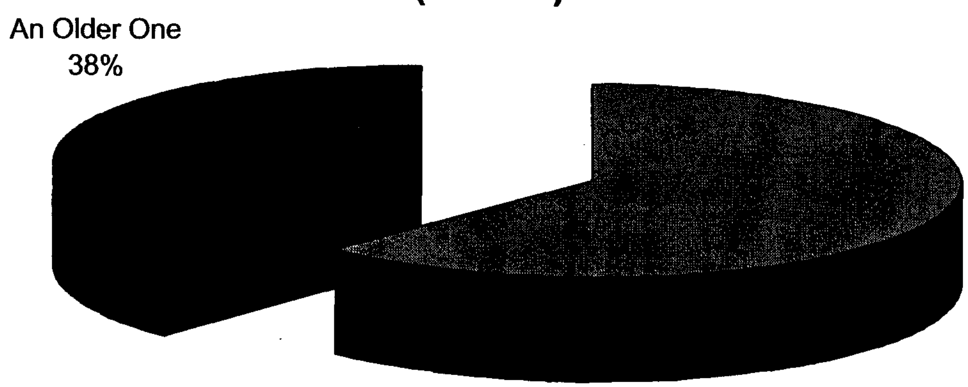

When Were Broadband Users' Computers Purchased?
(n=599)
Single-PC Users' Computer
Multi-PC Users' Newest Computer
Percent
60
50
40
30
20
10
0
19.4
16.5
42.2
31.8
38.3
51.7
Before 1997
1997-1998
1999-2000
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-2

Which Computer Is Directly Connected to the High-speed Modem?

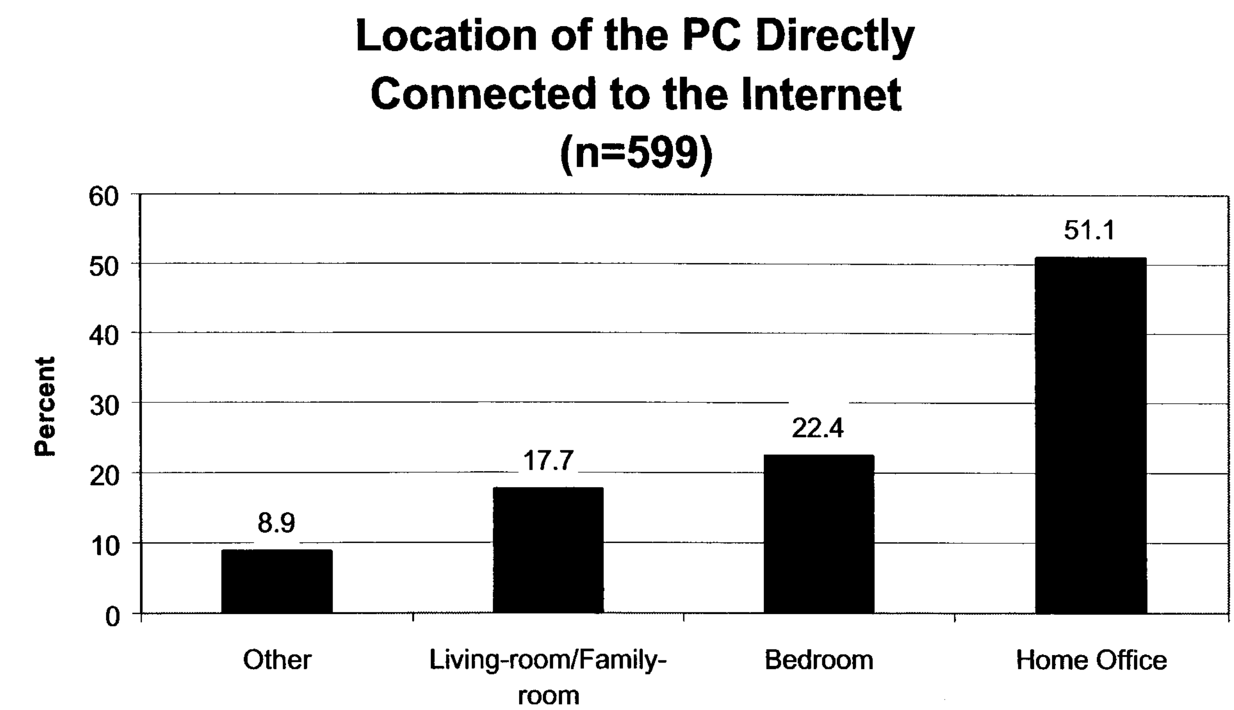
(Among Broadband Users with Multiple PCs)

(n=393)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

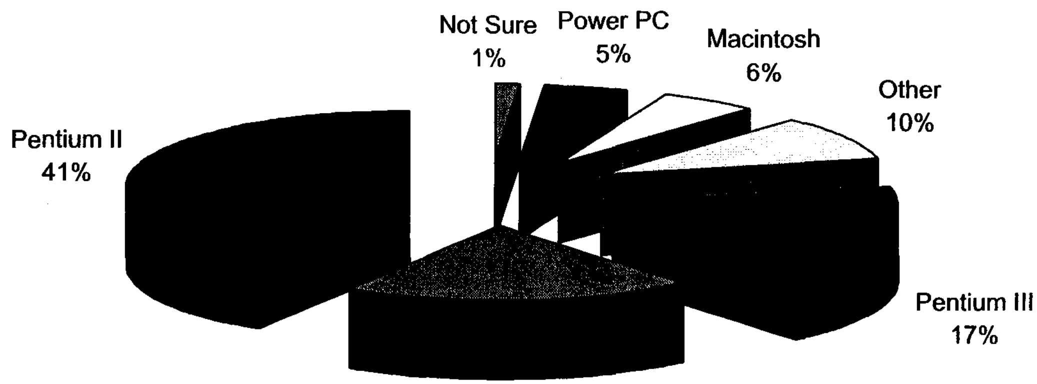
Figure 8-3



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 8-4

Type of Computer Directly Connected to the Internet (n=599)



Source: *Broadband Access @ Home:* Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-5

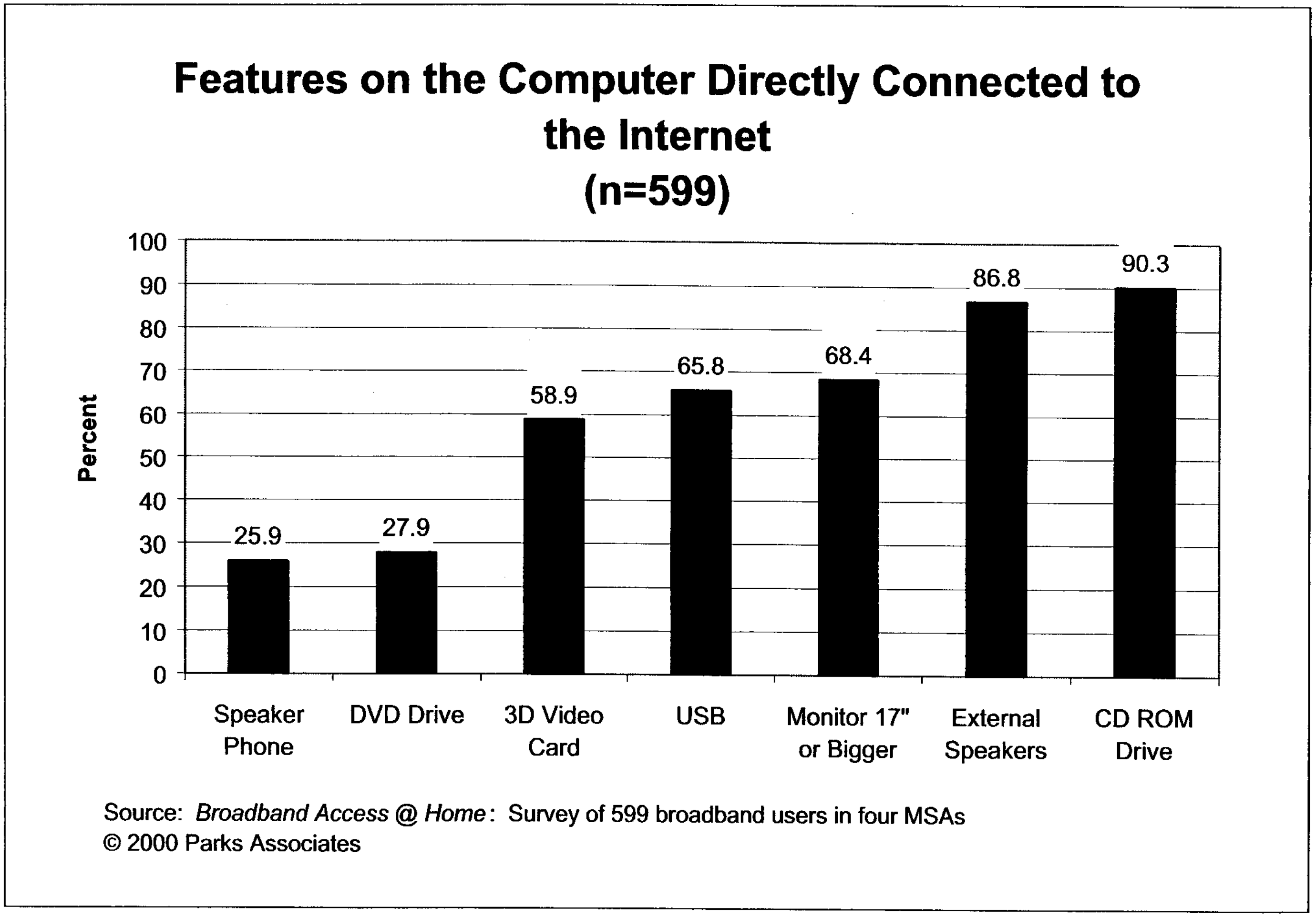

Features on the Computer Directly Connected to the Internet
(n=599)
Percent
100
90
80
70
60
50
40
30
20
10
0
25.9
27.9
58.9
65.8
68.4
86.8
90.3
Speaker Phone
DVD Drive
3D Video Card
USB
Monitor 17" or Bigger
External Speakers
CD ROM Drive
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-6

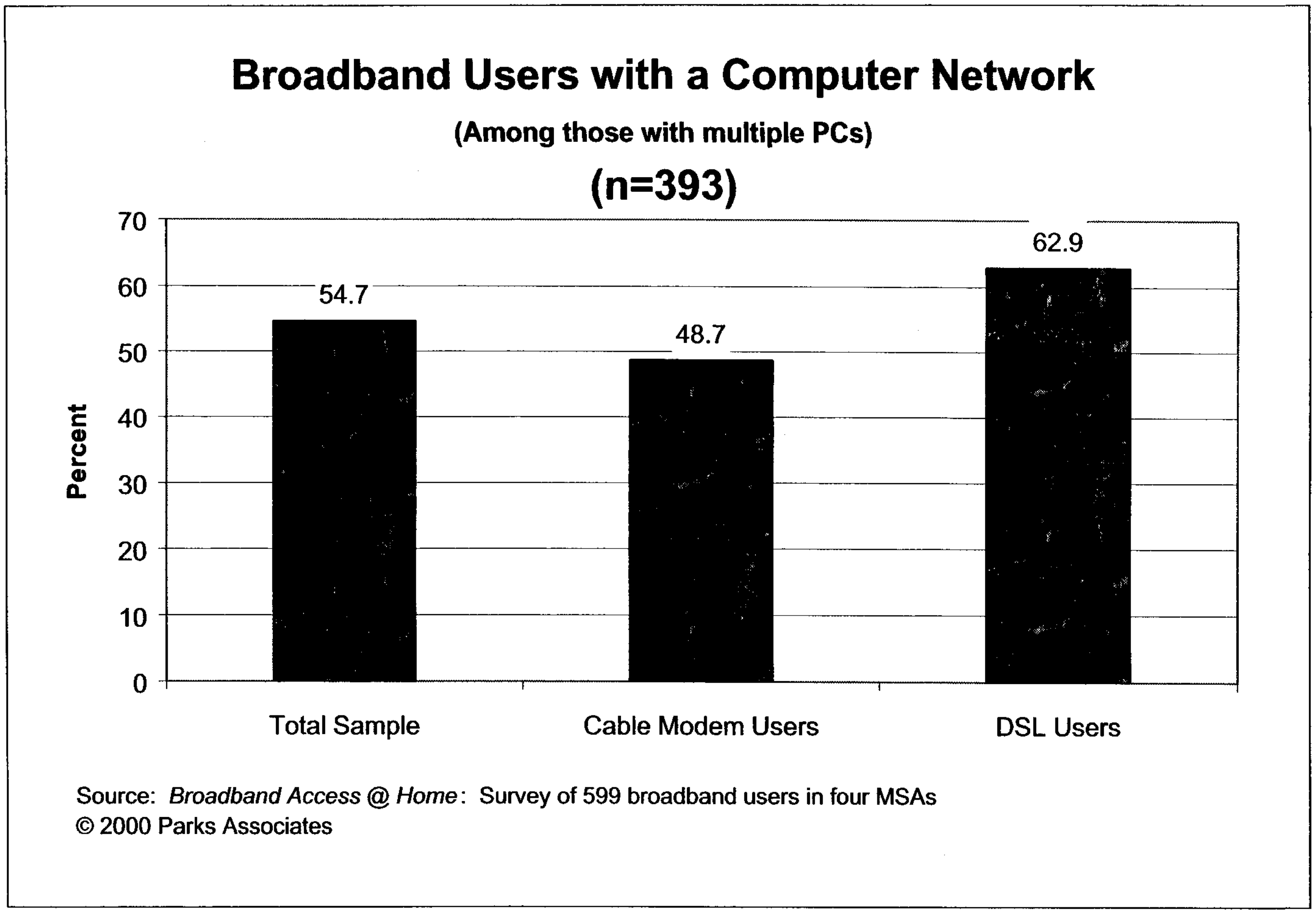

Broadband Users with a Computer Network
(Among those with multiple PCs)
(n=393)
Percent
70
60
50
40
30
20
10
0
54.7
48.7
62.9
Total Sample
Cable Modem Users
DSL Users
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-7

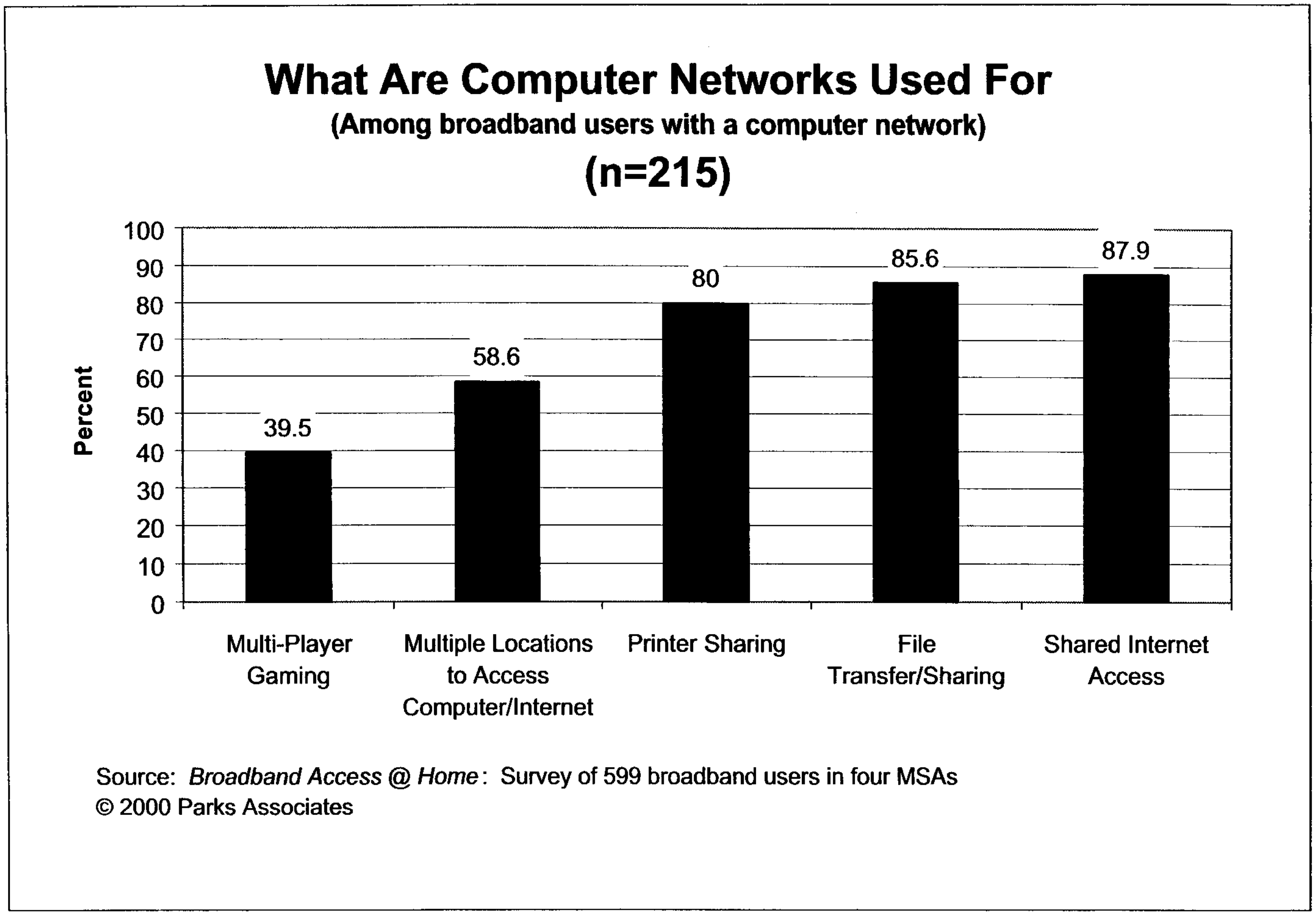

What Are Computer Networks Used For
(Among broadband users with a computer network)
(n=215)
Percent
100
90
80
70
60
50
40
30
20
10
0
39.5
58.6
80
85.6
87.9
Multi-Player Gaming
Multiple Locations to Access Computer/Internet
Printer Sharing
File Transfer/Sharing
Shared Internet Access
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-8

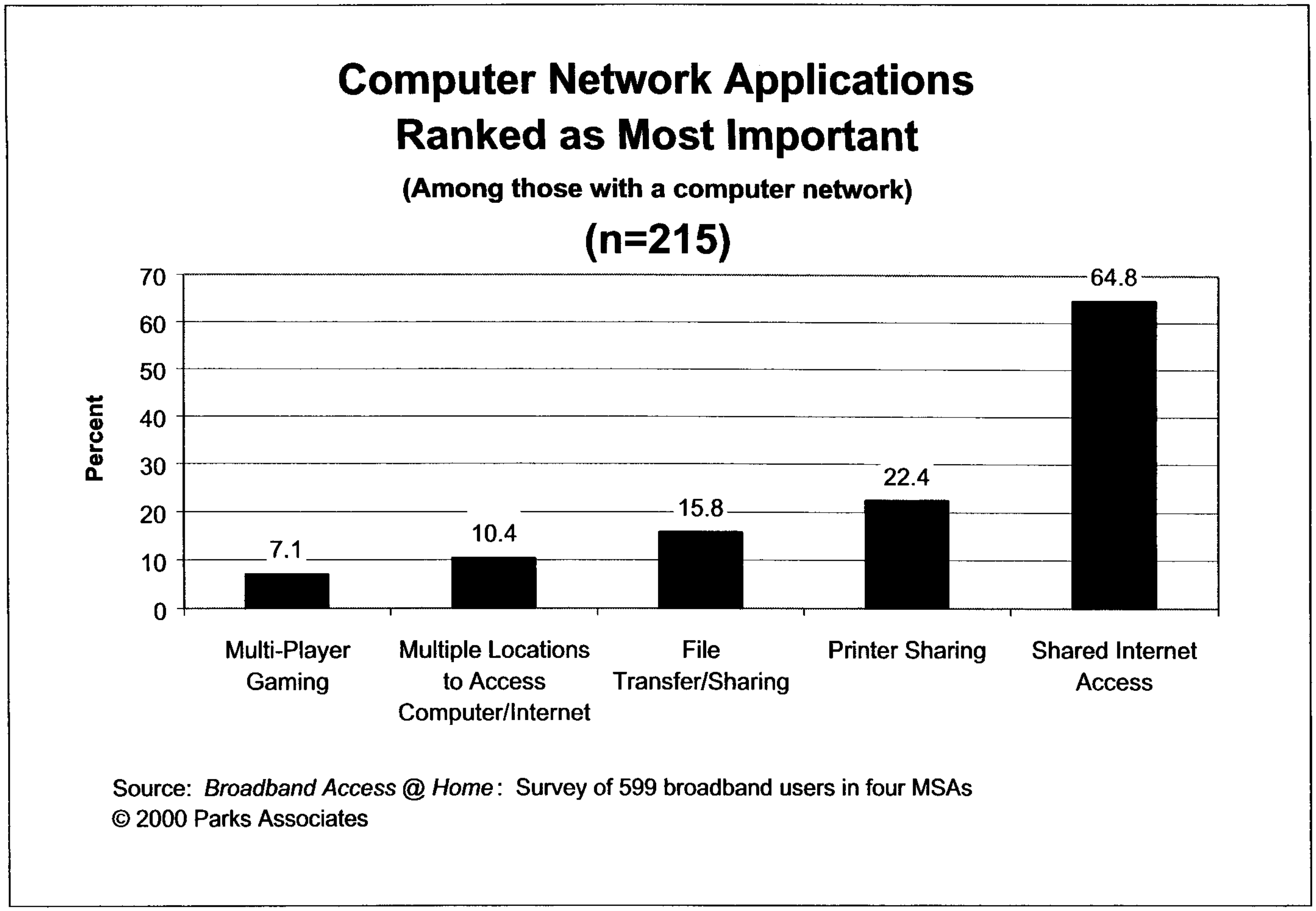

Computer Network Applications
Ranked as Most Important
(Among those with a computer network)
(n=215)
Percent
70
60
50
40
30
20
10
0
7.1
10.4
15.8
22.4
64.8
Multi-Player Gaming
Multiple Locations to Access Computer/Internet
File Transfer/Sharing
Printer Sharing
Shared Internet Access
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-9

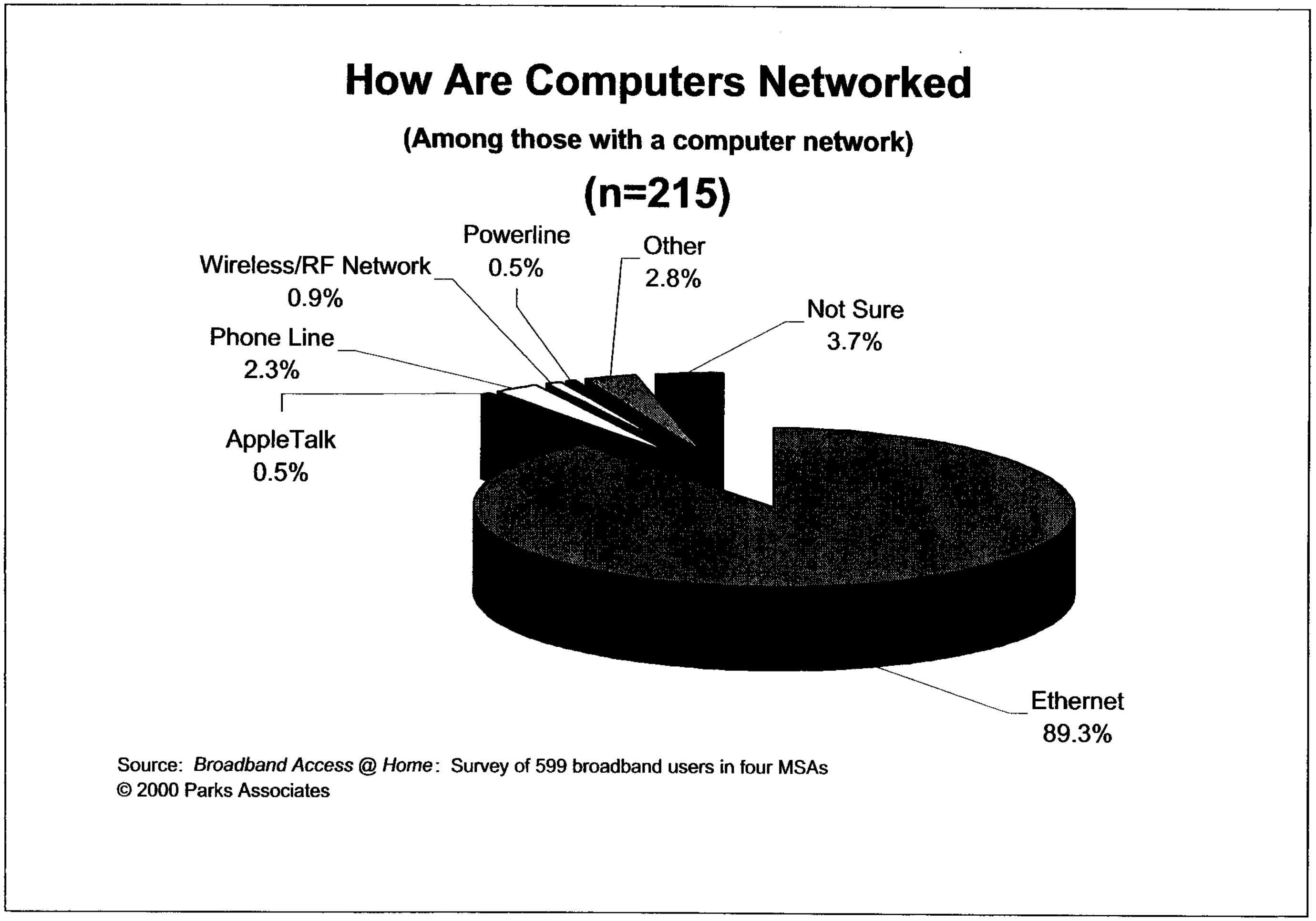
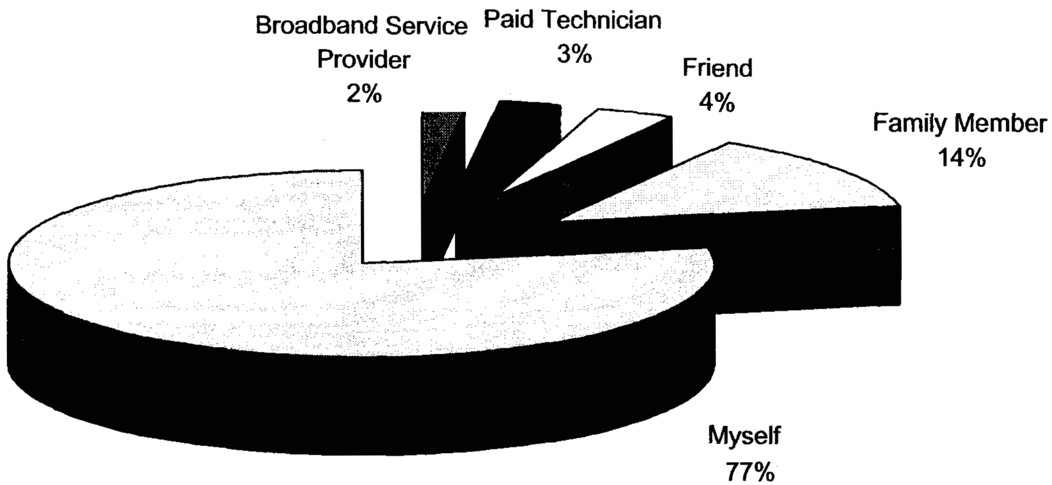

How Are Computers Networked
(Among those with a computer network)
(n=215)
Powerline 0.5%
Other 2.8%
Wireless/RF Network 0.9%
Not Sure 3.7%
Phone Line 2.3%
AppleTalk 0.5%
Ethernet 89.3%
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-10

Who Installed Computer Networks

(Among those with a computer network)

(n=215)



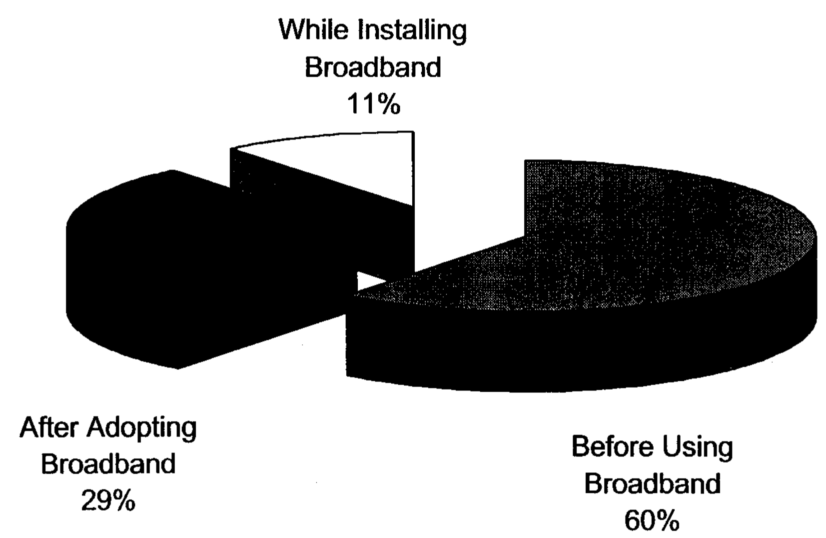
Source: *Broadband Access @ Home* Survey of 599 broadband users in four MSAs

Figure 8-11

When Were Computer Networks Installed

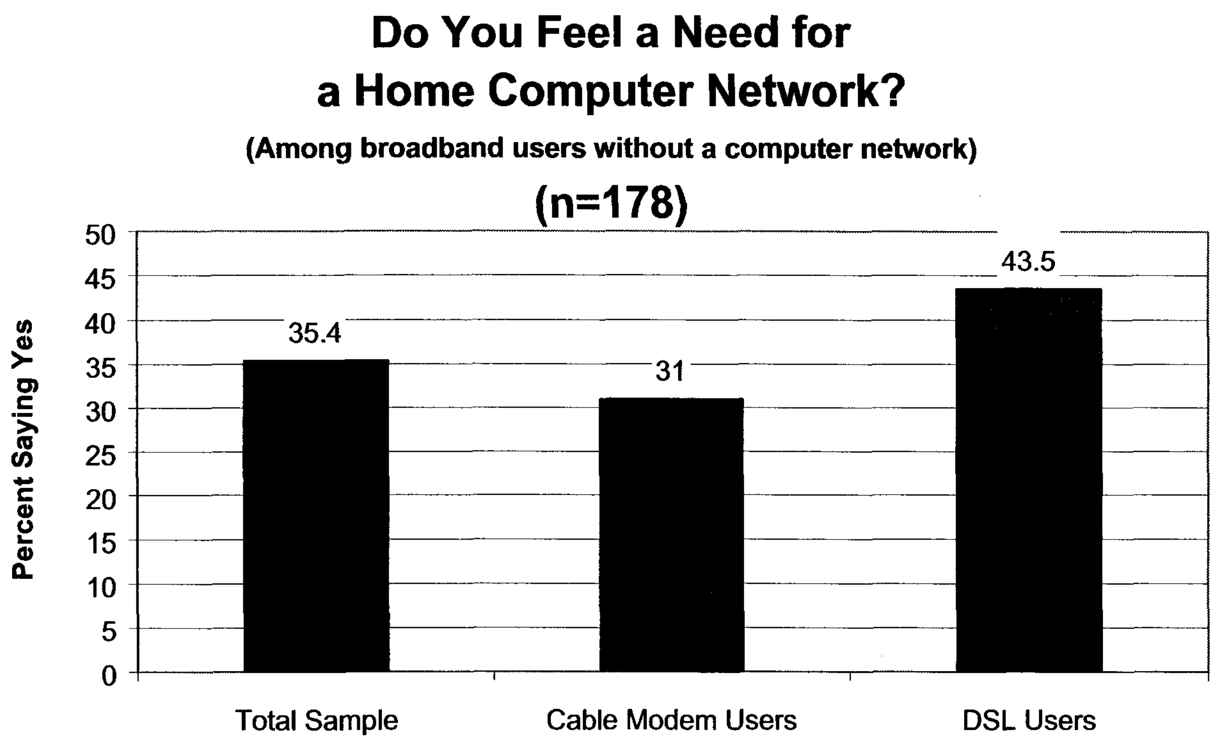
(Among those with a computer network)

(n=215)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-12



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 8-13

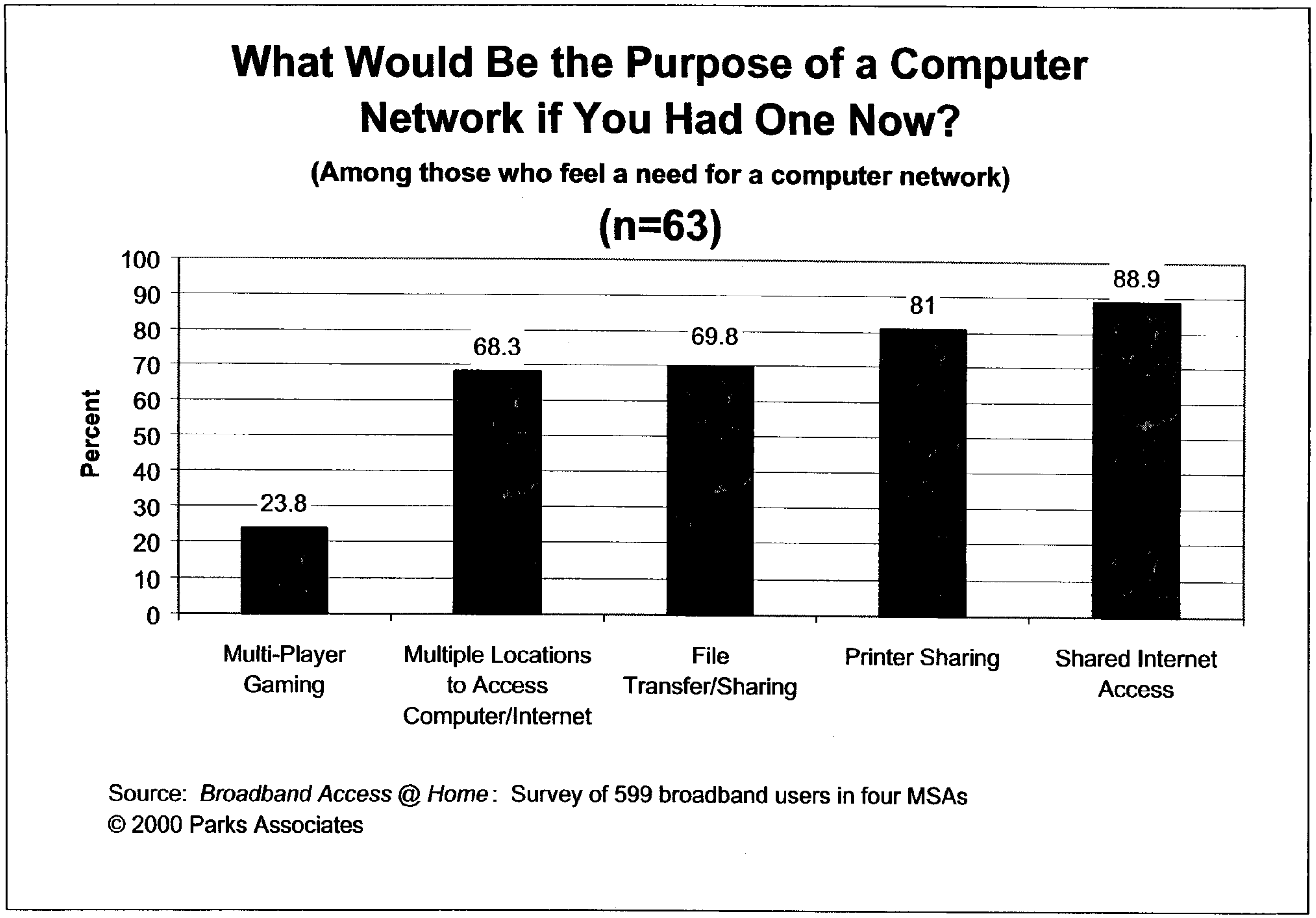
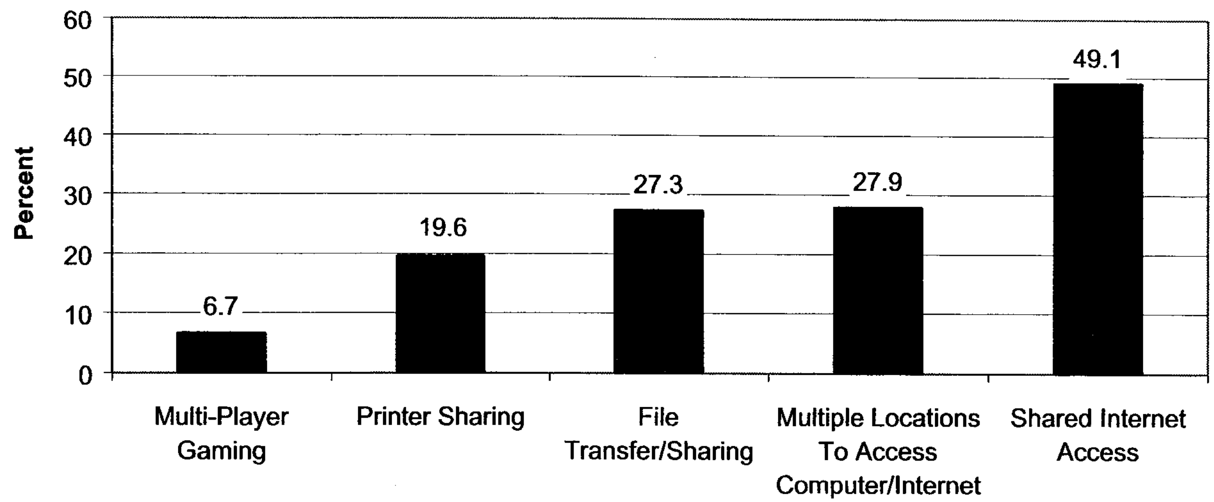

What Would Be the Purpose of a Computer Network if You Had One Now?
(Among those who feel a need for a computer network)
(n=63)
Percent
100
90
80
70
60
50
40
30
20
10
0
23.8
68.3
69.8
81
88.9
Multi-Player Gaming
Multiple Locations to Access Computer/Internet
File Transfer/Sharing
Printer Sharing
Shared Internet Access
Source: Broadband Access @ Home: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 8-14

Computer Network Applications Ranked as the Most Important

(Among those who feel a need for a computer network)

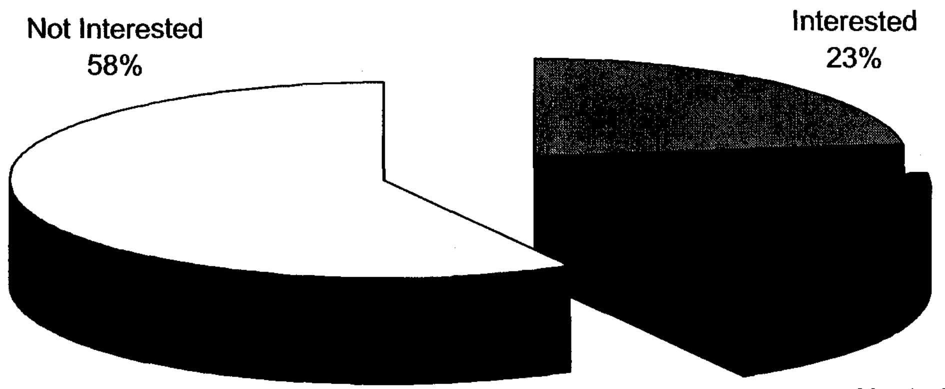
(n=63)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

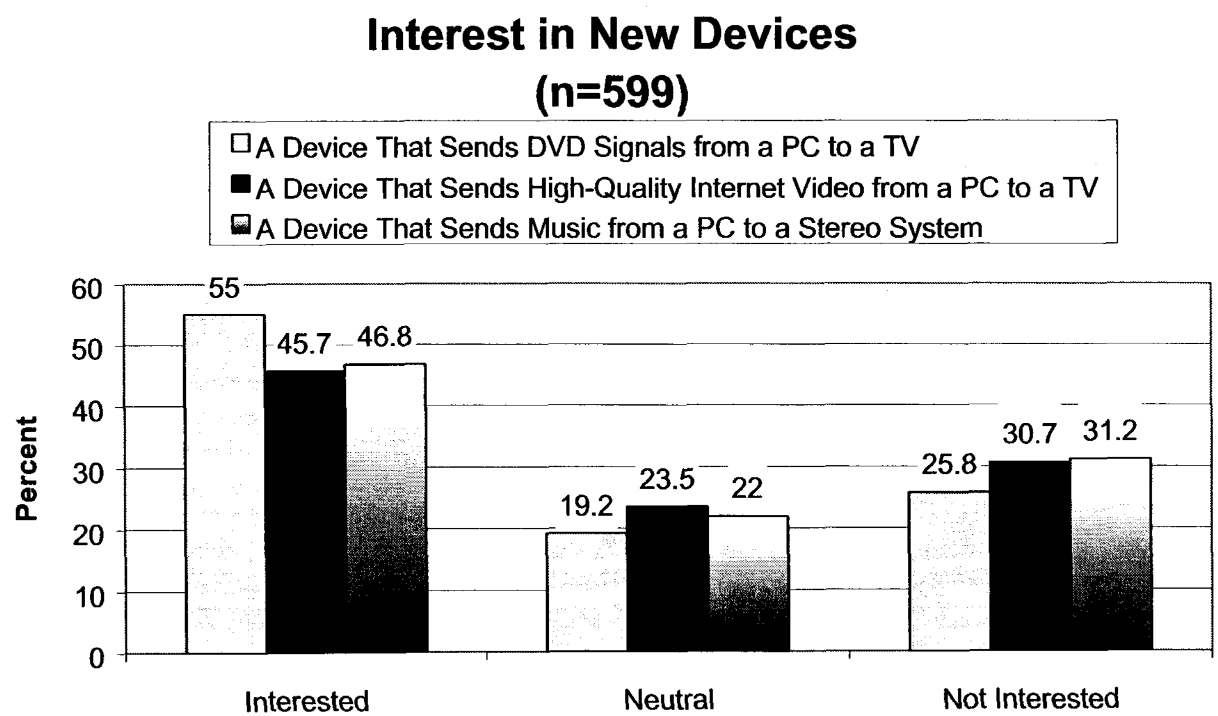
Figure 8-15

Interest in Ordering Computer Networking Service from Broadband Service Providers
(Among those without a computer network)
(n=178)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

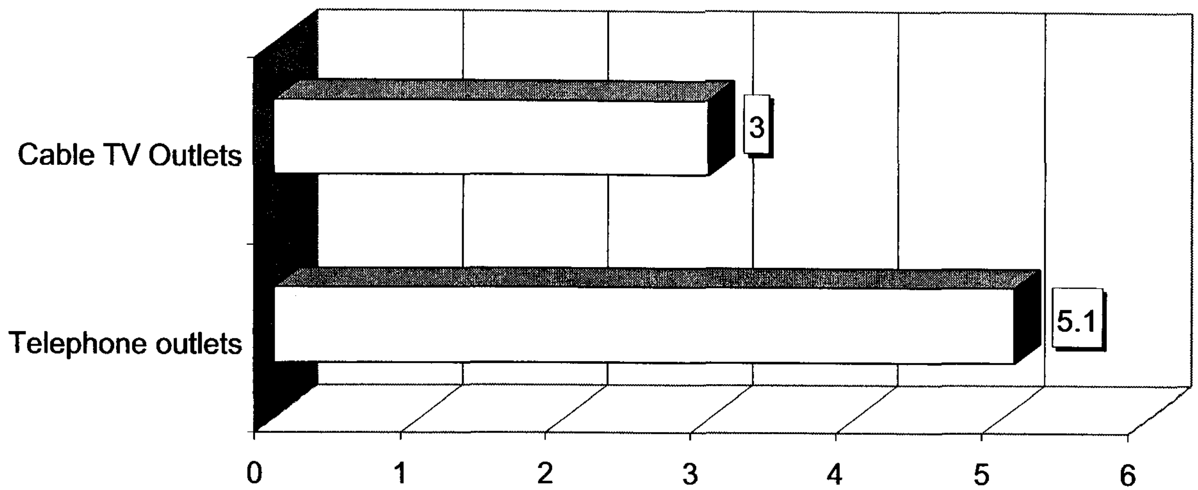
Figure 8-16



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 8-17

Average Number of Telephone and Cable Outlets Broadband Users Have at Home (n=599)



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs

Figure 8-18

9.0 Demographics

Most of the broadband users are male and in the age group 30-49. More than half are married, but less than a third (32%) have children living with them. Close to two-thirds (63%) have at least a four-year college degree, and 32% earn an annual household income of $100,000 or more.

Two-thirds (67.6%) of the broadband users perform some work-related tasks at home (Figure 9-7). If all household members are included, as many as 77% of the broadband households have at least one household member who performs some work-related tasks at home. This high percentage of work-at-home households partially explains why many of the survey respondents have adopted broadband services: a fast connection to the Internet can improve their efficiency while working at home. Indeed, 38% of the broadband users said that business-related use was important in their decision to get broadband services (Figure 6-7).

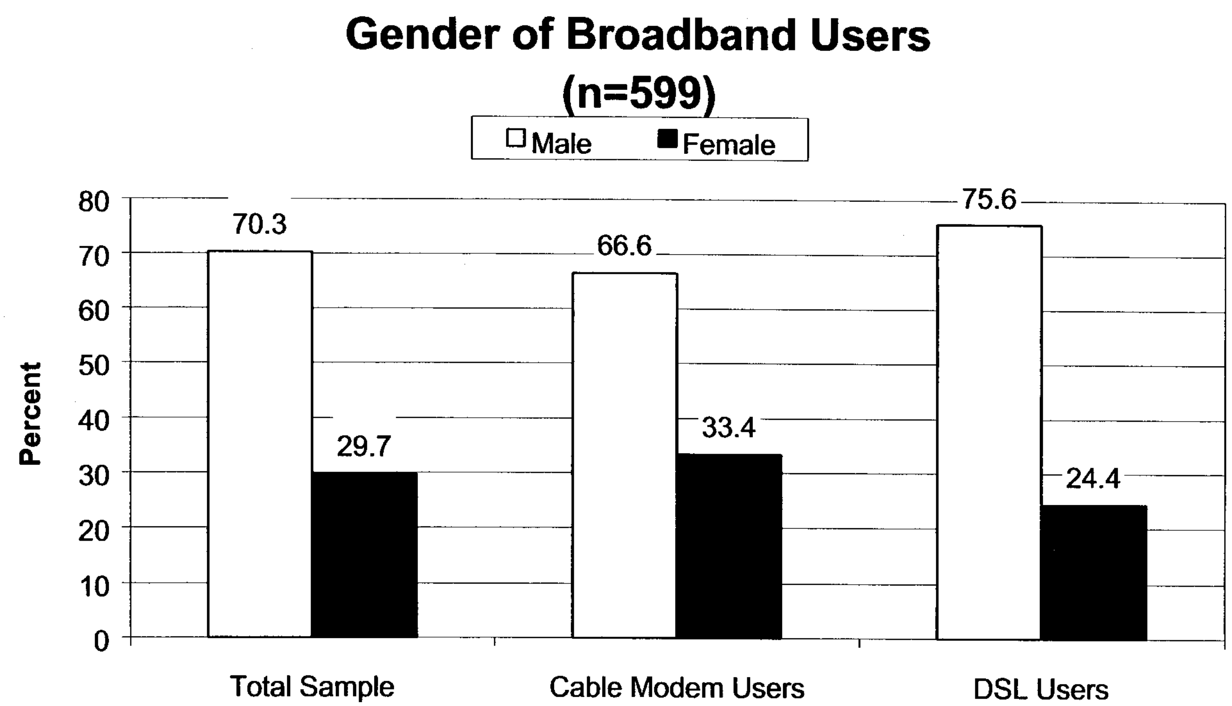
It is noteworthy that a respondent may fit two or more work-at-home types. Thus, there is an overlap among the five work-at-home segments. The category "any work-at-home type" includes the overlap and is not the arithmetic sum of the numbers for the five work-at-home categories.

Figure 9-1 illustrates some key differences in demographics and technology adoption between broadband users and the average consumer.

