DIRECT TESTIMONY OF ANTHONY V. PECORARO

ON BEHALF OF BELLSOUTH TELECOMMUNICATIONS, INC.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

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Q. PLEASE STATE YOUR NAME, ADDRESS AND POSITION.

A. My name is Anthony V. Pecoraro. My address is 3100 Braddock Drive, Raleigh, North Carolina 27612. I am a Partner Emeritus at Rendall and Associates. I am a consultant to the telecommunications industry on technical matters.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL BACKGROUND AND EXPERIENCE.

A. I have worked with telephone switching systems for over 30 years. I was employed by Northern Telecom (Nortel) for 18 years. The most recent assignment at Nortel was as Director of Advanced Switching Systems for both DMS-10 and the DMS-100 family of products. In this position I was responsible for assessing the market demand for switching products in terms of capabilities and features and planning the DMS evolution to meet the market needs.

Since 1985 I have consulted with telecommunications companies regarding evolving technological changes in the industry, business and technology issues resulting from regulatory change and business strategies that involve both network design and commercial implications.

I have presented papers at numerous industry conferences including various state telephone association meetings, USTA conferences and NARUC meetings. The general theme of these papers was either networking technology or the impact of regulatory change. I have published articles on network reliability and network evolution in Telephony and Telephone Engineer and Management. In addition, while at Nortel, I represented the Switching Group in the information meetings for the Exchange Carriers Standards Association (ECSA) T1 committees which were established to develop consensus on industry technical issues.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY BEING FILED TODAY?

A. My testimony provides an assessment of the technical feasibility of using central office switching capabilities to provide for the selective routing of 0-, 411 and 611 calls. More specifically I assess the viability and effects of using Line Code Screening within the switch software translations to allow the routing of 0-, 411 and 611 calls to different

places based solely on the identity of the Alternative Local Exchange Company (ALEC) serving the particular subscriber line involved. I should note that my testimony also supports the direct testimony filed in this proceeding by Mr. Keith Milner of BellSouth Telecommunications, Inc. ("BellSouth") regarding these same topics.

Q. IT HAS BEEN ASSERTED THAT THE USE OF A SWITCH SOFTWARE FEATURE CALLED "LINE CLASS CODES" COULD BE USED TO ALLOW CARRIER SPECIFIC ROUTING OR "SELECTIVE ROUTING" FOR 0-, 411 AND 611 CALLS. DO YOU AGREE WITH THESE ASSERTIONS?

A. No. My testimony will show that the Line Class Code capability is not sufficient to allow for selective routing on any substantive basis. I will further show that BellSouth has exercised prudent conservation of this limited capability and that attempts to utilize Line Class Codes in the manner suggested would significantly jeopardize call processing reliability.

Before I explain the fallacies in these claims I would like to first discuss the general architecture of a stored program control switching system with special emphasis on the computer memory and translation areas. This background should assist in understanding a very complicated process with which MCI evidently wants this Commission to tamper.

Q. WHAT ARE THE MAIN COMPONENTS OF A TYPICAL STORED PROGRAM CONTROLLED LOCAL SWITCHING SYSTEM THAT ARE RELEVANT TO THE ISSUES BEING CONSIDERED HERE?

A. A local switching system such as the Lucent Technologies 5ESS, Siemens EWSD or Nortel DMS-100 is basically a large computer. Like all computers, including the personal computer that you may have on your desk, a switching system consists of two primary parts: the hardware and the software.

Q. PLEASE BRIEFLY DESCRIBE THE HARDWARE?

A. The switching system is composed of three major sub-systems. They are:

- The switching matrix
- The computing complex
- The peripheral complex

The switching matrix is the part of the switch which allows connections to be made between different parts of the switch. This is the hardware that, when properly connected, allows the completion of calls. The computing complex controls the switching matrix and all other aspects of the actual local switching functions. This is the equivalent of the personal computer's "chip" or central processor. The peripheral complex of the switching system is a large set of port circuits. These

ports are interface devices that connect the switching matrix to various external and internal elements. In plain English, ports are the doorways in and out of the switch. The external elements may be (1) transmission facilities used to connect the switch to subscribers' telephones or (2) trunk circuits which connect the switch to other switching systems or operator platforms. The internal elements are service circuits which provide various tones, announcements, and other internal functions.

