GTE FLORIDA INCORPORATED

DIRECT TESTIMONY OF BERT I. STEELE

DOCKET NO. 961537-TP

Q. PLEASE STATE YOUR FULL NAME AND BUSINESS ADDRESS.

A. My name is Bert I. Steele. My business address is 600 Hidden Ridge Drive, Irving, Texas 75038.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by GTE Telephone Operations as Manager - Pricing and Tariff Support. In this capacity I have responsibility for supporting incremental cost models and their application to support the pricing of network services for all of the GTE Telephone Operations ("Company" or "GTE").

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND BUSINESS EXPERIENCE.

A. I have a Bachelor of Science Degree in Mathematics from Gannon University and a Master of Engineering Degree in Engineering Science from Pennsylvania State University. I joined GTE in 1972 with General Telephone Company of Pennsylvania. During the course of my career with GTE, I have held various valuation engineering, marketing, product management, and regulatory positions throughout GTE Telephone Operations. I assumed my present position in January of 1994.

Approximately fourteen of my twenty-four years with GTE have been in the area of developing incremental costs for pricing decisions. I have taken a number of incremental cost and pricing courses from AT&T, Bellcore, United States Telephone Association ("USTA"), GTE and the University of Chicago. For seven years I have been an active participant of the USTA Economic Cost Analysis Subcommittee and the USTA Training/Education Work Group responsible for promoting awareness, understanding and proper application of economic principles. At present, I am the chairman of the USTA Economic Analysis Training/Education Work Group.

Q. **HAVE YOU TESTIFIED BEFORE THIS OR ANY OTHER STATE REGULATORY COMMISSIONS?**

A. I have testified on behalf of GTE's telephone operating companies as an expert witness in the area of incremental costing before numerous state public utility commissions including: Florida, California, Pennsylvania, Oklahoma, Wisconsin and Illinois.

COST STUDIES

Q. **WHAT COSTING PRINCIPLES DID GTE EMPLOY IN DEVELOPING ITS TOTAL ELEMENT LONG-RUN INCREMENTAL COST ("TELRIC") STUDIES?**

A. Exhibit No. BIS-1 to this testimony contains a detailed description of the cost study methodology and principles used by GTE to develop its TELRIC estimates for unbundled network services. Tab 1 of the separately filed "GTE's Cost Submission" in this proceeding contains further discussion on GTE's costing method and models. The cost study methodology conforms to the long-run incremental cost study methodology documented by Federal Communications Commission in its First Report and Order dated August 8, 1996. Certain parts of the FCC's First Report and Order have been stayed. Although I reference some of its provisions in my testimony, I do not endorse all of the FCC's rules.

Q. **WHAT COST STUDIES HAS GTE FILED IN THIS PROCEEDING?**

A. GTE's Cost Study Submission contains TELRIC estimates for certain "network elements" as well as Total Service Long-Run Incremental Cost ("TSLRIC") estimates for select bundled "services." The Company has provided TELRIC estimates for the following elements:

- Network Interface Device ("NID"): Basic and 12X
- Loops: 2-wire and 4-wire
- Local Switching
  - Ports: 2-wire analog and DS-1
  - End Office Switching: Originating and Terminating
  - Vertical Features
- Tandem Switching
- SS7 Signal Links: 56kb and DS-1
- SS7 Signal Transfer Point ports
- Transport: Common and Dedicated

Collocation element cost studies were also provided for:

- Network Access Cross Connection: DS-0, DS-1, and DS-3 levels
- Physical Engineering Fee
- Building Modification Charges
- Partitioned Space Rental
- DC Power
- Cable Space Charges

The GTE Submission also provides Service Provider Number Portability cost studies:

- Remote Call Forwarding per number ported
- Simultaneous Call paths

And it includes Service Ordering and Service Connection Activities.

In addition, TSLRIC studies were performed and submitted for other services that the Company offers (e.g., basic local service, vertical services, toll, and switched access). These studies were one of the components used in deriving the Company's total "forward-looking" costs for its services. This estimate of total forward-looking costs helped the Company to estimate its "forward-looking" common costs.

GTE's Cost Study Submission also includes its "Avoided Cost Study" analysis, which is a primary component of its recommended resale rates. This study and the resulting recommended price levels for resold services is the topic of GTE's Resale/Avoided Cost Presentation.

Q. WHAT DISTINCTION DOES GTE MAKE BETWEEN TELRIC AND TSLRIC STUDIES ?

A. GTE uses the terminology "TELRIC" when referring to network element cost studies and "TSLRIC" when referring to cost studies performed for GTE's current services.

Q. WHAT COST STUDIES ARE YOU SPONSORING?

A. I am presenting GTE's TELRIC and TSLRIC cost study methodology as described in Exhibit No. BIS-1 to my testimony. I am also sponsoring GTE's TELRIC and TSLRIC study results with the exception of non-recurring charges (i.e., service order cost studies), collocation and avoided costs. The cost study process and results for these three items are being handled by other witnesses in the proceeding.

Q. YOUR EXHIBIT NO. BIS-1 DOCUMENTS GTE'S TELRIC AND TSLRIC METHODOLOGY. PLEASE PROVIDE AN OVERVIEW OF GTE'S METHODOLOGY.

A. The cost study prepared for this proceeding is a very special type of cost study which captures the impact of providing loops, switching and transport network elements. In this regard, all of the forward-looking costs for loop facilities are assigned to loop network elements, all of the forward-locking costs for switching are assigned to switching network elements and all of the forward-looking costs for transport are assigned to transport network elements. None of the costs, from a cost study objective perspective, for loops, switching or transport facilities are assigned to GTE's common costs. Stated another way, all of the these forward-looking costs are included in the per unit TELRIC and TSLRIC results, respectively. Accordingly, the "cost objects" are the wholesale network elements not the retail services. This is consistent with the FCC First Report and Order ("Report"), which states in Paragraph 690, for example: ***"The increment that forms the basis for a TELRIC study shall be the entire quantity of the network element provided."***

Q. **ARE THE LONG-RUN INCREMENTAL COST STUDY RESULTS ESTIMATES OF GTE'S ACTUAL FORWARD-LOOKING COSTS?**

A. Yes. GTE's cost study results are forward-looking and representative, to the extent possible, of the future costs expected to be incurred by GTE. These long-run incremental cost study results are not for a hypothetical carrier nor are they representative of the costs for a new entrant. Rather, all input prices for equipment, installation, maintenance, repair and other expenses are estimates of GTE's future costs. These input prices are based on the most efficient outcome available to GTE as neither a hypothetical nor embedded view is appropriate for determining long-run incremental costs for the LEC. Forward-looking costs for the actual carrier in question should be used to perform TELRIC and TSLRIC studies.

Q. **DO THE COST STUDY RESULTS PROVIDE CONSERVATIVE ESTIMATES OF GTE'S LONG-RUN INCREMENTAL COSTS?**

A. Yes. The TELRIC and TSLRIC studies performed by GTE are conservative in that they do not adjust for the overall change in risk created by the introduction of competition intended by the Telecommunications Act of 1996. In addition, the cost study models currently available to GTE and the resulting input factors assume, for the most part, that GTE is the sole provider of loop, switching and transport facilities in the local network. This fact alone tells us that the cost numbers must be lower bound estimates of GTE's future costs since most certainly the marketplace will experience facility-based entry.

Depreciation rates and cost of capital should be adjusted to account for risks that a carrier incurs. Depreciation rates, in particular, should be adjusted for declining technology costs, sunk investments and rapid technology change. As even the FCC noted in the Report, an increase in risk due to entry into the market can increase the LEC's cost of capital. However, due to time constraints imposed by the Telecommunications Act, GTE was unable to adjust its depreciation lives for sunk investments and declining technology costs. In addition, the cost of capital used is based on GTE's current capital structure and rate of return. The cost of capital, therefore, was not adjusted to account for changes in risk.