Comparison Between Broadband Users and the Average Consumer

	Broadband Users	*National Average*
Medium household income	$75,000-$99,999	$38,885[19]
Attained college degree or more	63%	24.4%[20]
Have at least one work-at-homer in household	77%	42%[21]
Own a home theater	32%	21%[22]
Own a fax machine	41%	11%[23]
Subscribe to a premium channel	45%	35%[24]
Use a mobile phone	81%	51%[25]
Use a pager	45%	37%[26]
Have a DVD player	24%	5%[27]
Use a PDA	32%	5%[28]

[19] 1998 data from US Census Bureau
[20] Ibid.
[21] Based on several surveys Parks Associates conducted in 1998 and 1999
[22] January 2000 data from CEA
[23] Based on Parks Associates' own consumer research
[24] Based on data from the FCC
[25] January 2000 data from CEA
[26] Ibid.
[27] Ibid.
[28] Based on Parks Associates' own consumer research



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-2

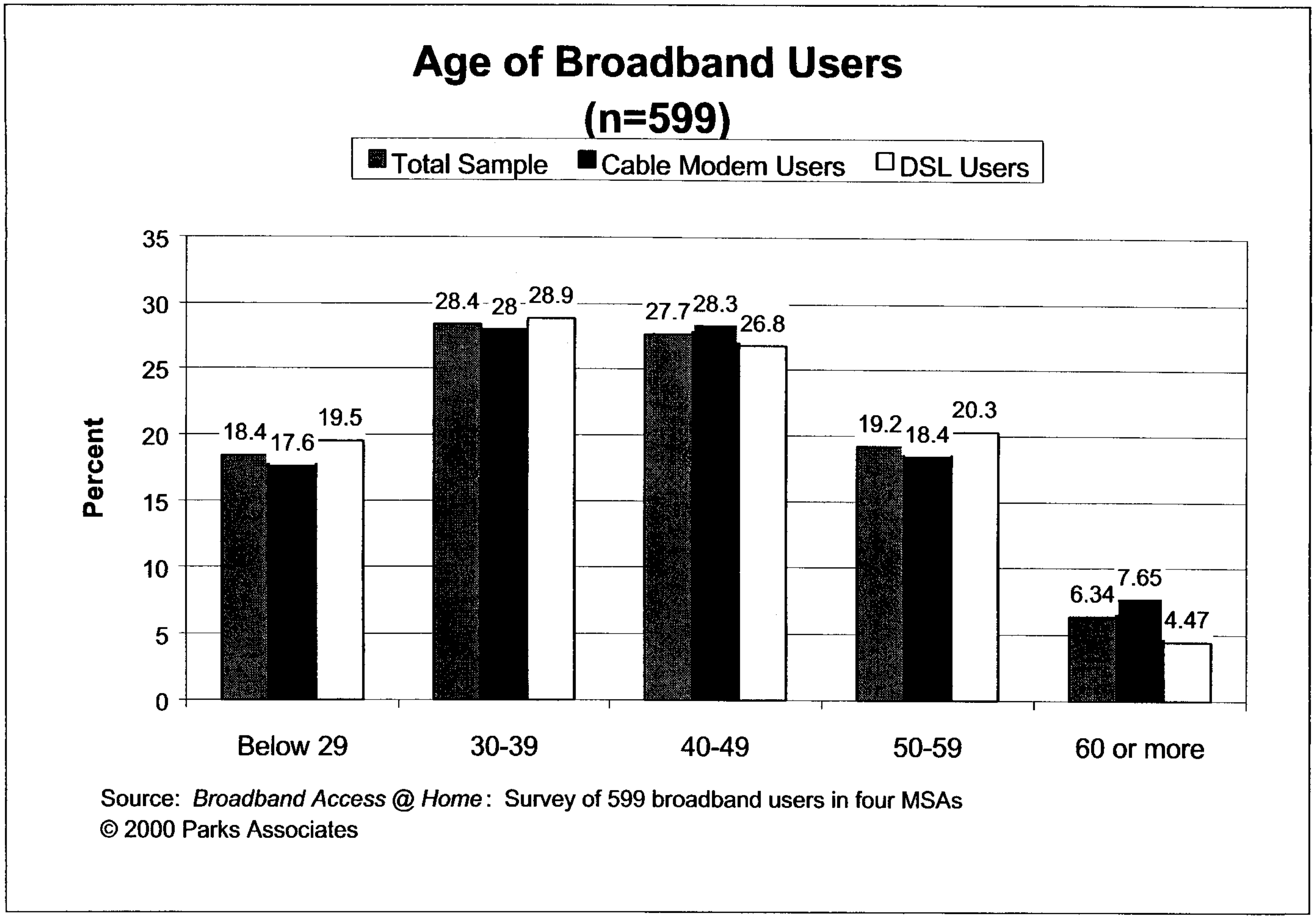

Age of Broadband Users
(n=599)
Total Sample
Cable Modem Users
DSL Users
Percent
35
30
25
20
15
10
5
0
18.4
17.6
19.5
28.4
28
28.9
27.7
28.3
26.8
19.2
18.4
20.3
6.34
7.65
4.47
Below 29
30-39
40-49
50-59
60 or more
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-3

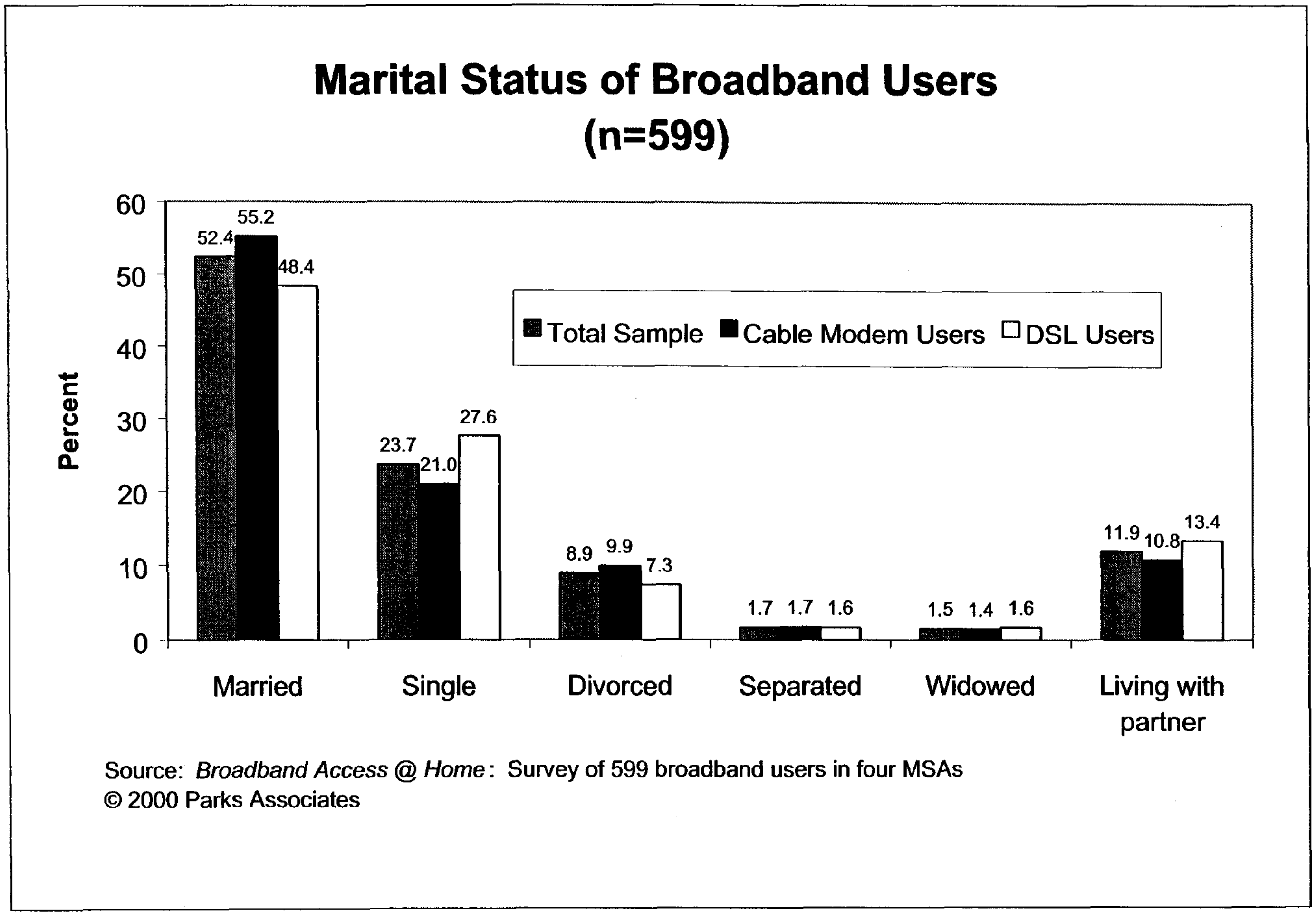

Marital Status of Broadband Users
(n=599)
Percent
60
50
40
30
20
10
0
Total Sample
Cable Modem Users
DSL Users
52.4
55.2
48.4
23.7
21.0
27.6
8.9
9.9
7.3
1.7
1.7
1.6
1.5
1.4
1.6
11.9
10.8
13.4
Married
Single
Divorced
Separated
Widowed
Living with partner
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-4

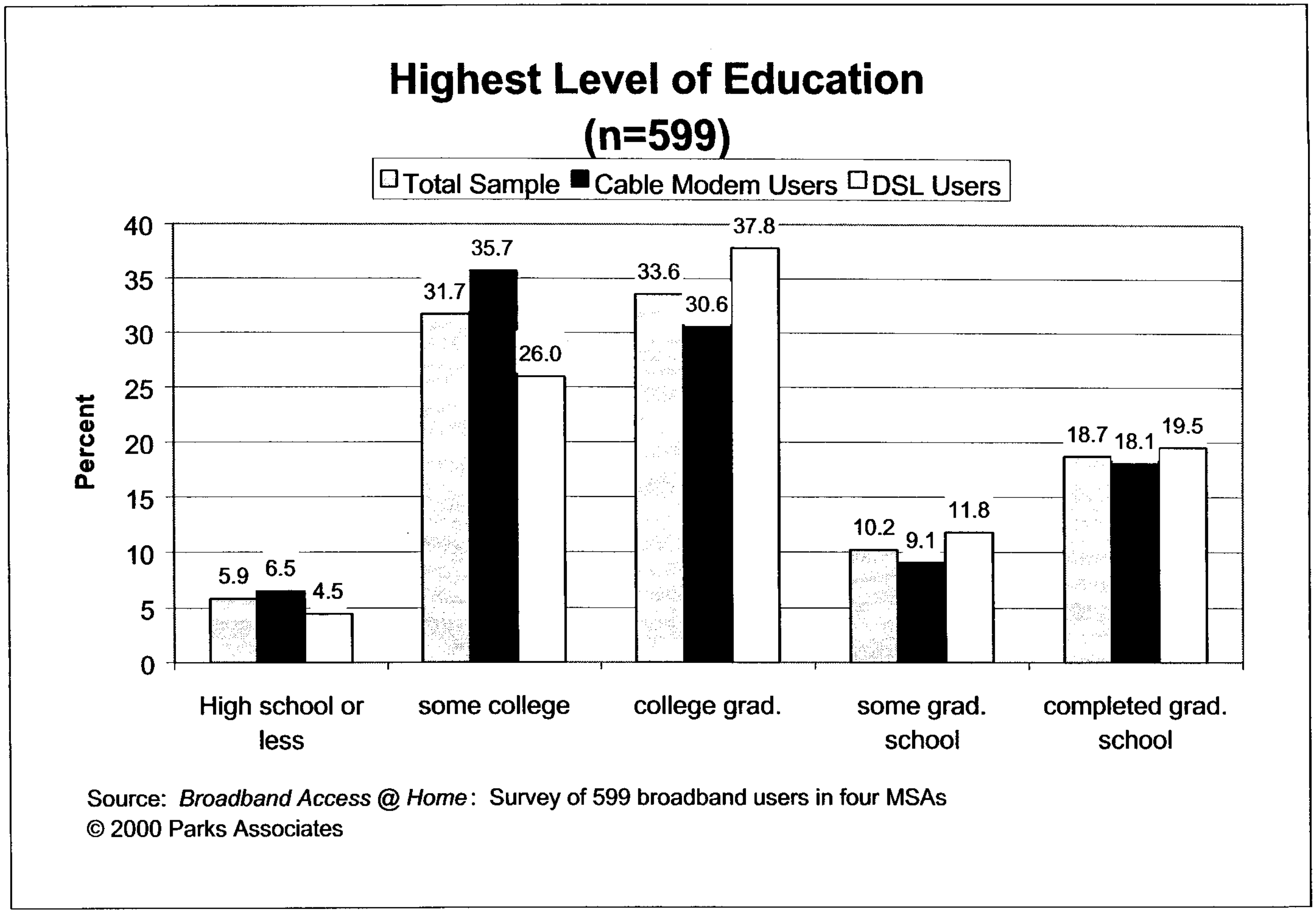

Highest Level of Education
(n=599)
Total Sample
Cable Modem Users
DSL Users
Percent
40
35
30
25
20
15
10
5
0
5.9
6.5
4.5
31.7
35.7
26.0
33.6
30.6
37.8
10.2
9.1
11.8
18.7
18.1
19.5
High school or less
some college
college grad.
some grad. school
completed grad. school
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
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Figure 9-5

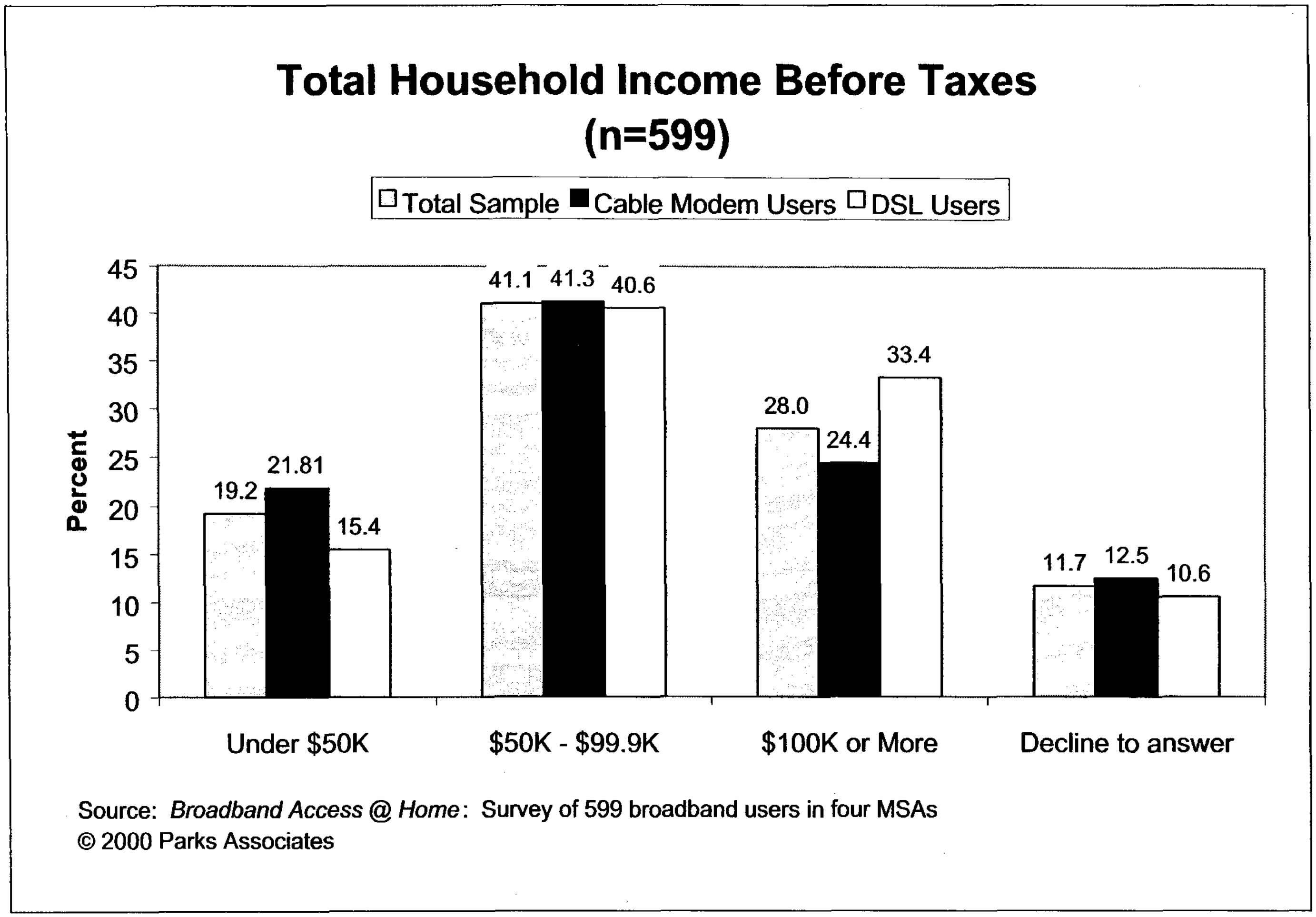
Total Household Income Before Taxes
(n=599)
Total Sample
Cable Modem Users
DSL Users
Percent
45
40
35
30
25
20
15
10
5
0
19.2
21.81
15.4
41.1
41.3
40.6
28.0
24.4
33.4
11.7
12.5
10.6
Under $50K
$50K - $99.9K
$100K or More
Decline to answer
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
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Figure 9-6

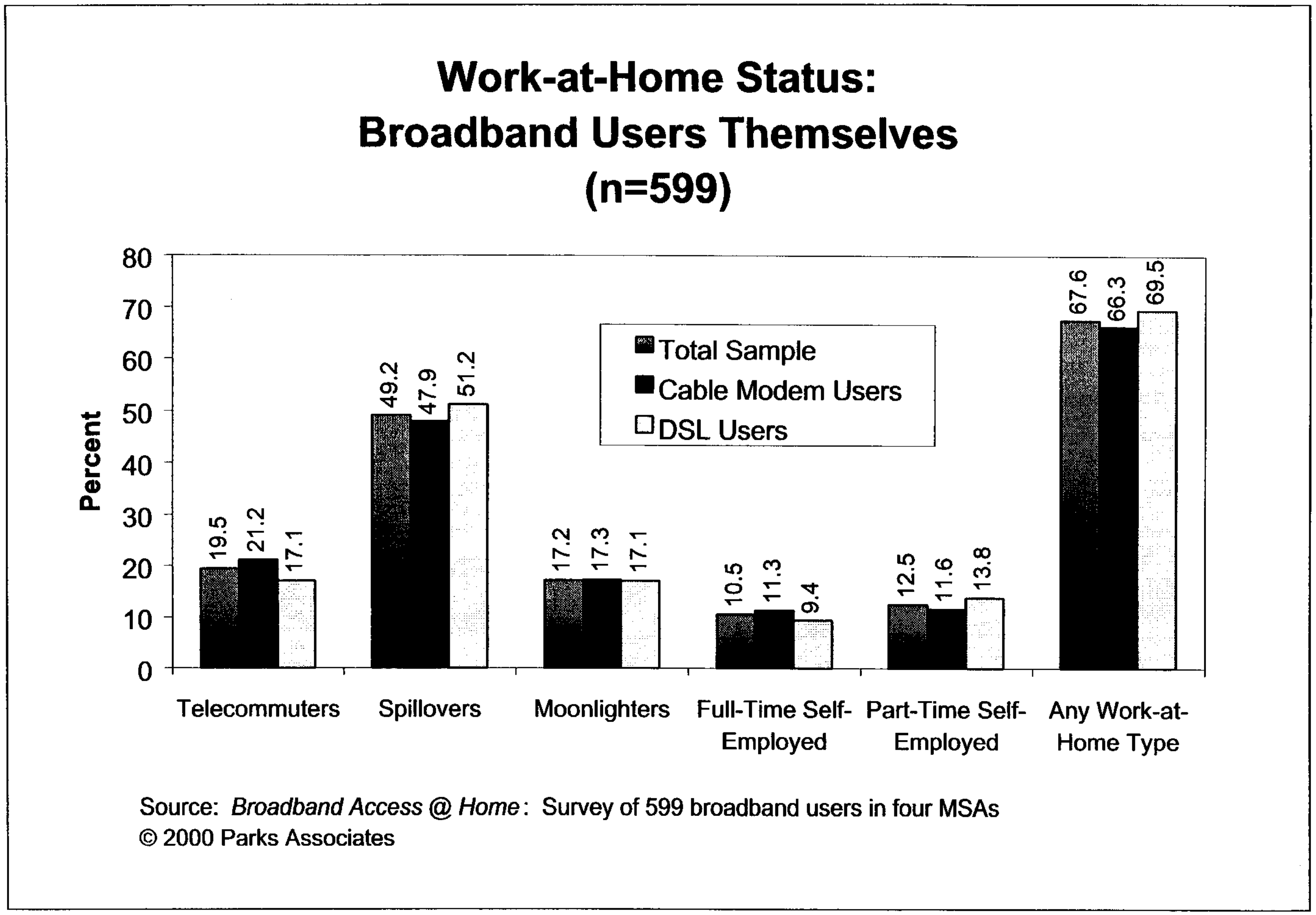

Work-at-Home Status:
Broadband Users Themselves
(n=599)
Percent
80
70
60
50
40
30
20
10
0
Total Sample
Cable Modem Users
DSL Users
19.5
21.2
17.1
49.2
47.9
51.2
17.2
17.3
17.1
10.5
11.3
9.4
12.5
11.6
13.8
67.6
66.3
69.5
Telecommuters
Spillovers
Moonlighters
Full-Time Self-Employed
Part-Time Self-Employed
Any Work-at-Home Type
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-7

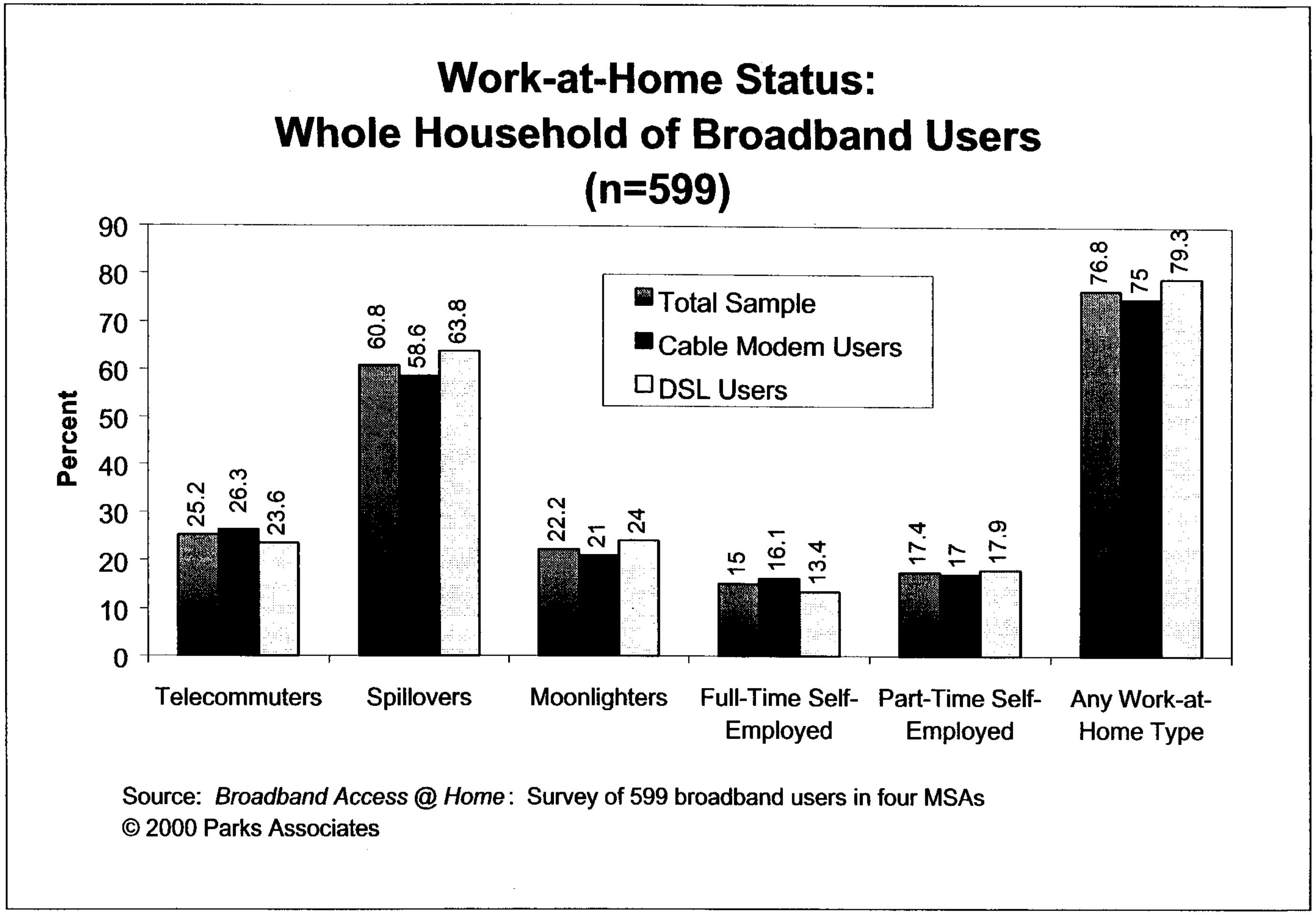
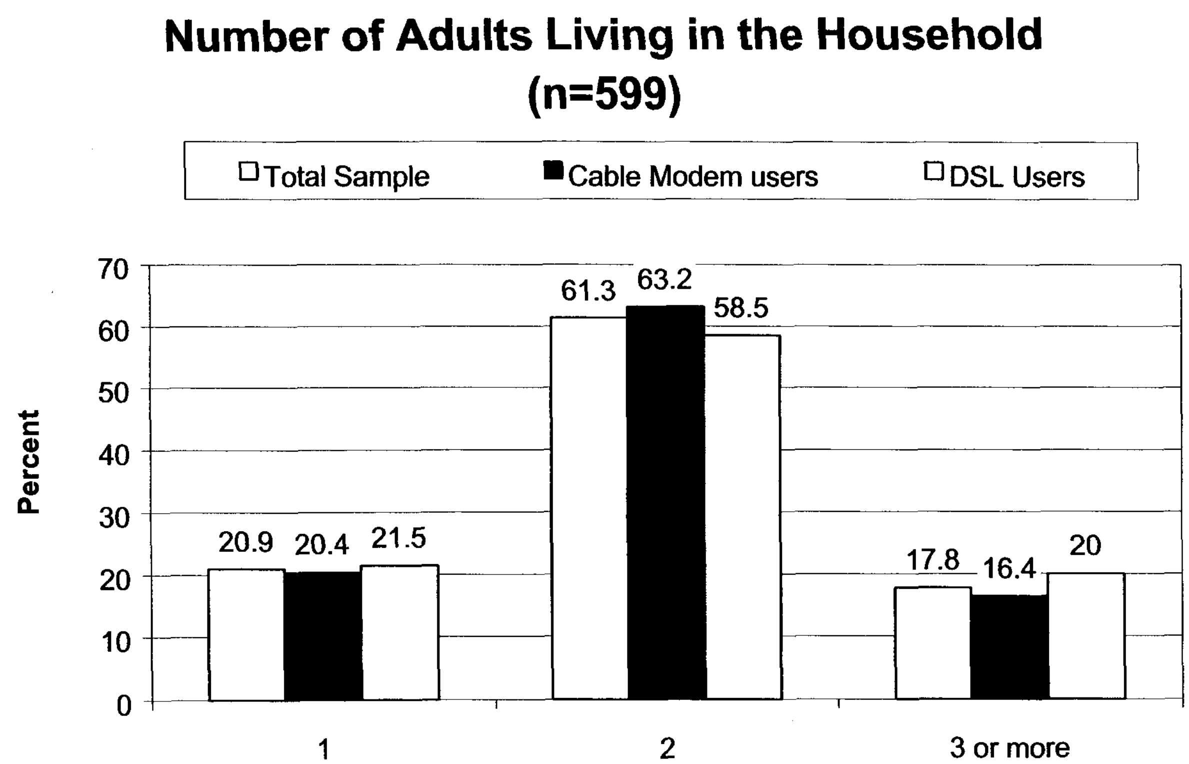
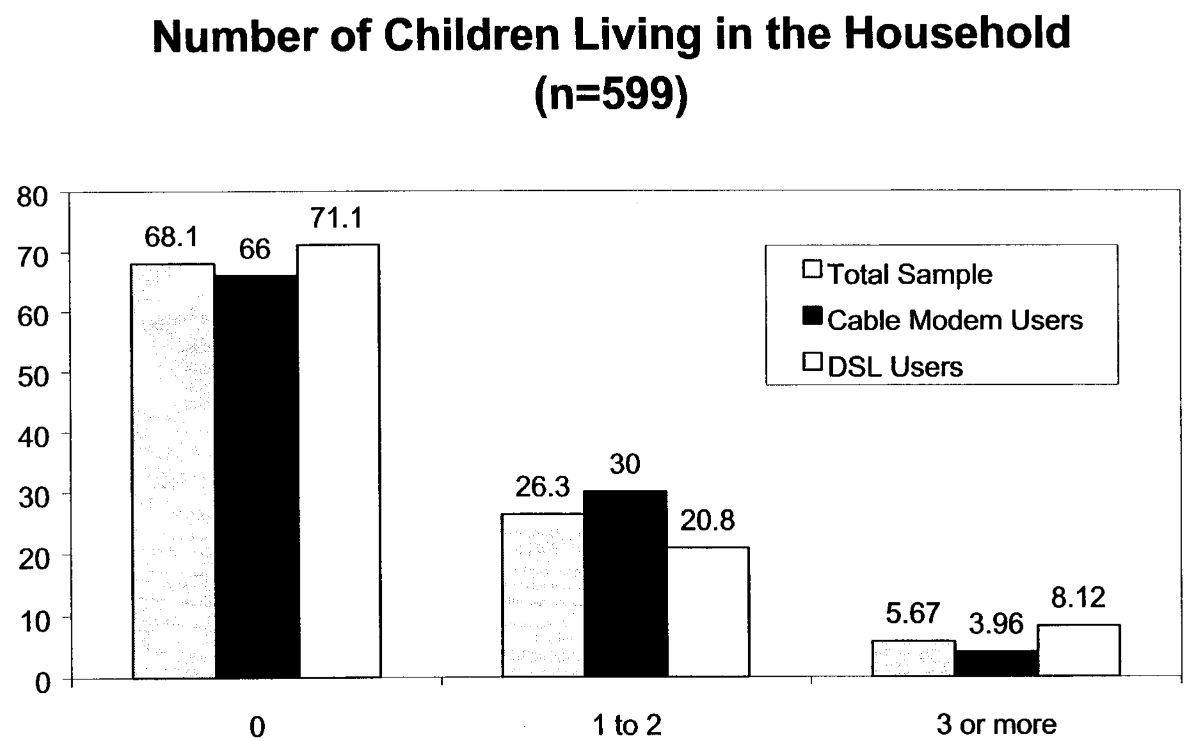

Work-at-Home Status:
Whole Household of Broadband Users
(n=599)
Percent
90
80
70
60
50
40
30
20
10
0
Total Sample
Cable Modem Users
DSL Users
25.2
26.3
23.6
60.8
58.6
63.8
22.2
21
24
15
16.1
13.4
17.4
17
17.9
76.8
75
79.3
Telecommuters
Spillovers
Moonlighters
Full-Time Self-Employed
Part-Time Self-Employed
Any Work-at-Home Type
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-8



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-9



Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-10

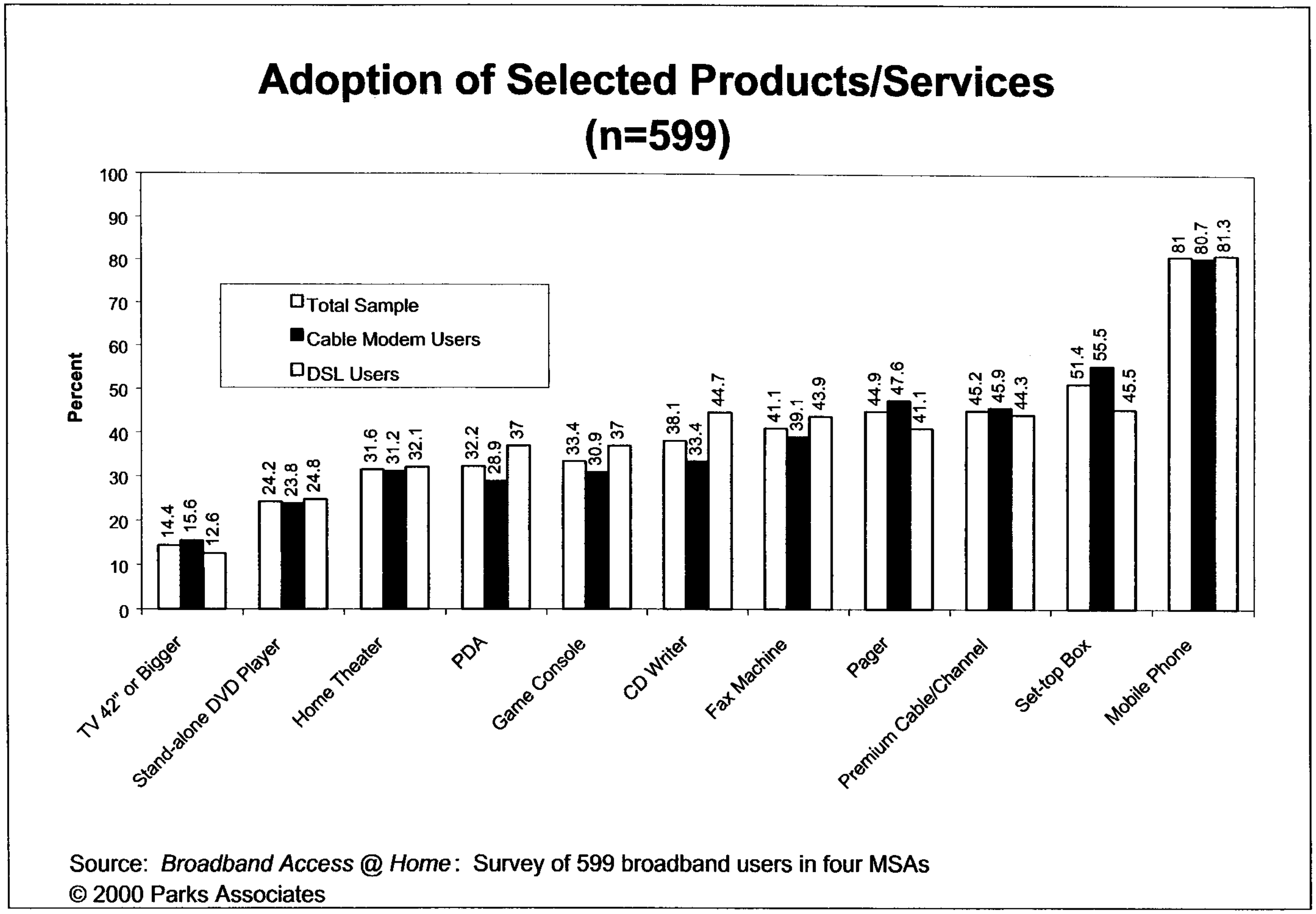

Adoption of Selected Products/Services
(n=599)
Percent
0
10
20
30
40
50
60
70
80
90
100
Total Sample
Cable Modem Users
DSL Users
14.4
15.6
12.6
24.2
23.8
24.8
31.6
31.2
32.1
32.2
28.9
37
33.4
30.9
37
38.1
33.4
44.7
41.1
39.1
43.9
44.9
47.6
41.1
45.2
45.9
44.3
51.4
55.5
45.5
81
80.7
81.3
TV 42" or Bigger
Stand-alone DVD Player
Home Theater
PDA
Game Console
CD Writer
Fax Machine
Pager
Premium Cable/Channel
Set-top Box
Mobile Phone
Source: *Broadband Access @ Home*: Survey of 599 broadband users in four MSAs
© 2000 Parks Associates

Figure 9-11

10.0 Survey of Dial-up Users in the Four MSAs

As mentioned in Chapter 3, the unqualified dial-up users who participated in the survey filled out a much shorter questionnaire that contains several questions related to awareness of broadband services and intentions of modem/service upgrades.[29]

Sixty-nine percent of these dial-up subscribers use a 56K modem (Figure 10-1), indicating that most of the Internet users bought a computer in the 1997-2000 time frame, as 56K modems did not become widely available until 1997. Although a 56K modem is the fastest among the analog dial-up modems, 37% of the 56K modem users intend to upgrade to a faster modem (compared with 38% of ALL dial-up users, as shown in Figure 10-2).

Despite broadband service providers' advertising and telemarketing efforts, more than a quarter (28%) have never heard of cable modem, DSL, or DirecPC (Figure 10). Perhaps due to cable modem service's current lead, more dial-up users are aware of cable modem than DSL (58% versus 50%). Only 37% are aware of both.

Even though cable modem service enjoys better market awareness, the dial-up users intending to upgrade their modem seem to like DSL better. As indicated in Figure 10-4, 34% picked DSL, compared with 25% that chose cable modem service. If we only look at the dial-up users aware of both DSL and cable modem, then consumers' preference becomes even more obvious: 42% of such dial-up users prefer DSL, compared with just 26% favoring cable modem service (Figure 10-9). Parks Associates believes that cable operators' past record for poor customer service is still hurting them. As discussed in Chapter 6, 41% of DSL users who were aware of cable modem availability while signing up for DSL said that they did not choose cable modem service because they don't like their cable company (Figure 6-15). It appears that cable operators need

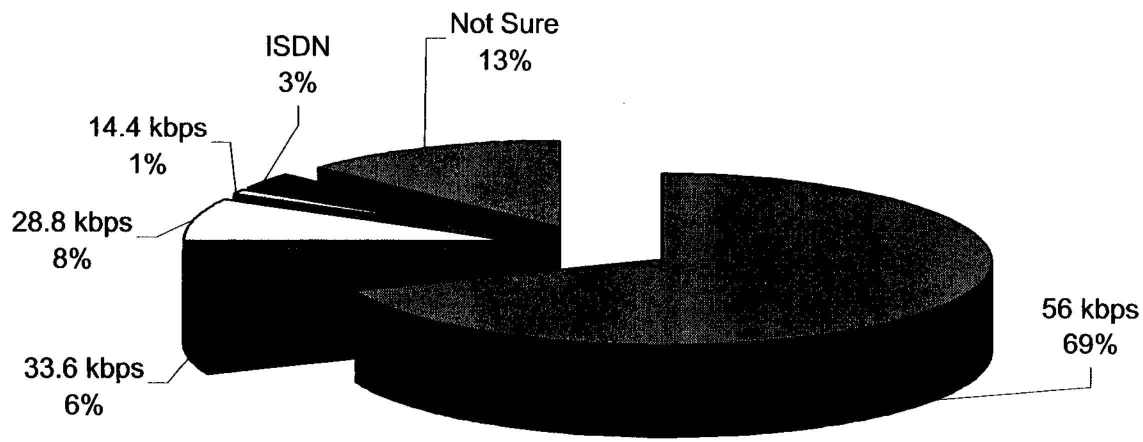
[29] A separate, nationwide, and in-depth survey of dial-up users will be provided as the second component of Parks Associates' *Broadband Access @ Home* study.

to make extra marketing efforts in order to win over broadband subscribers when they face direct competition from DSL.

There are some interesting differences among the four MSAs selected for the survey. For example, a much higher percentage of dial-up users in San Jose prefer DSL in comparison with the respondents from the other three MSAs. In addition, respondents in New York and Phoenix appear to have no clear preference between the two competing services (Figures 10-8 and 10-10).

There are some demographic differences between those who prefer DSL and the respondents favoring cable modem service. Younger dial-up users (ages 18-39) appear to be slightly more receptive to cable modem service than DSL in comparison with older consumers. As Figure 10-11 indicates, 55.7% of the respondents intending to subscribe to cable modem service are between 18 and 39 years old, whereas 49.5% of the respondents favoring DSL belong to the same age group. However, those who prefer DSL tend to be better educated and earn a higher household income. Figure 10-12 indicates that 63.3% of the respondents favoring DSL have a college degree or a higher level of education, compared with 55.6% of those favoring cable modem service. Similarly, 39.6% of the respondents favoring DSL earn $100K or more per year, compared with 30.9% of those favoring cable modem service that belong to the same income category. The demographic characteristics of the broadband users (Figures 9-5 and 9-6) demonstrate the same pattern. This suggests that DSL's potential customer base is slightly more attractive.

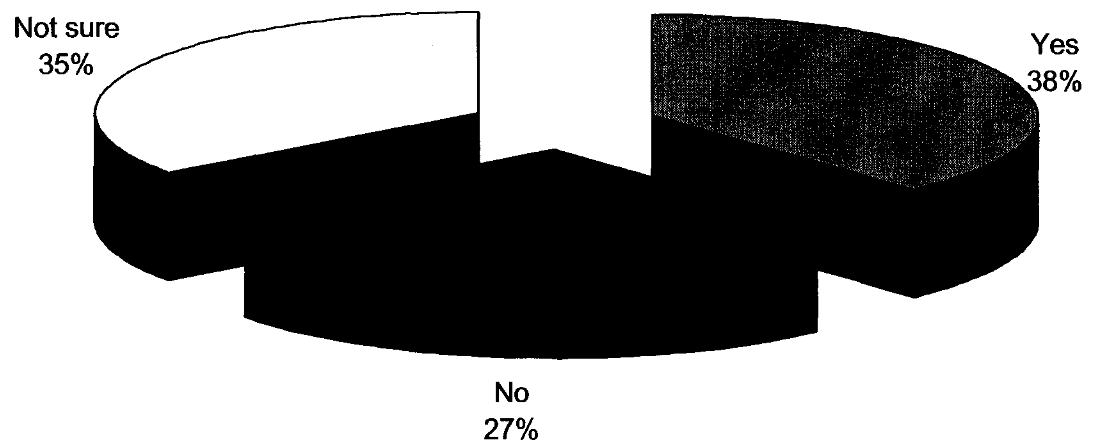
Modem Speed Reported by Dial-up Users in San Jose, Phoenix, Atlanta, and New York (n=6,645)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-1

Dial-up Internet Users Intending to Upgrade Modem/Internet Service (n=6,645)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-2

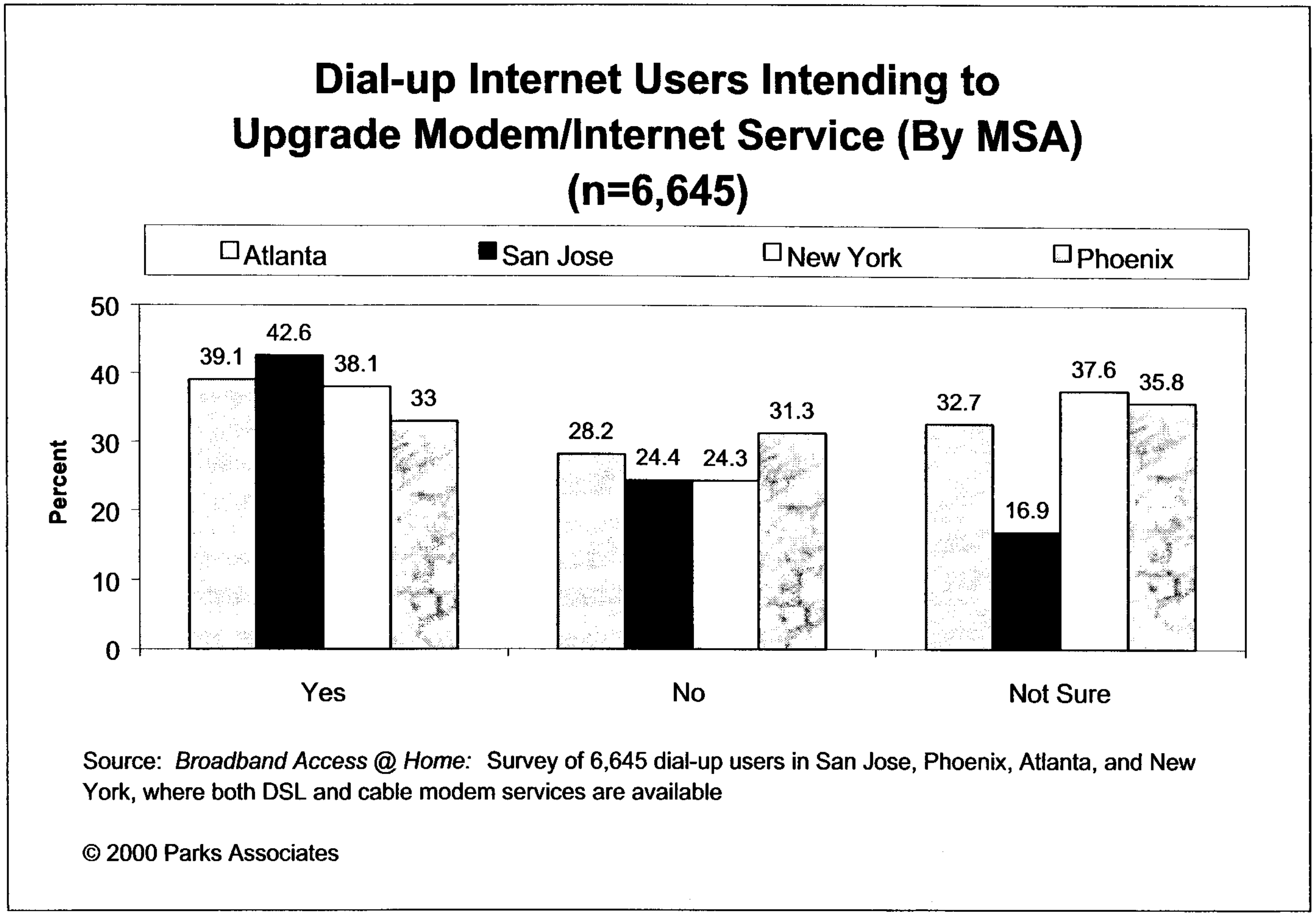
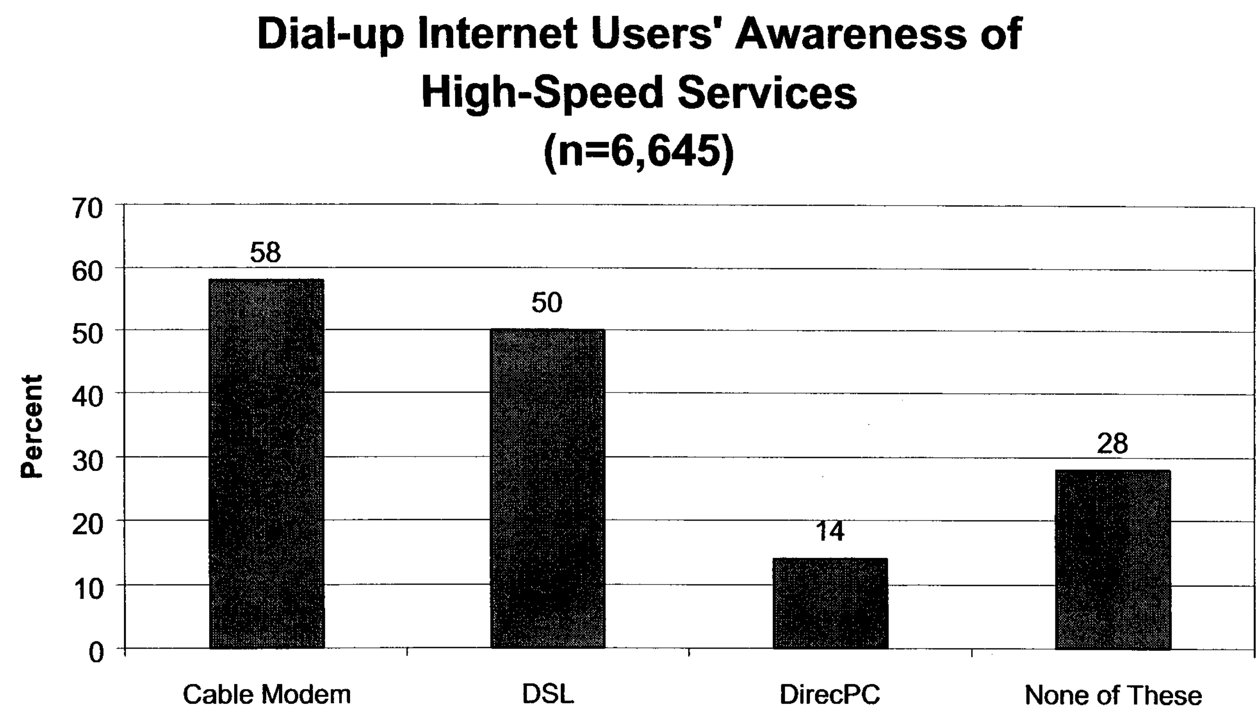

Dial-up Internet Users Intending to Upgrade Modem/Internet Service (By MSA) (n=6,645)
Atlanta
San Jose
New York
Phoenix
Percent
50
40
30
20
10
0
39.1
42.6
38.1
33
28.2
24.4
24.3
31.3
32.7
16.9
37.6
35.8
Yes
No
Not Sure
Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available
© 2000 Parks Associates

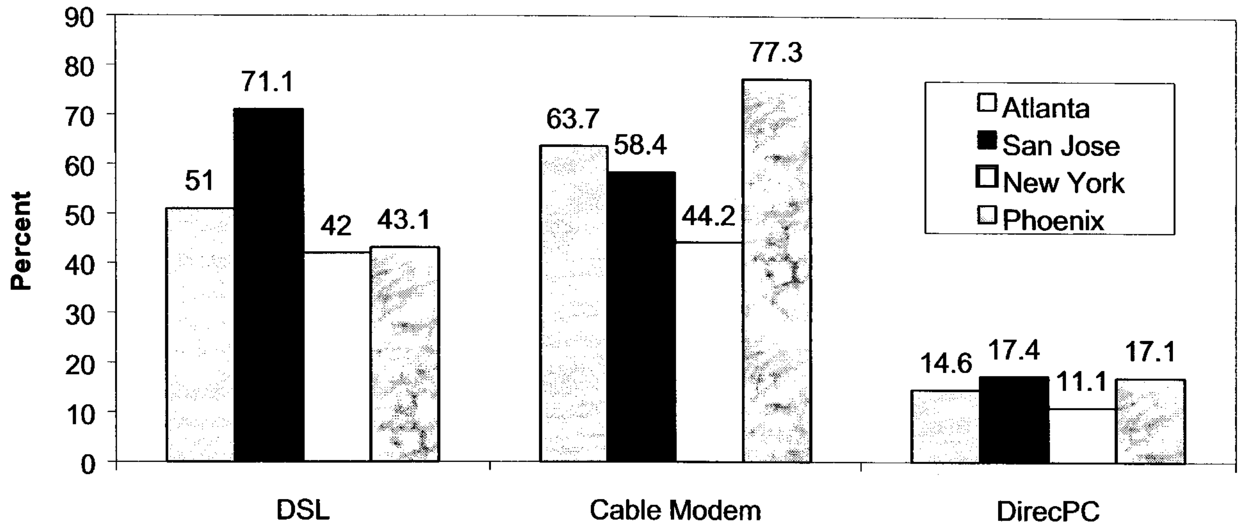
Figure 10-3



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

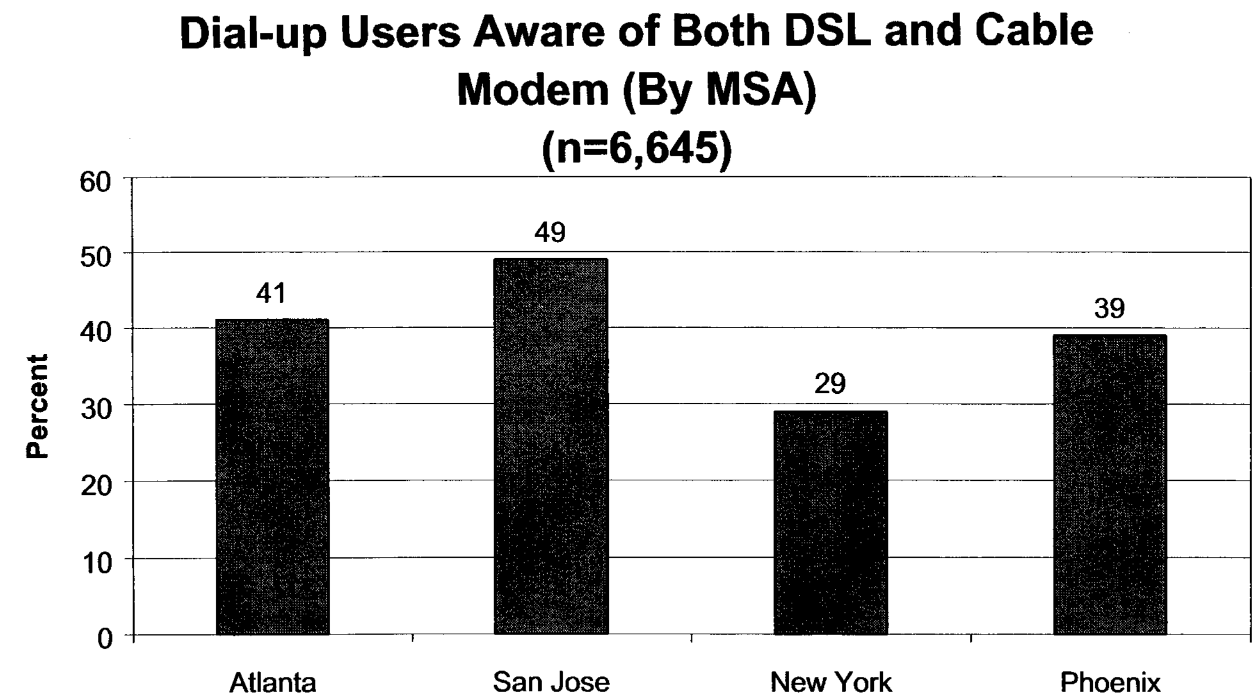
Figure 10-4

Dial-up Users Aware of High-speed Services (by MSA) (n=6,645)



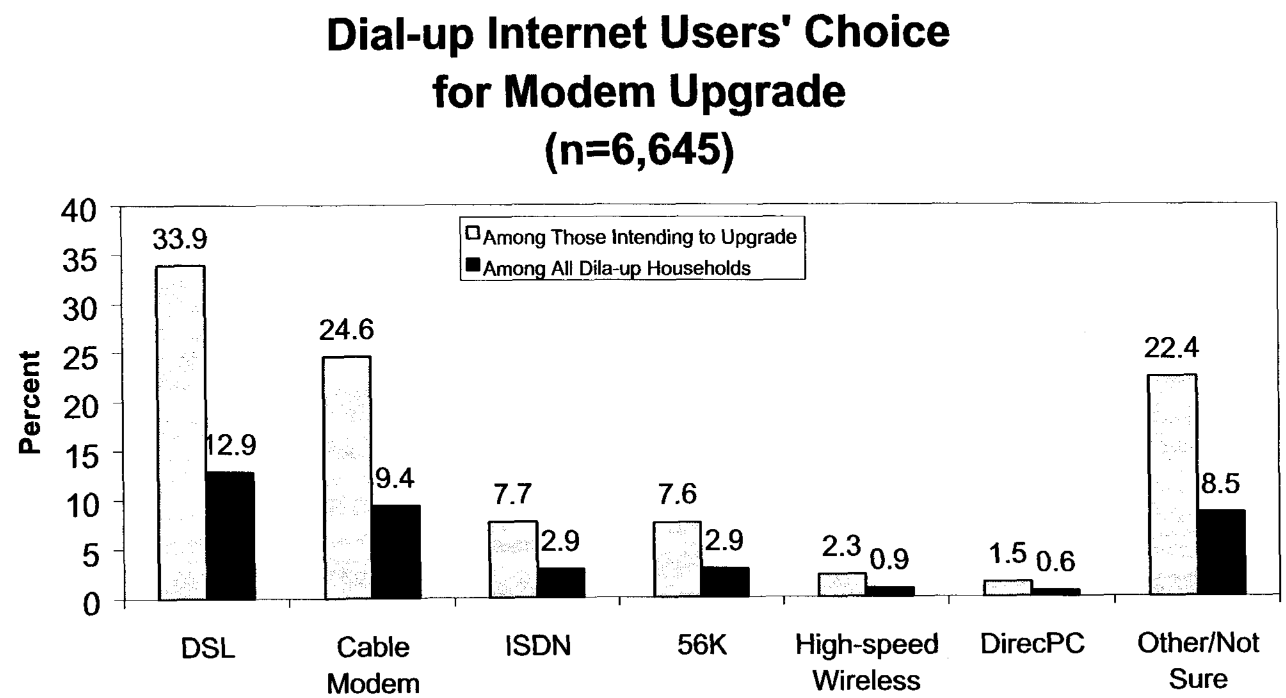
Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-5



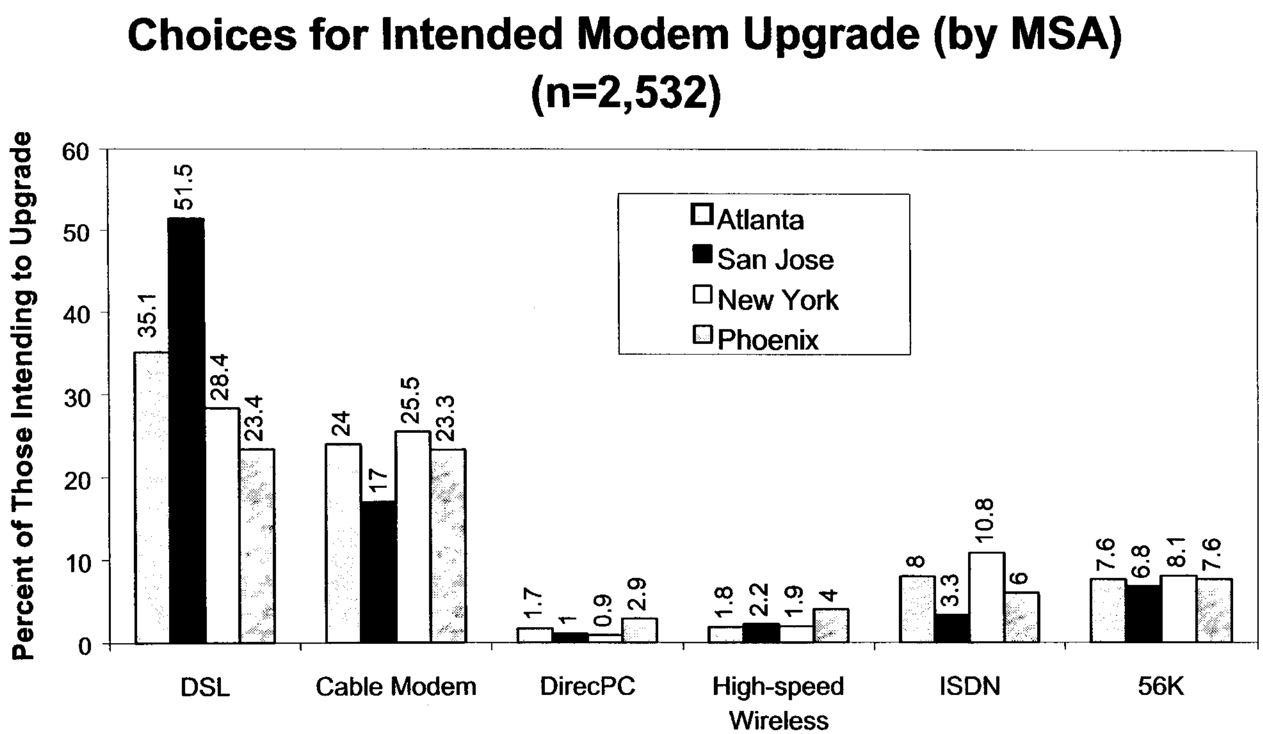
Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-6