Q. WILL YOU DESCRIBE THE SOFTWARE COMPONENTS OF THE TYPICAL SWITCH?

A. Yes. The software system represents the brain of the local switching system. Just as a personal computer is useless without its software, a switching system cannot function without software. There are two primary categories of software. The first includes the operating programs which contain all of the logic to perform all of the functions which the local switching system must perform. For virtually all of the switching systems of a particular type, i.e., DMS-100 local switches, the operating programs are identical in most respects. I say these programs are virtually identical because all of these switches perform essentially identical logical steps.

The second category of software deals with translation information. Each switch will have translations software, but the information the

software processes will be different. The translation software can be thought of as a database, with predefined "tables" containing specific kinds or types of information. For example, the information which differentiates the switching system in Courtland Street in Atlanta from the switching system in North Raleigh, is in the translation information.

Q. WHAT IS TRANSLATION INFORMATION?

A. To continue the personal computer example, the translation information is analogous to the data you input representing your financial records, your letters and documents. By comparison, the local switching operating programs are analogous to the Disk Operating System (DOS)®, Microsoft Windows® and Lotus 123® programs used on your personal computer.

Q. WHAT TYPE OF INFORMATION IS INCLUDED AS TRANSLATION INFORMATION?

A. Translation information includes all the information which identifies a particular end user, his or her services, telephone number, presubscriptions, billing arrangements and similar things. In addition, every trunk circuit in a particular switching system must be recorded in the translation information for that switching system. I should note that, although the information within the tables has to be customized for the specific geographic area served by each switch, the arrangement of the

tables and the structure of the translations software is rigidly defined to work with the call processing software.

Q. WHAT ARE THE MAIN CONSIDERATIONS OF A SWITCH MANUFACTURER IN DESIGNING THE TRANSLATION SYSTEM?

A. In designing the translation system for a switching system, most manufacturers have two primary objectives. First, the translation systems and its supporting subsystems are designed for flexibility. The more flexible the translation system, the more useful it tends to be for the operating telephone company. Secondly, the translation system is designed for very rapid access by the operating programs during call processing. The speed of access directly impacts the speed of response to subscribers' input and the total capacity of the switching system. The net result is that translation systems for all local switching systems are extremely complex.

Q. DO ALL TELEPHONE COMPANIES FILL IN THE TRANSLATION INFORMATION IN THE SAME WAY?

A. No. It may help to think of the translation software and information as being analogous to the way an individual chooses to fill out a Microsoft Excel or Lotus 123 spreadsheet. The form (the operating program) is preset, but the column and row labels, and the data in the columns and rows can be customized. Just as there are many ways of building a PC

spreadsheet to implement a particular accounting system, there are many ways to enter data into a local switching system translation data system to implement the same services and features for the same set of subscribers. Each telephone company enters the data in its own way in the manner which will optimize its own objectives.

Q. CAN YOU GIVE US A DESCRIPTION OF WHAT A TYPICAL SET OF TRANSLATIONS TABLES MIGHT CONTAIN?

A. Certainly. One table that the switch will have will contain the office parameter data. This table will identify the type of physical equipment in the office and will establish the location of the equipment in the switch. Other tables will contain information showing how trunks are arranged in the office. Another table will have individual subscriber data for subscribers taking service. You can see that the number of tables can be quite extensive.