Q. DO THE GTE TELRIC RESULTS INCLUDE COMMON COSTS?

A. No, there are no common costs incorporated in GTE's TELRIC results. Common costs, therefore, are addressed from a cost recovery or pricing perspective rather than from a per unit TELRIC perspective.

Q. WHY DOES GTE's COST STUDY SUBMITTAL INCLUDE LOOP COST STUDY RESULTS FROM THE BENCHMARK COST MODEL - VERSION 2 ("BCM 2")?

A. The BCM 2 results provide an independent estimate of GTE's two-wire loop costs. A comparison of the GTE TELRIC for two-wire loops with the BCM 2 results, as well as Hatfield results provided by BCSI witness Kahn (Kahn Exhibit 2) is provided in Exhibit No. BIS-2. The comparison shows that the BCM2 results are in concert with GTE's results while the Hatfield results are signifcantly out of range.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

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	GTE STUDY	BCM2 STUDY	HATFIELD STUDY
Two-Wire Loop TELRIC filed by GTE	$23.26	-	-
TELRIC using Hatfield Model Definition (Note 1)	$29.70	-	$10.30
Price using Hatfield Model Definition (Note 2)	$33.78	$33.61	
GTE Proposed Price	$33.08		

Notes:

(1) The Hatfield Model incorporates all costs other than Corporate Operating Expenses in TELRIC.

(2) The Hatfield Model uses 10% (i.e., TELRIC is increased by 11% or .10/.90 to reflect Corporate Operating or Common costs. The BCM2 results reflect Lucent Technology contract prices.

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GTE TELEPHONE OPERATIONS
TELRIC/TSLRIC METHODOLOGY

I. SUMMARY

This document presents a complete overview of the manner in which GTE develops costs for its services and its basic network functions (BNFs), which are the components that typically constitute a service. The type of cost developed for both BNFs and services is Total Service Long Run Incremental Cost (TSLRIC). TSLRIC, by design, does not incorporate any common cost and, as such, cannot be used for pricing without adjustments to reflect the total cost of doing business.

A TSLRIC is a very special type of cost that tries to capture the incremental impact of providing a service (or network element), such as basic loop.[1] Contained within this service definition is a collection of services provided to residence, business and carrier customers, such as residential local exchange service, business local exchange service and unbundled loop service. The TSLRIC, as a cost, is characterized by the basic principles that help to define it. These principles establish the increment of study, the conditions under which a cost should be included, the range of options to consider, the means of selecting between options, and the set of costs to be excluded.

Based on this set of principles, and on a set of engineering process cost models for switching, transport, outside plant and signaling, GTE develops costs for its

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[1] In its recent First Report and Order (CC Docket No. 96-98), the FCC states: "While we are adopting a version of the methodology commonly referred to as TSLRIC as the basis for pricing interconnection and unbundled elements, we are coining the term 'total element long run incremental cost' (TELRIC) to describe our version of this methodology." The Commission explained that TELRIC refers explicitly to discrete network elements, such as local loops and switching, in contrast to TSLRIC, which refers to conventional services such as interstate access service and local residential or business exchange service. The Commission also suggested that a TELRIC study likely would account for a greater percentage of a carrier's total costs than would a TSLRIC study.

The distinction between TSLRIC and TELRIC, thus, is one that relates to the object of study (e.g., retail services versus unbundled network elements). There is no distinction between the two regarding the fundamental long run incremental cost methodology. This methodology states that the LRIC for a service or element is equal to the total costs of the carrier with that service or element minus the total costs without that service or element. In its LRIC studies of both services and elements, GTE has followed this same methodology, which is also the methodology presented in the Commission's First Report and Order. Of course, whether or not the Commission's hypothesis that a TELRIC study would account for a greater percentage of a carrier's total costs than would a TSLRIC study is an empirical question, and the Commission's Order offers no evidence on that point.

services and for BNFs. The modeling process consists of first isolating and expressing on a unit basis the costs that change with the volume of service and then of associating with each unit a share of the fixed and standby capacity costs that do not vary with the level of output. Both these volume sensitive and volume insensitive costs need to be included with a properly developed TSLRIC.

The use of TSLRIC presents limitations that must be kept in mind. As a pricing tool, the user of a TSLRIC must first resolve how to appropriately modify it to account for common costs explicitly excluded by the principles. Although these costs are generally substantial, there are no clearly defined cost causative principles that dictate how to assign them to services. In addition, the TSLRIC, as it is developed today by GTE's models, is based on a narrow definition of the principles that ignores the costs of an uncertain environment: the world as it is postulated assumes all demand is known and static. This same method of TSLRIC should be refined to capture the interrelationship between the industry with rapidly changing technology and increased risk. This interrelationship is reflected in the adjustment of plant lives and the cost of money.

II. Definition of TSLRIC

TSLRIC is defined as the additional cost incurred by the company to produce the entire output of a particular service, holding constant the production of all other services produced by the company. In other words, TSLRIC is equal to the company's total cost of producing all of its services, assuming the service in question is offered, less the company's total cost of producing all of its services without the service in question. Strict adherence to this definition of TSLRIC would involve the preparation of two major cost studies, with the total costs calculated in one study subtracted from the total costs calculated in the other. However, it would be extremely difficult and complex to estimate TSLRIC in this manner. Instead, an estimate of TSLRIC is completed in a manner that can be calculated directly for the network element or service in question. Consistent with this approach, GTE has estimated the TSLRIC for its services by deriving the volume sensitive (variable) and volume insensitive (fixed) costs for each service.

III. TSLRIC Principles

Principle No. 1: Long run implies a period long enough so that all costs are avoidable.

Long run is a period of time long enough so that all costs are treated as avoidable. Variable, as a term, is synonymous with volume sensitive and therefore not synonymous with avoidable. Avoidable costs include both volume sensitive and volume insensitive costs.

Principle No. 2: Cost causation is a key concept in incremental costing.

Cost causation is a consistent and fundamental principle of TSLRIC studies. The principle of cost causation should be utilized to determine the appropriateness of including a cost in a TSLRIC study. The basic principle of cost causation is that only those costs that are caused by a cost object in the long run should be directly attributable to that cost object. Costs are considered to be caused by a cost object if the costs are brought into existence as a direct result of the cost object or, in the long run, can be avoided when the company ceases to provide the cost object.

For example, within the telecommunications industry, the principle of cost causation is best viewed from the standpoint of providing a service and what costs are necessary to offer that service. All costs caused by a decision to offer a service should be included in a TSLRIC study of that service.

Principle No. 3: The increment of the study should be the entire output of the service (or group of services) under study.

The methodology and associated TSLRIC studies are intended to answer the specific cost question: "What is the change in the company's costs due to offering or not offering the service?" Consistent with this definition, TSLRIC studies shall provide a measurement for the entire service under study. The TSLRIC results, therefore, will include both the volume sensitive and volume insensitive costs. The volume sensitive costs represent costs that change with output. The volume insensitive costs are fixed with respect to a given output, yet are incremental with the service offering.

Principle No. 4: All costs shall be forward-looking and reflective of the costs expected to be realized by the company.

TSLRIC studies shall be forward looking and representative, to the extent possible, of the future costs expected to be incurred by the company. TSLRIC studies do not necessarily reflect a company's embedded base facilities. Rather, studies shall account for the most efficient and cost-effective means available to the company. The technologies addressed shall be known and actually are being deployed by the company.

Principle No. 5: Common Costs are not part of a TSLRIC study, except for a TSLRIC study for the company as a whole. Recovery of those costs should be a pricing issue.

TSLRIC studies should include costs that are often called overhead costs, if those costs are caused by the decision to offer the cost object. TSLRIC studies of individual services should exclude overheads that are not demonstrated to be caused by the cost objects. Recognition of such costs will be treated as a pricing issue. No cost should be assumed to be volume insensitive shared or common costs on the basis of its accounting treatment.