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

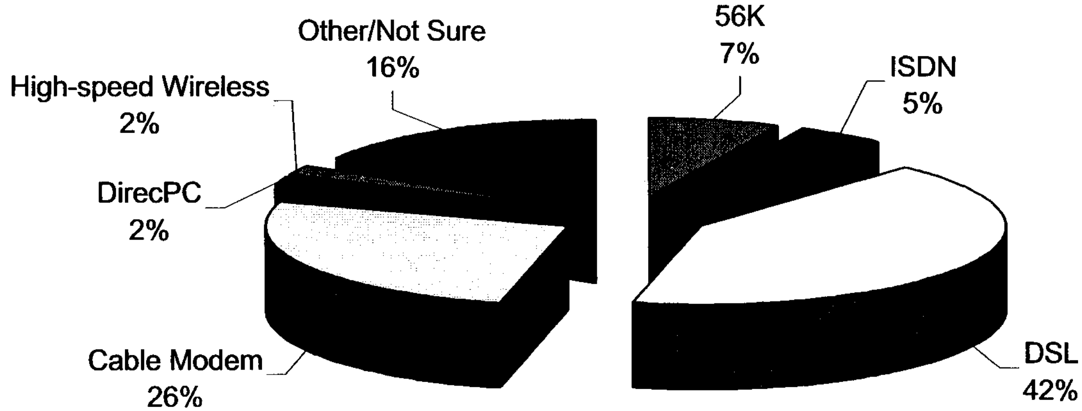
Figure 10-7



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-8

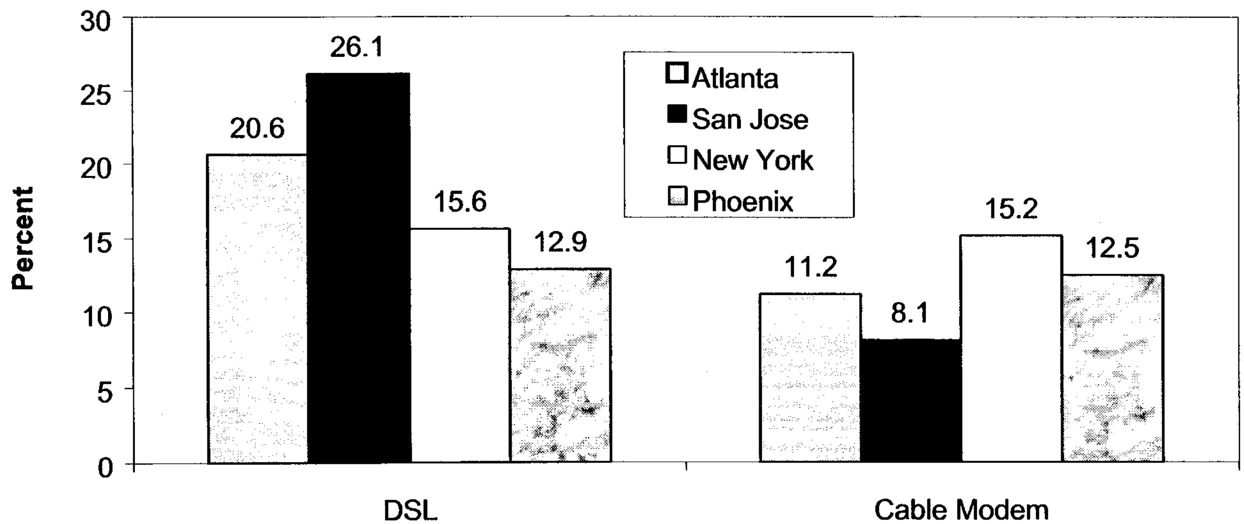
Choices for Intended Modem Upgrade: Among Dial-up Users Aware of Both DSL and Cable Modem Services (n=1,119)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-9

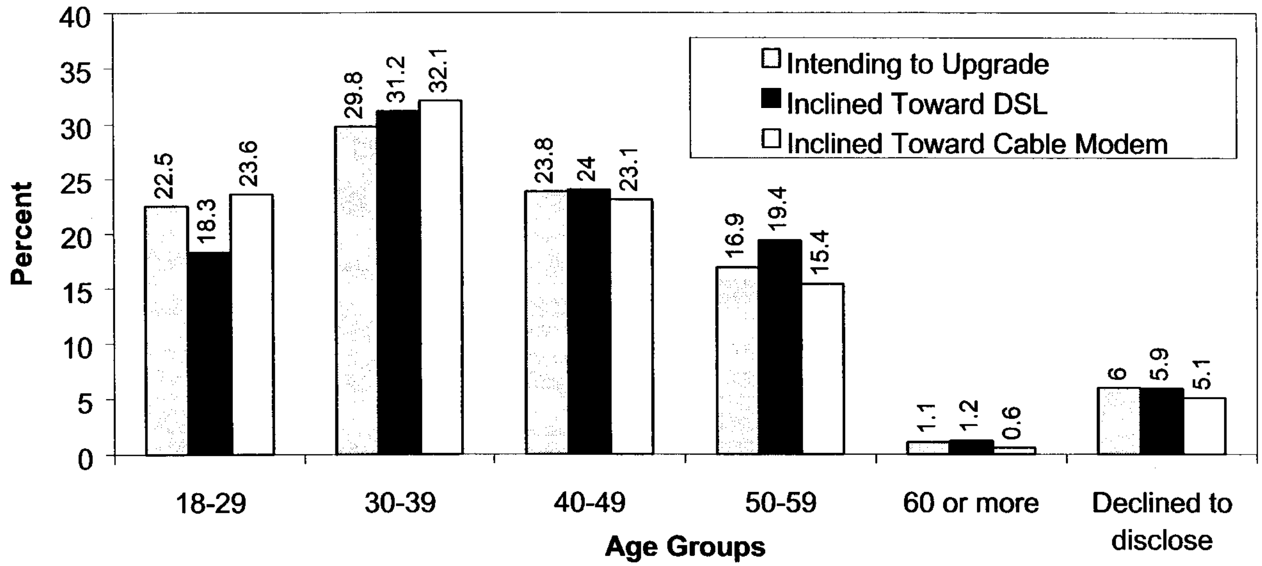
Choices for Intended Modem Upgrade (by MSA)
(Among Those Aware of Both DSL and Cable Modem)
(n=2,489)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

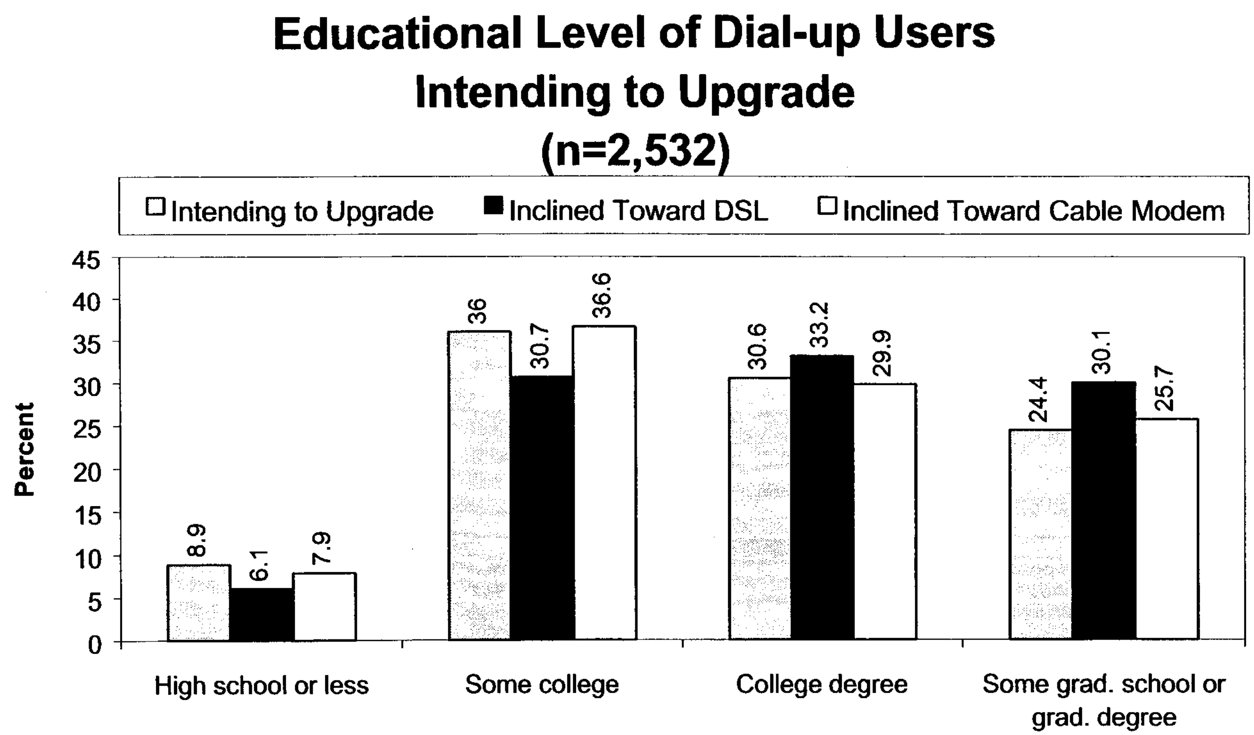
Figure 10-10

Age of Dial-up Users Intending to Upgrade (n=2,532)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

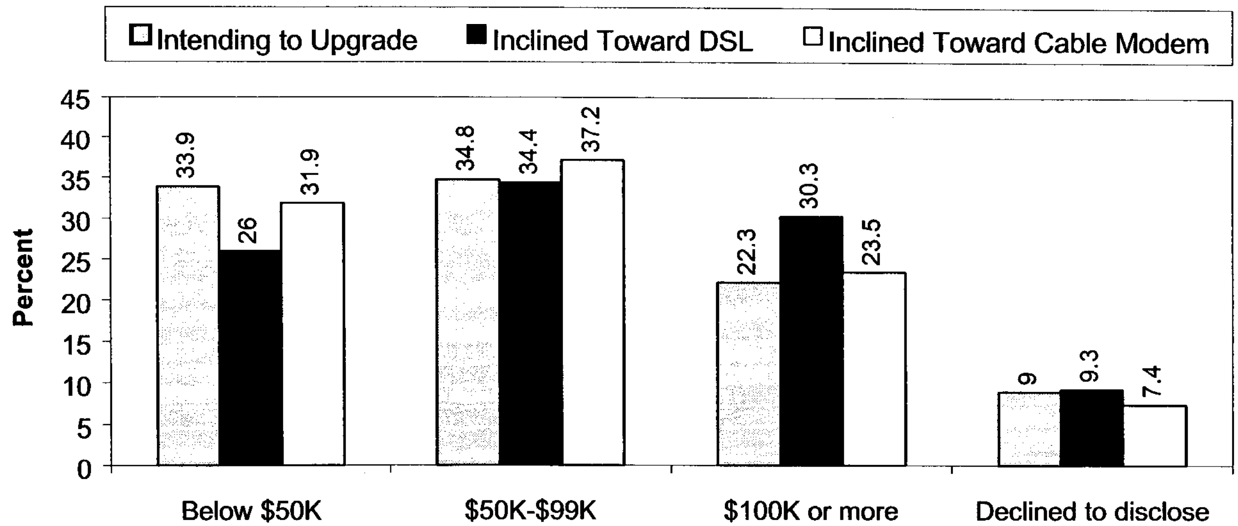
Figure 10-11



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-12

Household Income of Dial-up Users Intending to Upgrade (n=2,532)



Source: *Broadband Access @ Home:* Survey of 6,645 dial-up users in San Jose, Phoenix, Atlanta, and New York, where both DSL and cable modem services are available

Figure 10-13

11.0 Conclusions

11.1.1 What Drives the Adoption of Broadband?

The current subscribers of broadband services are clearly early adopters. Although early adopters generally have different buying behaviors from the average consumer, the drivers to their adoption of broadband services can nonetheless help understand how and when the mass market will develop.

High Speed

Any purchase decision starts from a perceived need that can be met through the purchase of a product or service. The most important benefit of broadband services that has met the need of current broadband users is high-speed. The need for speed is clearly related to the usage of the Internet. The more the Internet is used, the stronger the need for high speed becomes. Broadband subscribers have a high reliance on the Internet, as reflected by the following:

- Broadband households spent an average of more than 20 hours online per week before adopting broadband, compared with 15 hours[30] on average among all online households in the US.
- Seventy-seven percent of the broadband households have at least one household member that performs some work-related tasks at home, compared with 42% for all households in the nation.
- Fifty-one percent access business computer networks at home, versus 31% of the dial-up users[31].

It is easy to see that the broadband users have much stronger need for high speed compared with the average consumer. However, as the usage of the Internet continues to increase, the

[30] Source: cyberatlas.internet.com
[31] Based on a nationwide survey of 600 dial-up users that Parks Associates has just completed.

difference between the early adopters of broadband services and the average consumer regarding the need for high speed will gradually diminish.

Other Benefits of Broadband Services

The other benefits of broadband services (e.g., freeing up phone line, saving the cost of using an additional phone line for Internet access, and broadband content), though not as important as high speed, are still cited by more than 50% of the broadband users as being important to the purchase decision. This suggests that at least 50% of the broadband users adopted DSL or cable modem service partially because of these additional benefits. Parks Associates believes that as the average consumer is less likely to have additional phone lines at home and earn a lower income than the current broadband subscribers, the importance of these "other" benefits of broadband services will be more significant during the mass-market adoption of broadband services.

Awareness of Service Availability

Once consumers determine that they have a need that can be met through the purchase of a product/service, they will move to the next step: decide what to buy. Clearly, consumers will not buy a particular product or service of which they are not aware. Thus, creating market awareness of the availability of broadband services is critical.

The current broadband subscribers are very different from the average consumer. Many of them did not become aware of the availability of broadband services through service providers' marketing efforts but through their own research, as discussed in Section 6.1. These early adopters of broadband services are well educated and have generally kept themselves abreast of high-tech products/services. However, service providers should not count on the average consumer's "own research." Instead, more marketing efforts should be made to create awareness of broadband services. The fact that 29% of the dial-up users in the four MSAs selected for the survey are not even aware of the availability of cable modem service or DSL suggests that broadband service providers need to do a better job in marketing.

11.1.2 What Are the Inhibitors to the Adoption of Broadband?

The most important inhibitor, based on what the broadband subscribers dislike about broadband services, is a high monthly fee. The early adopters of broadband services generally earn a high income and are not as price-sensitive as the average consumer. If 42% of the broadband users cite a high monthly fee as what they dislike most, it is easy to image how the average consumer will react when he/she sees a high price tag of broadband services. The problem created by a high monthly fee will become even more serious when more consumers take advantage of free ISP services.

However, the current pricing level of broadband services is perhaps still acceptable to dial-up users that pay a regular monthly fee for dial-up service AND an additional phone line dedicated to Internet access. Parks Associates' survey of 600 dial-up users nationwide (to be discussed in a separate report) indicates that 30% of them pay a monthly fee of more than $20 or more AND use a separate phone line for Internet access. The challenge to broadband service providers is to communicate the benefit of "freeing up the phone line" to the target dial-up users.

Two other major inhibitors are the hassle of scheduling professional installation and the cost of paying for professional installation. Parks Associates believes that these two inhibitors will become non-issues when self-installable and interoperable high-speed modems are available at retail.

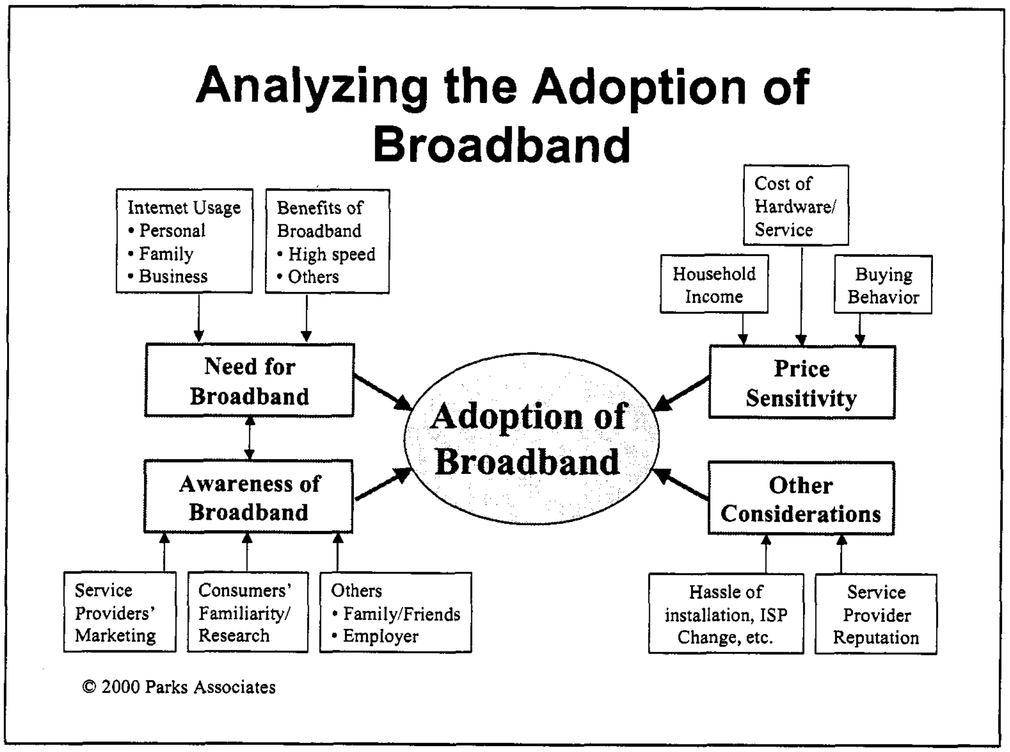


Figure 11-1

11.1.3 Cable Modem vs. DSL: Who Will Win?

Cable modem service and DSL are the two major contenders in the broadband consumer marketplace. Currently, cable modem service still enjoys a substantial lead over DSL mainly due to the fact that commercial cable modem service was launched much earlier than DSL. However, this lead is in jeopardy because the telcos are aggressively deploying DSL, and consumers appear to prefer telephone companies as service providers when they have a choice. Figure 11-1 summarizes some key findings related to the competition between the two services.

However, the comparisons made in Figure 11-1 do not necessarily mean that DSL will achieve a significantly dominant position in the consumer broadband market. Service providers' actual performance in the marketplace is not just a function of the variables included in Figure 11-1 but also a reflection of many other factors, including aggressiveness of marketing, pricing strategies, bundling of services, service provider consolidation, etc. In addition, cable companies have been making impressive efforts to address what appears to have been hurting them most: poor reputation. Thus, there is no guarantee that the telcos will enjoy a sustained advantage over cable companies based solely on reputation. Japanese-made products used to suffer a bad reputation for poor quality. But it did not take Japanese manufacturers long to reverse consumers' perception of their products. The cable industry may be able to do the same thing.

Overall, Parks Associates believes that the market for broadband services is big enough for both DSL and cable modem service to co-exist. They are really comparable services, and both will be winners. It will be hard for either one of them to maintain a significantly dominant position.

Cable Modem vs. DSL: A Comparison

	Winner	*Loser*	*Note*
Market Awareness	Cable Modem	DSL	• While signing up for broadband services, 83% of DSL users were aware of cable modem service, but only 62% of cable modem users were aware of DSL. • Among the dial-up users: 58% are aware of cable modem, vs. 50% aware of DSL. • However, cable modem's advantage may soon disappear as DSL service is more widely available.
Satisfaction	Even	Even	• Overall, there is no difference between DSL users and cable modem users regarding their satisfaction with services.
Pricing	Cable Modem	DSL	• Upfront expenses and monthly charge for cable modem service currently are lower than those for DSL. However, DSL providers have been lowering prices, and Parks Associates expects pricing differences to diminish soon.
Perception of Speed	Cable Modem	DSL	• Among the broadband users aware of the availability of both services while signing up for services, 51% of the cable modem users said that they did not pick DSL because cable modem is faster, and only 37% of the DSL users said that DSL is faster. • However, the advantage that cable modem service enjoys may not be very significant because the speed difference is not very big. In addition, slight differences of downstream speed may not play an important role in decision-making.
Reputation	DSL	Cable Modem	• Among the broadband users aware of the availability of both services while signing up for services, 41% of DSL users said that they did not pick cable modem service because they don't like their cable company, but only 24% of the cable modem users said the same thing about their local telephone company.
Potential to Churn	DSL	Cable Modem	• More cable modem users expressed likelihood to switch to an alternative service if certain discounts were offered. For example, 20% of the cable modem users said they would switch if they could get similar speed and save $10 a month, compared with just 13% of DSL users who expressed such likelihood to switch.
Customer Base	DSL	Cable Modem	• More DSL users earn a household income of at least $100K and hold college/graduate degrees than cable modem users do. Among the dial-up users surveyed, the same difference exists between those who favor DSL and those who cable modem service.

Figure 11-2

Index

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

THE COALITION'S FIRST REQUEST FOR PRODUCTION OF DOCUMENTS

POD NO. 7

PROPRIETARY

DECLASSIFIED

DIGITAL LINE DESIGN AND PAIR SELECTION RULES

SUBSCRIBER CARRIER SYSTEMS

CONTENTS PAGE

1. INTRODUCTION

1.01 This section provides repeater spacing design philosophy and digital line pair selection rules for any subscriber loop carrier system* employing digital transmission at the T1 bit rate (1.544 Mbits per second). The design philosophy, pair selection rules, and step-by-step procedures covered in this section are intended for the engineer of outside plant and provide the base for data input requirements of the Digital Line Engineering Program (DILEP). This computer program is to be used when determining or checking repeater spacing along a digital line. (Refer to Section 902-200-115.)

* An example of such a carrier system is the Subscriber Loop Multiplexer (SLM) System that is described in Section 902-217-100.

1.02 Section 855-351-101, covering T1, should not be used to design repeater spacing for subscriber carrier systems because of the frequent cable taper points and small size cables in exchange plant. The poorer crosstalk performance of such plant requires that more restrictive rules be used than for interoffice trunk cable.

2. GENERAL

2.01 Digital transmission at the T1 bit rate requires repeaters that regenerate pulses in the bit stream. The spacing of these repeaters is governed by the insertion loss and the interpair crosstalk coupling loss of the cable, which in turn are influenced by the electrical characteristics and temperature of the cable. Consequently, designing digital line carrier systems into exchange routes requires detailed analysis of existing cable plant, including the determination of core layups of all cables, an accurate prediction of the ultimate number of carrier systems to be assigned in the route, and selection of economical powering arrangements.

2.02 The determination of the ultimate number of carrier systems and their deployment, guidelines for powering the repeaters, and implementation and administrative procedures are covered in other engineering sections specifically related to each system. For example, system deployment, repeater powering, and implementation procedures for the SLM System are discussed in Sections 902-217-110, -125, and -130, respectively.

2.03 This section covers the detailed analysis of existing plant to determine repeater spacing, assuming the ultimate number of systems, the cable path for the digital line, and the location of the remote terminals have been determined previously.

2.04 Subscriber loop carrier systems differ from T1 carrier in two principal respects:

(1) Subscriber carrier systems will generally find application in much more complex exchange cable plant (involving frequent cable taper points,

gauge changes, and small pair sized cables) than in trunk or toll routes.

(2) It is anticipated that seldom will more than ten subscriber carrier systems be employed in a single route, while the inverse is true with T1 carrier trunk route applications.

2.05 These differences affect the relative importance of interpair crosstalk coupling loss for the two types of carrier systems as well as the relative difficulty of selecting the most suitable cable pairs for digital transmission. Consequently, the technique presented in this section for selecting the most suitable cable pairs always should be used when designing digital lines for subscriber loop carrier systems.

2.06 If subscriber loop carrier systems are proposed in a cable sheath that contains existing T1 carrier systems, the repeaters for the proposed systems ***must*** be located at the existing T1 repeater sites to avoid intersystem far-end crosstalk (FEXT) interference.

2.07 Any number of analog subscriber carrier systems with an upper frequency below 150 kHz is compatible with up to five digital lines (including spare digital lines) in the same 8-, 9-, 11-, 12-, 13-, 16-, 17-, 25-, and 50-pair units of PIC cable or in the same 11-, 16-, and 25-pair PIC cables. For adjacent or nonadjacent units in PIC cable and all cases in pulp-insulated conductor cable, there are no interference constraints, and standard system engineering rules apply.

3. DESIGN PHILOSOPHY

3.01 There are two basic digital line design philosophies. One philosophy is to locate repeaters at all existing loading coil sites, and if needed supplement with intermediate repeaters in those sections where either excessive loss or excessive crosstalk prevents spanning the length with a single repeater. The other design philosophy is to maximize the length of all repeater sections. In this design method, each repeater section length is based on the maximum insertion loss and crosstalk limitations of the cables included in the repeater section. No attempt is made to position repeater sites at existing loading coil locations.

3.02 Each design philosophy or combination of the two may have merit in specific instances. Locating repeaters at existing loading coil sites reduces the number of sheath openings if the same opening can be used. Alternatively, when repeater point costs are relatively high, the additional savings accrued from maximizing all of the repeater section lengths more than balances the higher construction costs.

3.03 Conditions that generally justify locating repeaters at existing loading coil sites are:

(1) When only one or two digital lines will be ultimately required.

(2) When the number of repeaters per digital line is only one or two greater than the number required, using the maximum spacing philosophy.

(3) When no additional monies would be required for powering (only relevant when systems such as SLM, which rely on remote power installations, are anticipated).

3.04 When locating repeaters on the digital line path, the cable insertion loss between repeaters must be low enough to ensure that the far repeaters can discriminate between signals and noise. The following three factors limit the permissible insertion loss of a repeater section:

(1) The repeater can automatically adjust to insertion losses between 9.2 and 35.0 dB at 772 kHz. The 35.0-dB upper limit is reduced by 1.5 dB to allow for manufacturing variations in cable loss characteristics, thus limiting it to 33.5 dB. This upper limit may be further reduced by crosstalk influences as discussed in 3.04(2) and (3).

(2) Crosstalk coupling loss between the send and receive digital pairs is another influence. The lower the crosstalk coupling loss, the more the digital signal will be influenced by crosstalk.

(3) The number of digital lines in the same sheath is still another influence. More lines produce more crosstalk energy.

3.05 In addition to the preceding transmission considerations, repeaters must be located at sites physically and aesthetically acceptable. They should be located away from interstate highway rights-of-way, areas that flood, or any location that has limited accessibility.

3.06 Repeaters on other systems in the same cable sheath must be located at the same repeater points to minimize crosstalk even if the repeaters are installed in different apparatus cases. ***Remote terminals (RTs) contain digital repeaters and must be considered regular repeater points.***

ROUTE JUNCTIONS

3.07 There are two types of route junctions that must be considered in the design of the digital line. One type of route junction is formed when lines from two or more systems enter the same cable sheath. This type of junction can occur when separate subscriber carrier systems are used to serve two branches in a cable network, as illustrated in Fig. 1.

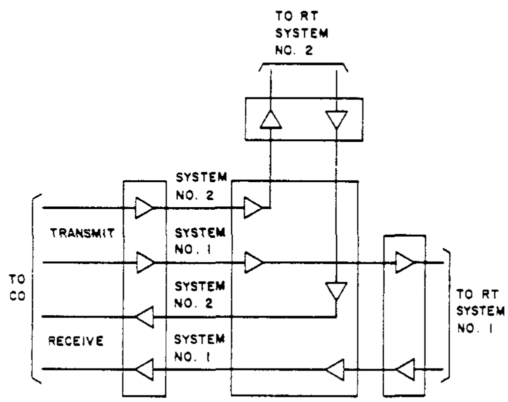


Fig. 1—Route Junction—More Than One System

3.08 The other type of route junction is formed when a single system capable of serving more than one terminal (such as SLM) is used to serve two or more branches of a feeder route. An example of this type of junction is shown in Fig. 2. NOTE THAT WHEN A DIGITAL LINE IS LOOPED OUT AND BACK ON A FEEDER BRANCH, AS IS REQUIRED WITH THIS TYPE OF JUNCTION, THE FEEDER BRANCH REQUIRES TWICE THE NORMAL NUMBER OF DIGITAL LINE PAIRS AND REPEATERS.

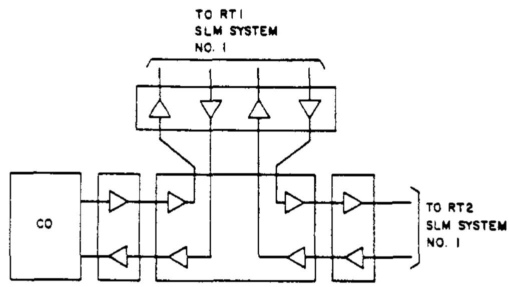


Fig. 2—Route Junction—Single System

3.09 A repeater site must be engineered at all junctions. If a junction also is to be an RT site and the RT is to be located a short distance away in a branch leg (for physical or aesthetic reasons), the required length of suitable size cable should be installed and the RT padded to ensure meeting the minimum loss requirement of 9.2 dB.

INSERTION LOSS LIMITATIONS

3.10 The cable insertion loss limit for the first repeater section is less than the limit for all other repeater sections because of central office (CO) noise. The following insertion loss limitations in dB at 772 kHz apply to digital line repeater spacing using T1 frequencies:

CO TO FIRST REPEATER SECTION		ALL OTHER REPEATER SECTIONS	
Minimum Loss	Maximum Loss	Minimum Loss	Maximum Loss
9.2 dB	23.0 dB	9.2 dB	33.5 dB

3.11 Insertion loss factors (at 772 kHz and 55°F), together with their temperature coefficients in dB per kilofoot for several of the more common pulp-insulated conductor and PIC cables are given in Table A.

TABLE A

CABLE LOSSES AT 772 kHz

CABLE TYPE	MUTUAL CAPAC. nF/MILE AT 900 Hz	ENGR LOSS AT 55°F IN dB/Kft	TEMP COEFFEC. FOR 10°F STEPS IN dB/Kft
17 AHC	83	3.18	0.030
17 ANC	83	3.80	0.028
19 AHB	83	3.18	0.030
19 ANB, DNB, GNB	66	3.00	0.025
19 BHB	83	3.18	0.030
19 BNB, CNB, ENB, FNB	84	3.80	0.028
19 ADB	83	3.80	0.028
19 AJB	83	2.54	0.018
20 AHD	83	4.39	0.043
20 AND	82	5.10	0.047
22 ADA	83	5.10	0.047
22 AHA, BHA	83	4.39	0.043
22 AJA	83	3.67	0.035
22 BSA, CSA, DSA, ESA	83	5.10	0.047
22 ASF (24 EQUIV)	84	6.80	0.066
24 ADM	83	6.80	0.066
24 AKM	83	5.60	0.033
24 ASM, BSM	72	5.90	0.057
24 BKM	83	5.58	0.033
24 CSM, ESM	72	5.85	0.057
24 DSM, FSM	84	6.80	0.066
24 AJM	83	4.65	0.046
26 ADT, DST	83	8.17	0.096
26 AKT	83	7.50	0.041
26 AST	69	6.80	0.066
26 CST	69	6.79	0.081
26 BST	79	7.70	0.093
26 BKT	83	7.48	0.041
26 AJT	83	5.90	0.057
COMPOSITE CABLES			
19 CAB	83	3.80	0.028
22 CAA	83	5.10	0.047
24 CAM	83	6.80	0.066
26 CAT	83	8.17	0.096

3.12 In DILEP these losses are adjusted within the program to reflect the maximum expected temperature and humidity conditions based on the cable environment, ie, aerial or below ground. For example, the losses are adjusted to reflect maximum temperatures for aerial and below-ground cables of 140° and 100°F, respectively. In addition, aerial and below-ground PIC cable losses are increased an additional 2 and 6 percent, respectively, to allow for some transmission degradation due to moisture. No allowance is included in DILEP for any moisture in pulp-insulated conductor cable, since any significant moisture would cause them to be inoperative.

3.13 Insertion loss factors for less common types of cable can be obtained from the appropriate section in the 626-759 layer of the Bell System Practices. It can be assumed that exchange grade (83 nF/mile) composite cables have loss characteristics comparable to the single gauge pulp-insulated cables having the same capacitance (CNB, DSA, DSM, and DST). ***Composite cables are specifically coded CAB, CAA, CAM, and CAT for 19-, 22-, 24-, and 26-gauge, respectively.***

3.14 In nearly all instances, the standard insertion losses at the predetermined temperature and moisture levels specified in 3.12 will satisfy the input requirements of DILEP. However, in some cases, ie, very hot or arid climates, more realistic factors may be warranted. In these situations, the factors may be adjusted using the temperature coefficients in Table A, and by adjusting the percent correction for moisture content. See 5.28(1) for procedures to use to input resulting maximum expected insertion loss in dB per kilofoot.

4. CROSSTALK CONSIDERATIONS

4.01 Crosstalk is a function of:

(a) The number of subscriber carrier systems in the same sheath

(b) The relative position of the transmit and receive pairs of the systems in a single cable sheath.

4.02 Subscriber carrier should be applied in a single cable sheath of the route only. Even though NEXT may be virtually eliminated and repeater spacings increased in twin (two cables, one apparatus case for both directions of transmission) cable sheath routes by assigning transmit and receive pairs in separate cable sheaths, this design is discouraged for three reasons.

(1) Cable splicing is complicated at repeater points and at RTs.

(2) Gauge of future cable additions may be unnecessarily dictated by these repeater locations.

(3) Future cable removal options in the fine gauge area may be limited.

Separate repeater apparatus cases for each direction of transmission ***cannot*** be used with SLM.

4.03 ***Nonstaggered twist cable is not suitable for digital line subscriber carrier systems and is not to be used for any part of the digital line.*** Low capacitance, waterproof, reclaimed, and aluminum cables can be used.

4.04 ***It is very important to space repeaters initially for the maximum number of systems that will ultimately be applied in the route.*** Crosstalk problems may result if the number of systems exceeds the number for which the original repeater spacing was designed.

CROSSTALK-PRONE ZONE

4.05 Almost all NEXT occurs within the crosstalk-prone length of cable adjacent to both the send and receive repeaters (see Fig. 3). This length is equivalent to 3 dB (at 772 kHz) of cable insertion loss and is therefore a function of cable gauge as follows:

CROSSTALK-PRONE ZONE
(83 nF/mile Cable)

GAUGE	DISTANCE IN FEET PIC	PULP
19	1000	800
22	700	600
24	550	450
26	400	375

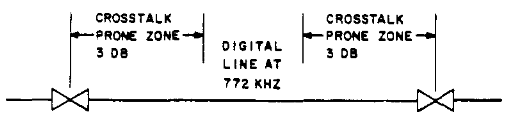


Fig. 3—Crosstalk-Prone Zone

4.06 A mechanized design program for locating the line repeaters on a subscriber carrier system is essential due to the design complexity resulting from the following factors that affect the maximum repeater spacing:

(a) Insertion loss of the cable employed

(b) Physical pair separation achieved in each of the cable sections employed in the total digital path

(c) Ultimate number of carrier systems contemplated

(d) Crosstalk influences are only relevant within a 3-dB zone on either side of each repeater.

4.07 DILEP provides this mechanized design assistance; therefore, the remainder of this section supplies the procedures for selecting suitable pairs for digital lines, obtaining basic input data, and using DILEP.

5. DESIGN PROCEDURES

5.01 The following step-by-step procedures illustrated by the flowchart (Fig. 4) provide an orderly approach for obtaining the input information necessary for DILEP.

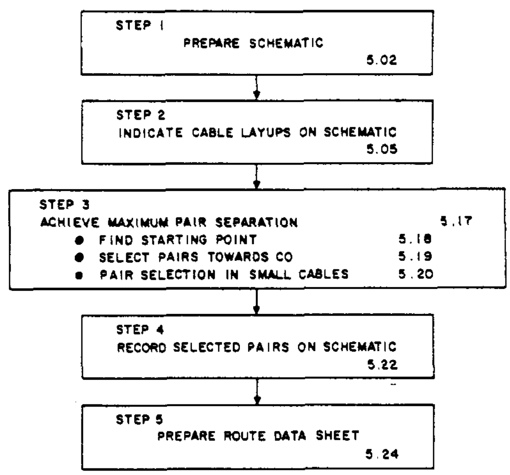


Fig. 4—Flowchart

3.11 Insertion loss factors (at 772 kHz and 55°F), together with their temperature coefficients in dB per kilofoot for several of the more common pulp-insulated conductor and PIC cables are given in Table A.

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3.14 In nearly all instances, the standard insertion losses at the predetermined temperature and moisture levels specified in 3.12 will satisfy the input requirements of DILEP. However, in some cases, ie, very hot or arid climates, more realistic factors may be warranted. In these situations, the factors may be adjusted using the temperature coefficients in Table A, and by adjusting the percent correction for moisture content. See 5.28(1) for procedures to use to input resulting maximum expected insertion loss in dB per kilofoot.

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4.01 Crosstalk is a function of:

(a) The number of subscriber carrier systems in the same sheath

(b) The relative position of the transmit and receive pairs of the systems in a single cable sheath.

4.02 Subscriber carrier should be applied in a single cable sheath of the route only. Even though NEXT may be virtually eliminated and repeater spacings increased in twin (two cables, one apparatus case for both directions of transmission)

Step 1—Schematic

5.02 Prepare a schematic (Fig. 5) of the route showing the following information:

(a) Cable code, eg, BKM. (Show 3- or 4-letter code. The fourth letter (X) is used to identify reclaimed* cable.) Also indicate the pair size for each cable section.

(b) Year of placement for each cable section.

(c) Length of cable section if it exceeds 20 feet. (For sections less than 20 feet, include with adjacent section length.)

(d) Cable pressurization status of each cable section.

(e) Type of construction (aerial, buried, or underground).

(f) Loading coil locations.

(g) Proposed and future RT locations.

(h) The ultimate number of systems in each repeater section. Note that if a multiple RT system is used to serve two or more feeder branches, the effective number of systems is larger than the actual number. (See 3.08.)

(i) Manholes that are potential repeater sites. Show cumulative distance to this location.

*Reclaimed cable has a higher capacitance and thus a higher insertion loss factor than nonreclaimed cable.

5.03 If pulp-insulated aluminum conductors are encountered, use a code representing a pulp-insulated copper conductor cable that is equivalent in electrical characteristics. The standard 3-letter code for PIC aluminum cable may be used when that type of cable is encountered.

5.04 Post cable section numbers on the schematic, starting with ⟨1⟩ adjacent to the CO and numbering consecutively to the end of the digital line. The CO is designated as cable section 0.

Step 2—Cable Layups

5.05 Indicate the construction "layup"* of all sections of cable on the schematic (Fig. 5), eg, 12-, 13-, or 25-pair units.

* "Layup" is defined as a cross-section view of the number of pairs assembled in a unit and the arrangement of the units as they are combined to form unit-type constructed cable. It also may be a view of the number and arrangement of pairs in a layer-type constructed cable.

5.06 Spacing of repeaters on the digital line is governed by both cable "layup" and the relative location of the transmit and receive pairs. The transmit and receive pairs may be assigned within the ***same*** unit, ***adjacent*** units, or ***nonadjacent*** units.

5.07 The following list of Bell System Practices and figures shown in this section is furnished to assist in obtaining knowledge regarding "layups" of various types of cables.

TITLE	SECTION NUMBER
PIC Cable, General	626-759-149
Superseded Exchange Cables (covers pulp and strip paper-insulated conductor cables)	626-759-400
Even-Count PIC Cable (B Series), General	632-033-102
Solid PIC Cables, Description (covers odd-count PIC cable, "A" Series, General)	632-033-151

*When only pair size, gauge, and year of placement are known, the "layup" can be estimated employing the instructional notes on Fig. 6, 7, and 8.

5.08 In general, 50-pair units are the smallest found in 22-, 24-, or 26-gauge non-PIC cables larger than 100 pairs. Most 19-gauge, non-PIC cables are assembled in 25-pair units. When layer-type cables are encountered, 25- and 50-pair cable sizes are to be considered as 25- and 50-pair unit cables since they have the same crosstalk characteristics.

5.09 Most 75-pair layered and some 100-pair layered cables are constructed as a single unit. These cables should be considered as 50-pair unit cables. The larger pair size layered cables are constructed with either 50- or 100-pair splicing groups, and these cables should be treated the same as 50-pair unit type, since both 50- and 100-pair layers have NEXT coupling losses comparable to 50-pair unit cable.

5.10 The B series of PIC cable is currently produced in various pair unit sizes (see Fig. 9).

(1) The layup design was changed in 1964 from 25-pair binder groups assembled in 8-, 8-, 9-pair units to 12-, 13-pair units.

(2) The layup is the basis of 50-pair "multiunit" constructed PIC cables in some of the 200- through 900-pair sizes.

Large quantities of Manufacture Discontinued PIC cable containing 8- and 9-pair units are in service, as well as lesser quantities of 13-, 17-, and 50-pair units. With the redesign in 1964, no change was made in the code (BK or BH) that identifies this type of cable.

5.11 Even though the design of 50-pair cable and 50-pair "multiunits" was changed in 1964, actual manufacture of 22-, 24-, and 26-gauge types in the 12-, 13-pair units occurred between Fall of 1964 and Spring of 1965 at various plants. In the 19-gauge type, some 12-, 13-pair unit cable was produced in late 1964 and some 8-, 8-, 9-pair unit cable was manufactured until late 1967.

5.12 When a particular size of PIC cable has been manufactured in more than one layup, proceed as follows:

(a) If it is not known whether the layup is 8-, 8-, 9-, or 12-, 13-type (BH or BK 50-, 200-, 600-, or 900-pair), assume that it is 12-, 13-type unless it is practical to verify the actual layup and the transmit and receive digital pairs ***must*** be selected from different binder groups.

(b) If it is not known whether the layup is 12-, 13-, or 25-pair unit type (BH or BK 300-pair), assume that it is the 25-pair unit type unless it is practical to verify the actual layup and the transmit and receive digital pairs ***must*** be selected from different binder groups.

Fifty-pair odd-count PIC cable should be considered the same as 50-pair unit constructed cable.

5.13 In multiunit PIC cables, the units spiral as they are combined in the cable manufacturing process. Units that appear to be nonadjacent and are in different rings might become adjacent as the units spiral around the core and inner ring. In the manufacture of cable, units may be slipped a maximum of one unit. For example, in the 400-pair cable (Fig. 11), the 126-150 binder group may become adjacent to binder group 351-375.

5.14 In multiunit PIC cables, the highest crosstalk coupling loss (most desirable condition) occurs when transmit and receive digital paths are carried in different units and spaced as widely apart as possible. In an 8-, 8-, 9-type, 50-pair cable, the units are B1 and A2, C1 and B2, and A2 and C2 (see Fig. 17).

5.15 In layered cables, when transmit and receive pairs are assigned in nonadjacent splicing groups, treat this cable in the same manner as though the pairs are assigned in nonadjacent units. Similarly, treat a cable that contains transmit and receive pairs in adjacent splicing groups the same as though they are assigned in adjacent units. ***However, if ten or more subscriber carrier systems are contemplated in the planning period, pair assignments in adjacent splicing groups must be treated as though they are within the same unit.***

5.16 In a 900-pair layer cable (Fig. 18), an ***adjacent group*** assignment is, for example, counts 1-100 and 101-200 and a ***nonadjacent group*** assignment is counts 1-100 and 201-300. Notice that to be nonadjacent, groups must have no pairs in adjacent layers. For example, counts 301-400 and 501-600 do not qualify as nonadjacent and must be considered adjacent.

Step 3—Digital Line Pair Selection

5.17 Careful attention must be given to the specific pair assignments made for the digital lines to ensure that maximum margin or maximum repeater spacing, depending on the design philosophy employed, is achieved (see 3.01). The cable pairs used for the two directions of transmission should be physically separated as much as practicable to achieve high interpair crosstalk coupling loss, thus minimizing the crosstalk influence of other digital lines in the same cable sheath. Consequently, the first choice for the transmit and receive pairs would be in ***nonadjacent*** binder groups; the second choice would be in ***adjacent*** binder groups; and the last choice would be in the ***same*** binder group.

5.18 Achieving maximum send and receive pair separation (nonadjacent binder group) in subscriber carrier system applications is difficult, since these systems prove most economically attractive near the extremities of rural routes where small cable sizes are encountered. Nonadjacent binder group separation can be achieved only in larger pair sized cables (150-pair and larger, even-count PIC cable, and 300-pair and larger pulp-insulated conductor unit-type cables).

5.19 Step 3 provides a step-by-step procedure for selecting pairs for the digital lines that will provide the best overall design, ie, the minimum number of repeaters per digital line. This selection is governed by the followng substeps:

- Start at the CO and proceed along the cable route to a point where either the farthest RT is to be located or where a cable smaller than 50 pairs is encountered, whichever comes first.

- At that point, select transmit and receive pairs toward the CO, using the following preferential sequence; most desirable (a), least desirable (d).

  (a) Transmit and receive pairs in nonadjacent binder groups

  (b) Transmit and receive pairs in adjacent binder groups but in nonadjacent units

  (c) Transmit and receive pairs in adjacent binder groups and in adjacent units

  (d) Transmit and receive pairs in the same unit.

5.20 In selecting pairs, be careful to ensure as much separation as possible in the smaller size cables (less than 50 pairs) at the extremities of the route. Select pairs in the outer ring and try to achieve a minimum of 2-pair separation between the send and receive pairs (see Fig. 14 and 16).

5.21 The following rules applicable to even-count PIC cables will result in maximum repeater spacing:

(1) Do not use sheath pairs 1-12 in 50-pair cables.

(2) Do not use sheath pairs 1-25 if the starting point (5.19) involves a 75-pair or larger cable.

(3) If the starting point is in a 75-pair cable, the transmit and receive pairs should be selected from the following units:

26-37 and 51-62
26-37 and 63-75
38-50 and 63-75.

(4) If the starting point is in a 100-pair cable the transmit and receive pairs should be selected from the following units:

26-37 and 76-87
38-50 and 76-87
38-50 and 88-100.

Step 4—Record Selected Pairs

5.22 Trace the selected pairs back toward the CO and record on the schematic the separation status of the transmit and receive pairs in each cable section (***same, adjacent,*** or ***nonadjacent*** units).

5.23 At the splice point between cables smaller than 50 pairs and cables larger than 50 pairs, it may be necessary to establish a cross-connecting terminal or make a cable throw to achieve the desired pair separation. A third option would be to place a 50-pair cable from the last repeater to the RT and use the existing small size cable for distribution. This would achieve the desired pair separation while avoiding the added cost and administration problems associated with a cross-connecting terminal or a cable transfer.

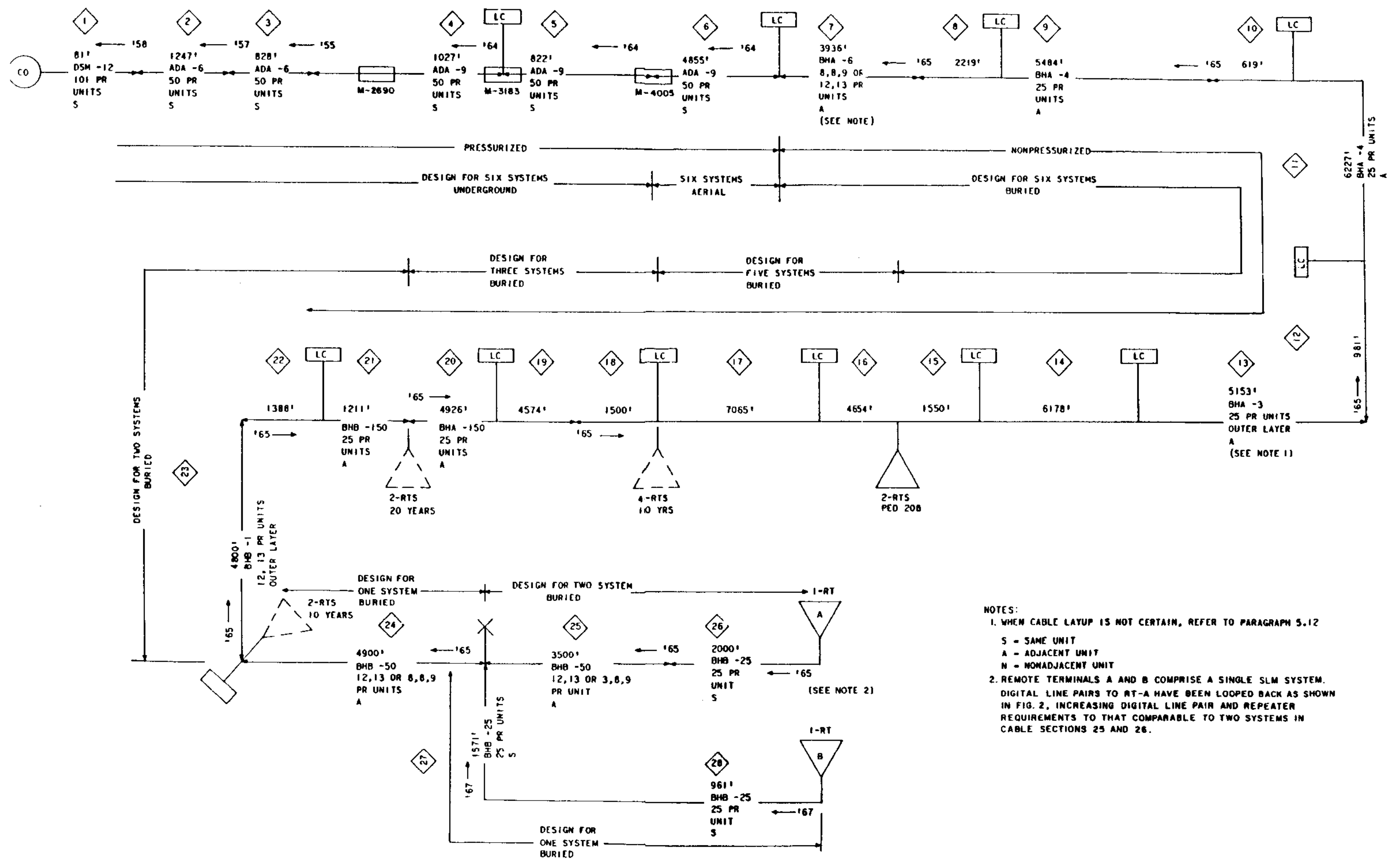
Step 5—Route Data Sheet

5.24 A Route Data Sheet (Fig. 19) must be prepared for each route. This Route Data Sheet is the primary input for the computer program DILEP and should be used to design or verify repeater spacing on digital line subscriber carrier systems.

5.25 DILEP is capable of handling up to 100 cable sections, 50 manhole locations, and 10 route junctions for a single route. If any of these limitations need to be exceeded for a particular route analysis, the study route must be divided into two separate route segments, using any RT site or route junction as the separation point for the two route segments.

5.26 DILEP stores data on 46 different cable codes (cable types), as listed in Table A. One of these codes must be used.

5.27 The Route Data Sheet provides the same basic information as the route schematic, but gives the data in tabular format.



NOTES:

1. WHEN CABLE LAYUP IS NOT CERTAIN, REFER TO PARAGRAPH 5.12

   S = SAME UNIT
   A = ADJACENT UNIT
   N = NONADJACENT UNIT

2. REMOTE TERMINALS A AND B COMPRISE A SINGLE SLM SYSTEM. DIGITAL LINE PAIRS TO RT-A HAVE BEEN LOOPED BACK AS SHOWN IN FIG. 2, INCREASING DIGITAL LINE PAIR AND REPEATER REQUIREMENTS TO THAT COMPARABLE TO TWO SYSTEMS IN CABLE SECTIONS 25 AND 26.

Fig. 5—Example Schematic of Proposed Digital Systems

HISTORICAL DATA – 22-GAUGE EXCHANGE CABLES								
CABLE CODE	NO. OF PAIRS AND INSULATION	APPROX AVG CAP. µF/MI AT 900 Hz	SHEATH	CORE TYPE	REMARKS	SPEC NO. AND DATE	GENERAL LETTERS AND DATE	SUPER-SEDED BY
A	6-480 Paper	0.062	Lead	Layer	Like-colored pairs Single twist	A.T.2300 3-25-05	—	AA
AA	6-500 Paper	0.062	Lead	Layer	Color Groups Single twist	A.T.3226 3-25-10	GC 85 4-28-10	TA

This representation from 626-759-400 illustrates a method of estimating the "layup" of a cable identified on a cable record merely as 4-22 (400 or 404 pair-22) placed in 1949. A glance at the "Spec. No. & Date" column indicates this exchange cable was covered by Spec. M-2553, 8-2-48. It is reasonable to assume, therefore, that a 22-gauge cable placed in 1949 is type DSA(L). Fig. 7 (an updated copy from 626-759-400) indicates type DSA cable to be covered by 626-759-427, a portion of which is reproduced in Fig. 8. The 404-pair size is assembled of 50- and 51-pair units, as illustrated.

CABLE CODE	NO. OF PAIRS AND INSULATION	APPROX AVG CAP. µF/MI AT 900 Hz	SHEATH	CORE TYPE	REMARKS	SPEC NO. AND DATE	GENERAL LETTERS AND DATE	SUPER-SEDED BY
BSA	11-909 Paper	0.082	Lead	Layer	Color groups Staggered twist[4]	AT&T 4610 6-1-26 and M-2519 6-7-26	GEC 1910 10-27-26 GEC 1910 10-27-26	CSA
CSA	11-909 Pulp	0.082	Lead	Unit	Uniform color units Staggered twist[5]	M-2536 12-10-35	PEL 2187 2-6-36	DSA
DSAL	11-909 Pulp	0.082	Lead	Unit	Mixed color units Staggered twist[6]	M-2553 8-2-48	—	ADA[7]
DSAC	26-909 Pulp	0.082	Stalpeth	Unit	Mixed color units Staggered twist[6]	M-2561 1-15-50	—	ADA[7]
DSAA	16-909 Pulp	0.082	Alpeth	Unit	Mixed color units Staggered twist[6]	M-2582 2-2-51	—	ADA[7]
DSAH	11-909 Pulp	0.082	PASP	Unit	Mixed color units Staggered twist[6]	M-57041 11-22-55	—	ADA[7]
ESAL	11-909 Paper	0.082	Lead	Layer	Color groups Staggered twist[4]	M-57021 12-5-32	PEL 5080 9-12-52	ADA[7]
ADAL	300-1100[2] Pulp	0.083	Lead	Unit	Mixed color units Staggered twist[6]	A-312376 10-1-62	PEL 7121 1-25-63	—
ADAH	300-900[2] Pulp	0.083	PASP	Unit	Mixed color units Staggered twist[6]	A-312376 10-1-62	PEL 7121 1-25-63	—
ADAC	300-1100[2] Pulp	0.083	Stalpeth	Unit	Mixed color units Staggered twist[6]	A-312376 10-1-62	PEL 7121 1-25-63	—

Note 1: Intended for underground use; all other cables are suitable for general use.

Note 2: Not supplied in 455-pair size.

Note 3: Before April, 1921, single pair twist lengths; after April, 1921, two lengths of pair twist per layer and reversed layers.

Note 4: Three lengths of pair twist and reversed layers.

Note 5: Four lengths of pair twist (two per layer).

Note 6: Nine lengths of pair twist (three per layer).

Note 7: BHA cable is the standard replacement cable for sizes smaller than 300 pairs.