Q. HOW IS THIS INFORMATION USED DURING CALL PROCESSING?

A. You will recall that I mentioned that there were two types of software. The first type, which I refer to as call processing software, receives the digits the subscriber has dialed, and, on the basis of the office parameter information and the data contained in the trunk and subscriber tables, as well as any other relevant tables, completes the call. Using the simplest example, if a call is placed from one subscriber

to another served by the same switch, the call processing software receives the dialed digits, looks up the relevant information in the translations tables and completes the call. If the called number is busy, the call processing software then looks up an alternative destination for the call, perhaps a busy signal. Remember that these switches are just computers and the processing software simply looks at alternatives until the call either reaches its destination or is otherwise handled. For instance, if the subscriber who was called in the example above was on his or her telephone when the second call came in, but had subscribed to call forwarding of some type, the computer would learn this as it searched the translation tables and would complete the call accordingly.

I have made the example as simple as possible, but you have to understand that, in fact, the process is very complicated. There is not a single translation table that is used in processing the typical call, but rather there may be a significant number of them. For instance, each table has a specific function and therefore in order to complete a call, the call completion software has to move from table to table, in sequence. It may be helpful to think of the process as a "decision tree," with choices at one level dictating which path the call processing follows to get to the next level.

Q. HOW DO THE TRANSLATION TABLES DIRECT THE CALL PROCESSING SOFTWARE TO THE NEXT STEP OR CHOICE?

A. Without getting overly technical, it may help to use the Nortel DMS-100 as an example. The switch has internal translation tables, which consist of vertical columns and horizontal rows. The intersection of the columns and rows create fields or spaces where information can be stored and subsequently located by the call processing software. These fields may contain data expressed in the form of numeric or alphanumeric strings of information, or they may simply point the way to another designated table. By processing the information in the designated fields, the call processing software works its way through the switch and delivers the call to the appropriate place.

Q. CAN YOU EXPLAIN IN MORE DETAIL HOW A CALL WOULD BE PROCESSED USING A SUBSCRIBER SERVED BY A DMS-100 SWITCH AS THE EXAMPLE?

A. Yes. When a subscriber picks up his telephone handset and dials a number, the call processing begins in a table called Line Equipment Number Lines (LENLINES). This table stores all the basic information related to the subscriber line. This table associates the equipment location or address for the subscriber with the subscriber's telephone number, lists the features the subscriber has taken, such as call waiting, and provides a pointer to another table called the Line Attribute (LINEATTR) Table. In this latter table, each subscriber's line is associated with a specific Class of Service (Line Class Code). For instance, for the basic residential flat rated line there is a specific Line

Class Code which happens to be designated or identified as 1FR. Other examples of Line Class Codes are:

- Residential Enhanced Services (RES)
- Dial Tone First Coin Service (CDF)
- Zero Minus Denied Service (ZMD)

Q. PLEASE EXPLAIN HOW THESE LINE CLASS CODES ARE USED.

A. When a residential customer, who has a 1FR Line Class Code dials 0-, the Line Attributes Table points to another table, the Position Table for 0- calls. This table in turn identifies a route to various operator positions. For calls requiring a number pretranslation such as 411 or 611, the Line Attributes Table points the call to the appropriate pretranslator table, and these tables then point the call to the appropriate destination. Obviously a separate Line Class Code is not needed for each subscriber for each function, but rather the same Line Class Code can be used for multiple subscribers, sending each of them (for the appropriate call) to the same destination.

Q. HOW MANY LINE CLASS CODES ARE THERE WHICH CAN BE USED IN THE LINE ATTRIBUTES TABLE?

A. There are 256 different Line Class Codes in the Nortel DMS-100. Each of the 256 codes can be associated with up to 20 additional variables. These variables can be considered as pointers that send the call to

other tables. Each unique combination of a Line Class Code and these other variables requires a separate entry in the Line Attributes Table. While this would seem to allow practically a limitless number of combinations, the DMS-100 Line Attributes Table will only allow a maximum of 1024 entries. Therefore, for the purpose of the discussion we are having, it would be accurate to think of there being 1024 different opportunities to use a Line Class Code-type function in the DMS-100.

Q. IF THERE ARE 1024 POSSIBLE SELECTIVE ROUTING POSSIBILITIES, IT SEEMS REASONABLE TO CONCLUDE THAT THERE ARE PLENTY OF OPPORTUNITIES TO USE THESE CODES TO ROUTE 0- TRAFFIC TO MCI. CAN YOU COMMENT ON THIS?