IV. GTE's TSLRIC Methodology

A. *Overview*

GTE's TSLRIC methodology incorporates a two-step process to identify the total costs for a given service offering. In the first step, the TSLRIC method identifies the volume sensitive costs. The volume sensitive costs represent the costs that vary with changes in the level of output for the service. The second step identifies the volume insensitive costs for the service. The volume insensitive costs represent the costs that are fixed with respect to changes in output, yet are incremental with the offering of the service. The results of the TSLRIC cost study represent the sum of the volume sensitive and volume insensitive costs.

The GTE methodology determines the TSLRIC associated with being in the loop, switching and transport business. The cost objects or services under evaluation are generic loop, switching and transport units of production. Within this approach, the TSLRIC for a voice-grade loop, for a specific distance and density, is the same regardless of the customer "type" ordering the service (i.e., a business customer versus a residential customer). Likewise, the TSLRIC for a minute-of-use for an outgoing call is the same for a local, EAS or toll call. This approach to TSLRIC analysis is particularly attractive because it brings to the surface cost information that is both easy to understand as well as consistent with the principles listed above. The approach assigns, on an equal and uniform basis, all of the forward-looking costs attributable to loops, switching and transport to the services that cause GTE to incur these costs. Accordingly, the costs associated with GTE's loop, switching and transport networks are identified and included in the service-specific TSLRIC studies. None of these facility-related costs are treated as shared or common.

Because incremental cost studies deal with forward-looking costs, one must have a means of assessing the future technologies from which products and services will be provided. GTE has performed such assessments for loop, central office switching and interoffice transport technologies. GTE's current and future plans identify the technologies that are expected to experience growth. Certain embedded technologies and vendor-specific embedded products are not experiencing growth, and these embedded technologies and products are not incorporated in GTE's TSLRIC studies.

GTE's TSLRIC studies incorporate a mix of copper and pair-gain facilities to satisfy the technology requirements for voice grade loops. Fiber facilities are used for loops at the DS-1 and DS-3 levels (i.e., 1.544 Mb/s and 45 Mb/s digital transmission levels). The predominant switching technology used by GTE to satisfy future growth is digital, and it is the sole technology used in the TSLRIC studies. Lucent 5ESS ("5ESS"), NTI DMS ("DMS") and AGCS GTD-5^{R} EAX ("GTD-5") digital switching technologies were analyzed to determine the cost of switched-based network services. Further, the predominant interoffice transmission technologies used by GTE to satisfy future growth are fiber optics facilities. Accordingly, fiber optic system costs are examined in GTE's TSLRIC studies for interoffice transport.

GTE utilizes engineering process models (e.g., COSTMOD System and SCIS) to measure the incremental costs of local, toll, switched access, unbundled loops, unbundled ports and other network services. The models, by definition, are designed to directly and explicitly reflect the underlying production technology by duplicating the processes required to engineer and provision the particular production function under review. Production units required to satisfy the desired demand are developed based on a set of engineering design criteria. The resulting production units are then multiplied by their respective unit costs, using a price list developed by component, to determine the associated investments. The engineering design criteria are determined based on the technology under review and reflect the network design standards used by GTE.

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Engineering process models are appropriate for telecommunications services since a discrete and well defined set of standard engineering design criteria are undertaken during the network design process. These algorithms and practices are readily incorporated into engineering process model equations. The necessary technology-specific technical information is available from vendors and GTE engineers.

GTE uses the COSTMOD System (COST MODel System), including the Bellcore SCIS (Switching Cost Information System) model, to measure the costs of the various network services. The COSTMOD System ("COSTMOD") is an integrated cost development tool that employs various "Technology Modules" and "Application Modules" to model the costs of services utilizing loop, switching and transport facilities. The models are populated with company specific information required by the models to size and determine the number of associated production units. This includes office/system size, technology, traffic data and mileage information, along with other information needed to run the models.[2] The following modules are contained in the COSTMOD System.

The Technology Modules include:

- Loop Technology Module (for voice grade applications);
- GTD-5 Switching Technology Module;
- Fiber Optic Technology Module;
- DMS Switching Technology Module (via the Bellcore SCIS model);
- SS7 Technology Module (System Signaling Seven -- out-of-band signaling);
- Lucent 5ESS Switching Technology Module (via the Bellcore SCIS model).

The Application Modules include:

- Usage Application Module (calls and minutes for local, toll, switched access);
- GTD-5 Switching Features Application Module (for custom calling and other features);
- DMS Switching Features Application Module (for custom calling and other features via SCIS);
- Lucent 5ESS Switching Features Application Module (for custom calling and other features via SCIS).

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[2] A description of the COSTMOD System, including SCIS, is provided in Appendix 1.

The COSTMOD System provides the technology and application modules necessary for modeling costs. The technology and application modules are used in different combinations for assessing costs. The technology modules provide the costs for the technologies (e.g., fiber optic systems) under investigation, without regard to use or application. When the technology modules are used in conjunction with an application module, the costs for GTE services are identified.

In practice, the technology and application modules are linked or combined to assess the costs for network services. In order to estimate the costs for a network element or service, a user of the COSTMOD System must first identify the relevant technology modules needed to support the element or service. Each technology module provides the investment costs for each cost category, or cost driver (e.g., cost per busy hour centrum call second). The unit investments provided by each technology module are then passed to the relevant application module where, along with user-input feature or service data, they are applied to determine the incremental cost for the element or service under study (e.g., minutes and calls via the usage application module).

The production unit-dependent investments provided by the engineering models are converted into the per-unit costs of providing GTE's services, based on annual cost factors. These annual cost factors represent the relationship between plant investment and expenses incurred by GTE. These state-specific cost factors are identified by USOA (Uniform System of Account) categorization reflecting the forward-looking technology under analysis. The annual cost factors include depreciation, return, income taxes, maintenance and repair, customer operations and miscellaneous taxes (e.g., ad valorem tax, gross receipts tax).[3]

B. *Modeling Process*

1. Service Mapping

Most of the services provided by a telecommunications company can be perceived to consist of various functional components. Some of these components represent primary network functions that are designated "basic network functions" or "BNFs." Other components, such as billing and collection, are non-network related and are designated non-BNF components. The following table provides an example of the relationship between services (i.e. Local Exchange and Toll Services) and their components. The mapping is

[3] Customer operations expenses are the only "administrative costs" identified in GTE's TSLRIC studies.

broken into two categories: BNF Components and Non BNF Components. Table 1 below shows how local exchange and toll services are mapped into different components.[4]

Table 1
Mapping of Cost Components to Services

Service	BNF Component	Non-BNF Component
Local Exchange Service	· Network Access Channel Basic Level · Network Access Channel Connection-Basic Analog Level-Switch Interface · Network Access Channel Connection-Basic Level · Intraoffice Call Setup · Intraoffice minute-of-use (MOU) · Outgoing Call Setup · Outgoing MOU · Incoming Call Setup · Incoming MOU · Tandem Call Setup · Tandem MOU · Sw. Transport Per Setup Termination · Sw. Transport Per MOU Termination · Sw. Transport Per Setup Per Air Mile · Sw. Transport Per MOU Per Air Mile · Measurement (if a Measured Service) · DTMF	· Billing and Collection · Directory Assistance · Directory · Terminating Access Charges
Toll Service	· Outgoing Call Setup · Outgoing MOU · Incoming Call Setup · Incoming MOU · Tandem Call Setup · Tandem MOU · Sw. Transport Per Setup Termination · Sw. Transport Per MOU Termination · Sw. Transport Per Setup Per Air Mile · Sw. Transport Per MOU per Air Mile · Measurement	· Billing and Collection · Terminating Access Charges

2. Estimating the TSLRIC

TSLRIC includes both volume sensitive and volume insensitive costs. As previously stated, the TSLRIC for a service is estimated by a two-step approach. The first step is to estimate the volume sensitive costs for the service, and the second step is to incorporate the volume insensitive costs to determine the TSLRIC for the service.