Fig. 6—Historical Data

ELECTRICAL CHARACTERISTICS OF SUPERSEDED PAPER OR PULP-INSULATED EXCHANGE CABLE								
					DIELECTING STRENGTH IN EXCESS OF			
GAUGE AND SERIES[1]	DC-RES, OHMS/ LOOP MI AT 68°F	CAP. μF/MI AT 900 Hz	CONDUC-TANCE μMHOS/MI AT 900 Hz	ATTN[2] dB/MI AT 1000 Hz	BETWEEN COND. VOLTS RMS	COND AND SHEATH VOLTS RMS	BELL SYSTEM PRACTICE	PR STA C.
16-Ga								
NH	42	0.066	2.0	0.7	700	1000	626-759-405	
19-Ga								
ANB	85	0.066	1.5	1.2	500	1000	626-759-408	,
DNB	86	0.066	1.5	1.2	500	1000	626-759-409	,
GNB	85	0.066	1.7	1.1	500	1000[5]	626-759-410	,
CNB	85	0.084	2.0	1.3	500	1000	626-759-415	,
ENB	86	0.086	2.0	1 3	500	1000[5]	626-759-416	.
FNB	86	0.084	2.0	1.3	500	1000[5]	626-759-417	.
ADB	86	0.083	2.0	1.3	500	1000[5]	626-759-106	
22-Ga								
BSA	171	0.082	2.0	1.8	350	1000	626-759-425	.
CSA	171	0.082	2.0	1.8	350	1000	626-759-426	.
DSA	171	0.082	2.1	1.8	350	1000[5]	626-759-427*	.
ESA	171	0.082	2.0	1.8	350	1000	626-759-428	.
ADA	173	0.083	2.0	1.8	350	1000[5]	626-759-107	
							*See Fig. 6.	
24-Ga								
ASM	274	0.072	2.0	2.1	350	1000	626-759-440	
BSM	274	0.072	2.0	2.1	350	1000	626-759-441	.
CSM	274	0.072	2.0	2.1	350	1000	626-759-442	.
DSM	274	0.084	2.0	2.3	350	1000[5]	626-759-443	.
ESM	274	0.072	2.0	2.1	350	1000	626-759-444	.
FSM	274	0.084	2.0	2.3	350	1000[5]	626-759-445	.
ADM	274	0.083	2.0	2.3	350	1000[5]	626-759-108	—

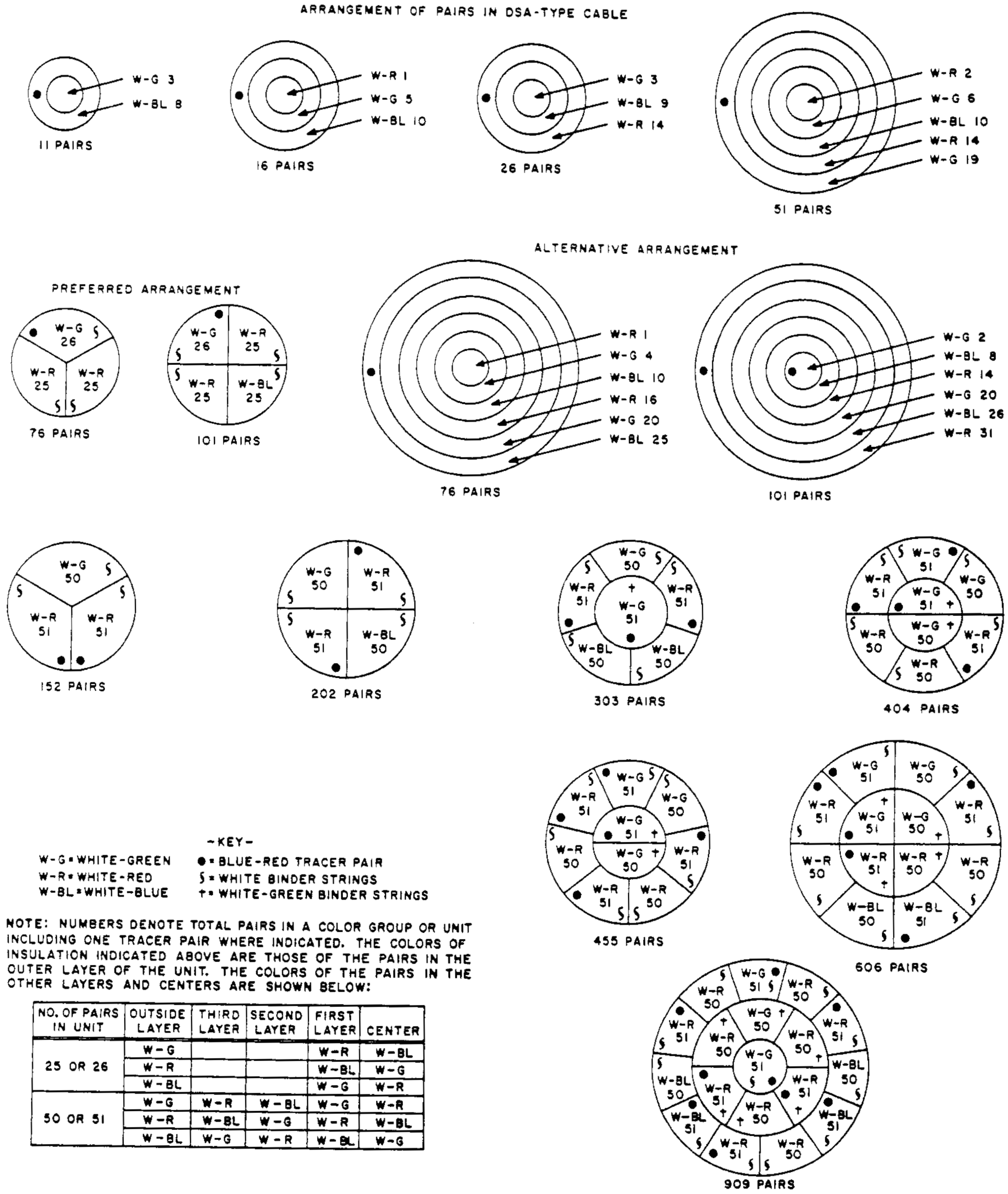
This reprint, from 626-759-400 illustrates a method of estimating the "layup" of a cable identifie records merely as a 4-22 (400- or 404- pair -22) placed in 1949. Referring to Fig. 6, it is estimated the cable is type DSA(L). A check above indicates type DSA cable to be covered by 626-75ç which is illustrated in Fig. 8.

Note 4: See referenced practice for replacement cables.

Note 5: The dielectric strength between each conductor and sheath of this series of cable with PASP sheath is of 20,000 volts dc. The dielectric strength between each conductor and stalvyn sheath of ADM and ADT c excess of 1400 volts rms.

Fig. 7—Superseded Pulp Cable

See Fig. 6 and 7, from which it has been estimated a 4-22 (404-pair, 22 gauge) cable placed in 1949 would most likely be coded. Thus, the core makeup is in 50- and 51-pair units.



-KEY-

W-G = WHITE-GREEN
W-R = WHITE-RED
W-BL = WHITE-BLUE
● = BLUE-RED TRACER PAIR
S = WHITE BINDER STRINGS
† = WHITE-GREEN BINDER STRINGS

NOTE: NUMBERS DENOTE TOTAL PAIRS IN A COLOR GROUP OR UNIT INCLUDING ONE TRACER PAIR WHERE INDICATED. THE COLORS OF INSULATION INDICATED ABOVE ARE THOSE OF THE PAIRS IN THE OUTER LAYER OF THE UNIT. THE COLORS OF THE PAIRS IN THE OTHER LAYERS AND CENTERS ARE SHOWN BELOW:

NO. OF PAIRS IN UNIT	OUTSIDE LAYER	THIRD LAYER	SECOND LAYER	FIRST LAYER	CENTER
25 OR 26	W-G			W-R	W-BL
	W-R			W-BL	W-G
	W-BL			W-G	W-R
50 OR 51	W-G	W-R	W-BL	W-G	W-R
	W-R	W-BL	W-G	W-R	W-BL
	W-BL	W-G	W-R	W-BL	W-G

Fig. 8—DSA Cable Layup

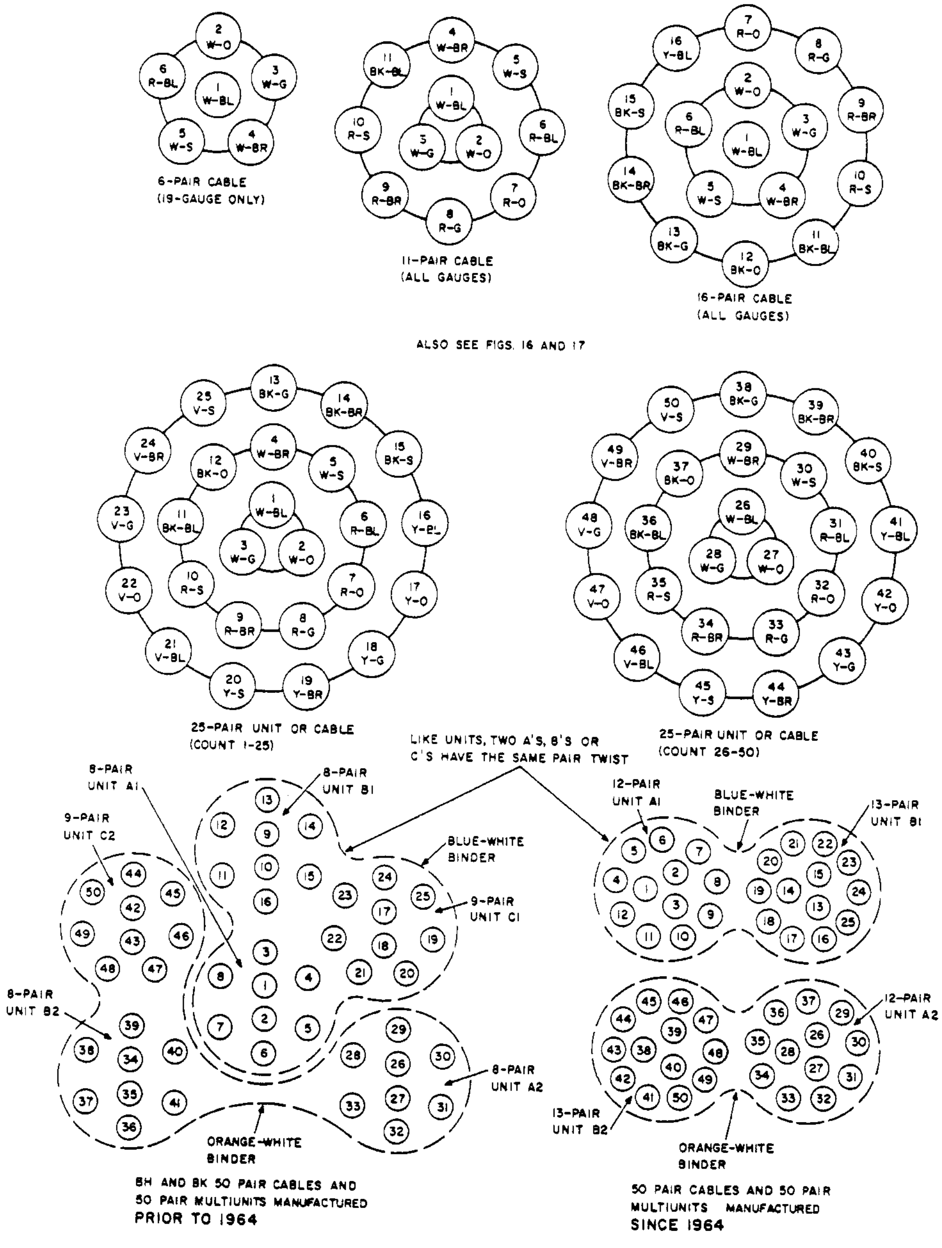


Fig. 9—Layup of BH and BK Small PIC Cables—11- to 50-Pair Units and Multiunits

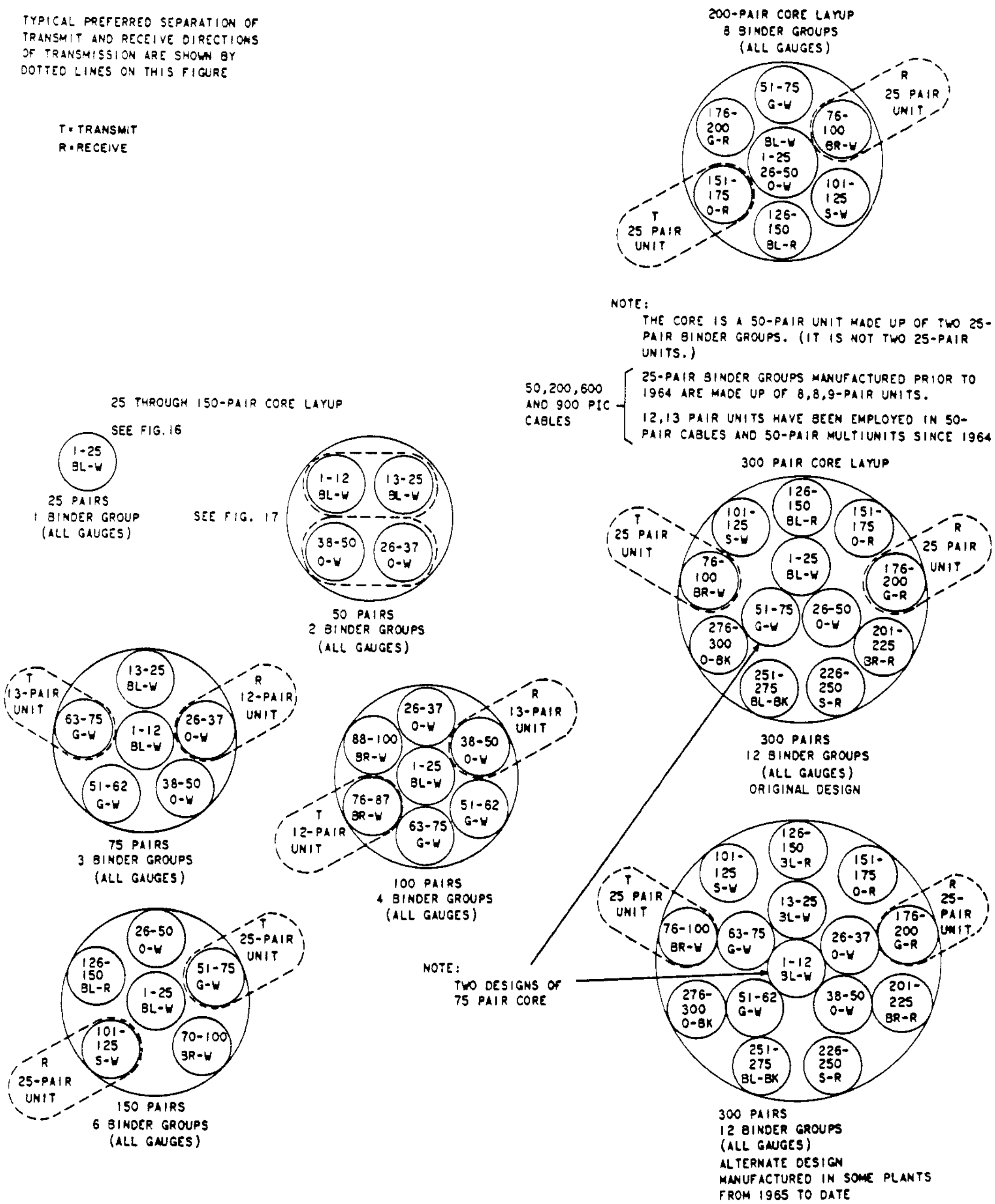


Fig. 10—Layup of 25- to 300-Pair Even-Count BH- and BK-Type PIC Cables

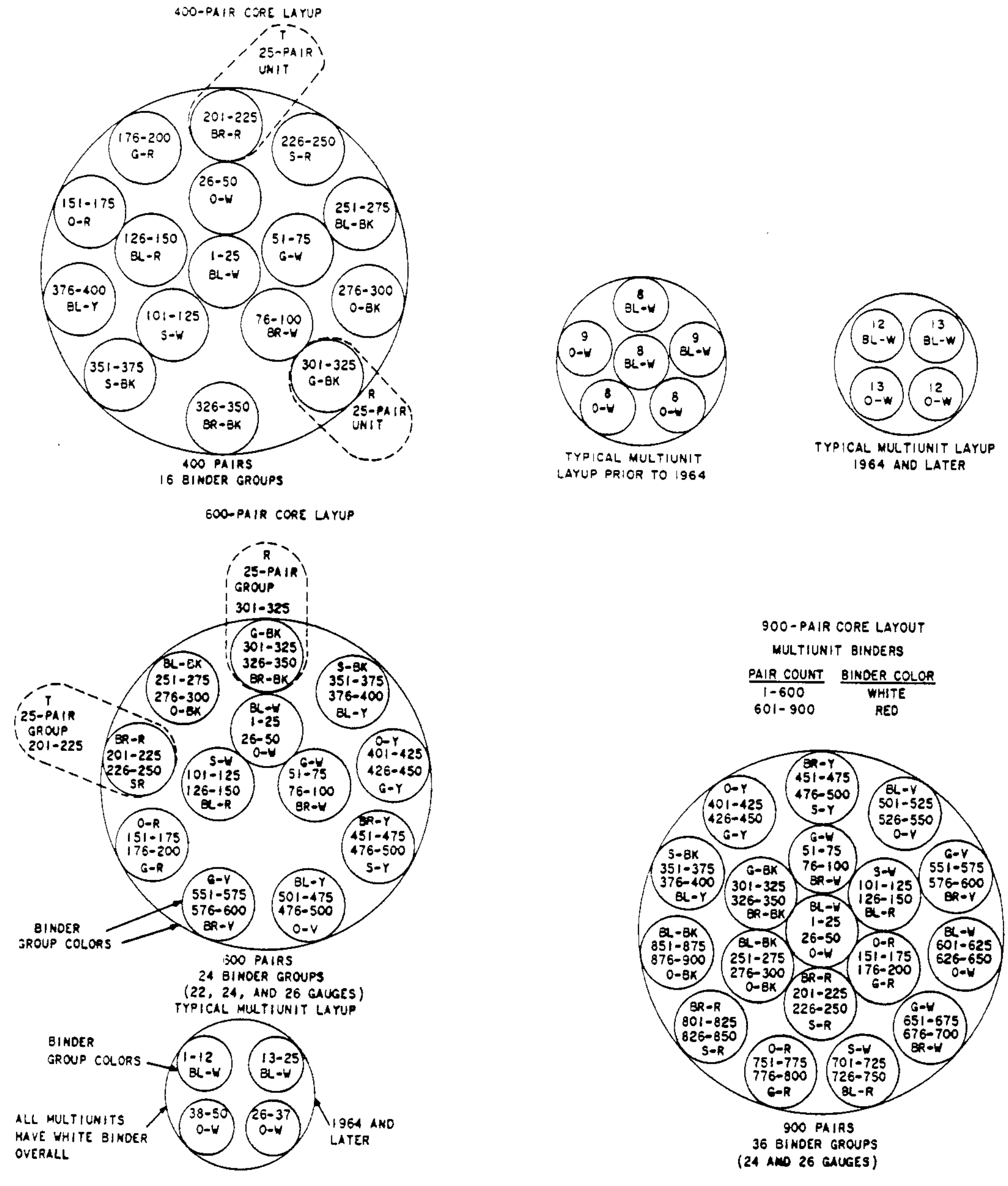
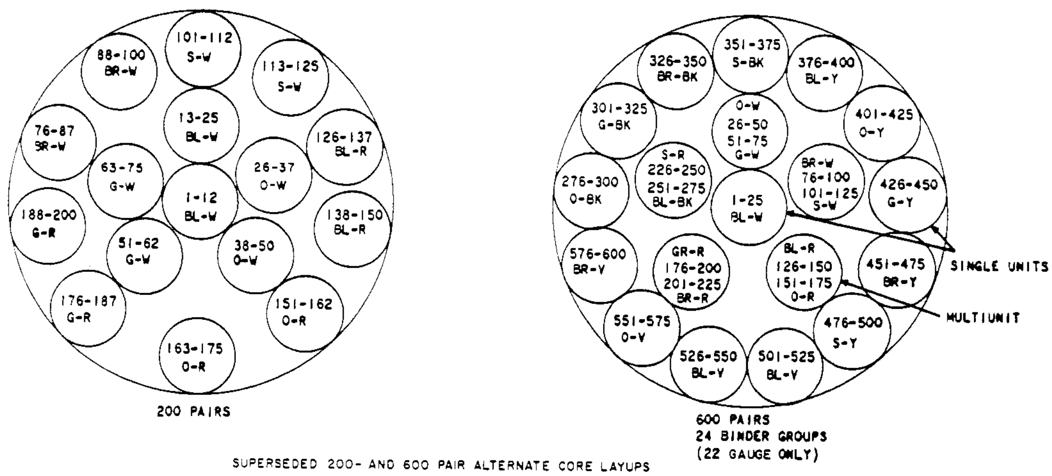


Fig. 11—Layup of 400-, 600-, and 900-Pair Even-Count BH and BK PIC Cables

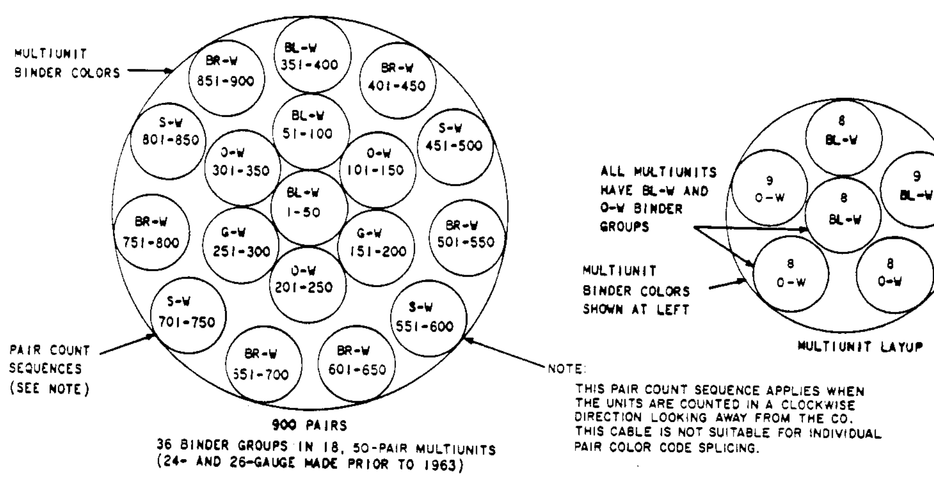
SUPERSEDED CABLES

IN 1965, SLIGHTLY DIFFERENT UNIT LAYUPS, AS SHOWN BELOW, WERE USED FOR 200- AND 600-PAIR PIC CABLES THAT WERE MANUFACTURED IN SOME PLANTS. THE 200-PAIR CABLE WAS MADE IN ALL GAUGES AND THE 600-PAIR CABLE WAS MADE IN 22-GAUGE ONLY. THESE ALTERNATE LAYUPS WERE ADOPTED TO PROVIDE A MORE COMPACT, SMOOTHER CORE AND TO IMPROVE HANDLING CHARACTERISTICS. THE 200-PAIR ALTERNATE LAYUP WAS RATED MANUFACTURE DISCONTINUED (MD) IN 1967 AND THE 600-PAIR ALTERNATE LAYUP WAS RATED MD IN 1966. THE CHANGE BACK TO THE ORIGINAL (STANDARD) DESIGNS OF 200- AND 600-PAIR CABLES WAS NECESSITATED BY PROBLEMS EXPERIENCED WHEN USING THE ALTERNATE DESIGN CABLES FOR T1 CARRIER.



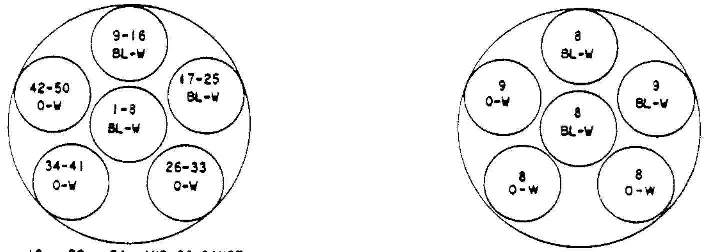
SUPERSEDED 200- AND 600 PAIR ALTERNATE CORE LAYUPS

THESE DRAWINGS ILLUSTRATE THE LAYUP OF CERTAIN SUPERSEDED CABLES.



SUPERSEDED 900-PAIR CORE LAYUPS

Fig. 12—Layup of BH- and BK-Type PIC Cables



19-, 22-, 24, AND 26-GAUGE
SUPERSEDED 50-PAIR CABLE CORE LAYUP

SUPERSEDED MULTIUNIT LAYUP

NOTE:
50-PAIR CABLES AND CABLES EMPLOYING 50-PAIR MULTIUNITS MANUFACTURED PRIOR TO 1964. SEE FIGURES 11 AND 17.

Fig. 13—Layup of 50-Pair and BH- and BK-Type PIC Cables and Multiunits

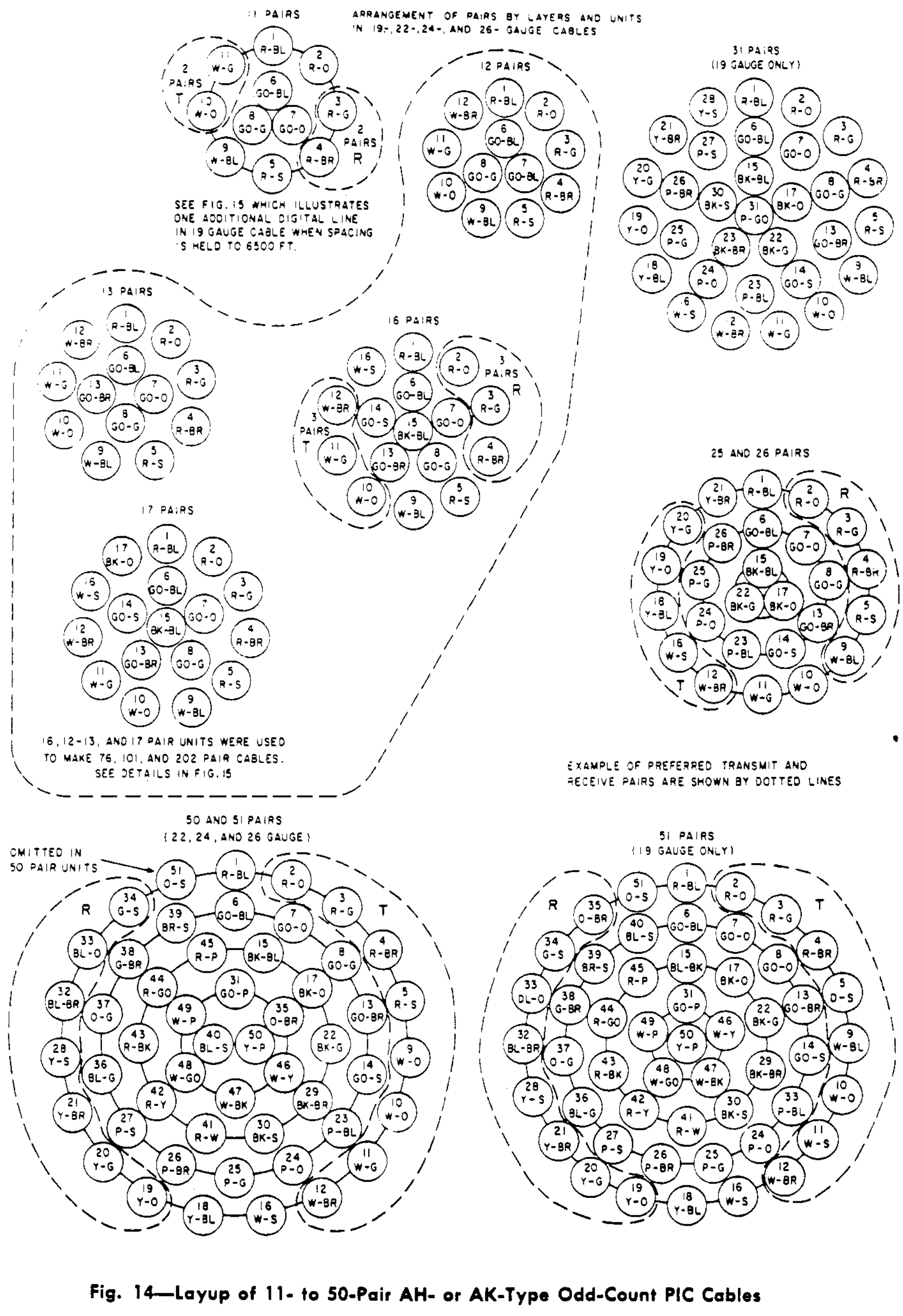
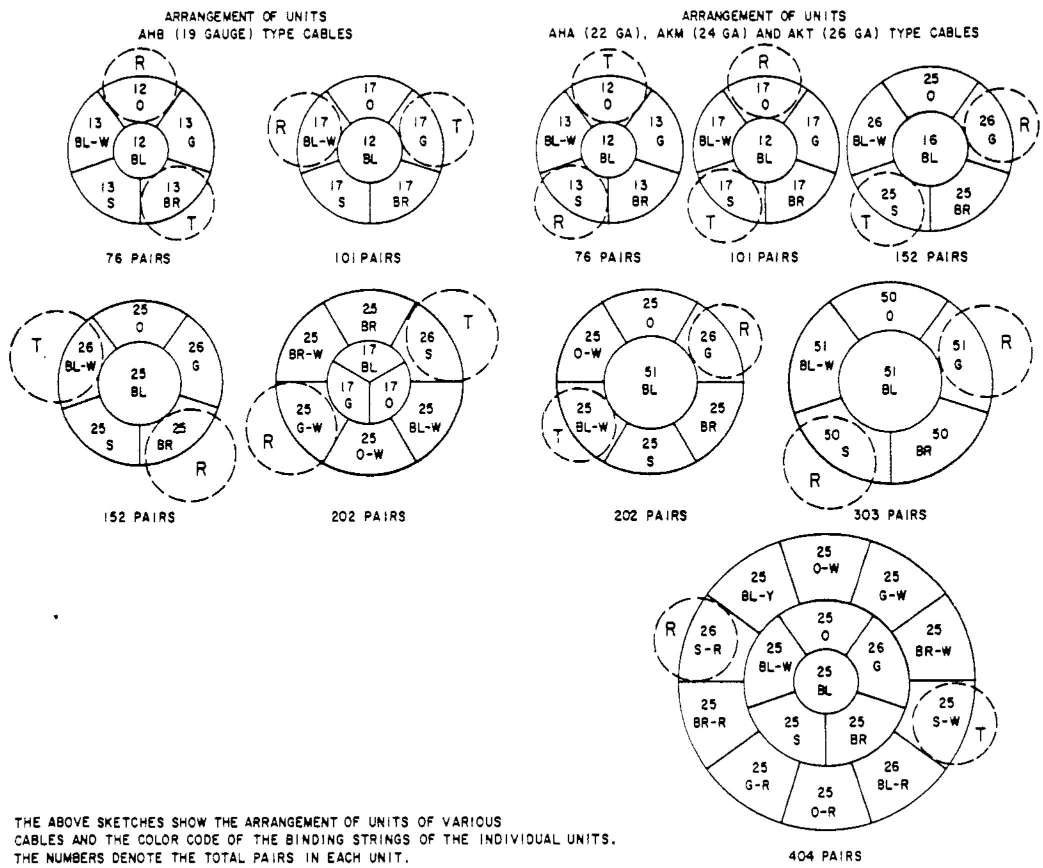
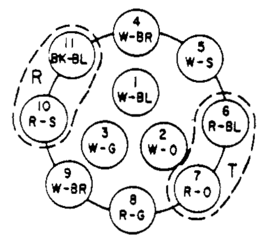


Fig. 14—Layup of 11- to 50-Pair AH- or AK-Type Odd-Count PIC Cables



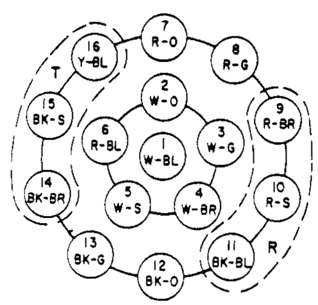
THE ABOVE SKETCHES SHOW THE ARRANGEMENT OF UNITS OF VARIOUS CABLES AND THE COLOR CODE OF THE BINDING STRINGS OF THE INDIVIDUAL UNITS. THE NUMBERS DENOTE THE TOTAL PAIRS IN EACH UNIT.

Fig. 15—Layup of 76- to 404-Pair AH- or AK-Type Odd-Count PIC Cables

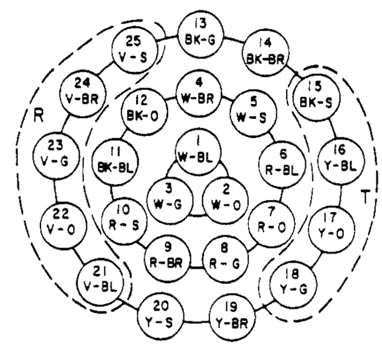


11-PAIR CABLE
(ALL GAUGES)

THERE SHOULD BE A MINIMUM OF TWO PAIRS SEPARATION IN THE OUTER RING IN ALL GAUGES.



16-PAIR CABLE
(ALL GAUGES)



25-PAIR UNIT OR CABLE
(ALL GAUGES)

THERE SHOULD BE A MINIMUM OF TWO PAIRS SEPARATION IN THE INNER RING AND ONE PAIR SEPARATION IN THE OUTER RING.

Fig. 16—Method of Pair Selection

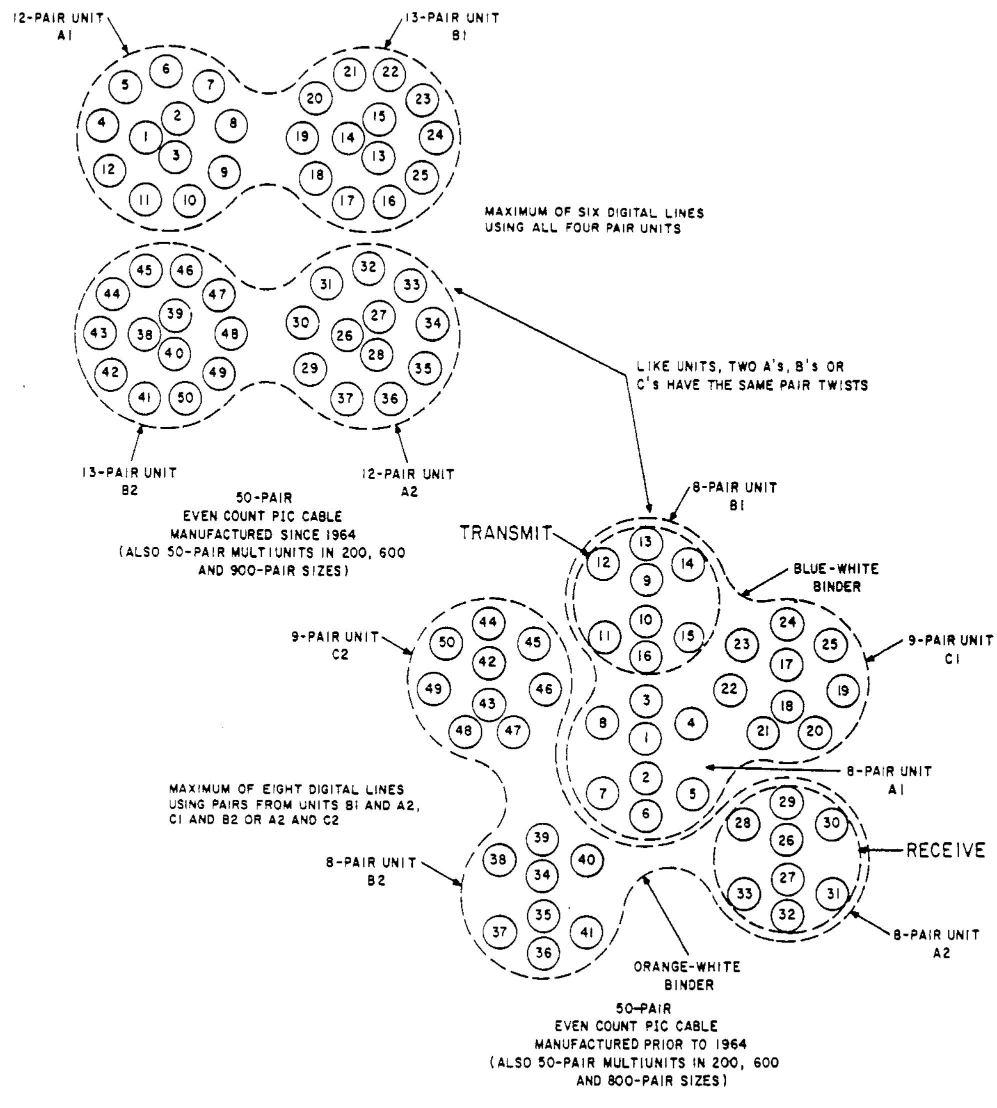


Fig. 17—Layup of 50-Pair Cable and 50-Pair Multiunits in Even-Count PIC Cable

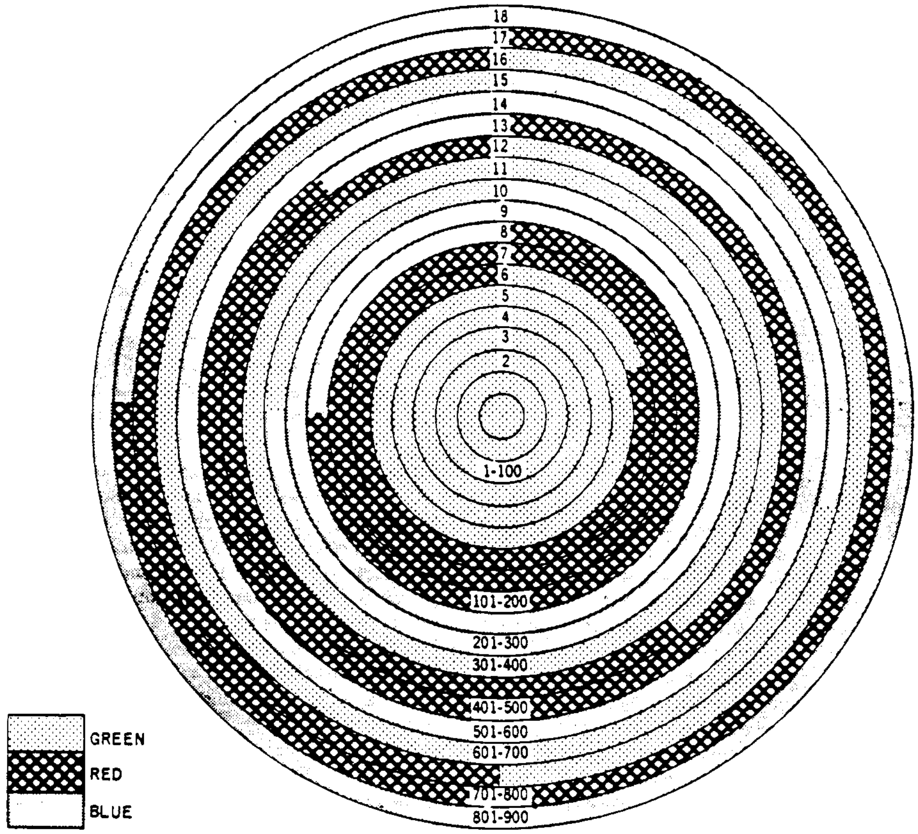


Fig. 18—Configuration of 900-Pair Layer—22 Gauge

ROUTE DATA SHEET

FILE NAME [ ][ ][ ][ ][ ][ ][ ][ ] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T][▨][ ]
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF CARRIER SYSTEMS	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25 OR 50	(10) ** INSERTION LOSS FACTOR DB/KFT AT 772 KHZ

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

* FOR RECLAIMED CABLE, ADD "X"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP

Fig. 19—Route Data Sheet

ROUTE DATA SHEET

FILE NAME | B | R | U | C | E | | | | DATA

(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION | T | ▨ | E | X | A | M | P | L | E | | R | O | U | T | E | | N | O | | 1 | (remaining boxes blank)

(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF CARRIER SYSTEMS	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25 OR 50	(10) ** INSERTION LOSS FACTOR DB/KFT AT 772 KHZ
1	0	6	81	U	P	DSM	S	50	
2	1	6	1247	U	P	ADA	S	50	
3	2	6	828	U	P	ADA	S	50	
4	3	6	1027	U	P	ADA	S	50	
M	2690								
M	3183								
5	4	6	822	U	P	ADA	S	50	
M	4005								
6	5	6	4855	A	P	ADA	S	50	
7	6	6	3936	B	N	BHA	A	12	
8	7	6	2219	B	N	BHA	A	25	
9	8	6	5484	B	N	BHA	A	25	
10	9	6	619	B	N	BHA	A	25	
11	10	6	6227	B	N	BHA	A	25	
12	11	6	981	B	N	BHA	A	25	
13	12	6	5153	B	N	BHA	A	25	
14	13	6	6178	B	N	BHA	A	25	
15	14	6	1550	B	N	BHA	A	25	
RT									

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

* FOR RECLAIMED CABLE, ADD "X"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP

Fig. 20—Route Data Sheet—Example (Sheet 1 of 2)

ROUTE DATA SHEET

FILE NAME | B | R | U | C | E | | | | DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION | T | ▨ | E | X | A | M | P | L | E | | R | O | U | T | E | | N | O | | 1 | ...
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF CARRIER SYSTEMS	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25 OR 50	(10) ** INSERTION LOSS FACTOR DB/KFT AT 772 KHZ
16	15	5	4654	B	N	BHA	A	25	
17	16	5	7065	B	N	BHA	A	25	
RT									
18	17	3	1500	B	N	BHA	A	25	
19	18	3	4574	B	N	BNA	A	25	
20	19	3	4926	B	N	BHA	A	25	
RT									
21	20	2	1211	B	N	BHB	A	25	
22	21	2	1388	B	N	BHB	A	25	
23	22	2	4800	B	N	BHB	A	12	
RT									
24	23	1	4900	B	N	BHB	A	12	
DR									
25	24	1	3500	B	N	BNB	A	12	
26	25	1	2000	B	N	BHB	S	25	
RT									
27	24	1	1571	B	N	BNB	S	25	
28	27	1	961	B	N	BHB	S	25	
RT									

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

* FOR RECLAIMED CABLE, ADD "X"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP

Fig. 21—Route Data Sheet—Example (Sheet 2 of 2)

DIGITAL LINE DESIGN AND PAIR SELECTION RULES

SUBSCRIBER CARRIER SYSTEMS

1. GENERAL

1.001 This addendum supplements Section 902-200-110, Issue 1.

1.002 This addendum is issued for the following reasons:

(a) To add waterproof cables and make minor corrections to air core cable loss factors and temperature coefficients in Table A.

(b) To correct paragraph 5.26.

(c) To change copyright notice.

2. CHANGES TO SECTION

2.001 On the bottom of Page 1, delete the copyright notice and add the following: Not for use or disclosure outside the Bell System except under written agreement.

2.002 On Page 4, Table A, Cable Losses at 772 kHz, replace information in table with new Table A.

2.003 On Page 9, change paragraph 5.26 to read: DILEP stores data on 52 different cable codes (cable types), as listed in Table A.

TABLE A

CABLE LOSSES AT 772 kHz

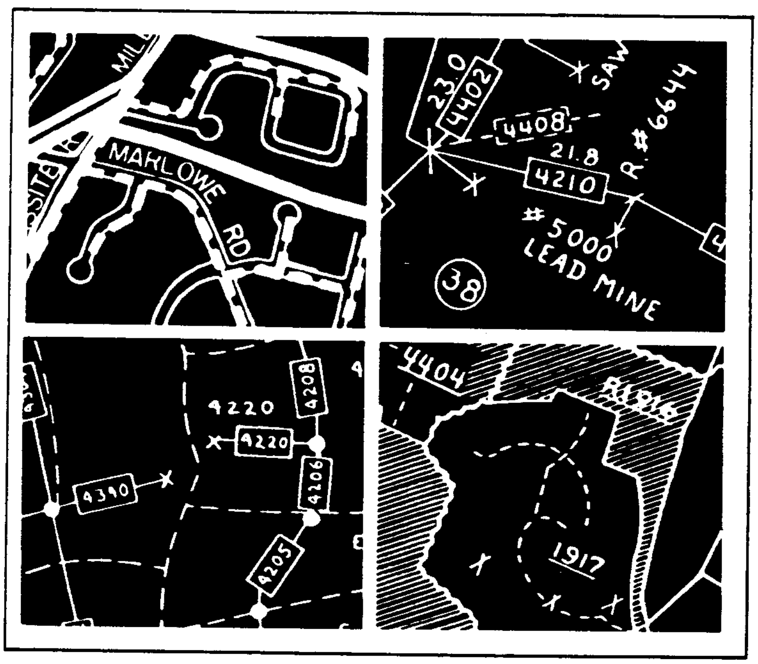
CABLE TYPE	MUTUAL CAPAC. nF/MILE AT 900 Hz	ENGR LOSS AT 55°F IN dB/Kft	TEMP COEF. FOR 10°F STEPS IN dB/Kft
17 AHC	83	3.18	0.030
*17 ALC	83	3.20	0.034
17 ANC	83	3.80	0.028
19 AHB	83	3.18	0.030
*19 ALB	83	3.20	0.027
19 ANB, DNB, GNB	66	3.00	0.025
**19 BHB	83	3.30	0.034
19 BNB, CNB, ENB, FNB	84	3.80	0.025
**19 ADB	83	3.90	0.034
**19 AJB	83	2.90	0.020
20 AHD	83	4.39	0.042
*20 ALD	83	4.40	0.043
20 AND	82	5.10	0.047
**22 ADA	83	5.20	0.034
22 AHA	83	4.39	0.043
**22 AJA	83	4.00	0.035
*22 ALA	83	4.40	0.040
**22 BHA	83	4.60	0.045
22 BSA, CSA, DSA, ESA	83	5.10	0.047
22 ASP (24 EQUIV)	84	6.80	0.066
**24 ADM	83	6.30	0.047
24 AKM	83	5.60	0.033
*24 ALM	83	5.50	0.052
24 ASM, BSM	72	5.90	0.057
**24 BKM	83	5.80	0.055
24 CSM, ESM	72	5.85	0.057
24 DSM, FSM	84	6.80	0.066
**24 AJM	83	5.00	0.048
**26 ADT	83	7.80	0.059
26 DST	83	8.17	0.096
26 AKT	83	7.50	0.041
*26 ALT	83	6.90	0.067
26 AST	69	6.80	0.066
26 CST	69	6.79	0.081
26 BST	79	7.70	0.093
**26 BKT	83	7.30	0.068
**26 AJT	83	6.30	0.065
COMPOSITE CABLES			
19 CAB	83	3.80	0.028
22 CAA	83	5.10	0.047
24 CAM	83	6.80	0.066
26 CAT	83	8.17	0.096

* Additions

** Changes

Outside Plant Engineering

Digital Line Engineering Program (DILEP)



Digital Line Engineering Program (DILEP)

Contents

1 INTRODUCTION

This section describes the use of the Digital Line Engineering Program (DILEP), a time-shared Engineering Planning and Analysis Systems (EPLANS) program. DILEP is designed to assist the outside-plant engineer in setting the spacing between repeaters for subscriber loop carrier systems (such as the SLC™-96) that employ digital line transmission at the T1 bit rate (1.544 Mbits per second).

This section is being reissued primarily to incorporate information on new features that have been added to DILEP. These new features are:

- The output now includes the ***length*** (in feet) of each repeater section (ie, each series of cable sections between two repeaters).
- Users may specify the ***loss limit*** globally for all repeater sections.
- Users may specify a ***loss-limit reduction*** for selected repeater sections.
- Users may specify ***surge-protected repeaters.***

This is a general revision of this section; therefore, arrows ordinarily used to indicate changes have been omitted.

Users do not need extensive knowledge of computers or programming to work with this program; familiarity with general information and instructions for the Remote Data Entry System (RDES) will provide the necessary background (see Section 901-601-110 and PA-599001). Note that only the CHANGE, DELETE, FILE, INSERT, LOCATE, PRINT, QUIT, and REPLACE commands for the edit mode are guaranteed to be supported by DILEP. BSP Section 902-200-110 (Digital Line Design and Pair Selection Rules for Subscriber Carrier Systems) provides the information necessary for adequate understanding of the engineering principles involved in repeater spacing. That section also provides guidelines and instructions for preparing data in the format required by DILEP.

A blank Route Data Sheet which may be copied for use in data preparation is provided on the last page of this BSP.

2 GENERAL

Digital line repeater spacing is based on insertion loss and on limitations imposed by crosstalk. Insertion loss, for a signal transmitted on a communication channel, is the ratio (expressed in dB) of received power to transmitted power. Crosstalk is the undesired power coupled into a communications circuit from other communications circuits. Three types of crosstalk are involved: near-end crosstalk (NEXT), far-end crosstalk (FEXT), and apparatus-case crosstalk (ACXT). Insertion loss and crosstalk are in turn affected by:

- Number of T1 lines in the cable
- Length of each cable section
- Type of plant construction
- Cable pressure treatment
- Cable code (cable type)
- Relative separation between transmit and receive pairs
- Pair unit size
- Type of apparatus case (800 or not).

The engineer of outside plant supplies the data for a DILEP analysis on ***Route Data Sheets.*** (A reduced-size sample sheet is shown in Figure 2-1; a larger, reproducible sheet is provided at the end of this BSP.) A DILEP ***user*** then accesses DILEP by means of an input/output device which is referred to throughout this section as a data ***terminal.*** The user enters all data (the ***input)*** from the Route Data Sheets into an input data file, using the data terminal keyboard. This information is transmitted via telephone lines to the time-share computer where it is received and stored. The user then requests DILEP to process the data file. Before processing the data, DILEP gives the user the opportunity to specify any or all of three options. It then analyzes the route data and causes a potential repeater location plan (the ***output)*** to be printed out or otherwise displayed at the terminal.

The engineer of outside plant must analyze the DILEP output to determine if modifications are needed to satisfy other engineering and economic considerations. Examples of such modifications could be the desire to locate repeaters at existing loading-coil sites or to avoid locating repeaters at inaccessible points. The engineer may modify the layout of the system to demand that repeaters be placed at specific locations; DILEP will then analyze the modified layout and insert additional intermediate repeaters when necessary.

Authorization and procedures for using DILEP may be obtained from the local EPLANS coordinator.

DILEP executes on a time-share computer, which may be a vendor-dependent system. Therefore, periodic updates, changes by a vendor, or a switch in vendors, are likely to occur. All references to DILEP operation on a particular Time-Share System (TSS) are contained in PA-599001 (RDES User's Guide), which is updated as required.

DILEP
ROUTE DATA SHEET

FILE NAME [ ][ ][ ][ ][ ][ ][ ][ ] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T][ ]
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF ACTIVE T-1 LINES	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25, 50, OR 100	(10)** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	(11)*** LOSS LIMIT REDUCTION (dB)

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

- 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
- ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
- REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
  IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"

** USE ONLY IF NECESSARY TO OVERRIDE DILEP

*** 15 dB MAXIMUM

Figure 2-1. Route Data Sheet.

3 DESCRIPTION OF DILEP

DILEP is an engineer-oriented tool for performing the mathematical analysis needed to obtain the location of digital line repeater sites for loop carrier systems.

3.1 Run Types

DILEP can be used to provide either an ***automatic*** run or a ***constrained*** run, as discussed below.

Automatic Run

The automatic run provides outputs specifying the proposed repeater sites, using, as the only input, information about the cable sections and the locations of remote terminals (RTs) and manholes. It provides optimal repeater spacing for the loop carrier system, but ignores any special engineering considerations; consequently, it may place repeaters at impractical locations such as at a busy intersection or in the middle of a river. If one or more repeaters are needed in underground plant, DILEP will place the repeaters at user-specified manhole sites if possible. If the user has not specified manhole sites within underground plant, DILEP will place, at optimal locations, the fewest repeaters required to achieve the transmission objectives. The output from the automatic run provides the outside-plant engineer with a starting-point design which he or she can then adapt to meet specific boundary conditions.

Constrained Run

The constrained run permits the engineer to specify some or all of the repeater locations to meet specific conditions. These specified repeaters are called Demand Repeaters (DRs). The program then uses location data (for demand repeaters, remote terminals, and manholes) and cable-section data to determine any additional repeater sites that are needed to satisfy the digital line transmission requirements.

In general, the user should start by making an automatic run to determine the minimum number of repeaters needed for the route. He or she can then use constrained runs, inserting DRs to meet specific conditions, until a satisfactory design has been developed.

3.2 Inputs

DILEP inputs are of two types: route data contained on an input data file previously prepared from Route Data Sheets, and additional options specified interactively by the user after he or she requests a run. A discussion of each type of input follows.

Route Data Sheet (Data file) Inputs

Before evaluating a route with DILEP, the user should enter the route data on a Route Data Sheet. (A reduced-size sample sheet is shown in Figure 2-1; a larger, reproducible sheet is provided at the end of this BSP.) Background information for preparing this sheet is given in Section 902-200-110. A properly filled-in sheet provides the following basic types of data in tabular form:

- Title information
- Cable section information
- RT and DR requests
- Manhole locations.

Each of these data types will now be discussed in more detail.

Title Information:

Two kinds of title information are provided on the Route Data Sheet:

FILE NAME—This identifies any particular data file among all possible data files being stored in the user's storage area. Use of this information is covered in 6.3—"Entering Input."

ROUTE DESCRIPTION—The route description line ("title"), if specified by the user, will appear at the top of the printed listing after the ***DIGITAL LINE ENGINEERING PROGRAM*** heading. The same description will appear each time the problem is run unless the user subsequently changes it. When the title line is entered into the input data file from a terminal, the format is:

T titlename

where *T* is typed immediately after the system cue and ***titlename*** can consist of up to 70 characters. Any spaces entered will count in the 70-character limit. If a title line is given, it must be the first line of the data file that will be submitted to DILEP.

Cable Section Information:

The required data for each cable section (100 sections maximum for each route or route segment) is given on a line across the first nine columns of the Route Data Sheet. The contents of each column, in order by number as given on the Route Data Sheet, are:

(1) Cable section numbers, numbered consecutively from the Central Office (CO), starting with 1

(2) Previous cable section numbers, starting with zero for the first section line on the sheet

(3) Ultimate number of active T1 lines (ie, those to be installed in the cable section during the planning period plus any already existing in the same sheath)

(4) Length of the cable section in feet, if more than 20 feet. (Sections less than 20 feet should be included with an adjacent section length.)

(5) Type of outside plant construction — ie, aerial (A), buried (B), or underground (U)

(6) Pressurization code for each cable section—ie, pressurized (P) or nonpressurized (N)

(7) Cable type code— three letters, plus a fourth letter if the cable is reclaimed or screened (X for reclaimed, S for screened)[1]

(8) Relative pair-unit separation between transmit and receive pairs—ie, same unit (S), adjacent units (A), or nonadjacent units (N)

(9) Pair-unit size (number of pairs per cable unit)— 8, 9, 11, 12, 13, 16, 17, 25, 50, or 100.

(10) Insertion loss factor in dB per kilofoot. User inserts a value in this column only if a factor other than the normal is wanted.

(11) Loss limit reduction in dB. User inserts a value in this column for only those sections whose loss limit is to be reduced (if any).

When entered into the input data file from a terminal, the data for one section must be typed entirely on one input line and in the same sequence as given on the Route Data Sheet. The data items must be separated by commas.

RT and DR Requests:

On the Route Data Sheet, each RT or DR entry is made in column 1 as the only entry on the next line after the number of the cable section in which the RT or DR appears. To enter the request for a ***remote terminal*** into the input data file, the user types an input line containing only the letters RT. To enter the request for a ***demand repeater,*** the user types an input line containing only the letters DR.