A. First, you must realize that the existing telephone system uses a number of these Line Attributes, perhaps, let's say, as many as 300 of the total of 1024 in a given DMS-100 switch. One could mistakenly conclude, I suppose, that if MCI wanted to have all of its customers sent to its operators when they dial 0-, that it would be a simple matter of adding one new attribute, that is, utilizing one more of the 1024 opportunities, and that there would be plenty left. However, this is simply not accurate. One would assume that MCI, who has gone to the trouble of having its own operators available, would like all of its customers, irrespective of the type of service that customer has, to be able to reach the operators. Therefore, there would have to be a new

attribute created in the Line Attributes Table, for every class of customer service that MCI chooses. To make this clear, there is currently a Line Class Code for residential services and dialing 0- sends the call to BellSouth's operators. To route 0- to MCI's operators, the Line Attribute Table would have to use another of the 1024 opportunities, but with a different variable assigned to the 1FR Line Class Code. The same would also be true for MCI's 1FB customers. Of course, this would not only have to be done for every combination of line features chosen, but also for every other ALEC which wanted to provide this type of service. There is a finite number of these codes. You could perhaps proceed on a first-come, first-served basis, but at some point, the last fellow is going to come up short.

Q. WOULD THIS SITUATION ALSO ADVERSELY IMPACT THE INTRODUCTION OF NEW SERVICES?

A. Absolutely. The easiest way to demonstrate this is to consider what happens when a new service or feature is added to the network. Let's use an optional calling plan. It is not simply a matter of adding one additional attribute, to account for the new plan. That is, residential customers might (or might not) want to use the new plan, and business customers might (or might not) want the service as well. Customers who presently have flat rate service might want the new service (or they might not). As a result, when a new service is added like this, all of the existing entries would have to be duplicated to offer these options.

Q. ARE THERE OTHER PROBLEMS WITH THIS SELECTIVE ROUTING CAPABILITY BEYOND THAT WHICH YOU HAVE JUST DESCRIBED?

A. Yes. The DMS-100, for example, is configured such that there are only 16 possible routes (pointers to outgoing trunk groups) to operators for 0- calls. Moreover, there is only a single route available for 411 and a single route for 611 calls. Here again, even if the Line Class Code problem could be overcome, at some point all of these routes would be assigned and some ALECs could not be accommodated.

Q. WHAT DO YOU MEAN WHEN YOU SAY THAT THERE IS ONLY A SINGLE ROUTE FOR 411 AND A SINGLE ROUTE FOR 611 CALLS IN THE DMS-100 SWITCH?

A. In the DMS-100 switch 411 and 611 are "hard coded" in software, that is, they cannot be changed by the telephone company. Nortel has conducted a number of tests for the DMS-100 to determine if 411 could be code converted and properly routed to an MCI operator. None of these tests were successful.

Q. YOU HAVE BEEN DISCUSSING LINE CLASS CODES AND LINE ATTRIBUTE TABLES. IS THERE ANOTHER OPTION THAT COULD BE USED TO SELECTIVELY ROUTE CALLS?

A. Yes. It is possible to screen and route a call specifically on the Line Class Code assigned in the LINEATTR Table. In this case an entirely new Class of Service would be assigned to the MCI lines. The LINEATTR Table can point these classes to Class Of Service Screening sub-tables which can identify preferred trunk routes on the basis of the Line Class Code. Each unique Line Class Code would require a separate sub-table. The DMS-100 is limited to 256 of these sub-tables which effectively sets the limit of 256 Line Class Codes in the LINEATTR Table. Of course, that new Class of Service would consume one of the 1024 fields in the Line Attribute Table but is also subject to the additional limitation of a maximum of 256 classes of service. Thus the option of creating new classes of service gets you nowhere. In summary, there is simply not enough translation capability to provide selective routing for the quantity of ALECs that would request it.