Volume sensitive costs are determined by the engineering process models in conjunction with the annual cost factors previously addressed. The engineering models simulate the investment of providing the BNF and associated service on

[4] A description of the basic network functions (i.e., BNFs) is provided in Appendix 2.

a forward-looking basis, based on a host of parameters (e.g., loop length, central office size, call volumes, holding times, transport distance, etc.). These investment costs are converted into monthly costs using annual cost factors for depreciation, return, income taxes, maintenance and repair, customer operations and miscellaneous fees and taxes (e.g., ad valorem tax, gross receipts tax).

GTE has developed a series of engineering process models within its COSTMOD System to develop investment costs. GTE also uses Bellcore's Switching Cost Information System (SCIS) to develop switch-related costs associated with the DMS (Nortel) and 5ESS (Lucent Technologies) switches. The GTE engineering process models, which reflect the long run view of costs, account for advancement or delay in investment attributable to changes in output for network services. The models provide good estimates of this causal relationship when a production component is divided by its usable capacity. This capacity cost calculation essentially smoothes the "lumpy" investment to account for the advancement or delay of future costs due to the change in output. It provides a good measurement of the volume sensitive cost for telecommunications BNFs and associated services.

The following table summarizes the engineering process models used by the Company to estimate volume sensitive costs:

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Table 2

Summary of Engineering Process Models

Engineering Process Model	Output
Loop Technology Module	· Network Access Channel Basic Level
GTD-5 Switching Technology Module	· Network Access Channel Connection-Basic Analog Level Switch Interface · Touch Call (DTMF) · Cost input for Usage Services Application Module - See Below
DMS Switching Technology Module 5ESS Switching Technology Module (via Bellcore SCIS model)	· Network Access Channel Connection-Basic Analog Level Switch Interface · Touch Call (DTMF) · Cost input for Usage Services Application Module - See Below
Fiber Optic Technology Module	· Transport Per Termination (Voicegrade, DS1, DS3) · Transport Per Air Mile (Voicegrade, DS1, DS3) · Also used as input into Usage Service Application Module - See Below
SS7 Technology Module	· Input into Usage Services Application Module - See Below
Usage Services Application Module	· Intraoffice Call Setup · Intraoffice MOU · Outgoing Call Setup · Outgoing MOU · Incoming Call Setup · Incoming MOU · Tandem Call Setup · Tandem MOU · Measurement · Sw. Transport Per Setup Termination · Sw. Transport Per MOU Termination · Sw. Transport Per Setup Per Air Mile · Sw. Transport Per MOU Per Air Mile

The last component of TSLRIC is the volume insensitive costs. The volume insensitive costs represent the costs associated with standby capacity. GTE must have sufficient capacity to service its customers on a ready-to-service basis. In this industry, the nature of the service and the market expectation have made the service delays unacceptable. Accordingly, GTE must install sufficient capacity in its network in advance of the realization of customer demand. The cost of this "standby capacity" is a necessary component of the TSLRIC studies for GTE's services. The cost for standby capacity was determined for loops (feeder) and transport based on examination of GTE's forward-looking objective utilization levels in conjunction with the forward-looking actual utilization levels required to support GTE's "standby" obligation. The volume insensitive costs for switching were identified by using the COSTMOD and SCIS models. In this case, the volume insensitive costs represents the difference between the total cost, by technology type, and the total volume sensitive costs. Taking these costs into account in this manner assures that the entire cost of the network facility is included in the TSLRIC calculation.

3. Company Specific Expenses

The following expenses items are included in GTE's service-specific TSLRIC studies:

- Depreciation;
- Return;
- Income Taxes;
- Plant Specific Maintenance and Repair (by technology);
- Central Office Land and Buildings;
- Customer Operations (e.g. Sales);
- Miscellaneous Fees and Taxes (e.g., ad valorem tax, gross receipts tax).

The following expenses items are not presently included in GTE's service-specific TSLRIC studies. These costs are specific to service groups offered by GTE or are common to the GTE as a whole.[5] It is not unusual for these costs to range from 35% to 45% of a company's total costs:

- Plant Specific Expenses - network support, general support, and general purpose computers (adjusted for data processing costs for billing production);
- Plant Nonspecific Expenses;
- General Support Assets - furniture, office support equipment, company communications equipment, and general purpose computers;
- Land and Buildings (other than Central Offices);
- Indirect Labor - indirect support/supervision and indirect departmental labor expenses;
- Corporate Expenses;
- Other Taxes and Fees, such as local franchise taxes, federal superfund taxes, local and state business license and occupation taxes.

[5] GTE's current TSLRIC studies rely on the accounting treatment of "overhead or common" expenses . See Principle No. 5 and Model Limitations.

V. Model Limitations

As with any model, it is important to understand the limitations of TSLRICs, as currently developed. First, the TSLRICs cannot be directly used to determine prices for services. Based on principle 5, which states that common costs should be excluded, it is clear that common costs will not be covered if all services are priced at TSLRIC. All of the services must be marked-up to cover common cost if the firm is to stay in business. The TSLRIC principles provide no guidance on how services are to be marked-up. Second, TSLRICs tend, for various reasons, to be conservative estimates of GTE's cost of business.

A. Impact of Uncertainty, Competition and Growth

TSLRIC studies, as they are conducted today, assume that input price and demand are known with certainty. This assumption can have a significant impact on the cost of service. In the case of demand, it is typically assumed that for any wire center location and surrounding service area, the customer base is in place and will not change in the future. In the case of input prices, such as switch cost, it is assumed that all prices are known, available to all participants, and unchanging in the future. In actuality, demand is neither static nor known with certainty at the time plant is installed, nor is the costs of equipment known and unchanging over time.

Modeled costs for a known, static demand have efficiencies and economies of scale and scope that can never be achieved. Actual demand requires smaller, more costly quantities to offset the uncertainty in demand (e.g., feeder loop plant). In high growth areas, this cost can be substantial, since the uncertainty in demand and the frequency of additions increase with growth rate. In addition, as the market becomes more competitive, actual demand will become more uncertain and plant utilization and cable sizes will drop as market share erodes, driving up the cost.

In the case of investment, uncertainty will lead directly to higher costs of capital and shorter plant lives. Potential drops in input prices which, according to the model, translate into lower prices and lower margins will result in either delays in investing by the firm or shorter plant lives to allow the recovery of the investment before prices drop. This same potential squeeze on margin will also result in investors requiring a higher return on their money to cover the risk.

B. Other Factors

TSLRIC estimates tend to be conservative for a variety of reasons other than uncertainty, competition and growth. One of the more significant reasons is due to the difference between the accounting definition of common costs and the TSLRIC definition of common cost. The accounting definition of common cost includes many items which are, in reality, service specific but separated from the service by the way in which they are accounted for on the books. Another reason why the TSLRIC results are conservative is the modeling process. Models, by design, assume a standard environment which does not reflect any of the potentially high cost anomalies which can occur. Densities are generally assumed to be uniform, soil conditions average, traffic and weather conditions standard, and catastrophes like earthquakes, hurricanes and floods never happen.

VI. Appendixes

A. Appendix 1: COSTMOD System (including SCIS)

B. Appendix 2: Basic Network Function (BNF) Definitions

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

INTRODUCTION

This narrative provides a description of the methodology used by GTE in estimating the long run incremental costs associated with various network services. The costs developed by this approach are GTE's estimates of the long-run incremental costs of providing such services. The costs of installing and maintaining loop, switching, and transmission facilities, including directly associated operating expenses (developed externally via annual cost factors) are identified by the **family of cost models comprising the CostMod System**.

By definition, a model is a representation of something real; it shows relationships among variables and can be used to predict or explain a process or mechanism, such as an OSP facility incorporated in a telecommunications network. Despite their utility, however, one must recognize all models for what they are -- artificial representations for real-world processes or mechanisms, and as such, they have practical shortcomings. The criteria by which a particular modeling technique is selected should seek to minimize these inadequacies.

There exists a number of modeling techniques which may be employed in estimating network service costs. Foremost among these techniques are engineering process models, which, by definition, are designed to directly and explicitly reflect the underlying production technology by attempting to duplicate the processes required to engineer and provision the particular production function under review, given certain inputs. Production units that are required to satisfy the desired traffic load are developed based on a fixed set of rules. The resultant production units are then multiplied by their respective unit costs (based on some "master price list" developed by component part number) to determine the associated investment. It should be noted that these "rules" are defined consistent with the technology under review, and should be expected to change from technology to technology, and from vendor to vendor.