Manhole Locations:

On the Route Data Sheet, manhole locations (50 maximum for each route or route segment) can be designated as potential repeater sites either by interspersing them on separate data lines among the cable sections with which they are associated or by entering them as a separate group after a number of cable sections. They must, however, be given in order of increasing distance from the CO. On the Route Data Sheet, the user designates a manhole by entering in column 1 a letter ***M*** and in column 2 the cumulative distance from the CO to the manhole. The user inputs manhole site locations (potential repeater sites) in the format

M, distance

where ***M*** is typed immediately after the system cue and ***distance*** is the

1. For screened cable, the user must also specify the pair separation as nonadjacent (see "Input Alternatives and Options").

cumulative distance of the manhole site from the CO. One comma must separate ***M*** and ***distance.***

Interactive Inputs

Before processing the data, DILEP prints out each of the following questions in sequence:

> 800-TYPE APPARATUS CASE? (Y OR N)
>
> ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>
> CHANGE LOSS LIMIT? (Y OR N)

After each question, DILEP prints a prompt symbol and waits for a response from the user before proceeding. If the user's response to the third question is "Y", DILEP then asks "TO WHAT?", prints a prompt, waits for a valid loss-limit entry, then prints a confirming statement.

If the user specifies 800-series apparatus cases, the impairment caused by apparatus-case crosstalk will be virtually eliminated. If the user specifies surge-protected repeaters, the loss limit of all repeater sections except the first will be reduced by 1.5 dB (eg, from 33.5 dB to 32.0 dB). The reduction for the first repeater section will be only 1.0 dB (eg, from 23.0 dB to 22.0 dB) because there is no surge-protected repeater at the input end to add the other 0.5 dB. The user may also reduce the loss limit for all repeater sections below the default loss value of 33.5 dB to as low as 20.0 dB.

Input Alternatives and Options

When composite cable is used in the route, DILEP supplies a default value for the ***insertion loss per kilofoot.*** If the cable loss is known to differ from the default value, the user may override the default value by entering the desired value in column 10 of the Route Data Sheet. When it is to be entered into the computer, the new value is typed immediately following the last item of required information (ie, the pair-unit size), on the same input line. If the insertion loss per kilofoot is given, it may contain a decimal point. An example of a cable section entry with overriding insertion loss per kilofoot is:

3,2,5,3000,A,P,CAA,S,50,3.9

If a section of cable is ***screened***, the user must enter, in column 7 of the Route Data Sheet, the letter ***S*** as the fourth letter of the cable code. Also, the user must specify the pair unit separation as nonadjacent (letter ***N*** in column 8 of the Route Data Sheet, Figure 2-1) so that DILEP will recognize the cable as screened. DILEP assumes a 15-dB NEXT advantage for screened cable; therefore, ACXT and FEXT are the controlling types of interference in this situation.

When ***reclaimed*** cable is used in the route, the user must enter the letter ***X*** as the fourth letter of the cable code in column 7 of the Route Data Sheet. This will cause a 35 percent increase in the DILEP-provided insertion loss per kilofoot, since reclaimed cable has a higher capacitance than nonreclaimed cable.

In practice, the situation often arises where the user would like to decrease the *loss limit* of only one, or some, of the sections of the digital line (eg, to compensate for power line induction). To designate this to DILEP, the user enters the desired limit in column 11 of the Route Data Sheet. The computer entry must then have a ",R" at the end of the data line for a section, followed immediately by the dB amount of the reduction as entered on the Route Data Sheet. The reduction amount must be a number between 0.0 dB and 15.0 dB. A decimal point is not required; entries such as ",R3" are perfectly acceptable. This reduction is an option which behaves much like the option of overriding the default cable insertion loss. If the user wishes to do both—to override the default insertion loss and to specify a reduction—the insertion loss must be specified first. The reduction, if used, must always be the last item specified for the cable section. If the user tries to specify a reduction less than 0.0 dB or greater than 15.0 dB, DILEP will still run but the reduction will be set to 0.0 dB. An example of a cable section entry with a 3 dB loss limit reduction is:

3,2,5,3000,A,P,CAA,S,50,R3

3.3 Program Functions

DILEP will locate a repeater at each route ***junction*** if the user has not already placed an RT or a DR there. (A junction is formed when a single system serves two or more branches of a feeder route, or where lines from two or more systems enter the same feeder route; DILEP can handle up to 10 junctions per route or route segment.) DILEP also will place RTs at the end of each digital line. When a single system serves two or more branches of a feeder route, the cumulative distances of cable sections and repeater sites will be the actual distances from the CO, not the total length of the path (see last paragraph of 5.1—"Automatic Run").

DILEP ensures that the insertion loss for a repeater section will be within the minimum and maximum insertion loss limits given in Table 3-1. Even if a repeater is moved to the full extent of either the backward or forward margin, the final insertion loss will be between the minimum and maximum limits.

TABLE 3-1

REPEATER SPACING AS LIMITED BY CABLE INSERTION LOSS IN dB AT 772 kHz

REPEATER SECTION	MINIMUM LOSS (dB)	MAXIMUM LOSS (dB)
Adjacent to the CO	9.2	23.0
Not adjacent to the CO	9.2	33.5

When an RT or a DR has been requested by the user and the insertion loss limit for the repeater section has not yet been reached, DILEP subtracts the actual section loss from the permissible section loss. It then attempts to ***equalize*** the repeater sections—ie, to spread this difference over all repeaters between the previous and the current DR points. Groups of repeaters consisting solely of an RT or a DR cannot be equalized. Because equalization is done on an insertion loss basis rather than on a crosstalk basis, the forward and backward margins for a group of repeaters will be approximately equal, while the maximum number of T1 lines may differ for repeaters in the group. Equalization may cause the locations of the repeaters to change if one of the repeaters in the group is respecified as a DR and the other repeater sites are left to be calculated by DILEP.

Equalizing the repeater sections by spreading the insertion-loss difference over several repeater sections results in each equalized section having slightly less insertion loss than the maximum loss for that section, rather than the section containing the RT or DR having substantially less insertion loss than the maximum loss. This results in three benefits:

1. It is desirable to have the actual design loss less than the maximum permissible loss. From a transmission point of view, this provides additional transmission margins for factors such as high ambient cable temperatures, moisture accumulation in the cable, and cable manufacturing variations.
2. The smaller insertion loss provides repeater spacings that can accommodate additional T1 lines without the need to add repeater locations if unforecasted growth occurs during the study period.
3. The difference between actual loss and maximum permissible loss makes it possible to provide backward and forward margins for repeater sites, to assist the engineer in tailoring the line design to possible physical constraints.

When actual loss equals maximum loss for all repeaters in a route, the backward and forward margins will always be zero, and the maximum number of T1 lines for each repeater section will be no greater than the number specified by the user.

3.4 Outputs

DILEP analyzes the route problem data the user has previously stored in an input data file and provides two types of output— route description data (based on cable sections) and repeater section data (based on the series of cable sections between repeaters).

Route Description Data:

1. The title of the route problem.
2. For each cable section: the nine items of data entered by the user from the input data file for that cable section, the insertion loss factor being employed (default or specified), the insertion-loss limit imposed on the repeater section by that cable, the simplex loop resistance in ohms, the cumulative simplex loop resistance from the CO to the end of the section, and the cumulative distance from the CO to the end of that section. (The simplex loop resistance may be used in the design of repeater powering.) The abbreviated headings used for the section data on the printouts are:
   - SEC # (cable section number)
   - PRV SEC (number of the previous cable section)
   - # T1 LINES (number of T1 lines specified by the user)
   - SEC LEN (cable section length)

- TYP PLT (type of outside plant construction)
- P N (pressurized or nonpressurized)
- CA CODE (cable code)
- PR SP (pair unit separation)
- UNIT SIZE (number of pairs in each cable unit)
- DB/KFT LOSS (loss at 772 KHz, from stored DILEP data file)
- LOSS LIMIT (the maximum loss allowed in a repeater section that includes the type of cable used in this cable section)
- RESIST (simplex loop resistance between repeaters)
- CUM RESIST (cumulative simplex resistance between the CO and the repeater)
- CUM LENGTH (cumulative distance from the CO to the end of that cable section).

3. RT and DR locations in their input sequence among the cable section numbers.
4. A separate list of the manhole locations that were input as potential repeater locations.

Repeater Section Data:

The repeater section data is given in parts. Each part spans a series of cable sections along one of two possible types of path:

- From the CO to the end of the first ***branch*** of the route, or
- From one ***junction*** to the end of any branch of the route other than the first.

For each repeater section, the information is given under the following headings on the printout:

- REPEATER (the number of the section, followed by a code designating a special repeater, if applicable). The codes can designate a remote terminal (RT), demand repeater (DR), manhole (MH), or new manhole (NM).
- DISTANCE FROM C.O. (the distance in feet from the CO to the repeater site)
- SECTION LENGTH (repeater section length—distance between repeaters— in feet)
- DESIGN LOSS (DB) (the design insertion loss in dB at 772 kHz)
- MAX T1 LINES (the maximum number of T1 lines that can be assigned)
- BKWD MARGIN (the backward margin— ie, the distance that a repeater can be moved back toward the CO)
- FWD MARGIN (the forward margin— ie, the distance that a repeater can be moved forward, away from the CO)

3.5 Backward and Forward Margins

DILEP computes two types of margins that provide a measurement of the flexibility in the route design. First, it computes a backward and a forward margin for each repeater site. The ***backward margin*** is the number of feet a repeater site can be moved toward the CO without disturbing any other repeater location. The ***forward margin*** is the number of feet the repeater site can be moved away from the CO without disturbing any other repeater location. Calculation of the backward and forward margins for a particular repeater site is made under the assumption that the repeaters on either side of the site are not moved. ***If the user wishes to move two adjacent repeaters, he or she must rerun the DILEP program and specify the two new locations as DRs to ensure that no additional repeater is necessary.***

Backward and forward margins are not calculated for RTs, because cable data is not available for the cable beyond the RT site when the site is at the end of a digital line branch. RTs at the end of digital line branches can be moved back toward the CO as long as the insertion loss for the repeater section is not reduced below 9.2 dB. Backward and forward margins are not calculated for DRs at junctions, since these repeaters must be placed as close to the physical location of the junction as possible. However, backward and forward margins are calculated for all other DRs to indicate how much accuracy can be tolerated in measuring their distance from the CO. The user also should be aware that when a normal repeater is changed to a DR, DILEP will adjust the locations of repeaters on both sides of the new DR to achieve optimal repeater spacing between DR and RT locations. This condition may arise even if the new DR is placed at its DILEP-calculated site instead of being moved to a new site. If the user wishes to change one repeater to a DR and to leave all others in their original positions, he must specify as DRs all repeaters between two DRs, between two RTs, or between any combination of these.

3.6 Maximum Number of T1 Lines

The second type of margin calculated by DILEP is the maximum number of T1 lines that can be used in each repeater section. Calculation is made under the assumption that the repeaters at either end of a repeater section are not moved from their DILEP-calculated sites. If the user moves one or more repeaters in the route to obtain the final design, the maximum number of T1 lines calculated by DILEP may no longer be valid. The user should request DRs at the final sites for ***all*** repeaters and then rerun DILEP to obtain the maximum number of T1 lines that can be handled by each repeater section in the final design plan.

Note. Caution should be exercised when interpreting the maximum number of T1 lines calculated by DILEP, considering the following factors:

1. DILEP has no knowledge of cable size; therefore, the calculated maximum number of T1 lines could require more cable pairs than the cable contains.
2. DILEP has no knowledge of cable layup (ie, positioning of the pairs); therefore, it may not be possible to maintain the specified pair-unit separation for all T1 lines as the maximum number of T1 lines is approached.

3.7 Manhole Locations

If a repeater must be located in an underground cable section, it will be located at one of the specified manhole sites and marked with the letters ***MH***. However, if a repeater must be located in an underground cable and no manhole sites are specified, or if the number of manhole sites specified is insufficient to allow all required repeaters to be located at existing manhole sites, DILEP will determine the repeater sites and mark them with the letters ***NM*** to indicate that new manholes are needed.

3.8 Sample Problem

A simplified sample DILEP problem to introduce procedures is illustrated in Figures 3-1A through 3-1H. Figures 3-1A through 3-1C show the associated route schematic, Route Data Sheet, and route printout, respectively. Figure 3-1D shows a sample run in which all interactive questions are answered in the negative (N) and no loss limit reductions are specified by cable section. Each of the next three figures (3-1E, 3-1F, and 3-1G) illustrates the effect of a positive answer (Y) to a different one of the interactive questions while the others remain negative so that the effect of each option in isolation can be noted. Another figure (3-1H) then illustrates how the loss limit of any cable section can be reduced independently of the other cable sections.

The effects of different answers to the interactive questions can be noted by a careful study of the different examples (Figures 3-1E through 3-1H) in comparison with the reference figure (3-1D) where no options were requested. Figure 3-1E shows the effect of specifying 800-type apparatus cases. Here the repeater locations are the same as in Figure 3-1D but the maximum number of T1 lines is increased. When protected repeaters are specified (Figure 3-1F), the repeater locations stay approximately the same but the maximum number of T1 lines decreases. In Figure 3-1G, the loss limit for all repeater sections is reduced globally from 33.5 dB to 30.8 dB; the repeater locations are identical to those in Figure 3-1D but the maximum number of T1 lines is decreased. In Figure 3-1H, the loss limit of the first cable section is reduced by 3.0 dB (from 33.5 dB to 30.5 dB); this does not affect the repeater spacing or the maximum number of T1 lines (see Figure 3-1D) because the first repeater section is limited to 23.0 dB anyway.

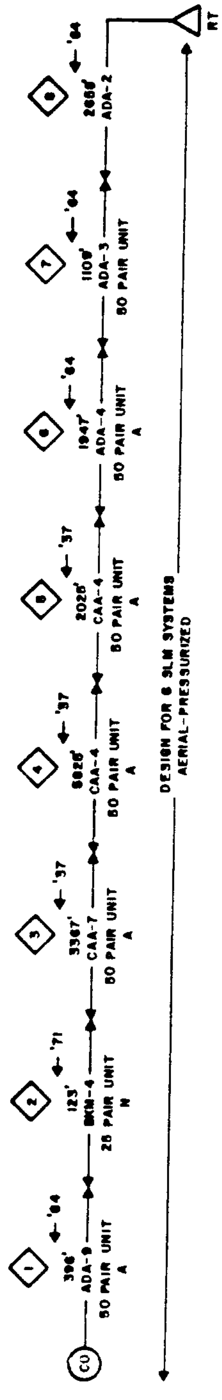


Figure 3-1A. Sample DILEP Problem, Route Schematic.

DILEP
ROUTE DATA SHEET

FILE NAME | S | A | M | P | L | E | | | DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION | T | ▨ | S | A | M | P | L | E | | D | I | L | E | P | | P | R | O | B | L | E | M | …
(UP TO 40 CHARACTERS)

① CABLE SECTION NUMBER	② PREVIOUS CABLE SECTION NUMBER	③ NUMBER OF ACTIVE T-1 LINES	④ CABLE SECTION LENGTH IN FT	⑤ TYPE OF CONSTRUCTION A, B, U	⑥ PRESSURE CODE P, N	⑦ CABLE CODE *	⑧ PAIR UNIT SEPARATION S, A, N	⑨ UNIT SIZE 8, 12, 16, 25, 50, OR 100	⑩ ** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	⑪ *** LOSS LIMIT REDUCTION (dB)
1	0	6	396	A	P	ADA	A	50		
2	1	6	123	A	P	BKM	N	25		
3	2	6	3367	A	P	CAA	A	50	4.1	
4	3	6	5825	A	P	CAA	A	50	4.1	
5	4	6	2025	A	P	CAA	A	50	4.1	
6	5	6	1947	A	P	ADA	A	50		
7	6	6	1109	A	P	ADA	A	50		
8	7	6	2658	A	P	ADA	A	50		
RT										

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL
• 800 - TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
• ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
• REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP
*** 15 dB MAXIMUM

Figure 3-1B. Sample DILEP Problem. Route Data Sheet.

```
NEXT?
>CREATE  <----------------- NOTE 1
FILENAME? >SAMPLE
NEW FILE:
INPUT:

>T SAMPLE DILEP PROBLEM
>1,0,6,396,A,P,ADA,A,50
>2,1,6,123,A,P,BKM,N,25
>3,2,6,3367,A,P,CAA,A,50,4.1  <------ NOTE 2
>4,3,6,5825,A,P,CAA,A,50,4.1
>5,4,6,2025,A,P,CAA,A,50,4.1
>6,5,6,1947,A,P,ADA,A,50
>7,6,6,1109,A,P,ADA,A,50
>8,7,6,2658,A,P,ADA,A,50
>RT
>     <------ NOTE 3
EDIT:
>FILE  <------ NOTE 4


NEXT?
>DILEP  <------ NOTE 5
```

NOTES ON THE ABOVE PRINTOUT:

Note 1: The user enters the input mode to create a new data file.

Note 2: CAA represents a composite cable with the digital lines in 22 gauge. The 4.1 data field is used to override the DILEP-provided default for the insertion loss per kilofoot.

Note 3: The user depresses the RETURN key without data input to enter a null line and transfer to the edit mode.

Note 4: The user saves the data file in his or her storage area.

Note 5: The user requests that the DILEP program be run.

Figure 3-1C. Sample DILEP Problem, Route Printout.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N
```

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SAMPLE DILEP PROBLEM

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	6	396	A	P	ADA	A	50	5.49	30.5	7.2	7.2	396
2	1	6	123	A	P	BKM	N	25	6.27	33.5	3.6	10.8	519
3	2	6	3367	A	P	CAA	A	50	4.10	33.5	61.6	72.5	3886
4	3	6	5825	A	P	CAA	A	50	4.10	33.5	106.6	179.1	9711
5	4	6	2025	A	P	CAA	A	50	4.10	33.5	37.1	216.1	11736
6	5	6	1947	A	P	ADA	A	50	5.49	33.5	35.6	251.7	13683
7	6	6	1109	A	P	ADA	A	50	5.49	33.5	20.3	272.0	14792
RT 8	7	6	2658	A	P	ADA	A	50	5.49	33.5	48.6	320.7	17450

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4624	4624	19.76	>200	736	780
2	11937	7313	30.26	26	689	582
3 RT	17450	5513	30.26	36	0	0

Figure 3-1D. Sample DILEP Problem Run, All Options N.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>Y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N


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```

SAMPLE DILEP PROBLEM

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	6	396	A	P	ADA	A	50	5.49	30.5	7.2	7.2	396
2	1	6	123	A	P	BKM	N	25	6.27	33.5	3.6	10.8	519
3	2	6	3367	A	P	CAA	A	50	4.10	33.5	61.6	72.5	3886
4	3	6	5825	A	P	CAA	A	50	4.10	33.5	106.6	179.1	9711
5	4	6	2025	A	P	CAA	A	50	4.10	33.5	37.1	216.1	11736
6	5	6	1947	A	P	ADA	A	50	5.49	33.5	35.6	251.7	13683
7	6	6	1109	A	P	ADA	A	50	5.49	33.5	20.3	272.0	14792
8	7	6	2658	A	P	ADA	A	50	5.49	33.5	48.6	320.7	17450
RT													

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4624	4624	19.76	>200	786	780
2	11937	7313	30.26	33	689	582
3 RT	17450	5513	30.26	45	0	0

Figure 3-1E. Sample DILEP Problem Run, First Option Y.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>Y
CHANGE LOSS LIMIT? (Y OR N)
>N
```

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SAMPLE DILEP PROBLEM

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	6	396	A	P	ADA	A	50	5.49	29.0	7.2	7.2	396
2	1	6	123	A	P	BKM	N	25	6.27	32.0	3.6	10.8	519
3	2	6	3367	A	P	CAA	A	50	4.10	32.0	61.6	72.5	3886
4	3	6	5825	A	P	CAA	A	50	4.10	32.0	106.6	179.1	9711
5	4	6	2025	A	P	CAA	A	50	4.10	32.0	37.1	216.1	11736
6	5	6	1947	A	P	ADA	A	50	5.49	32.0	35.6	251.7	13683
7	6	6	1109	A	P	ADA	A	50	5.49	32.0	20.3	272.0	14792
8	7	6	2658	A	P	ADA	A	50	5.49	32.0	48.6	320.7	17450
RT													

PART 1

REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4705	4705	20.10	158	428	439
2	11967	7262	30.10	20	377	327
3 RT	17450	5483	30.10	25	0	0

Figure 3-1F. Sample DILEP Problem Run, Second Option Y.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>Y
TO WHAT?
>30.8
LOSS LIMIT IS NOW 30.8 DB MAXIMUM
```

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SAMPLE DILEP PROBLEM

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	6	396	A	P	ADA	A	50	5.49	27.8	7.2	7.2	396
2	1	6	123	A	P	BKM	N	25	6.27	30.8	3.6	10.8	519
3	2	6	3367	A	P	CAA	A	50	4.10	30.8	61.6	72.5	3886
4	3	6	5825	A	P	CAA	A	50	4.10	30.8	106.6	179.1	9711
5	4	6	2025	A	P	CAA	A	50	4.10	30.8	37.1	216.1	11736
6	5	6	1947	A	P	ADA	A	50	5.49	30.8	35.6	251.7	13683
7	6	6	1109	A	P	ADA	A	50	5.49	30.8	20.3	272.0	14792
8	7	6	2658	A	P	ADA	A	50	5.49	30.8	48.6	320.7	17450
RT													

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4624	4624	19.76	129	97	97
2	11937	7313	30.26	13	72	72
3 RT	17450	5513	30.26	17	0	0

Figure 3-1G. Sample DILEP Problem Run, Third Option Y.

```
T SAMPLE DILEP PROBLEM
1,0,6,396,A,P,ADA,A,50,R3
2,1,6,123,A,P,BKM,N,25
3,2,6,3367,A,P,CAA,A,50,4.1
4,3,6,5825,A,P,CAA,A,50,4.1
5,4,6,2025,A,P,CAA,A,50,4.1
6,5,6,1947,A,P,ADA,A,50
7,6,6,1109,A,P,ADA,A,50
8,7,6,2658,A,P,ADA,A,50
RT
```

```
EXECUTION:
300-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N
```

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SAMPLE DILEP PROBLEM

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	6	396	A	P	ADA	A	50	5.49	30.5	7.2	7.2	396
2	1	6	123	A	P	BKM	N	25	6.27	33.5	3.6	10.8	519
3	2	6	3367	A	P	CAA	A	50	4.10	33.5	61.6	72.5	3886
4	3	6	5825	A	P	CAA	A	50	4.10	33.5	106.6	179.1	9711
5	4	6	2025	A	P	CAA	A	50	4.10	33.5	37.1	216.1	11736
6	5	6	1947	A	P	ADA	A	50	5.49	33.5	35.6	251.7	13683
7	6	6	1109	A	P	ADA	A	50	5.49	33.5	20.3	272.0	14792
8	7	6	2658	A	P	ADA	A	50	5.49	33.5	48.6	320.7	17450

RT

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4624	4624	19.75	>200	786	780
2	11937	7313	30.26	26	639	582
3 RT	17450	5513	30.25	36	0	0

Figure 3-1H. Sample DILEP Problem Run, Reduced Loss Limit.

4 EVALUATION OF THE PRINTOUT

When the engineer receives the proposed repeater sites from DILEP, he or she must evaluate the design with the following questions in mind:

1. Is there sufficient margin in the design in terms of maximum number of T1 lines and forward and backward margin?
2. Are the proposed sites physically suitable? (This can be determined by making a field check of the sites.)

If the proposed design is unsatisfactory, the engineer can use a constrained run, requesting DRs at locations that will create additional margin in the route or at physically acceptable locations such as loading-coil sites, to obtain a new design. This process can be repeated as necessary until a final route design is obtained.

5 PROBLEM EXAMPLES

More detailed examples of problem inputs and their solutions will now be given, with emphasis on the capabilities of DILEP and on basic procedures used to input data and obtain the output solutions.

The user must type certain commands to enter or change problem data and to run the DILEP program. Throughout this section, the following commands are used:

1. The CREATE command, together with the name of a data file not already saved in the user's storage area, is used to enter the ***input*** mode to begin entering data for a new data file.
2. The ACCESS command, together with the name of a data file currently saved in the user's storage area, is used to enter the ***edit*** mode so the data file can be modified.
3. The FILE command is used to ***store*** a data file.
4. The DILEP command, together with the appropriate data file name, is used to ***run*** the DILEP program.

Additional commands can be found in RDES PA-599001 (see INTRODUCTION). Throughout that PA, the "greater-than" symbol (>) is used as the prompt, or cue, to indicate that the TSS is ready to receive input. This symbol thus precedes all user input.

5.1 Automatic Run

Figure 5-1 is a route schematic of a proposed Subscriber Loop Multiplex (SLM™) carrier route. Each SLM system requires one T1 line. Figure 5-2 gives the corresponding Route Data Sheets prepared from this schematic. In this example, the user has elected to have DILEP automatically place all repeaters (other than the RTs) that are needed on the route. The proposed route contains one junction at the end of cable section 24. The junction occurs where a single system serves two branches of the feeder route. Note that cable sections 25 and 26 must be designed for two T1 lines to reflect the digital line loop-back design procedure covered in Section 902-200-110. Only three manhole sites have been specified by the user. One of these sites is located near the center of section 4, and the other two are located at the ends of cable sections 4 and 5. Note that other manhole sites could have been included if the user had so desired, either at the ends of other underground cable sections or within any underground cable section.

This example is used in Section 902-200-110, and the development of the Route Data Sheet from the route schematic is discussed there. From the Route Data Sheet, the user can create a data file as shown in Figure 5-3. The user can now analyze the route by executing DILEP; the procedure and results are shown in Figure 5-4.

If the user had not requested RTs after cable sections 26 and 28, DILEP would have automatically placed RTs at these points, since the ends of all digital line branches must terminate in an RT. Similarly, if the user had not requested a DR at the route junction (the end of section 24), DILEP would have automatically placed a DR at this site, since all route junctions ***must*** be repeater sites.

Since the first repeater was not needed until after the start of aerial cable, DILEP did not need to use any of the manhole sites.

The repeater section in the branch of the route has less than the minimum allowable loss; this caused the message "ONE OR MORE SECTIONS HAVE LESS THAN MIN. LOSS" to be printed. To bring this repeater section up to the minimum allowable loss, the user may either place the RT further out along the cable route or place a transmission pad at the RT. In situations where a second ***digital*** line is not likely to be extended beyond the RT, it is permissible to place a pad in the RT. Generally, pads in RTs should be avoided since the transmission levels of additional digital lines at these locations must be treated identically and there is no practical method of placing pads in repeater apparatus cases. Notice that the cumulative distances for the second part of the route (cable sections 27 and 28 and repeater 16) are the actual distances from the CO, not the total length of the path which would include the distance for looping back on the first branch (cable sections 25 and 26).

5.2 Constrained Run

For a constrained run, the user enters some or all repeaters as DRs. One possibility is to place DRs at all existing loading-coil sites and then have DILEP analyze the route to determine if additional repeaters are necessary.

The route schematic in Figure 5-1 was drawn so that loading-coil sites always fall between two logical cable sections. Consequently, the data file that was created by the user (Figure 5-3) can be easily modified to provide a constrained run. This is done by inserting a DR request after each line of cable section information in the data file that describes a cable section immediately preceding a loading-coil site. The loading coils after cable sections 17 and 23 have already been defined as RT sites. Therefore, it is not necessary to place DR requests after these cable sections.

The user can modify the data file by first locating the line of cable section information for the cable section preceding the loading-coil site and then inserting a DR request after the cable section line. This is done as shown in Figure 5-5. This modified data file can now be analyzed by DILEP, producing the results shown in Figure 5-6.

Comparison of this constrained run with the automatic run shows that placing DRs indiscriminately at every loading-coil site can be an expensive policy. This particular sample route required 50 percent more repeaters (24 instead of 16). Also, one of the DRs (repeater 20) forced a repeater section with less than minimum allowable loss to be created, and another DR (repeater 13) caused an RT section to have less than the minimum loss.

In general, the user first should make an automatic run to determine the minimum number of repeaters needed for the route, then gradually modify the data file to include a few new DRs on each successive constrained run. If the previous example is run using DRs at the loading-coil sites after cable sections 6, 10, 13, and 19 but omitting the DRs at the loading-coil sites after cable sections 4, 8, 11, 14, 16, and 21, a design is obtained which uses some of the loading-coil sites but requires fewer repeaters than when all loading-coil sites are used. This can be seen from the modified repeater section table as presented in Figure 5-7.

5.3 Two or More Systems

When two or more systems are planned at the same time and are to follow the same feeder route, DILEP can be used to calculate the necessary repeater sites for both systems simultaneously. This is done by using ***junctions*** to connect the separate branches of the systems to the feeder route. Figure 5-8 shows three systems which share cable sections 1 through 4. Systems 2 and 3 also share cable sections 9 through 12 (junctions occur after cable sections 4 and 12). Route Data Sheets that show the cable section data for the route are given in Figure 5-9.

The Route Data Sheet shows that cable sections 2 and 3 contain composite cable, and that for section 3 it is necessary to override the default value for the insertion loss factor that DILEP supplies. Cable section 15 uses reclaimed cable. Note that two manhole sites have been given for cable section 3.

The user can create the data file as shown in Figure 5-10 and run the problem as shown in Figure 5-11.

This designing of two or more systems simultaneously is recommended over designing each system separately for two reasons:

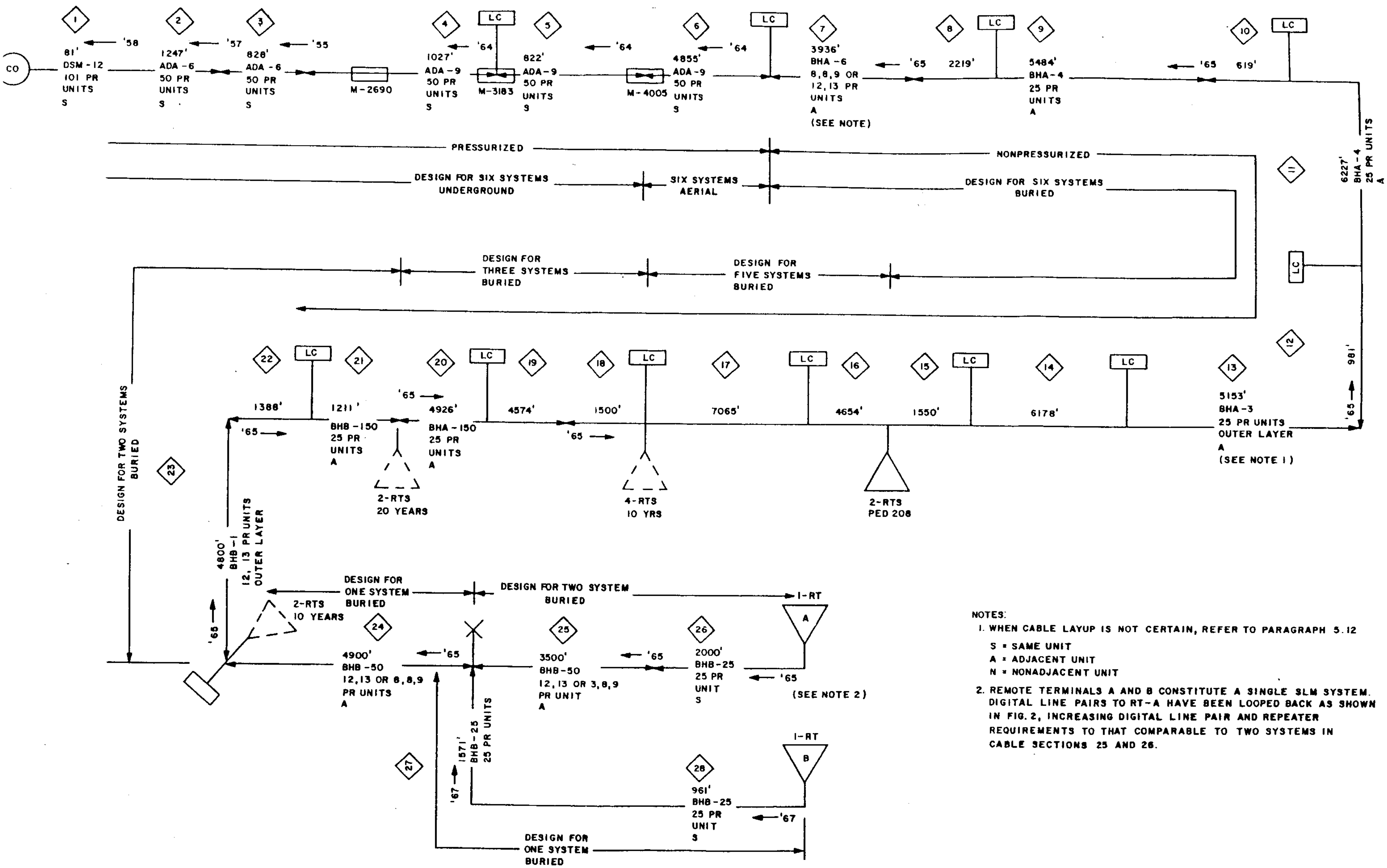
1. The portion of the route that is shared by all systems needs to be designed only once.
2. The DILEP program is executed only once to design all three systems, rather than once per system.

5.4 Additional System

When an unanticipated system must be added to an existing feeder route, it is necessary to review the design margin for the part of the feeder route that will be shared with the new system. In particular, the maximum number of T1 lines that can be accommodated by this portion of the feeder route must be examined to ensure that the new system can be properly handled. If the feeder route is operating at full capacity—ie, the number of T1 lines already installed in the feeder route is equal to the maximum number of T1 lines that can be handled—it is impossible to add the new system without adding intermediate repeaters in all repeater sections that currently operate with the maximum number of T1 lines. For this reason, it is important that the ***maximum*** number of T1 lines that will be installed over the planning period be employed in the initial route analysis.

When a new system is to be installed in an existing carrier route, it is done best by designing the new system so that it branches out from one of the repeater sites on the feeder route. If the new system must branch out between repeater sites, the branch cable will have to be in a sheath separate from the main cable sheath after the last common repeater point. Figure 5-12 illustrates this arrangement.

DILEP can be used to design the new system. The user must sectionalize the route data so that all existing repeater sites in the feeder route fall on cable section boundaries. The user also must request DRs at all points that correspond to existing repeater sites in the feeder route.



NOTES:

1. WHEN CABLE LAYUP IS NOT CERTAIN, REFER TO PARAGRAPH 5.12
   S = SAME UNIT
   A = ADJACENT UNIT
   N = NONADJACENT UNIT
2. REMOTE TERMINALS A AND B CONSTITUTE A SINGLE SLM SYSTEM. DIGITAL LINE PAIRS TO RT-A HAVE BEEN LOOPED BACK AS SHOWN IN FIG. 2, INCREASING DIGITAL LINE PAIR AND REPEATER REQUIREMENTS TO THAT COMPARABLE TO TWO SYSTEMS IN CABLE SECTIONS 25 AND 26.

Figure 5-1. Example Schematic of Proposed Digital Systems

DILEP
ROUTE DATA SHEET

FILE NAME [F][I][L][E][1][ ][ ][ ] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T][▨][S][A][M][P][L][E][ ][R][O][U][T][E][ ][N][O][.][1] (UP TO 40 CHARACTERS)

① CABLE SECTION NUMBER	② PREVIOUS CABLE SECTION NUMBER	③ NUMBER OF ACTIVE T-1 LINES	④ CABLE SECTION LENGTH IN FT	⑤ TYPE OF CONSTRUCTION A, B, U	⑥ PRESSURE CODE P, N	⑦ CABLE CODE *	⑧ PAIR UNIT SEPARATION S, A, N	⑨ UNIT SIZE 8, 12, 16, 25, 50, OR 100	⑩ ** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	⑪ *** LOSS LIMIT REDUCTION (dB)
1	0	6	81	U	P	DSM	S	50		
2	1	6	1247	U	P	ADA	S	50		
3	2	6	828	U	P	ADA	S	50		
4	3	6	1027	U	P	ADA	S	50		
M	2690									
M	3183									
5	4	6	822	U	P	ADA	S	50		
M	4005									
6	5	6	4855	A	P	ADA	S	50		
7	6	6	3936	B	N	BHA	A	12		
8	7	6	2219	B	N	BHA	A	25		
9	8	6	5484	B	N	BHA	A	25		
10	9	6	619	B	N	BHA	A	25		
11	10	6	6227	B	N	BHA	A	25		
12	11	6	981	B	N	BHA	A	25		
13	12	6	5153	B	N	BHA	A	25		
14	13	6	6178	B	N	BHA	A	25		
15	14	6	1550	B	N	BHA	A	25		
RT										
16	15	5	4654	B	N	BHA	A	25		
17	16	5	7065	B	N	BHA	A	25		

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL
• 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
• ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
• REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP
*** 15 dB MAXIMUM

Figure 5-2 (Sheet 1). Example Problem, Route Data Sheet.

DILEP
ROUTE DATA SHEET

FILE NAME [F I L E 1 _ _ _] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T ▨ S A M P L E _ R O U T E _ N O . 1 _ ...]
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF ACTIVE T-1 LINES	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25, 50, OR 100	(10)** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	(11)*** LOSS LIMIT REDUCTION (dB)
RT										
18	17	3	1500	B	N	BHA	A	25		
19	18	3	4574	B	N	BHA	A	25		
20	19	3	4926	B	N	BHA	A	25		
RT										
21	20	2	1211	B	N	BHB	A	25		
22	21	2	1388	B	N	BHB	A	25		
23	22	2	4800	B	N	BHB	A	12		
RT										
24	23	1	4900	B	N	BHB	A	12		
DR										
25	24	2	3500	B	N	BHB	A	12		
26	25	2	2000	B	N	BHB	S	25		
RT										
27	24	1	1571	B	N	BHB	S	25		
28	27	1	861	B	N	BHB	S	25		
RT										

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL
- 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
- ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
- REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
  IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"

** USE ONLY IF NECESSARY TO OVERRIDE DILEP

*** 15 dB MAXIMUM

Figure 5-2 (Sheet 2). Example Problem, Route Data Sheet.

```
NEXT?
>CREATE
FILENAME? >FILE1
EDIT:
NEW FILE:
INPUT:
>T SAMPLE ROUTE NO. 1
>1,0,6,81,U,P,DSM,S,50
>2,1,6,1247,U,P,ADA,S,50
>3,2,6,828,U,P,ADA,S,50
>4,3,6,1027,U,P,ADA,S,50
>M,2690
>M,3183
>5,4,6,822,U,P,ADA,S,50
>M,4005
>6,5,6,4855,A,P,ADA,S,50
>7,6,6,3936,B,N,BHA,A,12
>8,7,6,2219,B,N,BHA,A,25
>9,8,6,5484,B,N,BHA,A,25
>10,9,6,619,B,N,BHA,A,25
>11,10,6,6227,B,N,BHA,A,25
>12,11,6,981,B,N,BHA,A,25
>13,12,6,5153,B,N,BHA,A,25
>14,13,6,6178,B,N,BHA,A,25
>15,14,5,1550,B,N,BHA,A,25
>RT
>16,15,5,4654,B,N,BHA,A,25
>17,16,5,7065,B,N,BHA,A,25
>RT
>18,17,3,1500,B,N,BHA,A,25
>19,18,3,4574,B,N,BHA,A,25
>20,19,3,4926,B,N,BHA,A,25
>RT
>21,20,2,1211,B,N,BHB,A,25
>22,21,2,1388,B,N,BHB,A,25
>23,22,2,4800,B,N,BHB,A,12
>RT
>24,23,1,4900,B,N,BHB,A,12
>DR
>25,24,2,3500,B,N,BHB,A,12
>26,25,2,2000,B,N,BHB,S,25
>RT
>27,24,1,1571,B,N,BHB,S,25
>28,27,1,861,B,N,BHB,S,25
>RT
>
EDIT:
>FILE
```

Figure 5-3. Creating a Data File.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N


          ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                ****      ISSUE  4      ****

 SAMPLE ROUTE NO. 1

 SEC PRV #T1   SEC TYP P  CA  PR UNIT DB/KFT LOSS               CUM    CUM
  #  SEC LINES LEN PLT N CODE SP SIZE  LOSS  LIMIT RESIST    RESIST LENGTH
   1   0   6     81  U  P DSM  S   50   7.10  26.9    2.2       2.2     81
   2   1   6   1247  U  P ADA  S   50   5.35  25.7   20.9      23.1   1328
   3   2   6    828  U  P ADA  S   50   5.35  25.7   13.9      37.0   2156
   4   3   6   1027  U  P ADA  S   50   5.35  25.7   17.3      54.3   3183
   5   4   6    822  U  P ADA  S   50   5.35  25.7   13.8      68.1   4005
   6   5   6   4855  A  P ADA  S   50   5.49  25.9   88.8     156.9   8860
   7   6   6   3936  B  N BHA  A   12   5.09  30.3   66.1     223.1  12796
   8   7   6   2219  B  N BHA  A   25   5.09  31.0   37.3     260.3  15015
   9   8   6   5484  B  N BHA  A   25   5.09  31.0   92.1     352.5  20499
  10   9   6    619  B  N BHA  A   25   5.09  31.0   10.4     362.9  21118
  11  10   6   6227  B  N BHA  A   25   5.09  31.0  104.6     467.5  27345
  12  11   6    981  B  N BHA  A   25   5.09  31.0   16.5     484.0  28326
  13  12   6   5153  B  N BHA  A   25   5.09  31.0   86.6     570.5  33479
  14  13   6   6178  B  N BHA  A   25   5.09  31.0  103.8     674.3  39657
  15  14   6   1550  B  N BHA  A   25   5.09  31.0   26.0     700.4  41207
 RT
  16  15   5   4654  B  N BHA  A   25   5.09  31.8   78.2     778.6  45861
  17  16   5   7065  B  N BHA  A   25   5.09  31.8  118.7     897.2  52926
 RT
  18  17   3   1500  B  N BHA  A   25   5.09  33.5   25.2     922.4  54426
  19  18   3   4574  B  N BHA  A   25   5.09  33.5   76.8     999.3  59000
  20  19   3   4926  B  N BHA  A   25   5.09  33.5   82.8    1082.0  63926
 RT
  21  20   2   1211  B  N BHB  A   25   3.66  33.5   10.2    1092.2  65137
  22  21   2   1388  B  N BHB  A   25   3.66  33.5   11.7    1103.9  66525
  23  22   2   4800  B  N BHB  A   12   3.66  33.5   40.3    1144.2  71325
 RT
  24  23   1   4900  B  N BHB  A   12   3.66  33.5   41.2    1185.4  76225
 DR
  25  24   2   3500  B  N BHB  A   12   3.65  33.5   29.4    1214.8  79725
  26  25   2   2000  B  N BHB  S   25   3.66  25.9   16.8    1231.6  81725
 RT
  27  24   1   1571  B  N BHB  S   25   3.66  28.9   13.2    1198.6  77796
  28  27   1    861  B  N BHB  S   25   3.66  28.9    7.2    1205.8  78657
 RT
```

Figure 5-4 (Part 1). DILEP Run, Using Data File.

LOCATIONS OF MANHOLES FOR PART 1
2690 3183 4005

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 25

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4020	4020	21.65	16	201	218
2	8487	4467	24.52	8	218	227
3	13273	4785	24.52	8	242	235
4	19105	5832	29.69	8	235	235
5	24938	5833	29.69	8	235	235
6	30772	5834	29.69	8	235	235
7	36504	5832	29.69	8	1492	235
8 RT	41207	4603	23.43	38	0	0
9	47065	5359	29.83	9	353	353
10 RT	52926	5360	29.83	9	0	0
11	58426	5500	28.00	12	1060	1045
12 RT	63926	5500	28.00	12	0	0
13 RT	71325	7399	27.08	10	0	0
14 DR	76225	4900	17.93	82	0	0
15 RT	81725	5500	20.13	7	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 27 THROUGH 28

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
16 RT	78557	2432	8.90	104	0	0

ONE OR MORE SECTIONS HAVE LESS THAN MIN. LOSS

Figure 5-4 (Part 2). DILEP Run, Using Data File.

```
NEXT?
>ACCESS
FILENAME? >FILE1
EDIT:
>L ;1027;
4,3,6,1027,U,P,ADA,S,50
>I DR
>L ;4855;
6,5,6,4855,A,P,ADA,S,50
>I DR
>L ;2219;
8,7,6,2219,B,N,BHA,A,25
>I DR
>L ;619;
10,9,6,619,B,N,BHA,A,25
>I DR
>L 6227
11,10,6,6227,B,N,BHA,A,25
>I DR
>L ;5153;
13,12,6,5153,B,N,BHA,A,25
>I DR
>L ;6178;
14,13,6,6178,B,N,BHA,A,25
>I DR
>L ;4654;
16,15,5,4654,B,N,BHA,A,25
I DR
>L ;4574;
19,18,3,4574,B,N,BHA,A,25
>I DR
>L ;1211;
21,20,2,1211,B,N,BHB,A,25
>I DR
>FILE
```

Figure 5-5. Modifying a Data File.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N


            ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                  ****      ISSUE  4      ****

 SAMPLE ROUTE NO. 1

 SEC PRV #T1   SEC TYP P  CA  PR UNIT DB/KFT LOSS              CUM    CUM
  #  SEC LINES LEN PLT N CODE SP SIZE  LOSS  LIMIT RESIST  RESIST LENGTH
   1   0   6     81  U  P DSM  S   50   7.10  26.9    2.2     2.2     81
   2   1   6   1247  U  P ADA  S   50   5.35  25.7   20.9    23.1   1328
   3   2   6    828  U  P ADA  S   50   5.35  25.7   13.9    37.0   2156
   4   3   6   1027  U  P ADA  S   50   5.35  25.7   17.3    54.3   3183
 DR
   5   4   6    822  U  P ADA  S   50   5.35  25.7   13.8    68.1   4005
   6   5   6   4855  A  P ADA  S   50   5.49  25.9   88.8   156.9   8860
 DR
   7   6   6   3936  B  N BHA  A   12   5.09  30.3   66.1   223.1  12796
   8   7   6   2219  B  N BHA  A   25   5.09  31.0   37.3   260.3  15015
 DR
   9   8   6   5484  B  N BHA  A   25   5.09  31.0   92.1   352.5  20499
  10   9   6    619  B  N BHA  A   25   5.09  31.0   10.4   362.9  21118
 DR
  11  10   6   6227  B  N BHA  A   25   5.09  31.0  104.6   467.5  27345
 DR
  12  11   6    981  B  N BHA  A   25   5.09  31.0   16.5   484.0  28326
  13  12   6   5153  B  N BHA  A   25   5.09  31.0   86.6   570.5  33479
 DR
  14  13   6   6178  B  N BHA  A   25   5.09  31.0  103.8   674.3  39657
 DR
  15  14   6   1550  B  N BHA  A   25   5.09  31.0   26.0   700.4  41207
 RT
  16  15   5   4654  B  N BHA  A   25   5.09  31.8   78.2   778.6  45861
 DR
  17  16   5   7065  B  N BHA  A   25   5.09  31.8  118.7   897.2  52926
 RT
  18  17   3   1500  B  N BHA  A   25   5.09  33.5   25.2   922.4  54426
  19  18   3   4574  B  N BHA  A   25   5.09  33.5   76.8   999.3  59000
 DR
  20  19   3   4926  B  N BHA  A   25   5.09  33.5   82.8  1082.0  63926
 RT
  21  20   2   1211  B  N BHB  A   25   3.66  33.5   10.2  1092.2  65137
 DR
  22  21   2   1388  B  N BHB  A   25   3.66  33.5   11.7  1103.9  66525
  23  22   2   4800  B  N BHB  A   12   3.66  33.5   40.3  1144.2  71325
 RT
  24  23   1   4900  B  N BHB  A   12   3.66  33.5   41.2  1185.4  76225
```

Figure 5-6 (Part 1). DILEP Run, Using Modified Data File.

DR													
25	24	2	3500	B	N	BHB	A	12	3.66	33.5	29.4	1214.8	79725
26	25	2	2000	B	N	BHB	S	25	3.66	25.9	16.8	1231.6	81725
RT													
27	24	1	1571	B	N	BHB	S	25	3.66	28.9	13.2	1198.6	77796
28	27	1	861	B	N	BHB	S	25	3.66	28.9	7.2	1205.8	78657
RT													

LOCATIONS OF MANHOLES FOR PART 1

2690	3183	4005

PART 1

REPEATERS FOR CABLE SECTIONS 1 THROUGH 26

REPEATER #		DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	DR	3183	3183	17.18	45	1475	1077
2		6021	2838	15.47	67	1129	1129
3	DR	8860	2839	15.58	67	1129	1453
4		12157	3297	16.79	148	1453	1031
5	DR	15015	2858	14.55	>200	1021	1217
6		18066	3051	15.53	>200	1217	1217
7	DR	21118	3052	15.53	>200	1208	1296
8		24231	3113	15.85	>200	1296	1296
9	DR	27345	3114	15.85	>200	1296	1255
10		30412	3067	15.61	>200	1257	1257
11	DR	33479	3067	15.61	>200	1257	1257
12		36568	3089	15.72	>200	1257	1257
13	DR	39657	3089	15.72	>200	1257	0
14	RT	41207	1550	7.89	>200	0	0
15	DR	45861	4654	23.69	37	2671	1571
16		49393	3532	17.98	140	1689	1689
17	RT	52926	3533	17.98	140	0	0
18	DR	59000	6074	30.92	7	1650	471
19	RT	63926	4926	25.08	25	0	0
20	DR	65137	1211	4.43	>200	0	3628
21	RT	71325	6188	22.65	27	0	0
22	DR	76225	4900	17.93	82	0	0
23	RT	81725	5500	20.13	7	0	0

ONE OR MORE SECTIONS HAVE LESS THAN MIN. LOSS

PART 2

REPEATERS FOR CABLE SECTIONS 27 THROUGH 28

REPEATER #		DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
24	RT	78657	2432	8.90	104	0	0

ONE OR MORE SECTIONS HAVE LESS THAN MIN. LOSS

Figure 5-6 (Part 2). DILEP Run, Using Modified Data File.

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 26

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	4206	4206	22.69	13	36	36
2 DR	8860	4654	25.54	7	1785	39
3	12846	3986	20.30	64	1779	1933
4	16981	4135	21.06	69	1927	1925
5 DR	21118	4137	21.06	69	1954	1925
6	25237	4119	20.97	70	1964	1950
7	29359	4122	20.97	70	1973	1964
8 DR	33479	4120	20.97	70	2200	1964
9	37342	3863	19.67	95	2042	2039
10 RT	41207	3865	19.67	95	0	0
11	47066	5859	29.83	9	353	353
12 RT	52926	5860	29.83	9	0	0
13 DR	59000	6074	30.92	7	1650	471
14 RT	63926	4926	25.08	25	0	0
15 RT	71325	7399	27.08	10	0	0
16 DR	76225	4900	17.93	82	0	0
17 RT	81725	5500	20.13	7	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 27 THROUGH 28

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
18 RT	78657	2432	8.90	104	0	0

ONE OR MORE SECTIONS HAVE LESS THAN MIN. LOSS

15.53.01 >

Figure 5-7. Repeater Section Table, Modified.

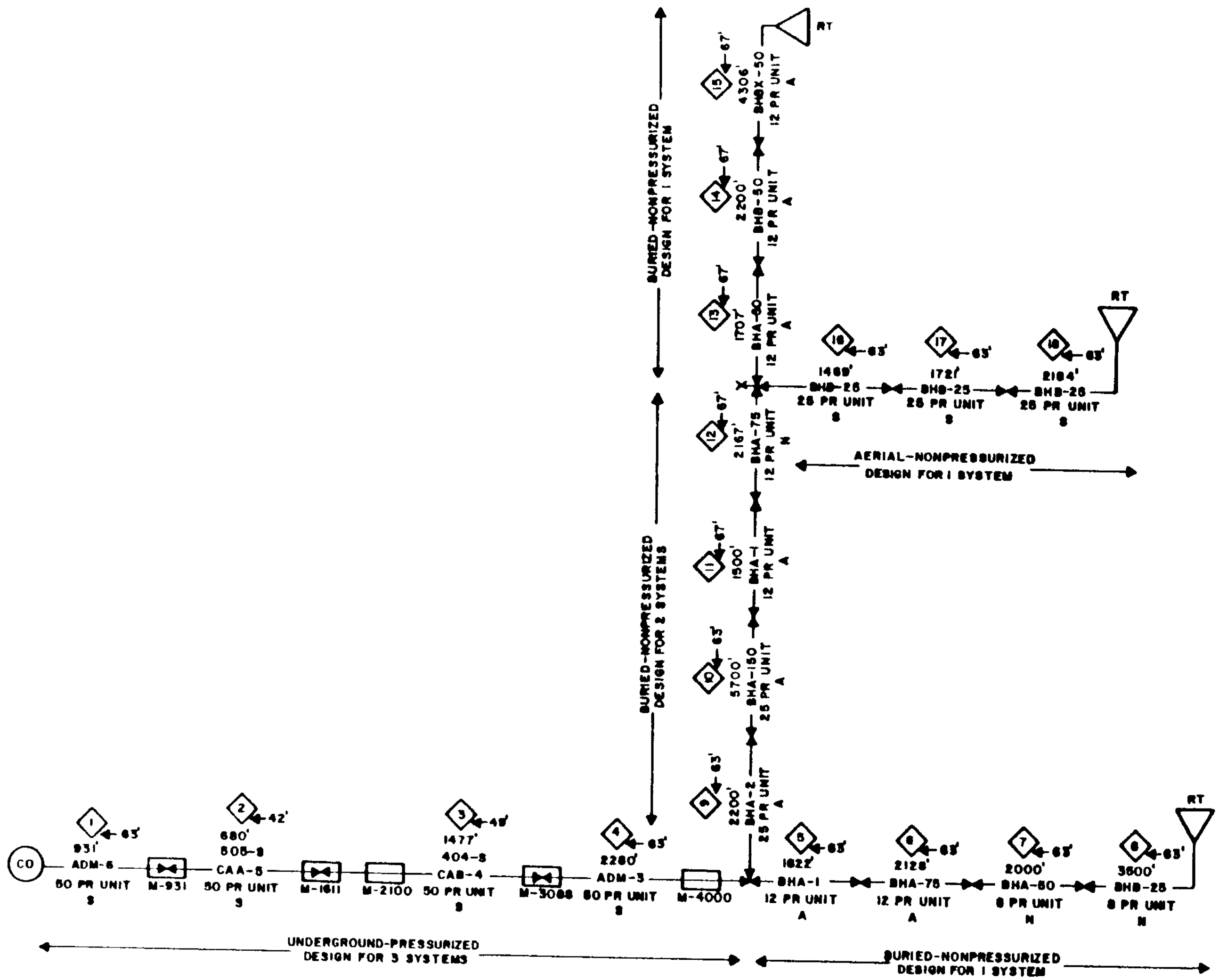


Figure 5-8. Schematic of Three SLM Systems.

DILEP
ROUTE DATA SHEET

FILE NAME F I L E 2 _ _ _ DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION T ▨ T H R E E _ S Y S T E M _ D E S I G N
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF ACTIVE T-1 LINES	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25, 50, OR 100	(10) ** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	(11) *** LOSS LIMIT REDUCTION (dB)
1	0	3	931	U	P	ADM	S	50		
M	931									
2	1	3	680	U	P	CAA	S	50		
M	1611									
3	2	3	1477	U	P	CAB	S	50	3.5	
M	2100									
M	3088									
4	3	3	2880	U	P	ADM	S	50		
M	4000									
5	4	1	1622	A	N	BHA	A	12		
6	5	1	2128	A	N	BHA	A	12		
7	6	1	2000	A	N	BHA	N	8		
8	7	1	3500	A	N	BHB	N	8		
9	4	2	2200	A	N	BHA	A	25		
10	9	2	5700	A	N	BHA	A	25		
11	10	2	1500	A	N	BHA	N	12		
12	11	2	2167	A	N	BHA	N	12		
13	12	1	1707	B	N	BHA	A	12		
14	13	1	2200	B	N	BHB	A	12		
15	14	1	4306	B	N	BHBX	A	12		
16	12	1	1469	A	N	BHB	S	25		

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL
• 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
• ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
• REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"
** USE ONLY IF NECESSARY TO OVERRIDE DILEP
*** 15 dB MAXIMUM

Figure 5-9 (Sheet 1). Three-System Design, Route Data Sheet.

DILEP
ROUTE DATA SHEET

FILE NAME [F|I|L|E|2| | |] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T| |T|H|R|E|E| |S|Y|S|T|E|M| |D|E|S|I|G|N| ...]
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF ACTIVE T-1 LINES	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25, 50, OR 100	(10) ** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	(11) *** LOSS LIMIT REDUCTION (dB)
17	16	1	1721	A	N	BHB	S	25		
18	17	1	2184	A	N	BHB	S	25		

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

- 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
- ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
- REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
  IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"

** USE ONLY IF NECESSARY TO OVERRIDE DILEP

*** 15 dB MAXIMUM

Figure 5-9 (Sheet 2). Three-System Design, Route Data Sheet.