Q. HOW MANY POTENTIAL ALECs MIGHT BE EXPECTED TO DEMAND SELECTIVE ROUTING?

A. My expertise is in the area of switching system technology; however, I would expect all the larger resellers (namely AT&T, Sprint, MCI, Worldcom, BTI) to want to extend their existing operator systems, respectively, to also handle the operator services for local calls.

Q. WHY DO YOU BELIEVE THAT?

A. MCI has already made its intent known by initiating these proceedings. AT&T has made its intent known by initiating a similar proceeding with this Commission. In addition, I spoke to representatives of the other three companies. The view of those companies I discussed this issue with is that if MCI gets the capability, they would want it too. This would require the replication and exhaust of limited capabilities.

Q. PLEASE EXPLAIN HOW THIS REPLICATION LEADS TO EXHAUSTION OF LIMITED CAPABILITIES.

A. If these five resellers wanted to provide their own operator services, additional codes would have to be provided. I would expect these companies to want to resell all or most of the same types of services BellSouth offers. In this case, therefore, BellSouth would have to provide 500% more Line Attribute codes.

Q. WOULD YOU EXPECT ANY OTHER DEMAND BEYOND THESE FIVE COMPANIES?

A. Yes. Again, though my main expertise is in the area of switching system technology, my experience in service development and deployment lead me to believe that there will be other companies wanting to provide operator services. Further, the additional requirement for individualized branding for the smaller resellers (which

do not provide their own operator services) would increase the demand on line class codes.

Q. IS BELLSOUTH USING REASONABLE CONSERVATION METHODS IN ASSIGNING ITS TRANSLATION TABLES.

A. I believe they are. Since they have limited the possible combinations of Line Class Codes and the other 20 variables in the same table to a few hundred it would seem BellSouth has been efficient in its assignments. In addition, I have discussed this with Nortel representatives who indicate that many telephone companies are already approaching exhaust of the LINEATTR table's capacity of 1024.

Q. COULD BELLSOUTH POSSIBLY REDUCE ITS LINEATTR ENTRIES AND RECOVER THIS CAPACITY FOR OTHER ALECs?

A. No. Although some translation tables allow for reassignment or reuse of entries the LINEATTR Table does not. Nortel documentation strongly cautions against reclamation or reassignment within the LINEATTR Table because of call processing reliability concerns. You will recall my description of linking of translation areas as resembling a "decision tree" where the decision at one level points to a different table or function. Nortel strongly advises against removing, reassigning or reusing entries in the LINEATTR Table in order to avoid a situation where pointers are left in that do not point to anything and thus could

inadvertently cause major disruptions in call processing or even switch "crashes".

Q. WHAT HAPPENS WHEN THESE CAPABILITIES ARE EXHAUSTED?

A. Two things occur. First, as I mentioned earlier, the ability of BellSouth to offer new services such as optional calling plans is severely, negatively impacted. Second, BellSouth would be unable to provide selective routing for any other ALECs.

Q. ARE THERE ANY OTHER SERVICES OR CALL TYPES THAT SHOULD BE CONSIDERED BESIDES 0-, 411, AND 611 FOR SELECTIVE ROUTING THAT ARE LIKELY TO BE REQUIRED BY RESELLERS?

A. Yes. I believe there is a whole class of incoming calls that could be negatively affected by the exhaust of limited capabilities due to the introduction of selective routing that should be considered in this proceeding. Some examples would be routing of incoming calls to an announcement when service has been disconnected, or to intercept when a number has been changed.

Q. DID YOU DISCUSS SELECTIVE ROUTING WITH OTHERS AND DID THEY HAVE A SOLUTION?

A. I discussed this with the other possible resellers, MCI, Sprint, WorldCom and BTI. In addition I have seen Ameritech's submission to the Illinois Commerce Commission and some correspondence from Nortel and Lucent Technologies regarding this capability.