Engineering process models are perhaps the most appropriate for the telecommunications industry, since a discrete and well-defined set of standard engineering procedures are undertaken during the network design process. These algorithms and practices, such as the use of Erlang-B or Poisson tables to determine the optimal number of interoffice trunks for a given traffic load and desired grade of service, are readily incorporated into engineering process model equations. Furthermore, the various technology-specific information is also available from manufacturers. The models employed by GTE Telephone Operations and described later in this narrative follow this approach to network services cost development. GTE Telephone Operations utilizes engineering process model techniques to estimate costs. For example, the transport cost models are based on the production functions inherent in DS-1/DS-3 digital transmission facilities that are typically used to provide interoffice trunking, while the switching cost models are based on the production functions inherent in digital stored program control (SPC) switching facilities that are typically used to provide switched network services. The models determine the appropriate input combination (e.g., processors, memory, cable, repeaters, etc.) for producing any given level of output (e.g., call attempts, CCS, circuits), based upon the engineered capacity that is provided to accommodate demand (e.g., ABSBH). The units in which inputs are purchased are called production units. The investment required to purchase each production unit depends upon the type of digital technology involved. Further details for each model are provided in their respective narratives.

The GTE-developed CostMod System is a PC-based, user-friendly, integrated cost development tool that employs various **"Technology Modules"** (e.g., loops, digital stored program control (SPC) switching, digital transport, etc.), along with various complementary **"Application Modules"** (e.g., usage services, vertical services, etc.) to produce "cost models" applicable to a large portion of the GTE Telephone Operations network service spectrum. Development of this system is a multi-phase, long-term endeavor that began several years ago and will continue for some time to come.

The PC CostMod Release 2.0 & 2.1 models, reflecting the GTD-5 EAX digital SPC switching technology (AG Communication Systems) up to and including System Version Release (SVR) 1.6.2.1, represented Phase-I of this evolutionary process. This involved the migration of a mainframe computer program to a PC platform. While this cost model integrated both digital SPC switching and digital transport to determine costs for usage services, it made no provision for the costing of the various special features or "vertical services" (e.g., call waiting, call forwarding, Centrex features, etc.) available with the GTD-5 EAX technology. In response to this need, the CostMod VS model, representing Phase-II of the CostMod System evolution, was designed primarily to assist in the cost development process for these special features available with the GTD-5 EAX digital SPC switching technology under SVR 1.6.3.X.

This cost model is derived from the **"GTD-5 EAX Switching Technology Module"** of the CostMod System, which develops the resource costs (i.e., cost primitives) for each "functionally significant" switching resource category, and the **"GTD-5 EAX Switching**

Application Module" of the CostMod System, which applies the cost primitives to user-input feature-specific traffic data in order to develop the investment associated with individual vertical service features. Release 1.4 of the CostMod VS model includes 380 special features and services available with the GTD-5 EAX digital SPC switching technology under SVR 1.7.1.1. Due to its modular design, the model is easily expanded as new features are developed by the manufacturer and released in future SVRs.

Comparable costs for the DMS-10 and DMS-100F (Northern Telecom), and the 5ESS (AT&T Network Systems) digital SPC switching technologies are developed via the Bellcore "Switching Cost Information System" (SCIS). GTE uses this model under license agreement with Bellcore. This "cost model" comprises the **"DMS-10 Switching Technology Module,"** the **"DMS-100F Switching Technology Module,"** and the **"5ESS Switching Technology Module"** of the CostMod System, which develop the resource costs (i.e., cost primitives) for each "functionally significant" switching resource category, and the **"DMS-10 Switching Application Module,"** the **"DMS-100F Switching Application Module,"** and the **"5ESS Switching Application Module,"** of the CostMod System, which apply the cost primitives to user-input feature-specific traffic data in order to develop the investment associated with individual vertical service features.

Phase-III of the CostMod System evolution incorporated digital transport facilities, local loops, and SS7 network costs via the **"DS-1 Technology Module," "Fiber Optic Technology Module,"** the **"Loop Technology Module,"** and the **"SS7 Technology Module,"** respectively, while Phase-IV reflected usage costs coincident with their respective tariff format via the **"Usage Services Application Module."** This module will provide the capability for a cost analyst to apply different rate structures (e.g., first minute/additional minute, per message/per minute, etc.) to the cost primitives developed in the various technology modules in order to determine the cost for usage services (e.g., local, toll, access). The CostMod System continues to evolve into a world-class costing tool and is widely used in the cost study process by GTE Telephone Operations.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

LOOP TECHNOLOGY MODULE

The **CostMod System "Loop Technology Module"** (Loop Model) is an engineering process model that is used to develop the incremental costs associated with loop facilities. The Loop Model replicates the processes and adheres to the same standards that an engineer would follow in designing and provisioning loops. It employs forward looking technology and includes only those technologies that are currently being installed or those planned for future use. The Loop Model is a flexible costing tool that allows the user to develop costs for either an all copper loop or a copper loop with fiber feeder (i.e., pair gain). Originally designed as a research tool to study loop costs, the model permits the user to easily examine how loop costs vary with length, distribution of plant, and central office size. It is applicable for all switched services as well as for non-switched services (e.g., DDS, voice, or data private lines) that require a loop.

The Loop Model employs GTE standard engineering designs that reflect the configurations and technologies currently being provisioned in the loop. These engineering designs indicate that there are two basic technologies in widespread use. The first technology employs copper cable for both feeder plant and distribution plant. Here, the terms "feeder" and "distribution" are used loosely -- there is no universally acceptable technical definition of the demarcation point between feeder and distribution facilities, particularly in the case where all copper facilities are used. It is generally accepted that feeder cables are larger in size and are engineered to an objective fill level (e.g., 85%) for a specific time frame (e.g., 5 years). Distribution cables, on the other hand, are usually smaller in size and are engineered to their ultimate capacity (i.e., total demand or output for a subdivision).

The second technology is fiber feeder cable to a remote pair gain device with copper cable used for the distribution to the customer. This technology is used for longer loops and to serve pockets of subscribers or remote areas from a centrally located serving wire center. This is one of the few instances where there is a clear demarcation point between feeder and distribution. For switched services, pair gain devices can be either "integrated" (i.e., interface directly with a digital switch at the 1.544 Mb/s level) or "non-integrated" (i.e., interface the switch through a Central Office Terminal - COT). For non-switched (e.g., for Private Line Services) the pair gain device must terminate on a COT.

The Loop Model determines the equipment units and their respective cost as well as the associated engineering and installation labor. The total investment is then divided by the unit capacity to determine the unit cost. For example, a 1,200 pair cable with a unit cost of $10.00 per foot plus engineering labor of $1.00 per foot and installation labor of $2.00 per foot results in a $13.00 per foot total cost. Dividing this by the capacity (i.e., 1,200 pair) yields a cost per pair foot of $.011. The typical loop requires investments for the following items:

1. Cable - copper and/or fiber (depending on design) including aerial, underground, and buried.

2. Customer prernise connections - the equipment which terminates the loop at the customer location (e.g., Drop Cable & Protector).

3. Central Office connectors - the equipment which terminates the loop at the central office (e.g., Main Distribution Frame and Protector).

4. Other equipment - including channel banks, repeaters, cross-connects, multiplexers, pair gain, or any specialized equipment required by the service.

Cable costs are developed based on GTE standard material costs and labor hours, along with jurisdictional specific financial factors. An effort was made to ensure that all significant components, both singularly and in the aggregate, were included in the loop cost. GTE standard labor hours, developed by labor group categories, are multiplied by the appropriate labor rates for the jurisdiction under review to develop a labor cost. The actual mix of cable type and size can be developed in two ways. In one case, the user inputs the loop length, central office size, and the aerial, buried, and underground fraction of plant. From this information, a default loop make-up would be generated, consisting of cable segments by size, type, and length. In the other case, the user directly inputs the loop make-up to be analyzed.