```
NEXT?
>CREATE
FILENAME? >FILE2
EDIT:
NEW FILE:
INPUT:
>T THREE SYSTEM DESIGN
>1,0,3,931,U,P,ADM,S,50
>M,931
>2,1,3,680,U,P,CAA,S,50
>M,1611
>3,2,3,1477,U,P,CAB,S,50,3.5
>M,2100
>M,3088
>4,3,3,2880,U,P,ADM,S,50
>M,4000
>5,4,1,1622,A,N,BHA,A,12
>6,5,1,2128,A,N,BHA,A,12
>7,6,1,2000,A,N,BHA,N,8
>8,7,1,3500,A,N,BHB,N,8
>9,4,2,2200,A,N,BHA,A,25
>10,9,2,5700,A,N,BHA,A,25
>11,10,2,1500,A,N,BHA,N,12
>12,11,2,2167,A,N,BHA,N,12
>13,12,1,1707,B,N,BHA,A,12
>14,13,1,2200,B,N,BHB,A,12
>15,14,1,4306,B,N,BHBX,A,12
>16,12,1,1469,A,N,BHB,S,25
>17,16,1,1721,A,N,BHB,S,25
>18,17,1,2184,A,N,BHB,S,25
>RT
>
EDIT:
>FILE
```

Figure 5-10. Data File for Three Systems.

```
EXECUTION:
800-TYPE APPARATUS CASE? (Y OR N)
>N
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>N
ALL NON-PROTECTED REPEATERS WILL BE USED

CHANGE LOSS LIMIT? (Y OR N)
>N
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 4 ****

THREE SYSTEM DESIGN

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	3	931	U	P	ADM	S	50	6.51	29.5	25.0	25.0	931
2	1	3	680	U	P	CAA	S	50	5.31	28.7	11.4	36.4	1611
3	2	3	1477	U	P	CAB	S	50	3.50	26.9	12.4	48.8	3088
4	3	3	2880	U	P	ADM	S	50	6.51	29.5	77.2	126.0	5968
5	4	1	1622	A	N	BHA	A	12	5.08	33.5	29.7	155.6	7590
6	5	1	2128	A	N	BHA	A	12	5.08	33.5	38.9	194.6	9718
7	6	1	2000	A	N	BHA	N	8	5.08	33.5	36.6	231.2	11718
8	7	1	3500	A	N	BHB	N	8	3.66	33.5	32.2	263.4	15218
9	4	2	2200	A	N	BHA	A	25	5.08	33.5	40.3	166.2	8168
10	9	2	5700	A	N	BHA	A	25	5.08	33.5	104.3	270.5	13868
11	10	2	1500	A	N	BHA	N	12	5.08	33.5	27.4	298.0	15368
12	11	2	2167	A	N	BHA	N	12	5.08	33.5	39.7	337.6	17535
13	12	1	1707	B	N	BHA	A	12	5.09	33.5	28.7	366.3	19242
14	13	1	2200	B	N	BHB	A	12	3.66	33.5	18.5	384.8	21442
15	14	1	4306	B	N	BHBX	A	12	4.94	33.5	36.2	421.0	25748
16	12	1	1469	A	N	BHB	S	25	3.66	28.9	13.5	351.2	19004
17	16	1	1721	A	N	BHB	S	25	3.66	28.9	15.8	367.0	20725
18	17	1	2184	A	N	BHB	S	25	3.66	28.9	20.1	387.1	22909
RT													

LOCATIONS OF MANHOLES FOR PART 1

931 1611 2100 3088 4000

PART 1

REPEATERS FOR CABLE SECTIONS 1 THROUGH 8

REPEATER #		DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1	MH	3088	3088	14.84	51	1552	1228
2	DR	5968	2880	18.75	38	0	0
3		10104	4136	21.01	55	2315	2597
4	RT	15218	5114	21.01	173	0	0

Figure 5-11 (Part 1). DILEP Run for Three Systems.

PART 2
REPEATERS FOR CABLE SECTIONS 9 THROUGH 15

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
5	11750	5792	29.39	9	787	787
6 DR	17535	5785	29.39	9	0	0
7	21900	4365	19.01	87	2494	1983
8 RT	25748	3848	19.01	86	0	0

PART 3
REPEATERS FOR CABLE SECTIONS 16 THROUGH 18

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9 RT	22909	5374	19.68	9	0	0

Figure 5-11 (Part 2). DILEP Run for Three Systems.

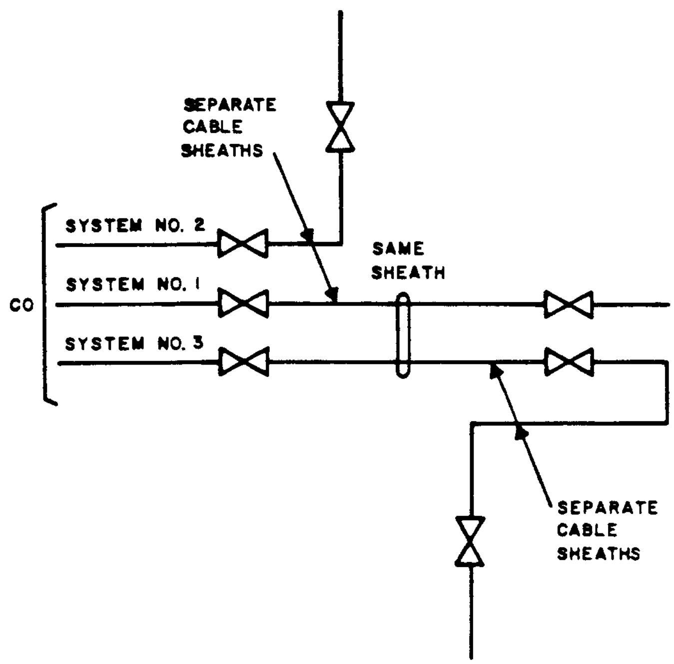


Figure 5-12. Addition of New SLM Systems.

6 IMPLEMENTATION

6.1 Establishing a Computer Connection

When the user has prepared the problem input data, a terminal session can be initiated to enter the data into a data file that can be processed by DILEP. The user must first establish a communications link with the computer. This is done by dialing an appropriate telephone number and then performing the logon procedure. The logon procedure is described in the RDES User's Guide, PA-599001. When the logon procedure is completed, the user can create a data file containing the problem data.

6.2 System Cues

Coordination between the Time Sharing System (TSS) and the user's terminal operations for satisfactory input and output is dependent on cues.

A ***system cue*** is an acknowledgment from the TSS that it is ready to accept input data. The cue varies among systems and terminals, but always means the same thing. Throughout this BSP the "greater-than" symbol (>) is used to indicate the system cue. The user may input data anywhere on the line after the system cue.

The user signals the conclusion of each data statement to the TSS by depressing the RETURN key on the terminal keyboard. The user must then wait for the system cue before typing new data.

6.3 Entering Input

The user must enter the input mode (environment) using the method described in PA-599001 to create a data file. When the system indicates that it is in the input mode, the user can begin entering data, copying line-for-line the information on the Route Data Sheet.

The user starts typing an input line after the system cue. Title and manhole information must begin with the letter ***T*** or ***M*** typed immediately after the system cue. Cable section information or requests for RTs or DRs may start at any print position after the system cue (spaces are absorbed).

Certain keyboard conventions are normally available to enable characters and lines to be deleted during input. These conventions depend on the particular TSS and data terminal involved, and are discussed in PA-599001.

When all data on the Route Data Sheet has been entered, the user must transfer from the input mode to the edit mode. This is done by depressing the RETURN key after a system cue without entering any data. At this point, the user may use any of the editing commands provided by the TSS to make additional corrections in the data file. It is recommended, however, that the edit commands be restricted to eight (LOCATE, CHANGE, PRINT, QUIT, DELETE, FILE, REPLACE, and INSERT) since these commands are the only ones guaranteed to be supported by DILEP.

When the user has checked the accuracy of the data file, that file should be saved in the user's storage area. The user can now employ DILEP to analyze the route by performing the following steps:

1. After a "NEXT?" message and cue from the TSS, type the request

   >DILEP

2. After the "FILENAME"? response to the DILEP request, and the cue, type

   >FILENAME

   where FILENAME is the name of the data file that contains information about the route that is to be analyzed by DILEP.

Immediately after the interactive session for options, DILEP will analyze the route and return the information on the proposed repeater sites. DILEP always processes problem data in real time—ie, the repeater sites are determined while the user is still at the terminal, and the results are immediately returned to the terminal.

6.4 Paper Tape Input/Output

Paper tape input/output capability is available with the teletypewriter terminal. It is possible for a user to input problem data from a paper tape or to have the data file punched as output onto a paper tape prior to using the TSS computer. Off-line preparation of input data on tape results in an obvious savings in processor time because the system can read the tape faster than a user can type. If the user exercises reasonable care when preparing the tape, additional time will be saved because virtually all input errors can be eliminated.

A paper tape can be punched any time the user wants a personal copy of the DILEP data file. The tape then may be used to rerun the problem at a later time. By maintaining a personal tape, the user has the option of using the problem data any time in an off-line environment. The user can also maintain a personal library of data files as another efficiency step against overloading the assigned disk storage area in the TSS computer.

Tapes with the XOFF feature (ie, where each data line is delimited by an XOFF character) can be used either to input a new file or to edit an existing file. ASCII tapes (tapes prepared without using the XOFF feature) can be used only to create a new file. (Paper-tape terminal procedures are discussed in Section 901-601-110.)

7 DIAGNOSTICS

DILEP provides three types of diagnostics: line, cable section, and system. When the DILEP environment is entered, DILEP will access the user's data file and read the input lines one at a time. If an error is found in a line of data, that line is printed as part of the cable section table and is followed by appropriate diagnostics. DILEP will not calculate repeater sites for a data file that contains errors. The user must make the corrections specified by the diagnostics before rerunning DILEP. The program checks input data for completeness and compatibility, but is unable to determine its accuracy. Therefore, reasonable care should be taken in preparing the input data so that problems will not have to be rerun.

7.1 Line Diagnostics

The line diagnostics apply to all input data statements; they specify that a line of input data is not acceptable for a specified reason. Table 7-1 lists all line diagnostics and gives an explanation of each. When a line error occurs, DILEP prints the actual line of input exactly as the user entered it into the data file, then prints the diagnostic statement.

TABLE 7-1
LINE DIAGNOSTICS

(Erroneous line appears here.) MISSING INFORMATION **Explanation**: For a cable section line, part of the required cable section data was not included in the input line. For a manhole line, no manhole site was given. For a request line, the request was incorrectly typed. ***Note that if a blank is accidentally entered, the program will ignore all data on the input line following the blank.***
(Erroneous line appears here.) (Line containing a question mark appears here.) INVALID CHARACTER **Explanation**: A character other than a blank, comma, letter, digit, or decimal point appears in the input line. A question mark is printed immediately below the erroneous character.
(Erroneous line appears here.) (Line containing a question mark appears here.) INVALID DECIMAL POINT—POSSIBLE MISSING INFORMATION **Explanation**: Either a decimal point was typed in an improper field or some of the required data was omitted from the input line. A question mark is printed immediately below the invalid decimal point.

7.2 Cable Section Diagnostics

The cable section diagnostics (Table 7-2) apply only to lines of cable section data. Cable section data is checked for validity only if all required data is provided for the cable section and no line errors have occurred for the section. More than one cable section diagnostic may be given for a cable section. When a cable section error is found, the section data is formatted and printed to correspond to the columns in the cable section table. All appropriate cable section diagnostics are printed after the section data.

TABLE 7-2
CABLE SECTION DIAGNOSTICS

SEQUENCING ERROR **Explanation**: The cable section number must be equal to the number of cable sections that have been entered. The error could be due to an invalid request for a remote terminal or demand repeater.
INVALID PREVIOUS SECTION NUMBER **Explanation**: The previous cable section number must be less than the current cable section number.
INVALID NUMBER OF T1 LINES **Explanation**: The number of digital lines must be greater than zero but less than or equal to 200.
INVALID CABLE LENGTH **Explanation**: The cable length must be greater than zero.
INVALID TYPE OF PLANT **Explanation**: The code for the type of plant must be specified as A, B, or U.
INVALID PRESSURIZATION CODE **Explanation**: The pressurization code must be specified as P or N.
INVALID CABLE CODE **Explanation**: Each of the first three letters of the cable code must be one of the allowable codes. If a fourth letter is given, it must be a letter X (for reclaimed cable) or S (for screened cable).
INVALID PAIR SEPARATION **Explanation**: The pair separation code must be specified as S, A, or N.
INVALID PAIR UNIT SIZE **Explanation**: The pair unit size must be 8, 9, 11, 12, 13, 16, 17, 25, 50, or 100.
INVALID LOSS PER KILOFOOT **Explanation**: This message is a warning only. It appears whenever the specified insertion loss per kilofoot is not within the range of losses that is valid for that particular gauge. DILEP will place repeaters along the route, using the user-specified insertion loss per kilofoot.
INVALID NEAR-END CROSSTALK OBTAINED **Explanation**: Either the combination of cable code and pair unit size is invalid or the combination of pair unit size, pair separation code, and number of T1 lines is invalid.
INVALID REDUCTION: REDUCTION SET = 0.0 **Explanation**: This message is a warning only. It indicates that the user-specified loss limit reduction entry is less than 0 dB or greater than 15.0 dB, or contains an invalid character. DILEP will still run, but the loss limit reduction is set to 0.0 dB.

7.3 System Diagnostics

System diagnostics provide general information and reminders to the user. Diagnostics may be printed at any time during the execution of DILEP. All system diagnostics, with appropriate user action for each, are given in Table 7-3.

TABLE 7-3
SYSTEM DIAGNOSTICS

TOO MANY CABLE SECTIONS HAVE BEEN GIVEN—MAX IS 100 **Explanation**: When this occurs, processing stops and the list of manholes and the list of cable sections having default values are not printed. **User Action**: Redefine the loop carrier route so that no more than 100 cable sections are needed.
TOO MANY MANHOLES HAVE BEEN GIVEN—MAX. IS 50 **Explanation**: When this occurs, all future manholes will be ignored but processing will continue until all lines of the data file are checked and the list of manhole sites and the list of cable sections having default values are printed out. **User Action**: Choose fewer manholes with greater distance between them.
INVALID CABLE SECTION DATA—CORRECT AND RERUN **Explanation**: Line errors or cable section errors were detected for one or more input lines in the data file. Processing stops after all lines of the data file have been examined and the list of manholes and the list of cable sections having default values are printed out. **User Action**: Enter the Edit environment, make the necessary corrections in the data file, then rerun DILEP.
ONE OR MORE REPEATER SECTIONS HAVE LESS THAN MIN LOSS **Explanation**: DILEP was forced to place two repeaters too close together. User may have requested remote terminals, demand repeaters, or junctions too close to each other, or DILEP may not have been able to equalize the repeater spacing. **User Action**: Modify the route layout. This may involve relocating remote terminals, demand repeaters, or junctions. The problem may also be corrected by placing a pad in the remote terminal if the violating section terminates in a remote terminal.
MUST BE BETWEEN 20.0 AND 33.5—REENTER **Explanation**: This diagnostic may occur during the interactive part of the DILEP run if the user attempts to specify a loss limit greater than 33.5 dB or less than 20.0 dB. **User Action**: Enter a number between 20.0 and 33.5 inclusive. (Entering 33.5 will have no effect on repeater spacing, because the default loss limit is 33.5.)

DILEP
ROUTE DATA SHEET

FILE NAME [ ][ ][ ][ ][ ][ ][ ][ ] DATA
(ONE TO EIGHT CHARACTERS)

ROUTE DESCRIPTION [T][ ][ ]...
(UP TO 40 CHARACTERS)

(1) CABLE SECTION NUMBER	(2) PREVIOUS CABLE SECTION NUMBER	(3) NUMBER OF ACTIVE T-1 LINES	(4) CABLE SECTION LENGTH IN FT	(5) TYPE OF CONSTRUCTION A, B, U	(6) PRESSURE CODE P, N	(7) CABLE CODE *	(8) PAIR UNIT SEPARATION S, A, N	(9) UNIT SIZE 8, 12, 16, 25, 50, OR 100	(10)** INSERTION LOSS FACTOR dB/KFT AT 772 kHz	(11)*** LOSS LIMIT REDUCTION (dB)

M - MANHOLE
DR - DEMAND REPEATER
RT - REMOTE TERMINAL

- 800-TYPE APPARATUS CASE ? Y OR N (CIRCLE ONE)
- ALL PROTECTED REPEATERS ? Y OR N (CIRCLE ONE)
- REDUCE LOSS LIMIT ? Y OR N (CIRCLE ONE)
  IF Y, TO WHAT ? ______ dB

* FOR RECLAIMED CABLE, ADD "X"
FOR SCREENED CABLE, ADD "S"

** USE ONLY IF NECESSARY TO OVERRIDE DILEP

*** 15 dB MAXIMUM

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Bellcore Practice
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Outside Plant Engineering Digital Line Engineering Program II (DILEP II) User Guide

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Project Number 424516

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1. INTRODUCTION

This practice describes the use of the Digital Line Engineering Program II (DILEP II). DILEP II assists the outside plant engineer in setting the spacing between repeaters for Digital Loop Carrier (DLC) systems and services that employ digital transmission at the T1 bit rate (1.544 megabits per second). The design philosophy, pair selection rules, and step-by-step procedures covered in this practice are intended to provide the basis for data input to DILEP II. DILEP II may also be used to check existing repeater spacing.

This practice is being reissued to incorporate additional information that may be useful to the outside plant engineer. In addition, new examples have been added.

1.1 Overview - DILEP II System Description and Functions

DILEP II primarily performs the mathematical analysis needed to determine the location of digital line repeater sites for DLC and 1.544 Mb/s services.

At the user's option, the program can be used to place repeaters at all route junctions, or to provide repeaterless route junctions where possible. DILEP II can also perform a pad analysis and select an optimum value from choices input by the engineer.

The program picks a repeater site from among selections input by the engineer, picks a new repeater site, or places a repeater site at a specific location upon request.

DILEP II provides:

- The insertion loss for the particular type of cable input
- The maximum loss for a given repeater section
- The loss at a repeaterless route junction
- The simplex resistance and cumulative simplex resistance. These resistance values are useful in powering calculations.

1.2 Organization of this Practice

This is a general revision of BR 902-200-120, Issue 1, November 1984; therefore, no margin arrows or page markers are indicated. Sections of this document are organized as follows:

- Section 1 - INTRODUCTION - Contains a general description of DILEP II.
- Section 2 - REPEATER SPACING DESIGN PROCEDURES - Provides general information on repeater spacing design procedures. This section is not meant to be all-inclusive, but can be used in conjunction with other practices.

- Section 3 - GETTING STARTED - Focuses on the preliminary work of preparing the route schematic and Route Data Sheet before inputting the data.
- Section 4 - RUNNING DILEP II - Explains the process of inputting the data and making a run using the Remote Data Entry System (RDES) editor.
- Section 5 - INTERPRETING THE DILEP II RESULTS - Describes a general process for interpreting the results.
- Section 6 - DILEP II EXAMPLES - Provides specific examples and explanations.
- Section 7 - ERROR MESSAGES - Describes error and diagnostic messages.

A list of related documents and a glossary are provided at the end of this document.

1.3 Equipment and Material Required

Authorization and procedures for using DILEP II may be obtained from the local Engineering Planning and Analysis Systems (EPLANS) coordinator, or they may be generally available in your company.

DILEP II executes on a time-share computer, which may be a vendor-dependent system. Therefore, periodic updates, changes by a vendor, or a switch in vendors, are likely to occur. A DILEP II user accesses the DILEP II program by means of a data terminal. Section 4 gives additional information on access. Currently, DILEP II uses the generic RDES. DILEP II has also been incorporated into the LEIS™ system; a description of that version of DILEP appears in BR 901-600-130, *LEIS Digital Line Engineering Program II (DILEP II) User Guide.*

The outside plant engineer organizes the data for a DILEP II analysis on Route Data Sheets. (A reproducible sheet is provided at the end of this User Guide.)

1.4 Prerequisite Knowledge of Users

DILEP II users do not need extensive knowledge of computers or programming to work with this program. The only required background is knowledge of RDES instructions.

1.5 Source Information

The determination of the ultimate number of digital loop carrier systems and their deployment typically comes from the route plan. Guidelines for powering the repeaters, and implementation and administrative procedures are covered in engi-

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neering practices such as the predivestiture Bell System Practice BSP 916-100-002, *Designing Digital Loop Carrier Systems.*

2. REPEATER SPACING DESIGN PROCEDURES

2.1 General

This section provides repeater spacing design rules for digital loop carrier systems employing digital transmission at the T1 bit rate (1.544 Mbits per second).

Digital transmission at the T1 bit rate requires repeaters that regenerate pulses in the bit stream. The spacing of these repeaters is governed by the insertion loss and the interpair crosstalk coupling loss of the cable, which in turn are influenced by the electrical characteristics and temperature of the cable. Consequently, designing digital loop carrier systems into exchange routes requires detailed analysis of the existing cable plant types, including the following:

- Determination of core layups of all cables
- An accurate prediction of the ultimate number of carrier systems to be provisioned in the route
- Selection of economical powering arrangements.

The design required in the local loop plant, as compared to the trunk plant, can be different for the following reasons:

1. The local loop, because of smaller cables, is very often limited in the number of digital lines available. Consequently, the ability to select pairs to meet error rate criteria (as in the trunk plant) is frequently not available in the local loop plant.
2. The quality of cable facilities most likely varies along the route of the local loop.
3. Generally, the cables in the local loop plant are more exposed to outside influences such as induction.
4. The cables in the local loop are generally more susceptible to the intrusion of moisture or other forms of degradation such as water in splices or open sheaths.
5. There are frequent cable taper points.
6. There will probably be other services in the local loop plant cables that can cause impulse noise or crosstalk.
7. The local loop plant may contain mixed gauges and many branches.
8. The binder group integrity may not be verifiable. Thus, unlike trunk plant, you may have to assume that loop plant transmit and receive digital lines are in adjacent pair units.

These differences affect the relative importance of interpair crosstalk coupling loss for the two applications of carrier systems, as well as the relative difficulty in selecting the most suitable cable pairs for digital transmission.

If T1 carrier lines are proposed in a cable sheath that contains existing T1 carrier lines, the repeaters for the proposed systems **must** be located at the existing T1 repeater sites to avoid intersystem far-end crosstalk (FEXT) interference.

2.2 Design Philosophy

A mechanized design program for locating the line repeaters on a digital loop carrier system is essential due to the design complexity resulting from the following factors that affect the maximum repeater spacing:

1. Insertion loss of the cable employed
2. Physical pair separation achieved in each of the cable sections employed in the total digital path
3. Ultimate number of carrier systems contemplated
4. Crosstalk influences are only relevant within a 3 dB zone on either side of each repeater.

When locating repeaters on the digital line path, the cable insertion loss between repeaters must be low enough to ensure that the far repeaters can discriminate between signals and noise. The following factors limit the permissible insertion loss of a repeater section:

1. The repeater can automatically adjust to insertion loss between 9.2 and 35.0 dB at 772 kHz. The 35.0 dB upper limit is reduced by 1.5 dB to allow for manufacturing variations in cable loss characteristics, thus limiting it to 33.5 dB. This upper limit may be further reduced by crosstalk influences in items 2 and 3, below.
2. The lower the crosstalk coupling loss between the send and receive digital pairs, the more the digital signal is influenced by crosstalk.
3. The more digital lines there are in the same sheath, the more crosstalk energy there is.

In addition to the preceding transmission considerations, repeaters must be located at physically and aesthetically acceptable sites. They should be located away from interstate highway rights-of-way, areas that flood, or any location that has limited accessibility.

Repeaters on other systems in the same cable sheath must be located at the same repeater points to minimize crosstalk, even if the repeaters are installed in different apparatus cases. Remote Terminals (RTs) contain digital repeaters and must be considered regular repeater points.

2.3 Route Junctions

A route junction is formed when lines from two or more branches enter the same cable sheath. This type of junction can occur when separate T1 digital lines are used to serve two branches in a cable network.

If a junction is also to be an RT site, and if the RT is to be located a short distance away in a branch leg (for physical or aesthetic reasons), the required length of suitably sized cable should be installed and the RT padded to ensure meeting the minimum loss requirement in DILEP II of 9.2 dB. If the junction is repeaterless, padding the RT will ensure being at or below the maximum level difference requirement of 7.5 dB.

Widespread deployment of digital loop carrier (DLC) and High Capacity Digital Services (HCDS) is causing a significant number of branches and route junctions on many routes. Placing a repeater at each of these junctions is unnecessary from a technical point of view. Subscriber loop T1 digital lines have always had a signal level coordination requirement that typically precluded unrepeatered route junctions. The original level coordination requirements of 1.5 dB maximum level difference limited the effect of far-end crosstalk (FEXT) on the overall T1 margin to 0.3 dB. However, studies using improved models for crosstalk have shown that the signal level coordination requirement can be relaxed from the present 1.5 dB maximum level to 7.5 dB. This change permits the effect of FEXT on the overall T1 margin to be a maximum of 1.1 dB instead of 0.3 dB. The 0.8 dB reduction in margin is insignificant to the performance of the T1 systems, and is economically justifiable.

While this change in engineering rules does not allow unrepeatered route junctions to be placed arbitrarily, it gives designers enough flexibility to solve the majority of their route junction problems. It should be noted, however, that elimination of a repeater at any given junction will not always ensure reduced cost for local loop designs. There are situations in which elimination of the route junction repeaters could cause the placement of additional repeaters in the branches.

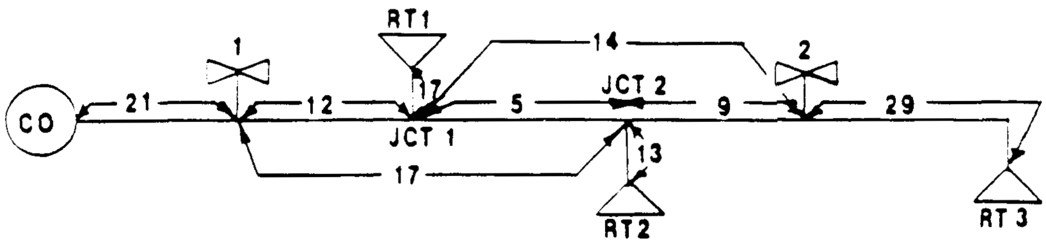
From the transmission engineering point of view, any number of repeaterless junctions can be permitted in a T1 line feeder route. Also, any number of repeaterless junctions (meeting the 7.5 dB maximum level difference) can be permitted between two digital regenerators or terminals, and any number of branches can be permitted. DILEP II, however, is able to care for only one repeaterless junction between any two regenerators or RTs on any given "run" of the program. By making more than one run, additional repeaterless junctions within a repeatered section can be handled. (See Figure 2-1.) There is also a constraint on branching such that any single junction cannot have more than three branches off the main feeder route terminating in demand repeaters, RTs, or program-selected repeater locations. This, also, can be addressed by making more than one run.

2.4 Insertion Loss Limitations

DILEP II ensures that the insertion loss for a repeater section is within the minimum and maximum insertion loss limits. Even if a repeater is moved to the full extent of either the backward or forward margin, the final insertion loss is between the minimum and maximum limits.

When the user requests an RT or a demand repeater (DR) and the insertion loss limit for the repeater section has not yet been reached, DILEP II subtracts the actual section loss from the permissible section loss. It then attempts to equalize the repeater sections to spread this difference over all repeaters between the previous

Schematic: two repeaterless route junctions in a repeatered section. All segment numerical values are in dB.



Run 1 determines losses for junction 1 (RT2 not input)
Run 2 determines losses for junction 2 (RT1 not input)

Subtractions yield losses in dB for each segment

Repeaters 1 and 2 would be input as demand, otherwise the program may change their location yielding different results from run 1 to run 2.

Level differences:

Junction 1 from RT2 ------------- 18 dB − 17 dB = 1 dB
Junction 1 from repeater 2 ------- 17 dB − 14 dB = 3 dB

Junction 2 from repeater 2 ------- 13 dB − 9 dB = 4 dB

Figure 2-1. Repeaterless Route Junctions in DILEP II and the current DR points. Groups of repeaters, consisting solely of an RT or a DR, cannot be equalized. Because equalization is done on an insertion loss basis rather than on a crosstalk basis, the forward and backward margins for a group of repeaters will be approximately equal, while the maximum number of T1 lines may differ for repeaters in the group. Equalization may cause the locations of the repeaters to change if one of the repeaters in the group is respecified as a DR and the other repeater sites are left to be calculated by DILEP II.

Equalizing the repeater sections by spreading the insertion-loss difference over several repeater sections results in each equalized section having slightly less insertion loss than the maximum loss for that section. This results in three benefits:

1. It is desirable to have the actual design loss less than the maximum permissible loss. From a transmission point of view, this provides additional transmission margins for factors such as high ambient cable temperatures, moisture accumulation in the cable, and cable manufacturing variations.
2. The lower insertion loss provides repeater spacings that can accommodate additional T1 lines without the need to add repeater locations if unforeseen growth occurs during the study period.
3. The difference between actual loss and maximum permissible loss makes it possible to provide backward and forward margins for repeater sites to assist the engineer in tailoring the line design to possible physical constraints.

When actual loss equals maximum loss for all repeaters in a route, the backward and forward margins will always be zero, and the maximum number of T1 lines for each repeater section will be no greater than the number specified by the user.

The cable insertion loss limit for the first repeater section is less than the limit for all other repeater sections because of central office (CO) noise. This CO end section consists of the cabling from the main distributing frame to the first repeater location. For purposes of repeater spacing designs, fiber hubs that terminate metallic T1 lines on the field side should be considered COs and the first repeater section spaced the same as a CO. The insertion loss limitations (Table 2-1) in dB at 772 kHz apply to digital line repeater spacing using T1 frequencies.

Insertion loss factors (at 772 kHz and 55°F), together with their temperature coefficients in dB per kilofoot for most of the common pulp-insulated conductor and PIC cables are given in Table 2-2.

In DILEP II, these losses are adjusted within the program to reflect the maximum expected temperature and humidity conditions based on the cable environment, i.e., aerial or below ground. For example, the losses are adjusted to reflect maximum temperatures for aerial and below-ground cables of 140° and 100°F, respectively. In addition, aerial and below-ground PIC cable losses are increased to allow for some transmission degradation due to moisture. No allowance is included

Table 2-1. Repeater Spacing as Limited by Cable Insertion Loss in dB at 772 kHz

Repeater Section	Protected Repeater		Non-Protected Repeater	
	Minimum Loss (dB)	Maximum Loss (dB)	Minimum Loss (dB)	Maximum Loss (dB)
Adjacent To The CO	9.2	22.0	9.2	23.0
Not Adjacent To The CO	9.2	32.0	9.2	33.5

in DILEP II for any moisture in pulp-insulated conductor cable, since any significant moisture would cause it to be inoperative.

Insertion loss factors for less common types of cable can be obtained from the appropriate section in the 626-759 layer of predivestiture Bell System Practices.

In nearly all instances, the standard insertion losses at the predetermined temperature and moisture levels specified above will satisfy the input requirements of DILEP II. However, in some cases, i.e., very hot or arid climates, more realistic factors may be warranted. In these situations, the factors may be adjusted using the temperature coefficients shown in Table 2-2, and by adjusting the percent correction for moisture content. Then these adjusted factors can be entered in the DILEP II file by using the 10th field (Insertion Loss Factor).

2.5 Pad Placements

Many manufacturers are designing a line build out (LBO) feature into their digital loop carrier systems. Usually, a number of different settings are available, any one of which can be selected for a given application. Another name for LBO is pad, the name used in DILEP II. Functionally, a pad adds a loss in the T1 section. DILEP II uses pads for two purposes: 1) to ensure the minimum loss in an end section, and 2) to ensure that the signal level mismatch at a repeaterless junction is not over the limit (7.5 dB in this case). The program selects one value of pad out of the permissible values as specified at an RT. If more than one pad value can meet the requirement, the program selects the pad value that results in the minimum loss value or the minimum signal level mismatch at the junction, if the junction is repeaterless. If a pad value is not specified, DILEP II assumes a 0 loss pad. If one pad value is specified, DILEP II uses that value.

2.6 DILEP II and High Capacity Digital Service

The design of the T1 repeatered line is the same for HCDS as it is for Digital Loop Carrier (DLC) except for the parameters of the customer end section. DILEP II is essentially designed for DLC systems with a central office terminal and RTs.

Table 2-2. Cable Losses at 772 kHz

CABLE TYPE	MUTUAL CAPAC nF/MILE AT 900 Hz	ENGR LOSS AT 55°F IN dB kft	TEMP COEF FOR 10°F STEPS IN dB kft
17 AHC	83	3.18	0.030
17 ALC	83	3.20	0.034
17ANC	83	3.80	0.028
17 BLC	83	3.20	0.034
17 KLC	83	3.20	0.027
19 AHB	83	3.18	0.030
19 ALB	83	3.20	0.027
19 ANB,DNB,GNB	66	3.00	0.025
19 BHB	83	3.30	0.034
19 BJB	83	2.90	0.020
19 BLB	83	3.20	0.027
19 BNB,CNB, ENB,FNB	84	3.80	0.028
19 ADB	83	3.90	0.034
19 AJB	83	2.90	0.020
20 AHD	83	4.39	0.043
20 ALD	83	4.40	0.043
20 AND	82	5.10	0.047
20 BLD	83	4.40	0.043
20 KLD	83	4.40	0.043
22 ADA	83	5.20	0.034
22 AHA	83	4.39	0.043
22 AJA	83	4.00	0.035
22 ALA	83	4.40	0.040
22 AFA	83	4.40	0.040
22 BDA	83	5.20	0.044
22 BJA	83	4.00	0.035
22 BLA	83	4.40	0.040
22 BSA	83	5.10	0.047
22 CDA	83	5.20	0.034
22 KDA	83	5.20	0.044
22 KFA	83	4.40	0.040
22 KGA	83	4.00	0.035
22 KHA	83	4.60	0.045
22 KJA	83	4.00	0.035
22 KLA	83	4.40	0.040
22 SDA	83	5.20	0.034
22 BHA	83	4.60	0.045

Table 2-2. Cable Losses at 772 kHz (Continued)

CABLE TYPE	MUTUAL CAPAC nF MILE AT 900 Hz	ENGR LOSS AT 55°F IN dB kft	TEMP COEF FOR 10°F STEPS IN dB kft
22 BSA,CSA DSA,ESA	83	5.10	0.047
22 ASF(24 EQUIV)	84	6.80	0.066
24 ADM	83	6.30	0.047
24 AKM	83	5.60	0.033
24 ALM	83	5.50	0.052
24 ASM,BSM	72	5.90	0.057
24 BKM	83	5.58	0.033
24 CSM,ESM	72	5.85	0.057
24 DSM	84	6.80	0.025
24 FSM	84	6.80	0.066
24 AJM	83	5.60	0.048
24 AFM	83	5.50	0.052
24 CDM	83	6.30	0.047
24 DCM	83	6.10	0.055
24 MCM	52	3.60	0.044
24 MLM	60	3.90	0.040
24 PKM	83	5.80	0.055
26 ADT	83	7.80	0.059
26 DST	83	8.17	0.096
26 AKT	83	7.50	0.041
26 ALT	83	6.90	0.067
26 AST	69	6.80	0.066
26 CST	69	6.79	0.081
26 BST	79	7.70	0.093
26 BKT	83	7.48	0.068
26 AJT	83	6.30	0.065
26 AFT	83	6.90	0.067
26 CDT	83	7.80	0.059
26 DCT	83	7.70	0.073
26 PKT	83	7.30	0.068
COMPOSITE CABLES			
19 CAB	83	3.80	0.028
22 CAA	83	5.10	0.047
24 CAM	83	6.80	0.066
26 CAT	83	8.17	0.096

The RTs are usually part of a long-range plan that has been identified well in advance of the detail engineering. However, HCDS is service-order-oriented, and requires that the outside plant engineer build some flexibility into the overall route digital design. One way to do this is to allow repeaterless route junctions in a route. It is very important to identify potential HCDS customers in advance of the detail digital design of a route. Of course, this is not always possible, so the engineer may want to consider placing repeaters at all junctions initially to allow flexibility for unforeseen HCDS orders.

The customer end section for HCDS consists of the length of cable from the last line repeater to the network interface, or NI (separation point between the operating company and the customer), the length of cable from the NI to the customer's network channel terminating equipment (NCTE), and any line build out (LBO) or loss pads associated with the NCTE. Under widely accepted design rules, the total losses in the three segments can be a maximum of 22.5 dB. These same design rules specify that the minimum loss for the three segments is 15 dB; the operating company's portion of the loss can be from 0 to 15.0 dB, while the customer's portion can be from 7.5 dB to the maximum of 22.5 dB.

An HCDS location is identified in DILEP II by specifying RT in the input. Any pads that are available in the customer premises equipment (CPE) may also be input (e.g., RT,0,7.5, 15.0). Up to five values may be input after RT with values between 0 and 22.5 dB. This is the same as for DLC RTs. The engineer must determine what the loss pad values are in the NCTE, and also the cable loss on the customer premises. Because several different customers in the same location can and probably will use different equipment with varying loss pad values, the engineer must ensure that any repeaterless route junctions within a building or industrial area do not exceed a maximum of 7.5 dB mismatch. Special attention must also be given when designing digital lines within the same riser or building tie cable. The desired degree of separation may not always be possible in these cables. Vacant pairs will probably have to be verified in the field.

The default loss for an RT end section is 33.5 dB for unprotected repeaters, and 32 dB for protected repeaters. When designing for HCDS, a reduction must be made in the customer or RT end section if the design rules are to be followed. This can be done by using column 11 on the Route Data Sheet. See the explanation in Section 3.2 under "Cable Section Information," and the example in Figures 5-8 and 5-9.

To reduce this last section, the engineer will first have to make an unconstrained run to determine generally what the repeater spacing will be. Sometimes the location of the last line repeater will be more clearly defined, such as a manhole near the customer, and the engineer can make the appropriate reduction with the first run and demand a repeater at that location.

2.7 Crosstalk Considerations

It is very important to space repeaters initially for the maximum number of systems that will ultimately be applied in the route. Crosstalk problems may result if the number of systems exceeds the number for which the original repeater spacing was designed.

Crosstalk is a function of:

1. The number of T1 carrier lines in the same sheath
2. The relative position of the transmit and receive pairs of the systems in a single cable sheath.

T1 carrier transmit and receive pairs should be applied in a single cable sheath of the route only. Even though near-end crosstalk (NEXT) may be virtually eliminated and repeater spacings increased in twin (two cables, one apparatus case for both directions of transmission) cable sheath routes by assigning transmit and receive pairs in separate cable sheaths, this design is discouraged for three reasons.

1. Cable splicing is complicated at repeater points and RTs
2. The gauge of future cable additions may be unnecessarily dictated by these repeater locations
3. Future cable removal options in the fine-gauge area may be limited.

3. ETTING STARTED

3.1)esign Procedures

The step-by-step procedures, as outlined below, provide an orderly approach for taining the input information necessary for running the DILEP II program.

Step 1 - Prepare the Schematic

Step 2 - Facility Selection and Cable Layups

Step 3 - Digital Line Pair Selection

Step 4 - Record Selected Pairs on the Schematic.

Step 1 - Prepare the Schematic

Prepare a schematic (Figure 3-1) of the route showing the following information:

1. Cable code, e.g., BKM or BKMA. Show 3- or 4-letter code. (If the cable is reclaimed or screened, the fourth letter becomes "X" or "S", respectively.) Also indicate the pair size for each cable section.
2. Length of cable section, if it exceeds ten feet. (For sections less than ten feet, include with adjacent cable section.)
3. Cable pressurization status of each cable section (pressurized or non-pressurized)
4. Type of construction (aerial, buried, or underground)
5. Proposed and future RT locations
6. Ultimate number of T1 lines in each repeater section
7. Manholes that are potential repeater sites. Show cumulative distance from CO to manhole location.

Post the cable section numbers on the schematic, starting with the number 1 adjacent to the CO and numbering consecutively to the end of the digital line. The CO is designated as cable section 0.

Step 2 - Facility Selection and Cable Layups

There are many considerations in selecting the facilities in which to construct the T1 digital line. These can include the following items for each cable sheath:

1. Type (PIC, pulp, waterproof, etc.)
2. Size (total number of pairs, and number of pairs in the splicing units)
3. Core cross-section configuration (layup)

4. Age of the cable
5. Pressurization
6. Compatibility with other services that may be developed in the future
7. Rearrangement and maintenance history
8. Proposed use (exchange-express feeder, feeder, distribution, etc.)
9. Susceptibility to interruptions from various sources.

The cable pairs within the sheath must be conditioned for T1 digital service. All bridged taps, load coils, and build out capacitors must be removed. When conditioning the pairs, consideration should be given to selecting enough pairs to fully splice in the apparatus case.

Nonstaggered twist cable is not suitable for T1 digital lines. Low-capacitance, reclaimed, waterproof, and aluminum conductor cables can be used.

One type of low-capacitance cable that can be used in the loop is ICOT.™ It is designated MCM (air core ICOT) and MLM (waterproof ICOT) in DILEP II. This cable, or its equivalent, is used for obtaining longer repeater spacings than conventional 22-gauge cable while using less copper (24-gauge). The area to be served by low-capacitance cable should be clearly defined, since this type cable should be considered a digital carrier facility rather than a general relief cable. The cable sheath should serve a digital facility such as an RT site or customer premises where a prevalent portion of the serving facility is to be digital carrier or services.

There are stringent rules to be followed in the design of low-capacitance cable facilities. It is recommended that the facility extend to the RT. If that is not possible, one interface is permitted between the low-capacitance cable and conventional capacitance cable (83 nF per mile). The interface is made at a repeater point and low-capacitance-type repeaters are used at that point. After the interface, conventional capacitance repeaters are used at repeater points in the 83 nF cable. Maximum length sections may be used on both sides of the interface.

DILEP II will print a system error diagnostic message when low-capacitance cable is used. This is to alert the engineer that this design is nonstandard, and that caution is needed when mixing with standard cables. This message is shown in Section 7, Table 7-3.

In designing digital loop carrier systems that will utilize existing air core PIC cable, attention should be given to the possibility of water in the sheath. Water causes problems due to its effects on corrosion rates and transmission. Water also causes an increase in the mutual capacitance of the cable pairs.

One way these sheaths have been recovered is by the use of reclamation compounds. The capacitance increase is less with reclamation compounds than with

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ICOT is a trademark of AT&T.

water, but is still greater than dry cable. Therefore, the insertion loss of the cable will be greater. A reclaimed cable sheath is cared for in DILEP II by the use of an X as the fourth letter in the cable code. A cable code such as AHAX will increase the loss of that section by 35 percent.

Any cable containing water or moisture, and any reclaimed cable, should be considered last for the T1 digital facility.

Table 2-2 shows the cable types that are available in DILEP II as of this issue. The type is shown in column 1; capacitance in column 2; loss in dB per kft in column 3; and steps of 10 degrees in dB per kft in column 4. When using a cable from a manufacturer, or a superceded cable type, with coding not found in Table 2-2, the electrical characteristics can be matched to a sheath type listed in the table and that sheath type entered. For instance, if pulp-insulated aluminum conductors are encountered, use a code representing a pulp-insulated copper conductor cable two gauges smaller that is equivalent in electrical characteristics. The standard 3-letter code from Table 2-2 for PIC aluminum cable may be used when that type of cable is encountered.

The temperature steps are useful when higher-than-normal temperatures are expected. Column 10 of the Route Data Sheet can be used in these cases.

Any number of analog multichannel subscriber carrier systems (such as 8-channel carrier) are compatible with up to five active digital pairs (either transmit or receive, and including spare digital pairs) in the same 8-, 9-, 12-, 13-, and 25-pair units of PIC cable or in 6-, 11-, 16-, and 25-pair PIC cable. For adjacent and nonadjacent units in PIC, and in all cases for pulp-insulated cable, there are no interference constraints. As an example, if five T1 digital lines (ten pairs) are to be served through a 25-pair cable, then no analog subscriber carrier is allowed in that cable.

If subscriber T1 digital lines are to be in the same sheath with trunk T1 lines, the subscriber apparatus cases must be in the same location as the trunk apparatus cases. It is not recommended that one apparatus case house both subscriber and trunk T1 repeaters.

Indicate the cable layup and the pair unit size on the schematic, e.g., 8, 9, 11, 12, 13, 16, 17, 25, 50, or 100. Layup is defined as a cross-section view of the number of pairs assembled in a unit, and the arrangement of the units as they are combined to form unit-type constructed cable. It may also be a view of the number and arrangement of pairs in a layer-type constructed cable.

Spacing of repeaters on the digital line is governed both by cable layup and by the relative location of the transmit and receive pairs. The transmit and receive pairs may be assigned within the **same** unit, **adjacent** units, or **nonadjacent** units.

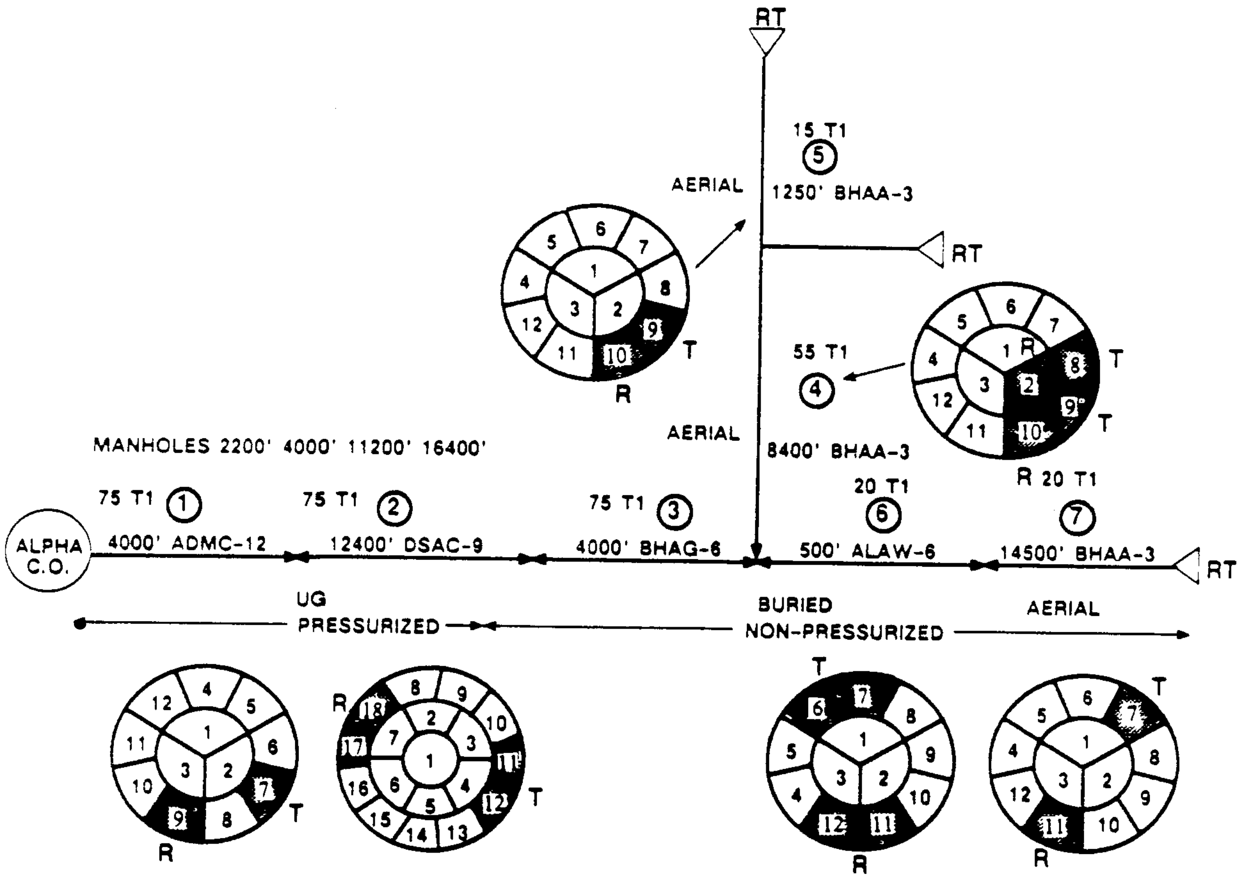

Figure 3-1. Example Schematic

Step 3 - Digital Line Pair Selection

Careful attention must be given to the specific pair assignments made for digital lines to ensure that maximum margin or maximum repeater spacing, depending on the design philosophy employed, is achieved. The cable pairs used for the two directions of transmission should be physically separated as much as practicable to minimize the crosstalk influence of other digital lines in the same cable sheath. Consequently, the **first** choice for the transmit and receive pairs would be in **nonadjacent** pair units, the **second** choice would be in **adjacent** units, and the **last** choice would be in the **same** pair unit.

Achieving maximum send and receive pair separation (nonadjacent pair unit) in digital loop carrier system applications is difficult, since these systems prove most economically attractive near the extremities or on rural routes where small sized cables are encountered. Nonadjacent pair unit separation can be achieved only in larger pair sized cables (150-pair and larger, even count PIC cable, and 300-pair and larger pulp-insulated conductor unit-type cables).

When describing the selection of pairs for transmit and receive in a digital span, the terms "layup," "pair unit," and "binder group" will be used in various publications. Layup has been defined as a cross-section view of the number of pairs assembled in a unit and the arrangement of the units as they are combined to form unit-type constructed cable. It also may be a view of the number and arrangement of pairs in a layer-type cable. Binder groups and pair units are terms that have been used interchangeably. They both are bound with a distinctive ribbon and have a fixed number of pairs. For this User Guide, binder group means an entity that maintains the same positioning in the sheath in relation to all other binder groups. In multiunit cables, the units and subunits spiral as they are combined in the cable manufacturing process. Subunits that may appear to be nonadjacent and are in different rings might become adjacent as the units spiral around the core and inner ring. In the manufacture of cable, units may be slipped a maximum of one unit. For example, in a 400-pair cable, the 126-150 binder group could become adjacent to binder group 351-375.

It is very important, when choosing binder groups or pair units, to ask yourself, "Does this particular entity keep the same position in the sheath in relation to other entities, and will the desired pair separation be achieved throughout the length of a particular piece of cable?" Also, it is important to pick pair units or binder groups that will allow the maximum number of T1 lines within the sheath for the type of separation that is initially chosen.

In selecting pairs, be careful to ensure as much separation as possible in the smaller cables (less than 50 pairs) at the extremities of the route. Select pairs in the outer ring and try to achieve a minimum of 2-pair separation between the send and receive pairs.

The following rules, applicable to even-count PIC cables, will result in maximum repeater spacing:

1. Do not use sheath pairs 1-12 in 50-pair cables.
2. Do not use sheath pairs 1-25 if the starting point involves a 75-pair or larger cable.
3. If the starting point is in a 75-pair cable, the transmit and receive pairs should be selected from the following units:

   26-37 and 51-62
   26-37 and 63-75
   38-50 and 63-75

4. If the starting point is in a 100-pair cable, the transmit and receive pairs should be selected from the following units:

   26-37 and 76-87
   38-50 and 76-87
   38-50 and 88-100

In general, 50-pair units are the smallest found in 22-, 24-, or 26-gauge non-PIC cables larger than 100 pairs. Most 19-gauge, non-PIC cables are assembled in 25-pair units. When layer-type cables are encountered, 25- and 50-pair cable sizes are to be considered as 25- and 50-pair unit cables, since they have the same crosstalk characteristics.

Most 75-pair layered and some 100-pair layered cables are constructed as a single unit. These cables should be considered as 50-pair unit cables. The larger size layered cables are constructed with either 50- or 100-pair splicing groups, and these cables should be treated the same as 50-pair unit type, since both 50- and 100-pair layers have NEXT coupling losses comparable to 50-pair unit cable.

In layered cables, when transmit and receive pairs are assigned in nonadjacent splicing groups, treat this cable in the same manner as though the pairs are assigned in nonadjacent units. Similarly, treat a cable that contains transmit and receive pairs in adjacent splicing groups as though they are assigned in adjacent units. However, if ten or more subscriber carrier systems or an equivalent number of DS-1 circuits are contemplated in the planning period, pair assignments in adjacent splicing groups must be treated as though they are within the same unit.

In a 900-pair layered cable, adjacent group assignments are, for example, in counts 1-100 and 101-200 and nonadjacent group assignments are in counts 1-100 and 201-300. Notice that to be nonadjacent, groups must have no pairs in adjacent layers. For example, counts 301-400 and 501-600 do not qualify as nonadjacent and must be considered as adjacent.

When only the pair size, gauge, and year of placement are known, the "layup" can be estimated by referring to the predivestiture Bell System Practice BSP 626-759-400, *Superseded Exchange Cables.*

The B series of PIC cable is currently produced in various pair unit sizes.