Q. DID THESE OTHER POSSIBLE RESELLERS IDENTIFY A POSSIBLE SOLUTION?

A. No.

Q. DID THE AMERITECH SUBMISSION INDICATE THEY HAD A SOLUTION?

A. No, on the contrary they indicated it was at present not feasible.

Q. DID NORTEL INDICATE THEY HAD A SOLUTION?

A. No. Nortel's letter said what they called Alternate Local Exchange Routing Capability is not currently available and would require major development effort of the DMS-100 system.

Q. DID LUCENT TECHNOLOGIES INDICATE THEY HAD A SOLUTION?

A. No. In a letter to BellSouth dated July 8, 1996, Lucent Technologies said Alternate Local Exchange Routing Capability or Third PIC is not

currently available on the 5ESS switch. Lucent Technologies did not provide any estimate of development effort but only said they were investigating the resources, time frames and costs of developing this feature.

Q. YOU HAVE EXTENSIVELY DISCUSSED THE CAPABILITIES OF THE NORTEL DMS-100 IN TERMS OF ITS ABILITIES TO PROVIDE FOR SELECTIVE ROUTING. WHAT OTHER SWITCH TYPES ARE USED IN BELLSOUTH'S NETWORK?

A. I understand that BellSouth uses the following switch types in addition to the DMS-100:

- Lucent Technologies 1AESS
- Lucent Technologies 2BESS
- Lucent Technologies 5ESS
- Nortel DMS-10
- Siemens Stromberg Carlson DCO
- Siemens EWSD

Q. DO THESE SWITCHES HAVE THE SAME CAPABILITIES CONCERNING CAPACITIES OF LINE CLASS CODES?

A. No. Though all of these switch types have a capability analogous to Line Class Codes or line types, the size of the capability varies

significantly. For example, the 2BESS has a capacity of only 256 while the 5ESS has a capacity of 4,096.

Q. DOES THIS MEAN THAT SWITCHES WILL VARY IN THEIR ABILITY TO ACCOMMODATE SELECTIVE ROUTING?

A. Yes. In fact, the FCC's Firsts Report and Order in Docket No. 96-98 ("Order") comments at Paragraph 418 that "We recognize that the ability of an incumbent LEC to provide customized routing to a requesting carrier will depend on the capability of the particular switch in question." Thus those switch types will smaller Line Class Code capacities are more constrained in their ability to accommodate selective routing or "customized routing" as described in the FCC's Order.

Q. DOES THE FCC'S ORDER MENTION ANY PARTICULAR SWITCH TYPE(S) IN ITS DISCUSSION OF SELECTIVE ROUTING?

A. Yes, at Paragraph 418, the Order states that "AT&T acknowledges that, although the ability to establish customized routing in 1AESS switches may be affected by "call load" in each office, only 9.8% of the switches used by the seven RBOCs, GTE and SNET are 1AESS switches."

Q. WHAT IS THE LINE CLASS CODE CAPACITY OF THE 1AESS?

A. The capacity is 1024, the same as for the Nortel DMS-100. Further, the capacity of Line Class Codes is frequently less than for the 1AESS in the cases for example of the Nortel DMS-10 (512), Stromberg Carlson DCO (512). Even for those switch types with higher Line Class Code capacities such as the Lucent 5ESS and Siemens EWSD, the replication of Line Class Codes for additional ALECs will ultimately lead to exhaust of the capability as is shown in Mr. Milner's direct testimony.

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. In my opinion, the selective routing of 0- calls can technically be accomplished only with significant, severe limitations on the total number of ALECs that could be accommodated, the service variations these ALECs could offer and the ability of BellSouth to provide new socially desirable services. Solutions for selective routing of 411 and 611 service code calls is not viable since the routing of these calls is relatively fixed by the software design of the system.

Both Lucent Technologies, the manufacturer of the 5ESS system and Nortel, the manufacturer of the DMS-100, assert the capability of "Alternate Local Exchange Routing Capability" does not currently exist within their respective systems.

In summary, the use of Line Code Screening techniques to

accommodate selective routing of 0-, 411, and 611 calls though possible is not practical.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.