Support equipment such as load coils, conduit, poles, and VF repeaters are added to the loop based upon GTE standard engineering guidelines for the type of plant. Loop length and plant mix are typically developed based upon a sample of loops currently providing the service under study, as an estimate of a prospective loop makeup. For example, if residential lines are being studied, a sample of residential lines would be taken to determine average loop length. This information can then be entered into the model.

Adjustments for capacity utilization (i.e., fill factors) are left to the discretion of the user. The model generates an outside plant network of sufficient size to meet the demand parameters input by the user. Loop Model outputs reflect investment by 6-digit USOA plant account.

COSTMOD VS MODEL
(AGCS GTD-5 EAX Switching Technology/Application Modules)

The CostMod VS model was designed specifically to assist GTE Telephone Operations pricing personnel in the cost development process for the various special features or "vertical services" available with the AGCS GTD-5 EAX digital stored program control (SPC) switching technology under System Version Release (SVR) 1.7.1.1. This cost model is derived from the **"GTD-5 EAX Switching Technology Module" of the CostMod System**, which develops the resource costs (i.e., cost primitives) for each "functionally significant" switching resource category, and the **"GTD-5 EAX Switching Application Module" of the CostMod System**, which applies the cost primitives to user-input feature-specific traffic data in order to develop the investment associated with individual vertical service features. It is similar to the Bellcore-developed "Switching Cost Information System" (SCIS), which develops switching costs for several alternative switching technologies, including the AT&T 5ESS and Northern Telecom DMS-100F. The CostMod VS model is a PC-based, interactive cost development tool that develops the long-run incremental costs (LRIC) for digital SPC switching in a GTD-5 EAX base unit (BU) or remote switching unit (RSU).

Economic theory defines a "production function" as a mathematical representation of a machine or process that uses inherent "economic resources" (e.g., land, labor, material, capital) to produce one or multiple products and/or services. A costing methodology that 1) determines the unit cost of each defined "economic resource," 2) determines what amount of these economic resources are consumed in providing the service, and 3) multiplies these consumed resource units by their respective unit cost to arrive at an extended resource cost is appropriate in the case of special switch features that have been traditionally termed "vertical services." It is appropriate because such a methodology is capable of discretely identifying the costs uniquely attributable to these vertical services.

A GTD-5 EAX digital SPC switching system can be viewed as a specialized computer that provides a variety of telecommunications services by utilizing specific "technical functionalities" that are inherently provided by its hardware and software. These "technical functionalities" may be broadly defined as "service resources" (and the associated unit costs as "cost primitives"), in that each service resource provides a particular functionality, and that groupings of these service resources form the framework for a given network product or service.

Any switched telecommunications service that is provided from a GTD-5 EAX must necessarily be "provisioned" by assigning the appropriate amount of each available service resource. The investment cost function (CF) for such services can be expressed with a single algebraic equation, with variables (X) for each available service resource cost category, as follows:

$$CF(i) = X_1(i) + X_2(i) + X_3(i) + X_4(i) + X_5(i) + \ldots + X_n(i)$$

where $X_n(i) = K_{i,n} * X_n$

= service resource cost
for category (n)
for service (i)

and X_n = service resource unit cost
variable for category (n)

and $K_{i,n}$ = coefficient
for service (i)
and service resource unit cost
variable for catagory (n)

Given that each variable (X_n) will have a unique coefficient ($K_{i,n}$), and that each feature (i) will have a unique set of coefficient values, this equation may be re-written as:

$$CF(i) = A_i * X_1 + B_i * X_2 + C_i * X_3 + D_i * X_4 + E_i * X_5 + \ldots + Z_i * X_n$$

where $A_i = K_{i,1}$

= coefficient
for service (i)
and service resource unit cost
variable for category (1)

and $B_i = K_{i,2}$
and $C_i = K_{i,3}$

and $D_i = K_{i,4}$

...

and $Z_i = K_{i,n}$

Thus, we have a single cost function (CF) and (i) sets (A_i, B_i, etc.) of feature-specific resource coefficients. This fundamental concept was central to the creation of the feature-specific "coefficient data records" that are employed in the CostMod VS model.

The approach used in the CostMod VS model is two-fold. In the **"GTD-5 EAX Switching Technology Module,"** the GTD-5 EAX base unit and remote switching unit equipment is "partitioned" or "classified" into one of several "resource categories" and is then sized based on user-input central office data (e.g., lines, trunks, busy hour traffic). Investment is derived by multiplying the resultant sized equipment quantities by the manufacturer's (AG Communication Systems Corporation) price, by component. Finally, the investment cost is divided by the appropriate quantity of each resource to arrive at a unit resource cost (i.e., cost primitive) for each of the major cost categories, including line terminations, network path CCS, and processor milliseconds.

This process applies to both hardware and software, and is tailored specifically to reflect the mix of traffic (i.e., POTS and vertical services) switched within the particular central office(s) under study. It is important to note that the "composite" office may reflect either an actual central office location, or some hypothetical "representative" example.

Having developed the cost primitives for each service resource via the **"GTD-5 EAX Switching Technology Module,"** the next step is to determine what amounts of the service resource units are necessary to provide a given feature. In the **"GTD-5 EAX Switching Application Module,"** user-input feature-specific central office data (e.g., lines, traffic) are used to determine the amount of switching resources required to provide the feature selected for cost development.

For example, the "Call Forwarding - Fixed" feature cost includes the central processor (TPC) time, in milliseconds, required to execute the series of binary software instructions associated with completing a call forwarding attempt. This "real time" is developed by the manufacturer and is provided to GTE Telephone Operations under strict nondisclosure guidelines as part of various support agreements for the GTD-5 EAX digital SPC switching technology. Assuming that the time for this special feature "event" is 65 milliseconds, assuming that the unit cost for this service resource (developed in and passed from the **"GTD-5 EAX Switching Technology Module"**) is $0.15 per millisecond, and also assuming that the feature-specific traffic data input by the user is 1.00 busy hour call attempt per feature line, then (for illustrative purposes) the cost for this "event" is given by 1.00 * 65 * $0.15 = $9.75. Similarly, the remaining service resource units (e.g., line terminations, line path CCS, trunk path CCS, TCU/RCU milliseconds, Right-To-Use (RTU) fees, memory words, special hardware, etc.) are determined and multiplied by their respective unit costs.

With certain exceptions (noted in the feature-specific documentation), all costs that are output from the **"GTD-5 EAX Switching Application Module"** are "per feature line" costs. All feature-specific "getting-started" Right-To-Use fees are reported at the bottom of the **"GTD-5 EAX Switching Application Module"** output screen as "excluded" from the cost analysis. This allows the user to decide the appropriateness, application, and cost recovery of these software costs. Release 1.4 of the CostMod VS model includes 380 special features and services available with the GTD-5 EAX digital SPC switching technology under SVR 1.7.1.1. Due to its modular design, the model is easily expanded as new features are developed by the manufacturer and released in future SVRs.

The **"GTD-5 EAX Switching Technology Module"** of the CostMod System has been benchmarked against the manufacturer's CASE-5 ("Computer-Aided Systems Engineering for the GTD-5 EAX") program used by GTE Telephone Operations engineering personnel to size and order GTD-5 EAX switching equipment. Using a variety of central office configurations, identical input parameters were passed through both models. During the development process the engineering equations were refined until the **"GTD-5 EAX Switching Technology Module"** matched the manufacturer's model within a plus or minus two percent variance for total investment. In most cases, this variance was less than one percent. Furthermore, the CostMod VS methodology was presented to and reviewed by the manufacturer. AGCS Technical Standards & Support personnel found that "the methodology reflected in the CostMod VS model represents a reasonable and relatively accurate approach to GTD-5 EAX special features costing."