1. The layup design was changed in 1964 from 25-pair binder groups assembled in 8-, 8-, and 9-pair units to 12- and 13-pair units.
2. The layup is the basis of 50-pair "multiunit" constructed PIC cables in some of the 200- through 900-pair sizes.

Large quantities of manufacture-discontinued PIC cable containing 8- and 9-pair units are in service, as well as lesser quantities of 13-, 17-, and 50-pair units. With the redesign in 1964, no change was made in the code (BK or BH) that identifies this type of cable.

Step 4 - Record Selected Pairs on the Schematic

Trace the selected pairs back toward the CO, and record on the schematic the separation status of the transmit and receive pairs in each cable section (**same**, **adjacent**, and **nonadjacent** units). All the information that is needed to prepare the Route Data Sheet is now on the schematic.

3.2 Preparing the Route Data Sheet

A Route Data Sheet (Figure 3-2), which must be prepared for each route, is the primary input for the DILEP II computer program. It should be used to design or verify repeater spacing for T1 digital lines.

DILEP II is capable of handling up to 100 cable sections, 50 manhole locations, and 35 route junctions for a single route. If any of these limitations need to be exceeded for a particular route analysis, the study route must be divided into two separate route segments, using any RT site or route junction as the separation point for the two segments.

DILEP II stores data on many different cable codes (cable types). One of these codes (which are listed in Table 2-2) must be used.

The Route Data Sheet provides the same basic information as the route schematic, but in tabular format. A properly filled-in sheet provides the following basic types of data:

- Title information
- Cable section information
- RT and DR requests
- Manhole locations.

Title Information

Two kinds of title information are provided on the Route Data Sheet:

1) FILE NAME – This identifies any particular data file among all possible data files being stored in the user's storage area. Use of this information is covered in Section 4, Running DILEP II.

2) ROUTE DESCRIPTION – The route description line ("title"), if specified by the user, will appear at the top of the printed listing after the ***DIGITAL LINE ENGINEERING PROGRAM*** heading. The same description will appear each time the problem is run unless the user subsequently changes it.

Cable Section Information

The required data for each cable section (100 sections maximum for each route or route segment) is given on a line across the first nine columns of the Route Data Sheet. Columns 10 and 11 are optional. The contents of each column, in order by number as given on the Route Data Sheet (Figure 3-2), are:

(1) Cable section numbers, numbered consecutively from the central office (CO), starting with one.

(2) Previous cable section numbers, starting with zero for the first section line on the sheet.

(3) Ultimate number of active T1 lines (i.e., those to be installed in the cable section during the planning period plus any already in the same sheath).

(4) Length of the cable section in feet, if more than ten feet. (Sections less than ten feet should be included with an adjacent cable section.)

(5) Type of outside plant construction, i.e., aerial (A), buried (B), or underground (U).

(6) Pressurization code for each cable section, i.e., pressurized (P) or nonpressurized (N).

(7) Cable code – three or four letters; if the cable is reclaimed or screened, the fourth letter becomes X for reclaimed, S for screened.

(8) Relative pair-unit separation between transmit and receive pairs, i.e., same unit (S), adjacent units (A), or nonadjacent units (N).

(9) Pair-unit size (number of pairs per cable unit) – 8, 9, 11, 12, 13, 16, 17, 25, 50, or 100.

(10) Insertion loss factor in dB per kilofoot. User inserts a value in this column only if he/she wants a factor other than the normal value given in Table 2-2.

(11) Loss limit reduction in dB. The user inputs a value up to a maximum of 24 dB in this column only for those sections (if any) where the loss limit is to be reduced. For instance, if the section were the customer end section of an HCDS T1 line, and all protected repeaters were being used, the loss reduction value entered in column 11 would be 9.5 dB. This would limit that section to 22.5 dB, which is the design limit for HCDS (32 dB - 9.5 dB = 22.5 dB). If nonprotected repeaters were used, the loss reduction value entered in column 11 would be 11 dB for the same HCDS line (33.5 dB - 11 dB = 22.5 dB).

(Insert Your Company Logo)

DILEP II
Route Data Sheet

EO 750-1 (6-87)

File Name (One To Eight Characters) Data: EXAMPLE1

Route Description (Up To 78 Characters): ALPHA ROUTE 1

(1) Cable Section Number	(2) Previous Cable Section Number	(3) Number Of Active T-1 Lines	(4) Cable Section Length In FT	(5) Type Of Construction A, B, U	(6) Pressure Code P, N	(7) Cable Code *	(8) Pair Unit Separation S, A, N	(9) Unit Size 6, 9, 11, 12, 13, 16, 17, 25, 50, Or 100	(10) Insertion Loss Factor dB/KFT AT 772 kHz **	(11) Loss Limit Reduction (dB) ***
1	0	75	4000	U	P	ADMC	N	100		
M	2200									
M	4000									
2	1	75	12400	U	P	DSAC	N	50		
M	11200									
M	16400									
3	2	75	4000	B	N	BHAG	N	50		
4	3	55	8400	A	N	BHAA	A	25		
RT	0	7.5								
5	4	15	1250	A	N	BHAA	A	25		
RT	0	7.5								
6	3	20	500	B	N	ALAW	N	50		
7	6	20	14500	A	N	BHAA	N	25		
RT	0	7.5	15.0	22.5						

M Manhole   DR Demand Repeater   RT Remote Terminal, Pad Value   800 Type Apparatus Case? (Check One) ( ) Yes ( ) No

All Protected Repeaters? (Check One) ( ) Yes ( ) No   Repeaters At All Junctions? (Check One) ( ) Yes ( ) No   Reduce Loss Limit? (Check One) ( ) Yes ( ) No If Yes, To What? dB

* Three Or Four Letter Code (If The Cable Is Reclaimed Or Screened, The 4th Letter Becomes "X" Or "S", Respectively.)

** Use Only If Necessary To Override Dilep II

*** 24 dB Maximum

Figure 3-2. Sample Route Data Sheet

RT Locations

Remote terminals (RTs) should be indicated in column one of the Route Data Sheet. (See Figure 3-2.) For an RT entry, the allowable pad values are entered in columns two through six for a maximum of five pad values. If no pad values are entered with an RT, the program will not place any pads at that RT.

DR Requests

Requests for DRs must always be made on a separate line placed between the data for two cable sections. That is, on the Route Data Sheet, each DR entry is made on a separate line following the line containing the number of the cable section in which the DR appears. Consequently, if the user plans to run the route initially without any DRs and later rerun the route with DRs at predesignated sites (e.g., at loading coil sites), he/she should sectionalize the route so that all loading coil sites fall on cable section boundaries. DRs and RTs cannot be placed at the end of the same cable sections.

For a DR entry in column one, the cumulative distance in feet from the CO is entered in column two. (If the DR is at the end of the cable section, no entry is needed in column two). If the DR distance, as entered by the user, falls within a cable section (as opposed to the end of the cable section), the program will create new cable section numbers.

Manhole Locations

Manhole locations suitable for repeater installation may be given for underground cables, if desired. If a repeater must be placed on an underground cable, the DILEP II program will locate it at one of the specified manhole sites, if at all possible, and mark it with the letters **MH** on the output. But, if a repeater must be placed on underground cable and no manhole sites or an insufficient number of manhole sites are given to allow all required repeaters to be located at specific manhole sites, DILEP II will determine the repeater sites and mark them as needing new manholes with the letters **NM** on the output.

Manholes need not be located at cable section boundaries. For example, it is possible to have several manhole sites within any single cable section. On the Route Data Sheet, manhole sites can either be interspersed with the cable sections with which they are associated, or "bulk" entered following a number of cable sections. They must, however, be given in sequence, starting with the manhole nearest to, and ending with the manhole farthest from, the CO. Furthermore, if a route junction occurs, all manholes for the first branch of the route must be given prior to the start of the cable section information for the second branch of the route. Manhole information for a branch cannot be given prior to the start of cable section information for that branch.

On the Route Data Sheet, the user designates a manhole by entering the letters **MH** or **M** in column one, and the cumulative distance from the CO to the manhole in column two. A maximum of 50 manholes can be specified for each route or route segment.

Alternatives and Options

If a section of cable is **screened**, the user must enter, in column 7 of the Route Data Sheet, the letter **S** as the fourth letter of the cable code. Also, the user must specify the pair unit separation as nonadjacent (letter N in column 8 of the Route Data Sheet, Figure 3-2) so that DILEP II will recognize the cable as screened. DILEP II assumes a 1.5 dB NEXT advantage for screened cable; therefore, apparatus-case crosstalk (ACXT) and far-end crosstalk (FEXT) are the controlling types of interference in this situation.

When **reclaimed** cable is used in the route, the user must enter the letter X as the fourth letter of the cable code in column 7 of the Route Data Sheet. This will cause a 35-percent increase in the DILEP II-provided insertion loss per kilofoot, since reclaimed cable has a higher capacitance than nonreclaimed cable.

When composite cable is used in the route, DILEP II supplies a default value for the insertion loss per kilofoot. If the cable loss is known to differ from the default value, the user may override the default value by entering the desired value in column 10 of the Route Data Sheet. If the insertion loss per kilofoot is given, it may contain a decimal point.

The situation may arise where the user would like to decrease the **loss limit** of only one, or some, of the sections of the digital line (e.g., to compensate for power line induction, or to limit the customer end section of an HCDS circuit). To do this, the DILEP II user enters the desired limit in column 11 of the Route Data Sheet. The reduction amount must be a number between 0.0 dB and 24.0 dB. If the user does not override the insertion loss per kilofoot in column 10, but enters the loss reduction in column 11, column 10 must appear as ,, (two commas without any space between).

This reduction is an option that behaves much like the option of overriding the default cable insertion loss. If the user wishes to both override the default insertion loss, and specify a reduction, the insertion loss must be specified first. The reduction, if used, must always be the last item specified for the cable section.

4. RUNNING DILEP II

4.1 Run Types

DILEP II can be used to provide either an **automatic** run or a **constrained** run, as discussed below.

Automatic Run

The automatic run provides outputs specifying the proposed repeater sites. The information input for this concerns the cable sections and the locations of remote terminals and manholes. It provides optimal repeater spacing for the loop carrier system, but ignores any special engineering considerations; consequently, it may place repeaters at impractical locations, such as at a busy intersection or in the middle of a river. If one or more repeaters are needed in underground plant, DILEP II will place them at user-specified manhole sites, if possible. If the user has not specified manhole sites within underground plant, DILEP II will place, at optimal locations, the fewest repeaters required to achieve the transmission objectives.

The automatic run output provides the outside plant engineer with a basic design that can then be adapted to meet specific boundary conditions. Junctions not needing repeaters will be identified whenever the repeaterless junction option is selected. They may not be in the optimum location. For instance, the outside plant engineer may elect to have no repeaterless junctions in the backbone feeder. Further, it should be kept in mind that a repeaterless junction could necessitate the future placement of more repeaters on legs of the junction.

Constrained Run

The constrained run permits the engineer to specify some or all of the repeater locations needed to meet specific conditions. These specified repeaters are called demand repeaters. The program then uses location data (for demand repeaters, remote terminals, and manholes) and cable-section data to determine any additional repeater sites that are needed to satisfy the digital line transmission requirements. Once again, the program may identify junctions without repeaters, if that option is used.

In general, the user should begin by making an automatic run to determine the minimum number of repeaters needed for the route. The user can then use constrained runs, inserting DRs to meet specific conditions, until a satisfactory design is developed. To place repeaters at a junction, identified as a repeaterless junction by the program, the user should make that location a DR.

4.2 Establishing a Computer Connection

Once the engineer has prepared the Route Data Sheet, a terminal session can be initiated to enter the data into a data file that can be processed by DILEP II. The user must first establish a communications link with the computer. This is done by dialing an appropriate telephone number and then performing the logon procedure. Once logged on, the user can create a file containing the Route Data Sheet information.

4.3 System Cues

A system cue is an acknowledgement from the Time Sharing System (TSS) that it is ready to accept input data. The cue varies among systems and terminals, but always means the same thing. Throughout this User Guide the "greater-than" symbol (>) is used to indicate the system cue. The user may input data anywhere on the line after the system cue.

The user signals the TSS at the end of each line of data by depressing the RETURN key on the terminal keyboard. The user must then wait for the system cue before typing a new line of data.

4.4 Entering Data

Once logged on, the user must enter the input mode by typing the command **CREATE** after the system cue and depressing the RETURN key (as described in the RDES User Guide) to create a data file. The system will respond with the word **FILENAME?** and a system cue. The user will then enter the name of the file where the data is to be stored. The system will respond with the word **INPUT**:, followed by another system cue.

Figure 3-2 is an example of a Route Data Sheet, prepared from the schematic shown in Figure 3-1, and Figure 4-1 is an example of how the data input session should appear on the terminal. Refer to these two figures for a better understanding of how to enter the information from the Route Data Sheet into the data file.

When the system indicates that it is in the input mode, the user can begin entering data, copying line-for-line the information on the Route Data Sheet. Each item of information on a line on the Route Data Sheet must be separated by a comma as it is typed and each line of data from the Route Data Sheet must be typed on a separate line.

Title and manhole information must begin with the letter **T** or **M**, and cable section information or requests for RTs or DRs may start at any print position after the system cue (spaces are ignored in these cases).

When all data on the Route Data Sheet has been entered, the user must transfer from the input mode to the edit mode. This is done by depressing the RETURN key after a system cue without entering any data. At this point, the user may use any of the editing commands provided by the TSS to make additional corrections in the data file. It is recommended, however, that the edit commands be restricted to the following eight: **LOCATE, CHANGE, PRINT, QUIT, DELETE, FILE, REPLACE,** and **INSERT**. These commands are the only ones guaranteed to be supported by DILEP II.

When the user has checked the accuracy of the data file, that file should be saved in the user's storage area by typing the command **FILE** after the system cue.

Table 4-1 provides condensed instructions for creating a new DILEP II data file. Table 4-2 has condensed instructions for editing an existing DILEP II data file.

Table 4-1. Simplified Data Entry Instructions - Create a New File

USER INPUT	SYSTEM RESPONSE	REMARKS
1. *logon*	NEXT? >	Follow local LOGON procedures.
2. >CREATE	FILENAME? >	RDES is now in input mode.
3. >*filename*	NEWFILE: EDIT: INPUT: >	Enter the name of the file to be created. RDES is ready to accept DILEP II data recorded on the Route Data Sheet.
4. >T *sample*		Enter the title of the DILEP II problem. Enter the T as the first item after the system cue (no spaces between > and T).
>*data,data*		Enter the data, line-by-line from the Route Data Sheet. Type a comma between each item.
>rt,*pad,pad*		Enter a maximum of five RT pad values after RT. These must constitute the only entry on the line.
>dr,*distance*		When entering a DR, it must be the only entry on the line.
>m,*distance* or mh,*distance*		When entering a manhole location, it must be the only entry on the line.
>*RETURN*	EDIT:	Depressing the RETURN key after the system cue is displayed puts RDES in the edit mode. Make changes to the data, if needed, using the DILEP II-supported commands.
>*file*	NEXT?	Typing "file" causes the file just created to be stored in the user's storage area.

Table 4-2. Simplified Data Entry Instructions - Edit an Existing File

USER INPUT	SYSTEM RESPONSE	REMARKS
1. *logon*	NEXT? >	Follow local LOGON procedures.
2. >ACCESS	FILENAME? >	Enter the name of the file that was created in a previous session.
3. >*filename*	EDIT: >	RDES is now in the edit mode. Use any DILEP II-supported editing commands to make changes to the file.
4. >*RETURN*	EDIT: >	User can now continue editing the file, if necessary.
5. >*file*	NEXT? >	Typing "file" causes the edited file to be stored in the user's storage area.

4.5 Running the DILEP II Program

When the user has completed building the problem file, the DILEP II program may be run to analyze the route by performing the following steps:

1. After the **NEXT** message and system cue from the TSS, type the following request:

   > dilep

2. The program will respond with the question:

   DO YOU WANT TO RUN DATA CHECK, STUDY OR QUIT? (ENTER D, S OR Q)

   The cue > will be returned so that **d**, **s**, or **q** may be entered. If **d** (DATA-CHECK) is entered, the program will ask:

   ENTER FILE NAME:

   The cue > will again be returned so that the name of the data file to be checked can be entered. Once the DATACHECK has been completed, the message:

   YOUR FILE HAS COMPLETED DATA CHECK

   will appear if there are no errors. If there are errors in the data file specified, DATACHECK will return error messages indicating the errors that must be fixed before a study can be done. See Section 7 for detailed descriptions of the error messages.

3. Once an error-free DATACHECK has been performed, you are ready to conduct a study. Once again, type DILEP after the system cue.

   > dilep

4. The system will respond with:

   DO YOU WANT TO RUN DATACHECK, STUDY OR QUIT? (ENTER D, S OR Q)

   If you wish to conduct the study, enter an "s" after the system cue.

   > s

   The system will respond by asking for the filename.

   ENTER FILE NAME:

   Enter the filename after the system cue.

   > *filename*

5. At this point, DILEP II prompts the user to answer the following questions:

   800-TYPE APPARATUS CASE? (Y OR N)

   If the user answers **Y** or **YES** and specifies an 800-series apparatus case, the loss caused by apparatus case crosstalk is virtually eliminated. When using any other type of apparatus case, an **N** or **NO** is entered. Of course, if a particular manufacturer's apparatus case is known to have the same crosstalk elimination characteristics as the 800 series, a **YES** is entered.

   ALL PROTECTED REPEATERS TO BE USED? (Y OR N)

   If surge-protected repeaters are to be used, a **Y** or **YES** is entered. The loss limit of all sections except the first will be reduced by 1.5 dB (e.g., from 33.5 to 32.0 dB). The reduction for the first repeater section will only be 1.0 dB (e.g., from 23.0 dB to 22.0 dB) because there is no surge-protected repeater at the input end to add the other 0.5 dB.

   REPEATERS AT ALL JUNCTIONS? (Y OR N)

   If the user desires repeaters at every junction, a **Y** or **YES** is entered. When an **N** or **NO** is entered, the program will attempt to maximize the repeater spacing by utilizing repeaterless route junctions whenever possible. The maximum signal mismatch is 7.5 dB at the repeaterless junction. Successive runs can be made, answering **Y** or **N**, to determine if less repeaters are specified by the repeaterless route junction option. Usually, this option will give less repeater points; however, because every design is different, this may not always be the case. If a design gives the same number of repeater points with either option, it is usually desirable to place the repeaters at junctions. Unforeseen future T1 lines entering the sheath can then be cared for by using a less complicated design procedure.

   CHANGE LOSS LIMIT? (Y OR N)

   If an **N** or **NO** is entered, the program will calculate the section losses based on the upper default values of 32.0 dB (protected repeaters) and 33.5 dB (nonprotected repeaters). If a Y or YES is entered, DILEP II asks:

TO WHAT?

The user then enters a value between 20.0 dB and 33.5 dB for nonprotected repeaters, and a value between 18.5 dB and 32.0 dB for protected repeaters. A statement is then printed:

LOSS LIMIT IS NOW xxxx DB MAXIMUM.

This has the effect of changing the upper loss limit of all sections. If a value less than 20.0 dB (18.5) or more than 33.5 dB (32.0) is entered, a system diagnostic message will occur, and the user will have to enter the correct value. Entering 33.5 dB or 32.0 dB will have no effect because these are the default values.

This option is useful if a company's policy is to use repeater section losses less than the default. This option would also be useful if the entire route consisted of cable that was subject to either moisture or induction and additional loss margin was desired.

Immediately after the interactive session for options, DILEP II will analyze the route and return the information on the proposed repeater sites. DILEP II always processes problem data in real time, i.e., the repeater sites are determined while the user is still at the terminal, and the results are immediately returned to the terminal.

```
NEXT?
>create  ← NOTE 1
FILENAME?
>example1
NEW FILE:
EDIT:
INPUT:

>t alpha route 1
>1,0,75,4000,u,p,admc,n,100
>m,2200
>m,4000
>2,1,75,12400,u,p,dsac,n,50
>m,11200
>m,16400
>3,2,75,4000,b,n,bhag,n,50
>4,3,55,8400,a,n,bhaa,a,25
>rt,0,7.5  ← NOTE 2
>5,4,15,1250,a,n,bhaa,a,25
>rt,0,7.5  ← NOTE 2
>6,3,20,500,b,n,alaw,n,50
>7,6,20,14500,a,n,bhaa,n,25
>rt,0,7.5,15.0,22.5  ← NOTE 2
>  ← NOTE 3
EDIT:
>file  ← NOTE 4
NEXT?
>DILEP or QUIT  ←NOTE 5
```

NOTES ON THE ABOVE DATA FILE:

Note 1: The user enters the input mode to create a new data file.

Note 2: The program will use one of these values, depending on the requirement. Given a choice, the program will select the value which gives the least level of signal difference.

Note 3: The user depresses the RETURN key without data input to enter a null line and transfer to the edit mode. The user may make changes to the data file while in this mode.

Note 4: The user saves the data file in his or her storage area.

Note 5: The user may either request that the DILEP II program be run, or quit the session at this point.

Figure 4-1. DILEP II Problem Route Data File Creation

5. INTERPRETING THE DILEP II RESULTS

5.1 General

DILEP II analyzes the route problem data the user has previously stored in an input data file, and provides two types of output – route description data (based on cable sections) and repeater section data (based on the series of cable sections between repeaters).

5.2 Route Description Data

The following descriptions detail the information found in the Route Description portion of the DILEP II program output:

1. The title of the route problem.
2. For each cable section:
   - the nine items of data entered by the user from the input data file for that cable section
   - the insertion loss factor being employed (default or specified)
   - the insertion loss limit imposed on the repeater section by that cable
   - the simplex loop resistance in ohms
   - the cumulative simplex loop resistance from the CO to the end of the section
   - the cumulative distance from the CO to the end of the section. (The simplex loop resistance may be used in the design of repeater powering.)

The abbreviated headings used for the section data on the printouts are:

- SEC (cable section number)
- PRV SEC (number of the previous cable section)
- T1 LINES (number of T1 lines specified by the user)
- SEC LEN (cable section length)
- TYP PLT (type of outside plant construction)
- P N (pressurized or nonpressurized)
- CA CODE (cable code)
- PR SP (pair unit separation)
- UNIT SIZE (number of pairs in each cable unit)
- DB/KFT LOSS (loss at 772 kHz, from stored DILEP II data file)
- LOSS LIMIT (the maximum loss allowed in a repeater section that includes the type of cable used in this cable section)

- RESIST (simplex loop resistance between repeaters)
- CUM RESIST (cumulative simplex resistance between the CO and the repeater)
- CUM LENGTH (cumulative distance from the CO to the end of that cable section).

3. RT and DR locations in their input sequence among the cable section numbers.
4. A separate list of the manhole locations that were input as potential repeater locations.

5.3 Repeater Section Data

The repeater section data is given in parts. Each part spans a series of cable sections along one of two possible path types:

- From the CO to the end of the first **branch** of the route, or
- From one **junction** to the end of any branch of the route other than the first.

For each repeater section, the information is given under the following headings on the printout:

- REPEATER (the number of the section, followed by a code designating a special repeater, if applicable. The codes can designate a remote terminal [RT], demand repeater [DR], manhole [MN], new manhole [NM], or repeaterless junction [JCT].)
- DISTANCE FROM CO (the distance in feet from the CO to the repeater site)
- SECTION LENGTH (repeater section length – distance between repeaters – in feet)
- DESIGN LOSS (DB) (the design insertion loss in dB at 772 kHz)
- LEVEL DIFF (DB) (the highest value of the signal level mismatch at a repeaterless junction)
- PAD (DB) (the value of the pad placed at an RT to meet the minimum loss requirement or to meet the maximum level difference requirement at a junction)
- MAX T1 LINES (the maximum number of T1 lines that can be assigned)
- BKWD MARGIN (the backward margin, i.e., the distance that a repeater can be moved back toward the CO while keeping all other repeaters fixed)
- FWD MARGIN (the forward margin, i.e., the distance that a repeater can be moved forward, away from the CO, while keeping all other repeaters fixed).

5.4 Backward and Forward Margins

DILEP II computes two types of margins that provide a measurement of flexibility in the route design. First, it computes a backward and a forward margin for each repeater site. The backward margin is the number of feet a repeater site can be moved toward the CO without disturbing any other repeater location. The forward margin is the number of feet the repeater site can be moved away from the CO without disturbing any other repeater location. Calculation of the backward and forward margins for a particular repeater site is made under the assumption that the repeaters on either side of the site are not moved. If the user wishes to move two adjacent repeaters, he or she must rerun the DILEP II program and specify the two new locations as DRs to ensure that no additional repeater is necessary.

Backward and forward margins are not calculated for RTs, because cable data is not available for the cable beyond the RT site when the site is at the end of a digital line branch. Besides, RT sites are fixed by the plan. RTs at the end of digital line branches can be moved back toward the CO as long as the insertion loss for the repeater section is not reduced below 9.2 dB. Backward and forward margins are not calculated for DRs at junctions, since these repeaters must be placed as close to the physical location of the junction as possible. However, backward and forward margins are calculated for all other DRs to indicate how much accuracy can be tolerated in measuring their distance from the CO. The user should also be aware that when a normal repeater is changed to a DR, DILEP II will adjust the locations of repeaters on both sides of the new DR to achieve optimal repeater spacing between DR and RT locations. This condition may arise even if the new DR is placed at its DILEP II-calculated site instead of being moved to a new site. If the user wishes to change one repeater to a DR and to leave all others in their original positions, he or she must specify as DRs all repeaters between two DRs, between two RTs, or between any combination of these.

5.5 Maximum Number of T1 Lines

The second type of margin calculated by DILEP II is the maximum number of T1 lines that can be placed in each repeater section. Calculation is made under the assumption that the repeaters at either end of a repeater section are not moved from their DILEP II-calculated sites. If the user moves one or more repeaters in the route to obtain the final design, the maximum number of T1 lines calculated by DILEP II may no longer be valid. The user should request DRs at the final sites for all repeaters and then rerun DILEP II to obtain the maximum number of T1 lines that can be handled by each repeater section in the final design plan.

Note. Caution should be exercised when interpreting the maximum number of T1 lines calculated by DILEP II, considering the following factors:

1. DILEP II has no knowledge of cable size; therefore, the calculated maximum number of T1 lines could require more cable pairs than the cable contains.
2. DILEP II has no knowledge of cable layup (i.e., positioning of the pairs); therefore, it may not be possible to maintain the specified pair-unit separation for all T1 lines as the maximum number of T1 lines is approached.

5.6 Manhole Locations

If a repeater must be located in an underground cable section, DILEP II will try to locate the repeater at one of the specified manhole sites and will mark it as MH. However, if a repeater must be located in an underground cable and no manhole sites are specified, or if the number of manhole sites specified is insufficient to allow all required repeaters to be located at existing manhole sites, DILEP II will determine the repeater sites and mark them with the letters NM to indicate that new manholes are needed.

5.7 Selected Samples of DILEP II Output

The sample data shown in the previous section is used in this section to illustrate some of the various outputs that DILEP II generates. Many types are possible, depending on the answers to the four interactive questions. These questions must be answered before a study can be made.

The following are explanations of Figures 5-1 through 5-10:

Figure 5-1. This example of a route schematic is used to illustrate the information needed to fill in the Route Data Sheet.

Figure 5-2. The Route Data Sheet is shown filled in with the information needed for input into a data file.

Figure 5-3. The data file has been input and is now ready for the datacheck and DILEP II run.

Figure 5-4. In this run, the questions, "800-Type Apparatus Case?" and "All Protected Repeaters To Be Used?" were answered **no**. The resulting maximum loss limit is set to 33.5 dB except for those sections that are limited to a lesser value because of factors such as pair unit separation or number of T1 lines. The engineer also asked for repeaters at all junctions.

Figure 5-5. This run has the questions, "800-Type Apparatus Case?" and "All Protected Repeaters To Be Used?" answered **yes**. The engineer again asked for repeaters at all junctions. The maximum loss limit is now 32 dB, except for the sections that are further limited by other factors.

Figure 5-6. This run illustrates the use of repeaterless route junctions. The question "Repeaters at all junctions?" was answered **no**. DILEP II placed one repeaterless route junction, but the total number of repeaters is the same as for the previous run, with repeaters at all junctions. The section loss values changed and the backward and forward margins were changed. One of the input manholes was used by the program in this run. Care should be taken in the use of repeaterless route junctions; if their use does not reduce the number of repeater locations, repeaters should probably be used at all junctions. This will give flexibility at a later date if unforeseen T1 requirements occur.

Figure 5-7. In this example, the maximum loss limit for all sections is changed to 29.0 dB. Nonprotected repeaters are specified. The program looks at all sections that have a maximum value of 33.5 dB and changes that loss to 29.0 dB. It does this by subtracting 4.5 dB from 33.5 dB. The other sections that are less than 29 dB initially are unaffected. Note that these other sections show a slight increase in loss limit from Figure 5-4 due to the use of the 800-type apparatus case in this example.

Figure 5-8. Two sections are to be limited to 22.5 dB. The first section to be limited is a 1250-foot section of BHAA. Referring to a previous run (Figure 5-6), there is an existing loss limit of 26.2 dB. To get the desired limit of 22.5 dB, a value of 3.7 is entered in column 11 of the data. The next section to be limited is 5756 feet of BHAA. The engineer had previously broken the original section of 14500 feet into two, 8744 feet and 5756 feet. This section has been shown to have a maximum loss of 32 dB when using protected repeaters (Figure 5-6). To get the desired limit of 22.5 dB, a value of 9.5 is entered in column 11 for this section.

Figure 5-9. The output with the two sections above limited to 22.5 dB is shown in this figure. This option is useful when individual sections are to be limited to a value less than the default. Usually, an initial run will have to be made to determine what the default value is. Examples of the use of this option are High Capacity Digital Service, and when a vendor's digital loop carrier system has end section parameters other than the default.

Figure 5-10. This figure shows the output after the number of T1 lines was increased in all sections. In three of the sections the engineer changed the pair separation from nonadjacent to adjacent because of the larger number of T1 lines. The combined changes caused the addition of two repeaters in part 2 and lower maximum loss limits in several sections. This illustrates the importance of specifying the ultimate number of T1 lines in the sheath initially.

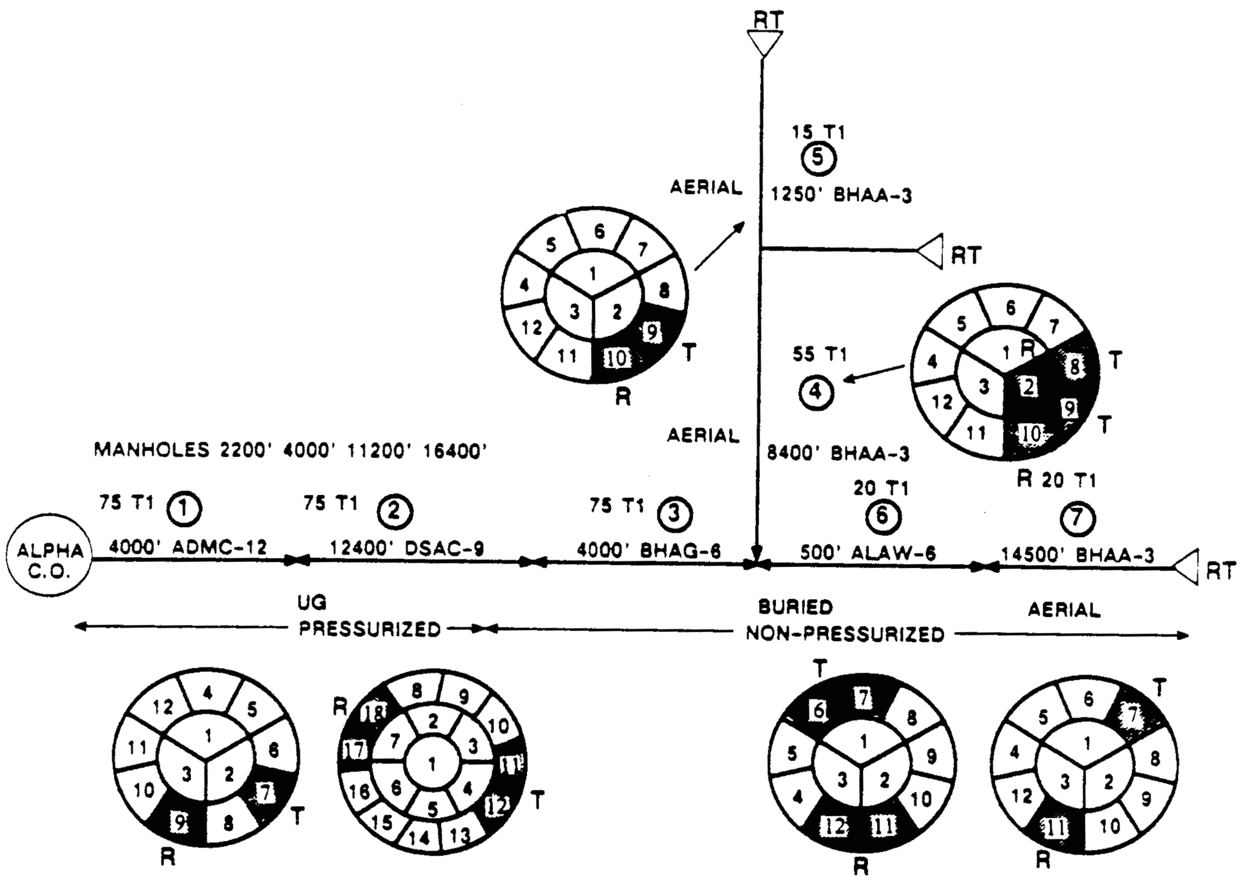

Figure 5-1. Simplified Route Schematic

(Insert Your Company Logo)

DILEP II
Route Data Sheet

EO 756 1 (6-87)

File Name (One To Eight Characters) Data
EXAMPLE1

Route Description (Up To 78 Characters)
ALPHA ROUTE 1

(1) Cable Section Number	(2) Previous Cable Section Number	(3) Number Of Active T-1 Lines	(4) Cable Section Length In FT	(5) Type Of Construction A, B, U	(6) Pressure Code P, N	(7) Cable Code *	(8) Pair Unit Separation S, A, N	(9) Unit Size 6, 9, 11, 12, 13, 16, 17, 25, 50, Or 100	(10) Insertion Loss Factor dB/KFT AT 772 kHz **	(11) Loss Limit Reduction (dB) ***
1	0	75	4000	U	P	ADMC	N	100		
M	2200									
M	4000									
2	1	75	12400	U	P	DSAC	N	50		
M	11200									
M	16400									
3	2	75	4000	B	N	BHAG	N	50		
4	3	55	8400	A	N	BHAA	A	25		
RT	0	7.5								
5	4	15	1250	A	N	BHAA	A	25		
RT	0	7.5								
6	3	20	500	B	N	ALAW	N	50		
7	6	20	14500	A	N	BHAA	N	25		
RT	0	7.5	15.0	22.5						

M Manhole DR Demand Repeater RT Remote Terminal, Pad Value

800 Type Apparatus Case? (Check One) [ ] Yes [ ] No

All Protected Repeaters? (Check One) [ ] Yes [ ] No

Repeaters At All Junctions? (Check One) [ ] Yes [ ] No

Reduce Loss Limit? (Check One) [ ] Yes [ ] No If Yes, To What? ____ dB

* Three Or Four Letter Code (If The Cable Is Reclaimed Or Screened, The 4th Letter Becomes "X" Or "S", Respectively.)

** Use Only If Necessary To Override Dilep II

*** 24 dB Maximum

Figure 5-2. Route Data Sheet

```
TOF:
T ALPHA ROUTE 1
1,0,75,4000,U,P,ADMC,N,100
M,2200
M,4000
2,1,75,12400,U,P,DSAC,N,50
M,11200
M,16400
3,2,75,4000,B,N,BHAG,N,50
4,3,55,8400,A,N,BHAA,A,25
RT,0,7.5
5,4,15,1250,A,N,BHAA,A,25
RT,0,7.5
6,3,20,500,B,N,ALAW,N,50
7,6,20,14500,A,N,BHAA,N,25
RT,0,7.5,15.0,22.5
EOF:
>
EDIT:
>file
NEXT?
```

Figure 5-3. Sample DILEP II Route Input Data

```
800-TYPE APPARATUS CASE? (Y OR N)
>n
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>n
ALL NON-PROTECTED REPEATERS WILL BE USED.

REPEATERS AT ALL JUNCTIONS? (Y OR N)
>y
REPEATERS WILL BE PLACED AT ALL JUNCTIONS.

CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 5 ****

ALPHA ROUTE 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	75	4000	U	P	ADMC	N	100	6.51	33.5	107.2	107.2	4000
2	1	75	12400	U	P	DSAC	N	50	5.31	33.5	208.3	315.5	16400
3	2	75	4000	B	N	BHAG	N	50	5.09	33.5	67.2	382.7	20400
4	3	55	8400	A	N	BHAA	A	25	5.08	21.9	153.7	536.4	28800
RT, 0.0, 7.5													
5	4	15	1250	A	N	BHAA	A	25	5.08	27.3	22.9	559.3	30050
RT, 0.0, 7.5													
6	3	20	500	B	N	ALAW	N	50	4.58	33.5	8.4	391.1	20900
7	6	20	14500	A	N	BHAA	N	25	5.08	33.5	265.3	656.5	35400
RT, 0.0, 7.5,15.0,22.5													

LOCATIONS OF MANHOLES FOR PART 1
2200 4000 11200 16400

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 NM	3359	3359	21.88	-	-	>1000	153	153
2 NM	9310	5951	32.38	-	-	498	188	188
3 NM	15406	6095	32.38	-	-	498	1468	188
4 DR	20400	4993	25.64	-	-	>1000	0	0
5	24600	4200	21.34	-	-	63	78	78
6 RT	28800	4199	21.34	-	0.0	63	0	0
7 RT	30050	1250	13.85	-	7.5	366	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 6 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
8	25925	5525	27.83	-	-	478	1101	1101
9	31400	5475	27.83	-	-	478	2557	1101
10 RT	35400	3999	20.33	-	0.0	>1000	0	0

Figure 5-4. Sample DILEP II Run Using Non-800-Type Apparatus Case and Nonprotected Repeaters

```
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>y
REPEATERS WILL BE PLACED AT ALL JUNCTIONS.

CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 5 ****

ALPHA ROUTE 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	75	4000	U	P	ADMC	N	100	6.51	32.0	107.2	107.2	4000
2	1	75	12400	U	P	DSAC	N	50	5.31	32.0	208.3	315.5	16400
3	2	75	4000	B	N	BHAG	N	50	5.09	32.0	67.2	382.7	20400
4	3	55	8400	A	N	BHAA	A	25	5.08	20.6	153.7	536.4	28800
RT, 0.0, 7.5													
5	4	15	1250	A	N	BHAA	A	25	5.08	26.2	22.9	559.3	30050
RT, 0.0, 7.5													
6	3	20	500	B	N	ALAW	N	50	4.58	32.0	8.4	391.1	20900
7	6	20	14500	A	N	BHAA	N	25	5.08	32.0	265.3	656.5	35400
RT, 0.0, 7.5,15.0,22.5													

LOCATIONS OF MANHOLES FOR PART 1
2200 4000 11200 16400

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 NM	3356	3356	21.86	-	-	>1000	0	0
2 NM	9208	5852	31.86	-	-	543	0	0
3 NM	15206	5997	31.86	-	-	543	979	0
4 DR	20400	5193	26.70	-	-	>1000	0	0
5	23691	3291	16.73	-	-	134	747	747
6	26983	3291	16.73	-	-	134	1456	0
7 RT	28800	1816	9.23	-	0.0	756	0	0
8 RT	30050	1250	13.85	-	7.5	260	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 6 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	25433	5033	25.33	-	-	738	1298	1298
10	30416	4983	25.33	-	-	738	1298	1298
11 RT	35400	4983	25.33	-	0.0	738	0	0

Figure 5-5. Sample DILEP II Run Using 800-Type Apparatus Cases and Protected Repeaters

```
>s
ENTER FILE NAME:
>example1
RUNNING DILEP STUDY ISSUE 5 07/01/87 AT 09:08:11

800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n


         ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                  ****     ISSUE 5     ****

 ALPHA ROUTE 1

SEC PRV #T1    SEC TYP P  CA   PR UNIT DB/KFT LOSS               CUM    CUM
 #  SEC LINES LEN  PLT N CODE SP SIZE  LOSS  LIMIT RESIST     RESIST LENGTH
 1   0   75    4000 U  P ADMC  N  100   6.51  32.0  107.2      107.2   4000
 2   1   75  12400 U  P DSAC  N   50   5.31  32.0  208.3      315.5  16400
 3   2   75    4000 B  N BHAG  N   50   5.09  32.0   67.2      382.7  20400
 4   3   55    8400 A  N BHAA  A   25   5.08  20.6  153.7      536.4  28800
RT, 0.0, 7.5
 5   4   15    1250 A  N BHAA  A   25   5.08  26.2   22.9      559.3  30050
RT, 0.0, 7.5
 6   3   20     500 B  N ALAW  N   50   4.58  32.0    8.4      391.1  20900
 7   6   20  14500 A  N BHAA  N   25   5.08  32.0  265.3      656.5  35400
RT, 0.0, 7.5,15.0,22.5


LOCATIONS OF MANHOLES FOR PART  1
    2200      4000      11200     16400


PART  1
REPEATERS FOR CABLE SECTIONS   1 THROUGH   5
REPEATER  DISTANCE  SECTION   DESIGN    LEVEL    PAD      MAX   BKWD   FWD
   #      FROM C.O.  LENGTH  LOSS(DB) DIFF.(DB) (DB)  T1 LINES MARGIN MARGIN
   1 MH      2200     2200    14.33      -        -     >1000     337   1167
   2 NM      7387     5187    29.71      -        -       890     414    414
   3 NM     12981     5593    29.71      -        -       890     414    414
   4        18670     5688    29.71      -        -       853       0    432
   JCT      20400     1729     8.80     7.5       -        -        -      -
   5        22272     3601    18.32      -        -        94       0    432
   6        25876     3604    18.32      -        -        94    1101    432
   7 RT     28800     2923    14.86      -       0.0      206       0      0
   8 RT     30050     1250    13.85      -       7.5      260       0      0


PART  2
REPEATERS FOR CABLE SECTIONS   6 THROUGH   7
REPEATER  DISTANCE  SECTION   DESIGN    LEVEL    PAD      MAX   BKWD   FWD
   #      FROM C.O.  LENGTH  LOSS(DB) DIFF.(DB) (DB)  T1 LINES MARGIN MARGIN
   9        23797     5127    25.82      -        -       657     432      0
  10        29643     5846    29.71      -        -       269     511    432
  11 RT     35400     5756    29.25      -       0.0      298       0      0
```

Figure 5-6. Repeaterless Route Junction

```
300-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>n
ALL NON-PROTECTED REPEATERS WILL BE USED.

REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>y
TO WHAT?
>29
LOSS LIMIT IS NOW 29.0 DB MAXIMUM.
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

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ALPHA ROUTE 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	75	4000	U	P	ADMC	N	100	6.51	29.0	107.2	107.2	4000
2	1	75	12400	U	P	DSAC	N	50	5.31	29.0	208.3	315.5	16400
3	2	75	4000	B	N	BHAG	N	50	5.09	29.0	67.2	382.7	20400
4	3	55	8400	A	N	BHAA	A	25	5.08	22.1	153.7	536.4	28800
RT, 0.0, 7.5													
5	4	15	1250	A	N	BHAA	A	25	5.08	27.7	22.9	559.3	30050
RT, 0.0, 7.5													
6	3	20	500	B	N	ALAW	N	50	4.58	29.0	8.4	391.1	20900
7	6	20	8744	A	N	BHAA	N	25	5.08	29.0	160.0	551.1	29644
8	7	20	5756	A	N	BHAA	N	25	5.08	29.0	105.3	656.5	35400
RT, 0.0, 7.5,15.0,22.5													

LOCATIONS OF MANHOLES FOR PART 1

2200	4000	11200	16400

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 NM	3379	3379	22.01	-	-	>1000	122	122
2 NM	8513	5133	28.01	-	-	>1000	150	150
3 NM	13786	5273	28.01	-	-	>1000	150	150
4	19176	5389	28.01	-	-	>1000	117	157
JCT	20400	1223	6.23	6.9	-	-	-	-
5	23329	4153	21.12	-	-	70	118	157
6	27484	4155	21.12	-	-	70	2321	0
7 RT	28800	1315	14.19	-	7.5	341	0	0
8 RT	30050	1250	13.85	-	7.5	369	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 6 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	24734	5558	28.01	-	-	562	157	118
10	30246	5511	28.01	-	-	562	521	157
11 RT	35400	5153	26.19	-	0.0	854	0	0

Figure 5-7. Specifying Loss Limit of 29 dB for All Sections

```
TOF:
T ALPHA ROUTE 1
1,0,75,4000,U,P,ADMC,N,100
M,2200
M,4000
2,1,75,12400,U,P,DSAC,N,50
M,11200
M,16400
3,2,75,4000,B,N,BHAG,N,50
4,3,55,8400,A,N,BHAA,A,25
RT,0,7.5
5,4,15,1250,A,N,BHAA,A,25
RT,0,7.5
6,3,20,500,B,N,ALAW,N,50
7,6,20,8744,A,N,BHAA,N,25
8,7,20,5756,A,N,BHAA,N,25
RT,0,7.5,15.0,22.5
EOF:
>u2
8,7,20,5756,A,N,BHAA,N,25
>replace
INPUT:
>8,7,20,5756,a,n,bhaa,n,25,,9.5
>
EDIT:
>u4
5,4,15,1250,A,N,BHAA,A,25
>replace
INPUT:
>5,4,15,1250,a,n,bhaa,a,25,,3.7
>
EDIT:
>t
TOF:
>p20
TOF:
T ALPHA ROUTE 1
1,0,75,4000,U,P,ADMC,N,100
M,2200
M,4000
2,1,75,12400,U,P,DSAC,N,50
M,11200
M,16400
3,2,75,4000,B,N,BHAG,N,50
4,3,55,8400,A,N,BHAA,A,25
RT,0,7.5
5,4,15,1250,A,N,BHAA,A,25,,3.7
RT,0,7.5
6,3,20,500,B,N,ALAW,N,50
7,6,20,8744,A,N,BHAA,N,25
8,7,20,5756,A,N,BHAA,N,25,,9.5
RT,0,7.5,15.0,22.5
EOF:
>
```

Figure 5-8. Changing an Existing File to Limit Two Sections to a Maximum Loss Limit of 22.5 dB

```
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

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ALPHA ROUTE 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	75	4000	U	P	ADMC	N	100	6.51	32.0	107.2	107.2	4000
2	1	75	12400	U	P	DSAC	N	50	5.31	32.0	208.3	315.5	16400
3	2	75	4000	B	N	BHAG	N	50	5.09	32.0	67.2	382.7	20400
4	3	55	8400	A	N	BHAA	A	25	5.08	20.6	153.7	536.4	28800
RT, 0.0, 7.5													
5	4	15	1250	A	N	BHAA	A	25	5.08	22.5	22.9	559.3	30050
RT, 0.0, 7.5													
6	3	20	500	B	N	ALAW	N	50	4.58	32.0	8.4	391.1	20900
7	6	20	8744	A	N	BHAA	N	25	5.08	32.0	160.0	551.1	29644
8	7	20	5756	A	N	BHAA	N	25	5.08	22.5	105.3	656.5	35400
RT, 0.0, 7.5,15.0,22.5													

LOCATIONS OF MANHOLES FOR PART 1

2200 4000 11200 16400

PART 1

REPEATERS FOR CABLE SECTIONS 1 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 NM	3352	3352	21.83	-	-	>1000	0	0
2 NM	9200	5847	31.83	-	-	546	0	0
3 NM	15193	5993	31.83	-	-	546	979	0
4	20400	5206	26.77	-	-	>1000	0	0
5	24422	4022	20.44	-	-	58	0	0
6	28444	4022	20.44	-	-	58	2203	0
7 RT	28800	355	9.31	-	7.5	743	0	0
8 RT	30050	1250	13.85	-	7.5	111	0	0

PART 2

REPEATERS FOR CABLE SECTIONS 6 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	26712	6312	31.83	-	-	164	0	0
10	31108	4395	22.33	-	-	164	118	0
11 RT	35400	4291	21.81	-	0.0	186	0	0

Figure 5-9. Output with Two Sections Limited to 22.5 dB

```
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 5 ****

ALPHA ROUTE 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	300	4000	U	P	ADMC	N	100	6.51	32.0	107.2	107.2	4000
2	1	300	12400	U	P	DSAC	N	50	5.31	32.0	208.3	315.5	16400
3	2	300	4000	B	N	BHAG	A	50	5.09	20.3	67.2	382.7	20400
4	3	150	8400	A	N	BHAA	A	25	5.08	16.3	153.7	536.4	28800
RT, 0.0, 7.5													
5	4	60	1250	A	N	BHAA	A	25	5.08	20.2	22.9	559.3	30050
RT, 0.0, 7.5													
6	3	60	500	B	N	ALAW	N	50	4.58	32.0	8.4	391.1	20900
7	6	60	8744	A	N	BHAA	A	25	5.08	20.2	160.0	551.1	29644
8	7	60	5756	A	N	BHAA	A	25	5.08	20.2	105.3	656.5	35400
RT, 0.0, 7.5,15.0,22.5													

LOCATIONS OF MANHOLES FOR PART 1
2200 4000 11200 16400

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 NM	3378	3378	22.00	-	-	>1000	0	0
2 NM	9262	5884	32.00	-	-	300	0	0
3 NM	15287	6024	32.00	-	-	300	0	0
4	19217	3930	20.25	-	-	300	0	0
JCT	20400	1182	6.02	4.0	-	-	-	-
5	22413	3196	16.25	-	-	150	0	0
6	25606	3193	16.23	-	-	151	0	0
7 RT	28800	3193	16.23	-	0.0	151	0	0
8 RT	30050	1250	13.85	-	7.5	260	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 6 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	23245	4027	20.23	-	-	60	196	0
10	27021	3776	19.19	-	-	76	196	196
11	30798	3777	19.19	-	-	76	196	196
12	34575	3776	19.19	-	-	76	1928	0
13 RT	35400	824	11.69	-	7.5	430	0	0

Figure 5-10. Effect of Increasing the Number of T1 Lines

6. DILEP II EXAMPLES

6.1 General

Two problem examples, and DILEP II digital design solutions to these, are included in this section to introduce basic procedures. These procedures will vary, depending on the route or area under study. DILEP II may be run in a number of different ways. Experienced users will develop their own procedures for performing and evaluating the studies.

In general, the following steps are necessary for an initial design in a route:

1. Assemble all data necessary to run DILEP II. Preparation of a digital line schematic will be helpful. Preparation of the Route Data Sheet is necessary for efficient data input.

2. Run the DILEP II datacheck. Each time the input file is changed, the data-check option must be run before a study can be made.

3. Make an initial run of the route under study. This first run can be made with the repeaterless route junction option. The engineer will probably want to make another run with repeaters at all junctions to determine any difference in either the spacing or number of repeater locations.

4. Analyze the results of these first runs. Some objective should be arrived at. For instance, does the engineer want to maximize the use of repeaterless route junctions, or does the route have unknown future requirements that could make flexibility more important? The engineer may decide to place repeaters at all junctions in the main feeder, but use repeaterless route junctions in the branches.

   In general, the plan with the fewest new manholes and repeater locations should be the most attractive. But there are occasions when initally placing the maximum number of repeaterless route junctions can, at a later date, necessitate more repeater locations in a branch.

5. This step consists of adding demand repeaters, and of generally refining the design and making successive runs until an acceptable design is obtained.

6.2 Example 1

In this example, digital lines are to be deployed in a route for the first time. Six remote terminal sites were selected and are shown on the schematic in Figure 6-1. A screened cable is to be utilized for a portion of the route. The engineer input all available loss pads for the type of equipment chosen for a particular RT site. The engineer also selected all suitable manholes and entered them in the data. The data as entered is shown in Figure 6-2, Route Data Sheet, and Figure 6-3, Input File.

All protected repeaters and 800-type apparatus cases are to be used. No reduction in loss value is to be made for any section.

Run 1 - This is an unconstrained run with repeaters at all junctions specified. Two manholes from the list were chosen by DILEP II, one at 2910 feet and one at

6980 feet from the central office. Eight line repeater locations were specified. Figure 6-4 is the output.

Run 2 - The engineer wanted to know if repeaterless route junctions would eliminate any of the line repeaters on the previous run. In this run, the question "Repeaters at all junctions?" was answered **no**. Again, the program picked the manholes listed in run 1. Three repeaterless route junctions were selected. However, this run still required eight line repeater locations. Figure 6-5 is the output.

The engineer noted that the first manhole that DILEP II picked was smaller than the next manhole at 3270 feet. The forward margin specified is 460 feet, so the repeater can be moved to the manhole at 3270 feet. The engineer also moved the next repeater at 6980 feet to the manhole at 7700 feet (forward margin is 829 feet). The file was edited to eliminate the list of manholes (this is optional and was only done to keep this list from printing on any subsequent run). The engineer then demanded repeaters at the two selected locations. The edited file is shown in Figure 6-6.

Run 3 - The engineer specified repeaters at all junctions in this run. The program still picked eight line repeater locations. It was noted that the demand repeater at 7700 feet could be moved still further to the manhole at 8100 feet (new forward margin is 460 feet), but the engineer felt that the location at 7700 feet was more favorable. The output is shown in Figure 6-7.

Run 4 - The engineer wanted to see if less line repeater locations were possible, so one more run was made, in which repeaterless route junctions were specified. In this run, DILEP II still specified eight line repeater locations. The output is shown in Figure 6-8.

Note that when the engineer put in the demand repeaters in the first section, the program automatically re-sectionalized the data, and a message was printed in runs 3 and 4 after the new sectionalized data. The message is only to alert the user that the data is in a different format than when originally input.

The engineer decided to use run 3 and have repeaters at all junctions. This will give added flexibility for repeaterless route junctions, should any unforeseen service needs arise. By using repeaters at all junctions in this example, the RT end sections all remain less than 22.5 dB. While no High Capacity Digital Service needs have been forecast, this may be an advantage in the future. In this case, no economic penalty was incurred to gain this flexibility.

The repeater locations specified in the buried sections must be verified to be sure they are suitable for actual field placement. There is sufficient backward and forward margin in run 3 in case they have to be moved.

The maximum number of T1 lines permitted is greater than the engineer's estimate in all cases in this example. However, as has been stated, DILEP II has no knowledge of cable size and, if the number of T1 lines is increased over the original estimate, the design might change. In smaller cables, nonadjacent spacing may become adjacent or even same unit, thereby changing the spacing. The estimated maximum number of T1 lines in a given sheath is critical in the initial design of a digital route.

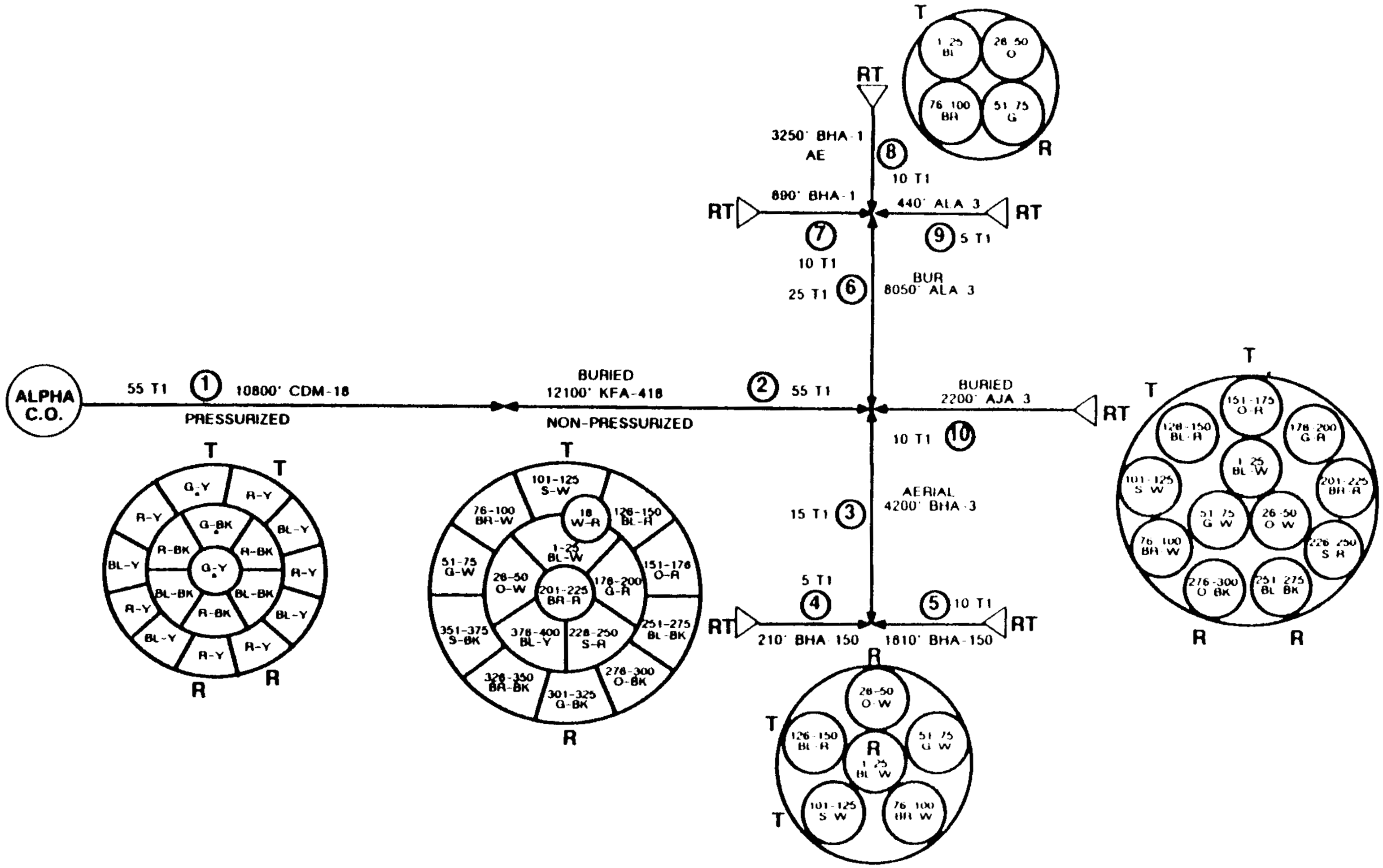

Figure 6-1. Digital Line Route Schematic

(Insert Your Company Logo)

DILEP II
Route Data Sheet

EO 756-1 (8-87)

File Name (One To Eight Characters) Data: EXAMPLE1

Route Description (Up To 78 Characters): T ALPHA ROUTE 2

(1) Cable Section Number	(2) Previous Cable Section Number	(3) Number Of Active T1 Lines	(4) Cable Section Length In FT	(5) Type Of Construction A, B, U	(6) Pressure Code P, N	(7) Cable Code *	(8) Pair Unit Separation S, A, N	(9) Unit Size 8, 9, 11, 12, 13, 16, 17, 25, 50, Or 100	(10) Insertion Loss Factor dB/KFT AT 772 kHz **	(11) Loss Limit Reduction (dB) ***
1	0	55	10800	U	P	CDM	N	100		
MH	1740									
MH	2118									
↓(ETC.)	↓(ETC.)									
MH	10800									
2	1	55	12100	B	N	KFAS	N	25		
3	2	15	4200	A	N	BHA	N	25		
4	3	5	210	A	N	BHA	A	25		
RT	0	7.5	15.0	22.5						
5	3	10	1810	A	N	BHA	A	25		
RT	0	7.5	15.0	22.5						
6	2	25	8050	B	N	ALA	N	25		
7	6	10	890	A	N	BHA	A	25		
RT	0.5	7.5								
8	6	10	3250	A	N	BHA	A	25		
RT	0	7.5	15.0	22.5						
9	6	5	440	B	N	ALA	N	25		
RT	0	7.5	15.0	22.5						
10	2	10	2200	B	N	AJA	N	25		
RT	0	7.5	15.0	22.5						

M Manhole DR Demand Repeater RT Remote Terminal, Pad Value

800 Type Apparatus Case? (Check One) ( ) Yes ( ) No

All Protected Repeaters? (Check One) ( ) Yes ( ) No

Repeaters At All Junctions? (Check One) ( ) Yes ( ) No

Reduce Loss Limit? (Check One) ( ) Yes ( ) No If Yes, To What? dB

* Three Or Four Letter Code (If The Cable Is Reclaimed Or Screened, The 4th Letter Becomes "X" Or "S", Respectively)

** Use Only If Necessary To Override Dilep II

*** 24 dB Maximum

Figure 6-2. Route Data Sheet

```
TOF:
T ALPHA ROUTE 2
1,0,55,10800,U,P,CDM,N,100
MH,1740
MH,2118
MH,2560
MH,2910
MH,3270
MH,3900
MH,4600
MH,5350
MH,6300
MH,6980
MH,7700
MH,8100
MH,8770
MH,9640
MH,10200
MH,10800
2,1,55,12100,B,N,KFAS,N,25
3,2,15,4200,A,N,BHA,N,25
4,3,5,210,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
5,3,10,1810,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
6,2,25,8050,B,N,ALA,N,25
7,6,10,890,A,N,BHA,A,25
RT,0.5,7.5
8,6,10,3250,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
9,6,5,440,B,N,ALA,N,25
RT,0,7.5,15.0,22.5
10,2,10,2200,B,N,AJA,N,25
RT,0,7.5,15.0,22.5
EOF:
>
EDIT:
>file
```

Figure 6-3. Input File

```
300-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>y
REPEATERS WILL BE PLACED AT ALL JUNCTIONS.