The CostMod VS model is an effective cost development tool that affords the user flexibility and ease-of-use. It follows generally accepted telecommunications industry costing methods, and determines the costs for a wide variety of GTD-5 EAX switched services and special features. The model has been reconciled with the manufacturer's engineering model, and has met all targeted acceptable tolerances. It is anticipated that the CostMod VS model, along with the Bellcore SCIS model, will be widely used to support future GTE Telephone Operations tariff filings and regulatory requirements.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

BELLCORE SCIS MODEL
(NTI DMS-10 Switching Technology/Application Modules)
(NTI DMS-100F Switching Technology/Application Modules)
(AT&T 5ESS Switching Technology/Application Modules)

The Bell Communications Research (Bellcore) "Switching Cost Information System" (SCIS) was designed specifically to assist telephone company personnel in the cost development process for switched network services available with several popular switching technologies. It may also be employed in the cost development process for basic usage and switched access services. The model reflects the cost of digital, stored program control (SPC) switching facilities (e.g., AT&T 5ESS, NTI DMS-10, and NTI DMS-100F) that are employed by GTE to provide growth in central office based, switched network services. The model is typically used to develop the long-run incremental costs for such GTE tariffed services as CentraNet® and Smart Call® features, in addition to local, toll, and switched access services.

SCIS is a PC-based, interactive cost development tool that develops the long-run incremental costs for digital switching equipment manufactured and sold by various vendors, including AT&T Network Systems and Northern Telecom. The model determines the required equipment combination (e.g., mounting frames, line cards, central processors, memory and interface cards, etc.) and associated investment for producing at a given level of output, assuming that the engineered capacity is provided to accommodate demand in the busy hour. Each then divides this investment by its associated units to determine unit LRIC. This cost model comprises the **"DMS-10 Switching Technology Module," the "DMS-100F Switching Technology Module," and the "5ESS Switching Technology Module" of the CostMod System**, which develop the resource costs (i.e., cost primitives) for each "functionally significant" switching resource category, and the **"DMS-10 Switching Application Module," the "DMS-100F Switching Application Module," and the "5ESS Switching Application Module," of the CostMod System**, which apply the cost primitives to user-input feature-specific traffic data in order to develop the investment associated with individual vertical service features.

Economic theory typically defines a "production function" as a mathematical representation of a machine or process that uses its inherent "economic resources" (i.e., land, labor, material, and capital) to produce one or multiple products and/or services. A costing methodology that: 1) determines the unit cost of each defined economic resource, 2) determines what amount of these economic resources are consumed in providing the service, and 3) multiplies these consumed economic resource units by their respective unit cost to arrive at an extended resource cost is appropriate in the case of central office based, switched network services and special switched features that have been traditionally termed "vertical services." It is appropriate because such a methodology is capable of discretely identifying the costs uniquely attributable to such services, which is a necessary attribute of a valid incremental cost study. This allows the proper application of cost causation principles in the study.

A digital SPC switching system can be viewed as a specialized computer that provides a variety of telecommunications services by utilizing specific "production units" or "cost primitives" that are inherently provided by its hardware and software. These "cost primitives" may be viewed as "economic resources," in that each cost primitive provides a particular functionality, and that groups of these cost primitives form the framework for the functionality of a particular service. With this concept in mind, it follows that any switched telecommunications service that is provided from a digital SPC switch must necessarily be "provisioned" by assigning the appropriate amount of each available cost primitive. The cost for such services can be expressed with a single equation, with variables for each cost primitive category, representing the amount of switch resources consumed by a given switched service or feature.

The costing approach employed in SCIS is two-fold. The first step in the process is to develop the appropriate unit costs in the "Model Office" (i.e., **"DMS-10 Switching Technology Module," "DMS-100F Switching Technology Module,"** or **"5ESS Switching Technology Module"**). Inputs to this module (i.e., "SCIS/MO") include lines and trunks, their associated traffic information, and standard central office parameters. Outputs from this module include the unit cost for lines and trunks, network path centum call seconds (CCS), processor milliseconds, memory words, SS7 octets, and Automatic Message Accounting (AMA) records. Once these unit costs are developed, the second step in the process is to integrate them with feature-specific information in the "Features Module" (i.e., **"DMS-10 Switching Application Module," "DMS-100F Switching Application Module,"** or **"5ESS Switching Application Module"**). This module (i.e., "SCIS/IN") has been given additional functionality in order to reflect the new features associated with the SS7 "intelligent network," hence the name. Inputs to SCIS/IN include feature lines, their associated traffic information, and standard feature parameters, in addition to SCIS Model Office outputs and costs associated with the external SS7 network (e.g., STPs, signaling links, etc.). Outputs from SCIS/IN include the cost of the switch resources used by the feature, plus any feature-specific hardware or software. This resultant output illustrates the cost (i.e., busy hour investment) for the given feature. The same approach is used to determine the cost for basic usage and switched access services, albeit not necessarily within SCIS/IN.

The Bellcore Switching Cost Information System (SCIS/MO and SCIS/IN) is an effective cost development tool that affords the user flexibility and ease-of-use. Furthermore, it follows generally accepted telecommunications industry incremental costing methods, and determines long-run incremental costs for a wide variety of digital SPC switched services and special features. The model has been reconciled with the vendor's engineering model (e.g., 5-DOPS for the 5ESS, and NT-ACCESS for the DMS-100F), and has (favorably) exceeded all targeted acceptable tolerances. It is anticipated that SCIS will continue to be widely used in support of GTE Telephone Operations management studies, tariff filings, and regulatory requirements.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

FIBER OPTIC TECHNOLOGY MODULE

The **CostMod System "Fiber Optic Technology Module"** (FO Model) is an engineering process model that can be used to develop the investment required to provide digital fiber optic transport facilities between central offices or from a customer to a central office. The model replicates the processes and standards that an engineer would follow to provide fiber optic service between two points. GTE standards for protection, fiber cable, fiber terminals, and engineering and installation hours along with GTE net material costs are used by the model to develop the investments on a DS-3/STS-1 (672 channels), DS-1 (24 channels), or DS-0 (individual channel) level. The investment provided by the FO Model includes the cost of fiber cable, fiber optic terminals, fiber distribution panels, DSX-3 or STS-1 cross-connects, regenerators, and DSX-1 and M1-3/STS-1 multiplexing when required. The GTE standard protection arrangement for all fiber systems is 1 for 1 (i.e., one stand-by DS-3 for each working DS-3 and stand-by transmit and receive fibers). The FO Model provides costs for standard DS-2 and DS-3 transmission systems as well as Synchronous Optical Network (SONET) technologies. The user may select fiber cables that range in size from four fibers to ninety-six fibers and system sizes (i.e., terminal bandwidth) that range from 6.3 M/bs to 1.13 G/bs.

Jurisdictional specific labor rates, material loading factors, utilization factors, outside plant support factor, facility distance, and the route-to-air mile factor must be provided by the user.

The output reports from the FO Model display the costs for the total system (i.e., fiber plus electronics on both ends); the cost expressed on a per DS-3 basis, the costs on a per DS-1 basis, and the cost per DS-0. If the interoffice transport option is selected, the model will provide a summary report in FCC Tariff format at the DS-1 and DS-0 level.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

SIGNALING SYSTEM 7 (SS7) TECHNOLOGY MODULE

The **CostMod System "SS7 Technology Module"** (SS7 Model) is used to determine the investments and expenses associated with busy hour usage on GTE's SS7 Network. The SS7 Model is an engineering process model that replicates GTE's SS7 Network for the area under study. The model develops the hardware investments and software expenses for Signal Transfer Points (STP) and Signal Control Points (SCP). The STP and SCP investments and expenses are expressed on a per octet basis so that they may be applied to any service that uses the SS7 network. Additionally, the SS7 Model converts the expenses associated with the leasing of facilities that carry the SS7 signaling links to a per octet basis.

The basic methodology employed by the SS7 Model is to determine the respective STP and SCP busy hour investments and expenses and to convert them into a cost per octet. This is accomplished by determining the network configuration for the area under study and then developing the costs associated with the Local and/or Regional STP. The SCP investment and expenses are developed in the same manner.