CHANGE LOSS LIMIT? (Y OR N)
>n

              ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                      ****     ISSUE 5     ****

 ALPHA ROUTE 2

SEC PRV #T1    SEC TYP P  CA   PR UNIT DB/KFT LOSS               CUM    CUM
 #  SEC LINES LEN PLT N CODE  SP SIZE  LOSS  LIMIT RESIST     RESIST LENGTH
 1   0   55  10800 U  P CDM   N  100   6.51  32.0  289.4      289.4  10800
 2   1   55  12100 B  N KFAS  N   25   4.58  32.0  203.3      492.7  22900
 3   2   15   4200 A  N BHA   N   25   5.08  32.0   76.9      569.6  27100
 4   3   5     210 A  N BHA   A   25   5.08  31.0    3.8      573.4  27310
RT, 0.0, 7.5,15.0,22.5
 5   3   10   1810 A  N BHA   A   25   5.08  28.0   33.1      602.7  28910
RT, 0.0, 7.5,15.0,22.5
 6   2   25   8050 B  N ALA   N   25   4.58  32.0  135.2      628.0  30950
 7   6   10    890 A  N BHA   A   25   5.08  28.0   16.3      644.2  31840
RT, 0.5, 7.5
 8   6   10   3250 A  N BHA   A   25   5.08  28.0   59.5      687.4  34200
RT, 0.0, 7.5,15.0,22.5
 9   6   5     440 B  N ALA   N   25   4.58  32.0    7.4      635.4  31390
RT, 0.0, 7.5,15.0,22.5
10   2   10   2200 B  N AJA   N   25   4.16  32.0   37.0      529.7  25100
RT, 0.0, 7.5,15.0,22.5


LOCATIONS OF MANHOLES FOR PART  1
    1740      2118      2560      2910      3270      3900

    4600      5350      6300      6980      7700      8100

    8770      9640     10200     10800
```

Figure 6-4. Output for Run 1

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 4

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 MH	2910	2910	18.94	-	-	>1000	829	460
2 MH	6980	4069	26.50	-	-	>1000	399	829
3	11752	4772	29.24	-	-	>1000	558	567
4	18137	6384	29.24	-	-	>1000	2183	567
5 DR	22900	4762	21.81	-	-	>1000	0	0
6 DR	27100	4200	21.35	-	-	>1000	0	0
7 RT	27310	210	16.07	-	15.0	157	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 5 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
8 RT	28910	1810	16.70	-	7.5	136	0	0

PART 3
REPEATERS FOR CABLE SECTIONS 6 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	26924	4024	18.43	-	-	>1000	2008	2008
10 DR	30950	4025	18.43	-	-	>1000	0	0
11 RT	31840	890	12.02	-	7.5	398	0	0

PART 4
REPEATERS FOR CABLE SECTIONS 8 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
12 RT	34200	3250	16.52	-	0.0	141	0	0

PART 5
REPEATERS FOR CABLE SECTIONS 9 THROUGH 9

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
13 RT	31390	440	9.52	-	7.5	>1000	0	0

PART 6
REPEATERS FOR CABLE SECTIONS 10 THROUGH 10

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
14 RT	25100	2200	16.65	-	7.5	>1000	0	0

Figure 6-4. Output for Run 1 (Continued)

```
DO YOU WANT TO RUN DATA CHECK, STUDY OR QUIT?  (ENTER D, S OR Q)
>s
ENTER FILE NAME:
>study1
RUNNING DILEP STUDY ISSUE 5 07/23/87 AT 14:43:43

800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n


            ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                    ****     ISSUE 5     ****

 ALPHA ROUTE 2

SEC PRV #T1   SEC TYP P  CA   PR UNIT DB/KFT LOSS               CUM    CUM
 #  SEC LINES LEN PLT N CODE  SP SIZE  LOSS  LIMIT RESIST  RESIST LENGTH
 1   0   55  10800 U  P CDM   N   100   6.51  32.0  289.4   289.4  10800
 2   1   55  12100 B  N KFAS  N    25   4.58  32.0  203.3   492.7  22900
 3   2   15   4200 A  N BHA   N    25   5.08  32.0   76.9   569.6  27100
 4   3    5    210 A  N BHA   A    25   5.08  31.0    3.8   573.4  27310
RT, 0.0, 7.5,15.0,22.5
 5   3   10   1810 A  N BHA   A    25   5.08  28.0   33.1   602.7  28910
RT, 0.0, 7.5,15.0,22.5
 6   2   25   8050 B  N ALA   N    25   4.58  32.0  135.2   628.0  30950
 7   6   10    890 A  N BHA   A    25   5.08  28.0   16.3   644.2  31840
RT, 0.5, 7.5
 8   6   10   3250 A  N BHA   A    25   5.08  28.0   59.5   687.4  34200
RT, 0.0, 7.5,15.0,22.5
 9   6    5    440 B  N ALA   N    25   4.58  32.0    7.4   635.4  31390
RT, 0.0, 7.5,15.0,22.5
10   2   10   2200 B  N AJA   N    25   4.16  32.0   37.0   529.7  25100
RT, 0.0, 7.5,15.0,22.5


LOCATIONS OF MANHOLES FOR PART  1
    1740      2118      2560      2910      3270      3900

    4600      5350      6300      6980      7700      8100

    8770      9640     10200     10800
```

Figure 6-5. Output for Run 2

PART 1

REPEATERS FOR CABLE SECTIONS 1 THROUGH 4

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 MH	2910	2910	18.94	-	-	>1000	829	460
2 MH	6980	4069	26.50	-	-	>1000	307	829
3	11880	4900	29.82	-	-	>1000	436	436
4	18392	6511	29.82	-	-	>1000	436	436
JCT	22900	4507	20.64	0.0	-	-	-	-
5	24705	6312	29.82	-	-	261	1298	393
JCT	27100	2394	12.17	0.6	-	-	-	-
6 RT	27310	2604	20.74	-	7.5	54	0	0

PART 2

REPEATERS FOR CABLE SECTIONS 5 THROUGH 5

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
7 RT	28910	4204	21.37	-	0.0	47	0	0

PART 3

REPEATERS FOR CABLE SECTIONS 6 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
8	24904	6511	29.82	-	-	235	0	436
JCT	30950	6045	27.69	1.7	-	-	-	-
9	31008	6104	27.99	-	-	10	0	0
10 RT	31840	831	11.73	-	7.5	426	0	0

PART 4

REPEATERS FOR CABLE SECTIONS 8 THROUGH 8

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
11	31007	6103	27.99	-	-	10	0	0
12 RT	34200	3192	16.23	-	0.0	150	0	0

PART 5

REPEATERS FOR CABLE SECTIONS 9 THROUGH 9

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
13 RT	31390	6485	29.71	-	0.0	241	0	0

PART 6

REPEATERS FOR CABLE SECTIONS 10 THROUGH 10

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
14 RT	25100	6707	29.79	-	0.0	215	0	0

Figure 6-5. Output for Run 2 (Continued)

```
TOF:
T ALPHA ROUTE 2
1,0,55,10800,U,P,CDM,N,100
DR,3270
DR,7700
2,1,55,12100,B,N,KFAS,N,25
3,2,15,4200,A,N,BHA,N,25
4,3,5,210,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
5,3,10,1810,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
6,2,25,8050,B,N,ALA,N,25
7,6,10,890,A,N,BHA,A,25
RT,0.5,7.5
8,6,10,3250,A,N,BHA,A,25
RT,0,7.5,15.0,22.5
9,6,5,440,B,N,ALA,N,25
RT,0,7.5,15.0,22.5
10,2,10,2200,B,N,AJA,N,25
RT,0,7.5,15.0,22.5
EOF:
>
EDIT:
>file
NEXT?
```

Figure 6-6. Edited Input File

```
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>y
REPEATERS WILL BE PLACED AT ALL JUNCTIONS.

CHANGE LOSS LIMIT? (Y OR N)
>n


            ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                    ****    ISSUE 5    ****

 ALPHA ROUTE 2

SEC PRV #T1   SEC TYP P  CA   PR UNIT DB/KFT LOSS              CUM    CUM
 #  SEC LINES LEN PLT N CODE SP SIZE  LOSS  LIMIT RESIST  RESIST LENGTH
 1   0   55   3270 U  P CDM   N  100   6.51  32.0   87.6    87.6   3270
DR
 2   1   55   4430 U  P CDM   N  100   6.51  32.0  118.7   206.4   7700
DR
 3   2   55   3100 U  P CDM   N  100   6.51  32.0   83.1   289.4  10800
 4   3   55  12100 B  N KFAS  N   25   4.58  32.0  203.3   492.7  22900
 5   4   15   4200 A  N BHA   N   25   5.08  32.0   76.9   569.6  27100
 6   5    5    210 A  N BHA   A   25   5.08  31.0    3.8   573.4  27310
RT, 0.0, 7.5,15.0,22.5
 7   5   10   1810 A  N BHA   A   25   5.08  28.0   33.1   602.7  28910
RT, 0.0, 7.5,15.0,22.5
 8   4   25   8050 B  N ALA   N   25   4.58  32.0  135.2   628.0  30950
 9   8   10    890 A  N BHA   A   25   5.08  28.0   16.3   644.2  31840
RT, 0.5, 7.5
10   8   10   3250 A  N BHA   A   25   5.08  28.0   59.5   687.4  34200
RT, 0.0, 7.5,15.0,22.5
11   8    5    440 B  N ALA   N   25   4.58  32.0    7.4   635.4  31390
RT, 0.0, 7.5,15.0,22.5
12   4   10   2200 B  N AJA   N   25   4.16  32.0   37.0   529.7  25100
RT, 0.0, 7.5,15.0,22.5


S05 - NEW CABLE SECTIONS WERE CREATED BY THE PROGRAM BECAUSE
      ONE OR MORE DRS WERE SPECIFIED WITHIN A CABLE SECTION.
```

Figure 6-7. Output for Run 3

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 6

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 DR	3270	3270	21.29	-	-	>1000	460	92
2 DR	7700	4430	28.85	-	-	>1000	1013	460
3	11894	4194	25.20	-	-	>1000	1338	1441
4	17397	5502	25.20	-	-	>1000	1441	1441
5 DR	22900	5502	25.20	-	-	>1000	0	0
6 DR	27100	4200	21.35	-	-	>1000	0	0
7 RT	27310	210	16.07	-	15.0	157	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 7 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
8 RT	28910	1810	16.70	-	7.5	136	0	0

PART 3
REPEATERS FOR CABLE SECTIONS 8 THROUGH 9

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
9	26924	4024	18.43	-	-	>1000	2008	2008
10 DR	30950	4025	18.43	-	-	>1000	0	0
11 RT	31840	890	12.02	-	7.5	398	0	0

PART 4
REPEATERS FOR CABLE SECTIONS 10 THROUGH 10

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
12 RT	34200	3250	16.52	-	0.0	141	0	0

PART 5
REPEATERS FOR CABLE SECTIONS 11 THROUGH 11

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
13 RT	31390	440	9.52	-	7.5	>1000	0	0

PART 6
REPEATERS FOR CABLE SECTIONS 12 THROUGH 12

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
14 RT	25100	2200	16.65	-	7.5	>1000	0	0

Figure 6-7. Output for Run 3 (Continued)

```
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n


            ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                    ****     ISSUE 5     ****

 ALPHA ROUTE 2

SEC PRV #T1    SEC TYP P  CA   PR UNIT DB/KFT LOSS                CUM    CUM
 #  SEC LINES  LEN PLT N CODE  SP SIZE  LOSS  LIMIT RESIST    RESIST LENGTH
 1   0   55   3270 U   P CDM   N  100   6.51  32.0   87.6       87.6   3270
DR
 2   1   55   4430 U   P CDM   N  100   6.51  32.0  118.7      206.4   7700
DR
 3   2   55   3100 U   P CDM   N  100   6.51  32.0   83.1      289.4  10800
 4   3   55  12100 B   N KFAS  N   25   4.58  32.0  203.3      492.7  22900
 5   4   15   4200 A   N BHA   N   25   5.08  32.0   76.9      569.6  27100
 6   5    5    210 A   N BHA   A   25   5.08  31.0    3.8      573.4  27310
RT, 0.0, 7.5,15.0,22.5
 7   5   10   1810 A   N BHA   A   25   5.08  28.0   33.1      602.7  28910
RT, 0.0, 7.5,15.0,22.5
 8   4   25   8050 B   N ALA   N   25   4.58  32.0  135.2      628.0  30950
 9   8   10    890 A   N BHA   A   25   5.08  28.0   16.3      644.2  31840
RT, 0.5, 7.5
10   8   10   3250 A   N BHA   A   25   5.08  28.0   59.5      687.4  34200
RT, 0.0, 7.5,15.0,22.5
11   8    5    440 B   N ALA   N   25   4.58  32.0    7.4      635.4  31390
RT, 0.0, 7.5,15.0,22.5
12   4   10   2200 B   N AJA   N   25   4.16  32.0   37.0      529.7  25100
RT, 0.0, 7.5,15.0,22.5

S05 - NEW CABLE SECTIONS WERE CREATED BY THE PROGRAM BECAUSE
      ONE OR MORE DRS WERE SPECIFIED WITHIN A CABLE SECTION.
```

Figure 6-8. Output for Run 4

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 6

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 DR	3270	3270	21.29	-	-	>1000	460	92
2 DR	7700	4430	28.85	-	-	>1000	460	460
3	12700	5000	28.90	-	-	>1000	655	655
4	19009	6309	28.90	-	-	>1000	655	655
JCT	22900	3890	17.82	1.9	-	-	-	-
5	25078	6069	28.90	-	-	324	1338	393
JCT	27100	2021	10.27	0.6	-	-	-	-
6 RT	27310	2231	18.84	-	7.5	83	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 7 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
7 RT	28910	3831	19.47	-	0.0	72	0	0

PART 3
REPEATERS FOR CABLE SECTIONS 8 THROUGH 9

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
8	25318	6308	28.90	-	-	292	393	655
JCT	30950	5631	25.79	1.6	-	-	-	-
9	31024	5706	26.17	-	-	16	0	0
10 RT	31840	815	11.64	-	7.5	434	0	0

PART 4
REPEATERS FOR CABLE SECTIONS 10 THROUGH 10

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
11	31023	5705	26.17	-	-	16	0	354
12 RT	34200	3176	16.14	-	0.0	153	0	0

PART 5
REPEATERS FOR CABLE SECTIONS 11 THROUGH 11

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
13 RT	31390	6071	27.81	-	0.0	374	0	0

PART 6
REPEATERS FOR CABLE SECTIONS 12 THROUGH 12

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
14 RT	25100	6090	26.97	-	0.0	412	0	0

Figure 6-8. Output for Run 4 (Continued)

6.3 Example 2

In this example, the engineer has received an order for two High Capacity Digital Service (HCDS) lines in the Megatec building. There is an existing HCDS line on the third floor. The new services are to go on the eighth and tenth floors. Refer to Figure 6-9.

The engineer looks at the records and notes that there is an existing apparatus case in the manhole outside the building, and that there are vacant pairs for T1 carrier usage in the case. The case is 2200 feet from the mainframe of the central office. The network channel terminating equipment (NCTE) on the third floor contains a line build out loss of 7.5 dB.

It is generally beneficial to both the customer and the operating company to design the HCDS circuits on the customer side of the network interface without a line repeater, if possible. Since there is only one riser cable, repeaterless route junctions will be formed when the new services are installed. It has been noted that DILEP II will handle only one repeaterless route junction in a repeatered section in a given run, but with successive runs more than one can be designed. See Section 2.3, Route Junctions.

The engineer has noted that, in the Megatec building, the two new services will cause two repeaterless route junctions to be formed, one on the third floor and one on the eighth floor. Using the technique in Figure 2-1 , two successive runs will have to be made.

For these runs, the HCDS rules outlined in Section 2.6 will be followed. This means that the customer end section (last line repeater to the NCTE) will be limited to 22.5 dB. In each of the runs, the engineer limited all cable sections following the demand repeater to 22.5 dB by entering a reduction of 9.5 in column 11 of the Route Data Sheet, as shown in Figure 6-10. Because the repeaters are protected, DILEP II subtracts 9.5 dB from 32 dB, yielding 22.5 dB. The engineer also wants repeaterless route junctions in the customer end section and the interactive question, "Repeaters at All Junctions?" will be answered **no** in all runs.

For run 1, the engineer inputs the existing cable from the CO, the existing repeater as a demand repeater, and the building cabling. The existing HCDS location is input as an RT with the 7.5 loss pad. (Refer to Figure 6-10). This run will include the new location on the tenth floor, leaving out the eighth floor location. The file input and run results are shown in Figure 6-11.

Run 2 includes the same information as run 1, but leaves out the tenth floor location and adds the cable information for the eighth floor location. The file input and run results are shown in Figure 6-12.

Both runs show that the repeaterless route junction formed at the third floor is within the 7.5 dB maximum loss limit. For run 1 it is 1.1 dB and for run 2 it is 0.4 dB. To arrive at the level difference at the repeaterless route junction on the eighth floor, the eighth floor section loss in run 2 ,12.29 dB, is subtracted from the tenth floor section loss of 12.92 dB in run 1, yielding a 0.63 dB loss difference at the junction at the eighth floor.

Another way to get this loss differential for the repeaterless route junction on the eighth floor is to make a third run, leaving out the location on the third floor (Figure 6-13). The result is the same. In this run, the engineer input the loss pads that DILEP II selected in the previous runs. When making successive runs for repeaterless route junctions, the engineer must be careful to input like values from run to run. It will probably be faster to make the manual subtraction.

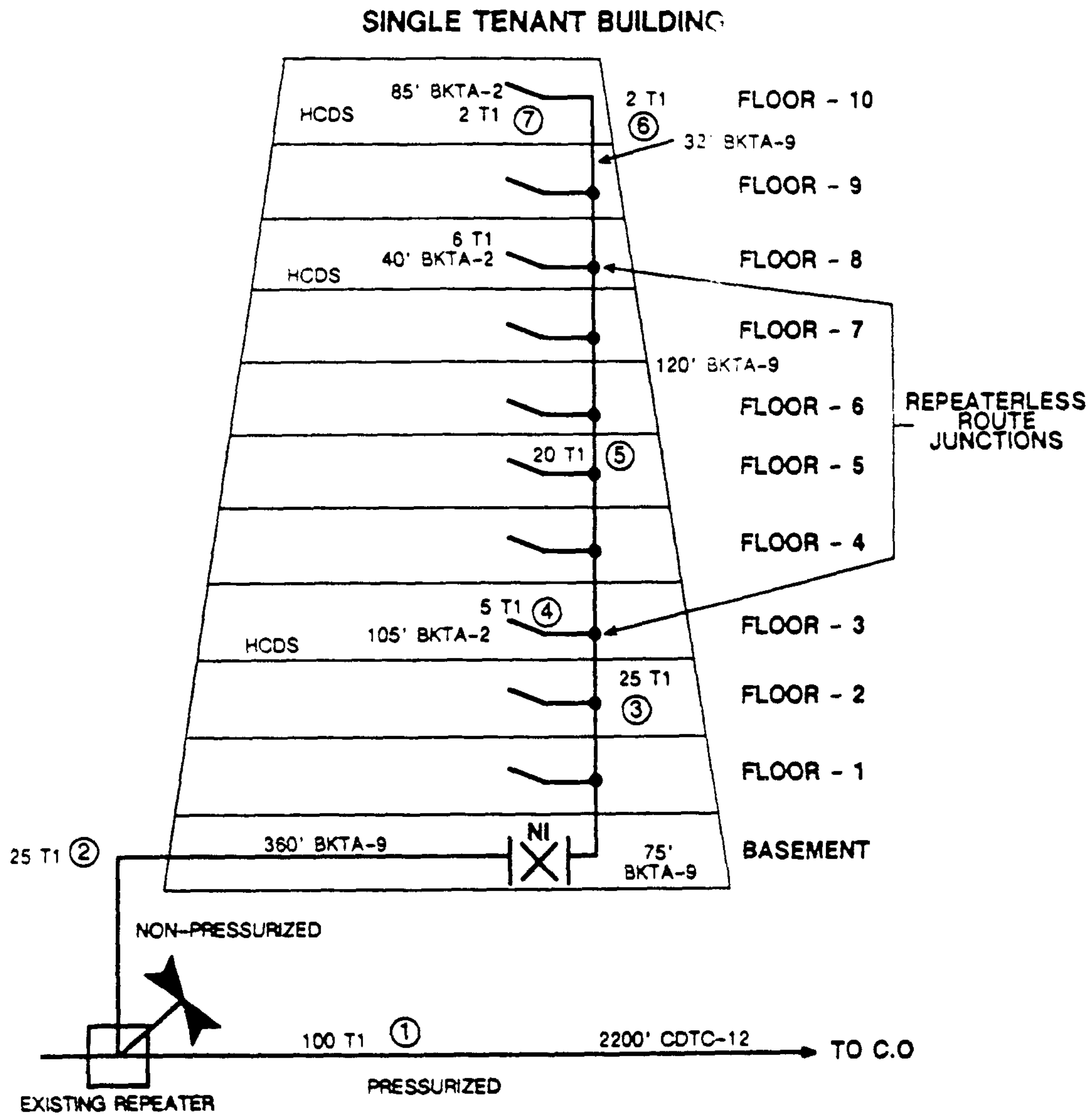

Figure 6-9. Megatec Building Schematic

(Insert Your Company Logo)

DILEP II
Route Data Sheet

File Name (One To Eight Characters) Data
EXAMPLE2

Route Description (Up To 78 Characters)
T[redacted]MEGATEC BLDG HKDS RUN 1

① Cable Section Number	② Previous Cable Section Number	③ Number Of Active T-1 Lines	④ Cable Section Length In FT	⑤ Type Of Construction A, B, U	⑥ Pressure Code P, N	⑦ Cable Code *	⑧ Pair Unit Separation S, A, N	⑨ Unit Size 8, 9, 11, 12, 13, 16, 17, 25, 50, Or 100	⑩ Insertion Loss Factor dB/KFT AT 772 kHz **	⑪ Loss Limit Reduction (dB) ***
1	0	100	2200	U	P	CDTC	N	100		
DR										
2	1	25	360	U	N	BKTA	N	50		9.5
3	2	25	75	U	N	BKTA	A	50		9.5
4	3	5	105	U	N	BKTA	A	25		9.5
RT	7.5									
5	3	20	120	U	N	BKTA	A	50		9.5
6	5	2	32	U	N	BKTA	A	25		9.5
7	6	2	85	U	N	BKTA	A	25		9.5
RT	0	7.5	15.0							

M Manhole DR Demand Repeater RT Remote Terminal, Pad Value

800 Type Apparatus Case? (Check One) ( ) Yes ( ) No

All Protected Repeaters? (Check One) ( ) Yes ( ) No

Repeaters At All Junctions? (Check One) ( ) Yes ( ) No

Reduce Loss Limit? (Check One) ( ) Yes ( ) No If Yes, To What? dB

* Three-Or Four-Letter Code (If The Cable Is Reclaimed Or Screened, The 4th Letter Becomes "X" Or "S", Respectively.)

** Use Only If Necessary To Override Dilep II

*** 24 dB Maximum

Figure 6-10. Route Data Sheet

```
TOF:
T MEGATEC BLDG HCDS RUN 1
1,0,100,2200,U,P,CDTC,N,100
DR
2,1,25,360,U,N,BKTA,N,50,,9.5
3,2,25,75,U,N,BKTA,A,50,,9.5
4,3,5,105,U,N,BKTA,A,25,,9.5
RT,7.5
5,3,20,120,U,N,BKTA,A,50,,9.5
6,5,2,32,U,N,BKTA,A,25,,9.5
7,6,2,85,U,N,BKTA,A,25,,9.5
RT,0,7.5,15.0
EOF:
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 5 ****

MEGATEC BLDG HCDS RUN 1

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	100	2200	U	P	CDTC	N	100	8.07	32.0	93.7	93.7	2200
DR													
2	1	25	360	U	N	BKTA	N	50	8.06	22.5	15.3	109.1	2560
3	2	25	75	U	N	BKTA	A	50	8.06	22.5	3.2	112.3	2635
4	3	5	105	U	N	BKTA	A	25	8.06	22.5	4.5	116.7	2740
RT, 7.5													
5	3	20	120	U	N	BKTA	A	50	8.06	22.5	5.1	117.4	2755
6	5	2	32	U	N	BKTA	A	25	8.06	22.5	1.4	118.7	2787
7	6	2	85	U	N	BKTA	A	25	8.06	22.5	3.6	122.3	2872
RT, 0.0, 7.5,15.0													

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 4

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 DR	2200	2200	17.74	-	-	>1000	1041	0
JCT	2635	435	3.50	1.1	-	-	-	-
2 RT	2740	540	11.85	-	7.5	74	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 5 THROUGH 7

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
3 RT	2872	672	12.92	-	7.5	58	0	0

Figure 6-11. Output for Run 1

```
TOF:
T MEGATEC BLDG HCDS RUN 2
1,0,100,2200,U,P,CDTC,N,100
DR
2,1,25,360,U,N,BKTA,N,50,,9.5
3,2,25,75,U,N,BKTA,A,50,,9.5
4,3,5,105,U,N,BKTA,A,25,,9.5
RT,7.5
5,3,20,120,U,N,BKTA,A,50,,9.5
6,5,6,40,U,N,BKTA,A,25,,9.5
RT,0,7.5,15.0
EOF:
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n
```

*** DIGITAL LINE ENGINEERING PROGRAM ***

**** ISSUE 5 ****

MEGATEC BLDG HCDS RUN 2

SEC #	PRV SEC	#T1 LINES	SEC LEN	TYP PLT	P N	CA CODE	PR SP	UNIT SIZE	DB/KFT LOSS	LOSS LIMIT	RESIST	CUM RESIST	CUM LENGTH
1	0	100	2200	U	P	CDTC	N	100	8.07	32.0	93.7	93.7	2200
DR													
2	1	25	360	U	N	BKTA	N	50	8.06	22.5	15.3	109.1	2560
3	2	25	75	U	N	BKTA	A	50	8.06	22.5	3.2	112.3	2635
4	3	5	105	U	N	BKTA	A	25	8.06	22.5	4.5	116.7	2740
RT, 7.5													
5	3	20	120	U	N	BKTA	A	50	8.06	22.5	5.1	117.4	2755
6	5	6	40	U	N	BKTA	A	25	8.06	22.5	1.7	119.1	2795
RT, 0.0, 7.5,15.0													

PART 1
REPEATERS FOR CABLE SECTIONS 1 THROUGH 4

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
1 DR	2200	2200	17.74	-	-	>1000	1041	0
JCT	2635	435	3.50	0.4	-	-	-	-
2 RT	2740	540	11.85	-	7.5	74	0	0

PART 2
REPEATERS FOR CABLE SECTIONS 5 THROUGH 6

REPEATER #	DISTANCE FROM C.O.	SECTION LENGTH	DESIGN LOSS(DB)	LEVEL DIFF.(DB)	PAD (DB)	MAX T1 LINES	BKWD MARGIN	FWD MARGIN
3 RT	2795	595	12.29	-	7.5	66	0	0

Figure 6-12. Output for Run 2

```
TOF:
T MEGATEC BLDG HCDS RUN 3
1,0,100,2200,U,P,CDTC,N,100
DR
2,1,25,360,U,N,BKTA,N,50,,9.5
3,2,25,75,U,N,BKTA,A,50,,9.5
4,3,20,120,U,N,BKTA,A,50,,9.5
5,4,6,40,U,N,BKTA,A,25,,9.5
RT,7.5
6,4,2,32,U,N,BKTA,A,25,,9.5
7,6,2,85,U,N,BKTA,A,25,,9.5
RT,7.5
EOF:
800-TYPE APPARATUS CASE? (Y OR N)
>y
ALL PROTECTED REPEATERS TO BE USED? (Y OR N)
>y
REPEATERS AT ALL JUNCTIONS? (Y OR N)
>n
CHANGE LOSS LIMIT? (Y OR N)
>n


          ***   DIGITAL LINE ENGINEERING PROGRAM   ***

                    ****    ISSUE 5    ****

 MEGATEC BLDG HCDS RUN 3

SEC PRV #T1   SEC TYP P   CA   PR UNIT DB/KFT LOSS                CUM     CUM
 #  SEC LINES LEN PLT N CODE SP SIZE   LOSS  LIMIT RESIST     RESIST  LENGTH
 1   0  100   2200 U  P CDTC  N   100   8.07  32.0    93.7      93.7    2200
DR
 2   1   25    360 U  N BKTA  N    50   8.06  22.5    15.3     109.1    2560
 3   2   25     75 U  N BKTA  A    50   8.06  22.5     3.2     112.3    2635
 4   3   20    120 U  N BKTA  A    50   8.06  22.5     5.1     117.4    2755
 5   4    6     40 U  N BKTA  A    25   8.06  22.5     1.7     119.1    2795
RT, 7.5
 6   4    2     32 U  N BKTA  A    25   8.06  22.5     1.4     118.7    2787
 7   6    2     85 U  N BKTA  A    25   8.06  22.5     3.6     122.3    2872
RT, 7.5


PART  1
REPEATERS FOR CABLE SECTIONS   1 THROUGH   5
REPEATER  DISTANCE  SECTION   DESIGN    LEVEL    PAD       MAX    BKWD    FWD
   #      FROM C.O.  LENGTH  LOSS(DB) DIFF.(DB) (DB)  T1 LINES  MARGIN  MARGIN
   1 DR       2200     2200    17.74       -       -    >1000    1041       0
    JCT       2755      555     4.47     0.6       -       -        -       -
   2 RT       2795      595    12.29       -     7.5      66        0       0


PART  2
REPEATERS FOR CABLE SECTIONS   6 THROUGH   7
REPEATER  DISTANCE  SECTION   DESIGN    LEVEL    PAD       MAX    BKWD    FWD
   #      FROM C.O.  LENGTH  LOSS(DB) DIFF.(DB) (DB)  T1 LINES  MARGIN  MARGIN
   3 RT       2872      672    12.92       -     7.5      58        0       0
```

Figure 6-13. Output for Run 3

7. ERROR MESSAGES

DILEP II provides three types of diagnostic error messages: fatal error diagnostic messages, warning error diagnostic messages, and system error diagnostic messages. When the DILEP II environment is entered, the datacheck routine will access the user's data file and read the input lines one at a time. If an error is found in a line of data, that line is printed on the screen, along with an appropriate diagnostic message. DILEP II uses the circumflex (^) character as an error indicator. DILEP II will not calculate repeater sites for a data file that contains errors. The user must make the corrections specified by the diagnostic message before rerunning DILEP II. The program checks input data for completeness and compatibility, but is unable to determine its total accuracy. Therefore, reasonable care should be taken in preparing the input data to avoid reruns.

7.1 Fatal Error Diagnostic Messages

The Fatal Error Diagnostic Messages apply to all input data statements; they specify that a line of input data is not acceptable for a specific reason. Table 7-1 lists all Fatal Error Messages and gives an explanation of each. Fatal Error Messages are designated with the prefix "F" and a number. When a fatal error occurs, DILEP II prints the actual line of input exactly as the user entered it into the data file, then prints the diagnostic statement. The datacheck routine will print a maximum of five fatal errors for each record it examines.

7.2 Warning Error Diagnostic Messages

The Warning Error Diagnostic Messages (Table 7-2) apply to all input data lines. Warning Error Messages are prefixed with the letter "W," followed by a number. DILEP II will continue to run even though it may encounter warning errors. All appropriate warning diagnostic messages are printed after the input line.

7.3 System Error Diagnostic Messages

System Error Diagnostic Messages provide general information and reminders to the user. System Error Diagnostic Messages are designated by the prefix "S" and a number. Diagnostic messages may be printed at any time during the execution of the DILEP II Study program. All System Error Diagnostic Messages, with appropriate action for each, are shown in Table 7-3.

Table 7-1. Fatal Error Diagnostic Messages

F01 - Character in numeric field *Explanation*: A character other than a blank, digit, or decimal point appears in a numeric field.
F02 - Invalid character in field *Explanation*: A character other than a blank, comma, letter, digit, or decimal point appears in the input line.
F03 - Invalid decimal point – possible missing information *Explanation*: Either a decimal point was entered in an improper field or some of the required data was omitted from the input line.
F04 - Missing information *Explanation*: Not enough information was given for this type of record. Please refer to Section 4.
F05 - Field too large – TRUNCATED after eighth character *Explanation*: Input overflow. Too many characters entered for this field. No more than eight characters permitted.
F06 - Too many fields are entered *Explanation*: Too many fields have been entered for this type of record. For more detail, refer to Section 4.
F07 - Cable sections out of sequence *Explanation*: Cable sections must be in consecutive increasing order.
F08 - Invalid previous section number *Explanation*: One of the following cases has occurred: 1) The previous cable section number is greater than the current cable section. 2) More than one cable section is beginning at the CO. 3) A junction is described incorrectly.
F09 - Invalid number of T1 lines *Explanation*: The number of digital lines must be greater than 0 and less than 1000.
F10 - Invalid plant type – must be A, B, or U *Explanation*: The plant type must be A (aerial), B (buried), or U (underground).

Table 7-1. Fatal Error Diagnostic Messages (Continued)

F11 - Invalid pressurization code – must be N or P *Explanation*: Pressurization code must be N (nonpressurized) or P (pressurized).
F12 - Invalid cable code *Explanation*: Three- or four-letter cable codes are permitted only. The first three letters of the cable code must be one of the allowable codes in Table 2-2. If X or S is entered as a fourth letter, the cable is calculated as reclaimed or screened, respectively.
F13 - Invalid pair unit separation – must be A, N, or S *Explanation*: The pair unit separation code must be A (adjacent), N (nonadjacent), or S (same).
F14 - Invalid pair unit size *Explanation*: The pair unit size must be one of the following values: 8, 9, 11, 12, 13, 16, 17, 25, 50, or 100.
F15 - Invalid cable section length *Explanation*: The cable length must be a value between 0 and 99,999,999.
F16 - RTs cannot be placed adjacent to each other *Explanation*: More than one RT cannot be placed at the same location.
F17 - DR location not within current cable section *Explanation*: When the distance of a DR is specified, its distance from the CO must be within the cable section entered before the DR input.
F18 - DRs out of sequence *Explanation*: Demand repeaters must be placed in increasing distances from the CO.
F19 - DR cannot be placed immediately after RT *Explanation*: A DR cannot be placed at the same location as an RT.
F20 - DRs cannot be placed adjacent to each other *Explanation*: More than one DR cannot be placed at the same location.

Table 7-1. Fatal Error Diagnostic Messages (Continued)

F21 - MHs out of sequence *Explanation*: Manholes must be placed at increasing distance from the CO.
F22 - RT cannot be placed immediately after DR *Explanation*: An RT cannot be placed at the same location as a DR.
F23 - Invalid pad value *Explanation*: Pad value must fall between 0 and 22.5
F24 - Too many manholes entered – MAX 50 *Explanation*: The maximum number of manholes allowed is 50.
F25 - Too many cable sections entered – MAX 100 *Explanation*: The maximum number of cables allowed is 100. *User Action:* Redefine the loop carrier route so that no more than 100 cable sections are needed.
F26 - Too many cable sections created from DR split *Explanation*: Too many cable sections now exist due to those created by DILEP when a DR is specified within a cable section.
F27 - DR/RT/MH before first cable section not allowed *Explanation*: A DR, RT, or MH was placed at the CO. The items must be located at some point after the first cable section or within it.
F28 - Too many DRs entered – MAX 50 *Explanation*: Only 50 demand repeaters can be entered in a route lay-out.
F29 - Invalid record type *Explanation*: The input line is not a valid record type.
F30 - Invalid loss per kilofoot *Explanation*: User-specified insertion loss per kilofoot is not within the range of losses valid for that wire gauge.
F31 - Invalid loss limit reduction *Explanation*: The user-specified loss limit reduction entry must be between 0 dB and 24 dB.

Table 7-2. Warning Error Diagnostic Messages

W01 -	**Decimal number in whole number field – TRUNCATED** *Explanation*: Warning only. A real number was found in an integer field. The value to the right of the decimal point is truncated.
W02 -	**Pad value is not a multiple of 7.5** *Explanation*: Warning only. Standard pad values are 0, 7.5, 15.0, or 22.5. However, any value between 0 and 22.5 dB may be entered after RT up to a maximum of five (e.g., RT, 0, 3.2, 6.4, 10.1, 20.5).

Table 7-3. System Error Diagnostic Messages

S01 - Limit must be between 20.0 and 33.5 – reenter *Explanation*: This diagnostic may occur during the interactive part of the DILEP II run if the user attempts to specify a loss limit greater than 33.5 dB or less than 20.0 dB (greater than 32.0 dB or less than 18.5 dB if protected repeaters are used). *User Action*: Enter a number between 20.0 and 33.5 (18.5 and 32.0) inclusive. (Entering 33.5 [32] will have no effect on repeater spacing, because the default loss limit is 33.5 [32] dB.)
S02 - The following repeater section(s) have less than the 9.2 minimum loss requirement:____________ *Explanation*: DILEP II was forced to place two repeaters too close together. The user may have requested remote terminals, demand repeaters, or junctions too close to each other, or DILEP II may not have been able to equalize the repeater spacing. *User Action*: Modify the route layout. This may involve relocating remote terminals, demand repeaters, or junctions. The problem may also be corrected by placing a pad in the remote terminal if the violating section terminates in a remote terminal.
S03 - Default insertion loss factor used for cable section(s) *Explanation*: Denotes the cable section that contains composite cable as noted in Table 2-2.
S04 - Nonstandard design – mixed low/standard capacitance cable *Explanation*: It is strongly recommended that low-capacitance cable never be mixed with paper, pulp, or standard PIC cable. Refer to the predivestiture Bell System Practice BSP 855-351-101, *Transmission and Outside Plant Design Procedures – T1 Digital Line Carrier Engineering*, for detailed information.
S05 - New cable sections were created by the program because one or more DRs were specified within a cable section. *Explanation*: The cable section numbers of the input file have been automatically sequenced by DILEP II because demand repeaters were specified within a cable section. The output report will show more cable sections than the route data as a result of this action.
S06 - DILEP system overload – ABEND code is:_______. Route is too long or too complex – try shortening or simplifying. Contact system support if necessary. *Explanation*: The route layout is too large or complex for DILEP II. The route must be shortened or simplified.

GLOSSARY

Apparatus Case – The component of the digital line that houses the line repeater.

Apparatus Case Crosstalk (ACXT) – Is a near-end type of disturbance, in that it is a crosstalk from high-level outputs to low-level inputs. The ACXT effect depends on the particular apparatus case used. The 800-type apparatus cases are not as susceptible to ACXT interference as the 475-type cases.

Binder Group – Binder groups and pair units are terms that have been used interchangeably. Both are bound with a distinctive ribbon and have a fixed number of pairs. For this User Guide, binder group means an entity that maintains the same relative positioning in the sheath in relation to all other binder groups.

Bit Rate – The speed at which digital information is transmitted, usually expressed in bits-per-second.

Bridged Tap – An extension of a cable pair beyond the point where it is used, or a branch cable that has bridged pairs. A bridged tap impairs transmission.

Build-Out Capacitor – A capacitor added to a cable pair to correct the pair's electrical length and thus eliminating any impedance irregularity.

Cable Code – A four-letter code used to identify all exchange cables. The first letter shows the standardization sequence of the particular type of cable. The second letter indicates the type of conductor insulation. The third letter shows the conductor material used in the cable, as well as the cable gauge. The fourth letter indicates the type of sheath.

Cable Layup – A cross-section view of the number of pairs in a unit (a group of pairs contained in one binder group) and the number of units. They are combined to form unit-type cable.

Capacitance – The property of an electric system comprised of conductors and associated dielectrics that determines, for a given rate of change of potential difference between the conductors, the displacement currents in the system. Also the property that determines how much electrical charge will be stored in the dielectric for a given potential difference between the conductors.

CO-End Section – The sections of cable from the Digital Cross-Connect Level 1 (DSX-1) to the Office Repeater Bay (ORB) to the Main Distributing Frame (MDF) to the first repeater, or from a DLC COT to the MDF to the first repeater.

Crosstalk – This occurs when one transmitted signal crosses over and interferes with other transmitted signals.

Customer Premises Equipment (CPE) – Any single item or assembly of telecommunications devices that is connected to the telephone network but are used by a customer and located in space the customer owns, leases, or rents.

Digital Repeater – An electronic device that restores the original waveshape of digital bits during their transmission over a digital line.

Digital Loop Carrier – An electronic system that reduces the number of pairs required to serve a given number of single-party or multi-party subscribers. Customers are served electronically between the remote terminal and the central office over a fiber pair or a small group of copper pairs.

DILEP – Digital Line Engineering Program, a computer tool for determining the locations of repeaters along a digital line transmitting at the T1 bit rate of 1.544 megabits per second.

DS1 – The level in the digital hierachy of 1.544 megabits per second, the digital signal level 1.

End Section – The length of cable from the last line repeater to the customer's network interface (NI) and the length of cable from the NI to the network channel terminating equipment (NCTE), or the length of cable from the last line repeater to the remote terminal.

Equalization – The process of reducing attenuation distortion and/or phase distortion of a circuit by introduction of networks that add compensating attenuation and/or time delay at various frequencies in the transmission band.

Far-End Crosstalk (FEXT) – Crosstalk that occurs between digital signals in the same direction of transmission along the digital line.

Fiber Hub – An outside plant location where fiber cables terminate. The hub contains multiplexers and other equipment that convert optical signals to electrical signals, which are then carried to customer locations over physical or derived pairs.

High Capacity Digital Service (HCDS) – HCDS provides two-point private line full-duplex transmission of 1.544 megabits per second between a Central Office and a customer premises or between two customer premises.

Impulse Noise – Noise due to short-duration, high-energy level spikes (voltage), normally caused by switching circuits in the central office on voice-frequency pairs or TTY circuits.

Induction – The process by which a change in current in one circuit causes a corresponding change in an adjacent circuit due to magnetic coupling, or by which a voltage on one conductor causes the opposite voltage to appear on another conductor with which there is electrostatic coupling.

Insertion Loss – The transmission loss caused by insertion of a component or network in a circuit. The ratio of power received at a load before insertion to that received at the load after insertion, expressed in decibels.

Interpair Crosstalk Coupling Loss – The loss in dB from a disturbing circuit to the disturbed circuit.

Kilohertz (kHz) – (1) One thousand hertz. (2) One thousand cycles-per-second.

LATIS – A computer tool that collects facility modifications, cable troubles, and assignment changes by Tracking Unit. It also ranks Tracking Units for the Facility Analysis Plan (FAP). A Tracking Unit is normally a Distribution Area (DA) or a group of DAs within an Allocation Area/Carrier Serving Area.

Layup – See **Cable Layup**.

Line Build Out (LBO) – See **Pad**.

Loop Plant – The name of the part of the telecommunications network that supplies service between customer locations and the equipment that switches their calls. Called "loop plant" because it originally consisted of the wire loops that form the electrical circuits between the customers and the switch.

Loss Factor – A measure of the relative amount of heating that will occur in a dielectric material that is in an alternating electric field. Heating is directly proportional to frequency and the loss factor.

Main Distributing Frame – The interface between the outside plant and the switch, where customer lines terminate on vertical strips, central office equipment terminates on horizontal strips, and the two are interconnected by jumper wires.

Mask – A representation, drawn on a computer-terminal screen, of a framework on which users can enter data. A mask usually consists of labeled fields; the user can move the cursor among the fields to enter, update, or delete data.

Menu – A list of choices drawn on a computer-terminal screen. A menu usually lists a number of options to be selected from when a user employs a computer program as a tool in performing work.

Multiunit Cable – Copper or aluminum cable that is made up of more than one group of insulated wire pairs bound, insulated, and color-coded as a unit.

Near-End Crosstalk (NEXT) – Crosstalk that occurs between the two different directions of transmission along the digital line.

Network Interface (NI) – The physical demarcation point between the operating company equipment and plant, and the customer-owned equipment and plant.

Nonpressurized Cable – Lengths of cable that are isolated from the air-pressurization system, which forces air through the cable network to prevent entry of water.

Office Repeater Bay (ORB) – Provides powering and equalization of the digital lines. The office repeater regenerates the incoming or receiving signal from the customer or the remote terminal. It does not have a regenerator in the outgoing or send side, but usually has artificial lines or loss pads in both directions.

Pad – Used to add loss in a T1 section, to ensure the minimum loss in an end-section, or to ensure that the signal level mismatch at a repeaterless junction is not over the allowable limit. Another name for pad is a Line Build Out (LBO).

Pair – Two wires of a single circuit associated together by twisting, binding, or by an overall braid or cover. May be laid spirally or parallel. The first wire of the pair is designated the "tip" and the second as the "ring;" or sometimes they are designated as the "wire" and the "mate."

Pair Unit – See **Binder Group.**

PLAN – The LEIS system current planning module that performs the planning, analysis, and evaluation features previously found in such separate computer tools as EFRAP and PGP.

Power Line Induction – Induction that, because of its sound or frequency, is identifiable as coming from commercial power lines. It may be noise induction at harmonics of the power frequency, or low-frequency induction at 60 Hz, 120 Hz, or 180 Hz.

Pressurized Cable – Telephone cable that is protected against the entrance of moisture at sheath breaks by filling the interior of the cable with dry air or nitrogen, at a pressure of about 7 psig for aerial cables and 10 psig for underground cables, permitting this pressure to drop to 2 psig at the far end of the cables. Either a sharp reduction in gas pressure or a sharp increase in the rate of gas flow actuates alarms to call attention to the presence of a leak.

Protected Repeater – Recommended for underground, buried, or aerial installations where protection from lightning and power surges is required.

Remote Data Entry System (RDES) – An editing program used to create and modify such programs as DILEP, EFRAP, EASOP, and LFAS.

Remote Terminal (RT) – The part of a subscriber loop carrier system that is placed at a site distant from the central office and the carrier system's central office terminal. The remote terminal and the central office terminal are usually connected by wire pairs that carry multiplexed digital or analog telephone conversations between the two terminals. The RT, located in a cabinet or hut, contains electronic circuits that demultiplex the carrier signals and maintain both the RT and the digital lines.

Resistance – The property of a conductive material that determines the current that will be produced by a given difference of potential. The practical unit of resistance is the ohm.

Route Junction – A route junction is formed when T1 lines from one or more branches enter the same cable sheath.

Signal Level Mismatch – A difference in the magnitude or phase of two impedances that causes reflections and prevents maximum power transfer.

Simplex Resistance – Is one-half the cable resistance of the digital line and is found on the DILEP output.

T1 Bit Rate – A rate of 1.544 megabits-per-second.

T1 Digital Facility – Is the facility, which is either copper or fiber, for transmitting the digital signal between two locations. The T1 line in a copper environment uses a four-wire transmission or two cable pairs, one for transmit and one for receive, with the necessary repeaters or other powering devices intermediately spaced along the line.

Time Sharing – The use of a facility or piece of equipment for more than one purpose or function, or for repetition of the same function within the same overall time period. This is accomplished by interspersing or interleaving the required actions in time.

(Insert Your Company Logo)

DILEP II
Route Data Sheet

EO-756-1 (8-87)

File Name (One To Eight Characters) Data

Route Description (Up To 78 Characters)

T

① Cable Section Number	② Previous Cable Section Number	③ Number Of Active T-I Lines	④ Cable Section Length In FT	⑤ Type Of Construction A, B, U	⑥ Pressure Code P, N	⑦ Cable Code *	⑧ Pair Unit Separation S, A, N	⑨ Unit Size 8, 9, 11, 12, 13, 16, 17, 25, 50, Or 100	⑩ Insertion Loss Factor dB/KFT AT 772 kHz **	⑪ Loss Limit Reduction (dB) ***

M - Manhole DR - Demand Repeater RT - Remote Terminal, Pad Value

800-Type Apparatus Case? (Check One) ☐ Yes ☐ No

All Protected Repeaters? (Check One) ☐ Yes ☐ No

Repeaters At All Junctions? (Check One) ☐ Yes ☐ No

Reduce Loss Limit? (Check One) ☐ Yes ☐ No If Yes, To What? ________ dB

* Three-Or Four-Letter Code. (If The Cable Is Reclaimed Or Screened, The 4th Letter Becomes "X" Or "S", Respectively.)

** Use Only If Necessary To Override Dilep II

*** 24 dB Maximum