The only input variables required for the model are the expenses associated with the SS7 signaling links and appropriate utilization factors for SCP storage and SS7 signaling links.

Outputs from the SS7 Module include the busy hour investments and expenses expressed on a per octet basis for the local and/or region STP and SCP. The SS7 signaling link busy hour expenses are also expressed on a per octet basis.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

USAGE SERVICES APPLICATION MODULE

The **CostMod System "Usage Services Application Module"** (USAM) is used to convert the investments associated with busy hour usage in digital stored-program control (SPC) switching equipment and digital fiber optic transmission facilities into a cost per call and per minute of use by time of day, by distance, for usage and access services. The USAM is applicable for the AT&T 5ESS, NTI DMS-10, NTI DMS-100F, and AGCS GTD-5 EAX digital SPC switching technologies.

The basic methodology employed by the USAM is to convert the various switching technology module developed cost primitives expressed as busy hour hardware and software investments into investments per call attempt and per minute of use. The annual cost factors for the appropriate USOA accounts are then applied to the hardware and software investments to convert them to a cost per call or minute of use.

The USAM input variables for the DMS-10, DMS-100F, and 5ESS switching investments include the cost primitives (e.g., cost per millisecond, cost per line CCS, cost per trunk CCS, etc.) developed by the Bellcore "Switching Cost Information System" (SCIS) Model Office Studies (i.e., **"DMS-10 Switching Technology Module," "DMS-100F Switching Technology Module,"** and **"5ESS Switching Technology Module"** of the CostMod System). The input variables for the GTD-5 EAX switching investments are the equivalent cost primitives developed by the CostMod System **"GTD-5 EAX Switching Technology Module"** Composite Office Study.

The interoffice transport investment inputs include the cost primitives (e.g., cost per DS-1 mile, cost per DS-1 termination, etc.) developed by the CostMod System **"Fiber Optic Technology Module"** (i.e., FO Model). The investments from the FO Model and the CCS per trunk that was used in the respective switching cost technology module, are used by the USAM to determine the interoffice transport costs.

The USAM inputs for Signaling System 7 (SS7) investments are developed by the CostMod System **"SS7 Technology Module"** and the appropriate switching cost technology module.

GTE TELEPHONE OPERATIONS

COSTMOD System (including SCIS)

The USAM outputs for basic usage services (e.g., for local, toll, EAS and Switched Access services) are expressed as a cost per call type (e.g., intraoffice, incoming, outgoing, or tandem) and per minute of use. If required, Automatic Message Accounting (AMA) costs for both access and basic services are expressed on a per call basis.

The costs for interoffice transport are expressed on a per end (termination) per minute of use, per mile, and per mile per minute of use basis. SS7 costs are expressed as a cost per interoffice call.

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

A. **Network Access (NA) Channel** - The subcategory of BNFs that provides the bandwidth specific transmission path between the point of interface at the customer's location and the main distribution frame or equivalent (i.e., DSX-1, DSX-3) at the customer's serving central office.

1. NA Channel Basic Level: A 2-wire transmission path that provides a maximum of 64 kilobits per second digital capacity. This includes 300 to 3,000 Hz analog voice service, which is the basic channel for most voice grade services such as basic residence and business main line service, PBX trunks, Centrex type access lines and voice grade private line service.[1]

   Each BNF consists of a Basic Level 2-Wire NA Channel for a particular NA Channel distance, for a particular office size and for a particular NA Channel density.

2. NA Channel DS-1 Level: A transmission path that has 1.544 Mbps digital capability. A high capacity transmission facility that operates in a full duplex, time division (digital) multiplexing mode. This is the first level (primary rate) within the "T" Carrier system. DS-1 service provides transmission of 193 bit frames at a rate of 8,000 frames per second to yield 1.544 Mbps.

   Each BNF consists of a NA Channel DS-1 Level for a particular system size, for a particular distance.

3. NA Channel DS-3 Level: A transmission path that has 45 Mbps digital capability. A high capacity transmission facility that operates in a full duplex, time division (digital) multiplexing mode. This is the third level within the "T" Carrier system. A DS-3 provides the equivalent of 28 DS-1s or 672 basic channels.

   Each BNF consists of a NA Channel DS-3 Level for a particular system size, for a particular distance.

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[1] Additional BNF costs are addressed under "NA Channel Connection - Performance and Other Features and Functions."

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

B. **NA Channel Connection** - The subcategory of BNFs that provide the interface between the NA Channel, the central office switching equipment, another NA Channel or a Dedicated Transport interoffice transmission path.

1. NA Channel Connection Basic Level: This is the interface between a NA Channel Basic Level and, (a) any other NA Channel Basic Level, (b) a basic analog transport path or, (c) a NA Channel Connection Basic Analog Level - Switch Interface (line) to the switch architecture.[2]

2. NA Channel Connection DS-1 Level: This is the interface between a NA Channel DS-1 Level and, (a) any other NA Channel DS-1 Level, (b) a DS-1 transport path or, (c) a NA Channel Connection DS-1 Level - Switch Interface to the switch architecture.

3. NA Channel Connection DS-3 Level: This is the interface between a NA Channel DS-3 Level and, (a) any other NA Channel DS-3 Level or, (b) a DS-3 transport path.

4. NA Channel Connection Basic Analog Level - Switch Interface: This is the analog interface to the switch architecture. The Standard line interface supports most services (e.g., residence, business, CentraNet®).

C. **NA Channel Connection - Performance and Other Features and Functions**[3] - The subcategory of BNFs that provide the necessary multiplexing required for interoffice transport from one digital Network Access Channel to another.

1. Voice Grade to/from DS-1 Multiplexing: This BNF allows the combining of 24 individual voice grade or equivalent channels into a single DS-1 (1.544 Mbps) signal or the provision of 24 individual voice grade or equivalent channels from a single DS-1 (1.544 Mbps) signal.

2. DS-1 to/from DS-3 Multiplexing: This BNF allows the combining of 28 discreet DS-1 (1.544 Mbps) signals into a single DS-3 (45 Mbps) signal or the provision of 28 discreet DS-1 (1.544 Mbps) signals from a single DS-3 (45 Mbps) signal.

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[2] (e.g., ISDN, Special Access, Private Line)

[3] This BNF subcategory also addresses equipment components which are used in conjunction with a NA Channel Basic Level to meet the quality or utility of specific private line or special access services. These unique service-specific, engineering requirements are typically addressed in conjunction with private line service cost studies.

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

D. **Interoffice Switching** - The establishment of a temporary path through the switch architecture for outgoing, incoming or tandem switching.

(a) Interoffice Switching - Outgoing: The establishment of a temporary transmission path between a NA Channel Connection Switch (line) Interface and a Switched Transport path (i.e., a line-to-trunk call or minute).

Each BNF consists of an: (a) outgoing switching call setup, by time-of-day (TOD), and (b) outgoing switching minutes-of-use (MOU), by TOD.

2. Interoffice Switching - Incoming: The establishment of a temporary transmission path between a Switched Transport path and a NA Channel Connection Switch (line) Interface (i.e., a trunk-to-line call or minute).

Each BNF consists of an: (a) incoming switching call setup, by TOD and (b) incoming switching MOU, by TOD.

3. Interoffice Switching - Tandem: The establishment of a temporary transmission path between two Switched Transport paths (i.e., a trunk-to-trunk call or minute).

Each BNF consists of a: (a) tandem call setup, by TOD, and (b) tandem MOU, by TOD.

E. **Intraoffice Switching** - The establishment of a temporary transmission path through the switch architecture between two NA Channel Connection Switch (line) Interfaces (i.e., a line-to-line call or minute).

Each BNF consists of an: (a) intraoffice call setup, by TOD and (b) intraoffice MOU, by TOD.

F. **Switch Features** - The category of BNFs that provides additional switched functionality to other BNFs or finished services (e.g. custom calling).

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

G. **Dedicated Transport -** A full period bandwidth specific interoffice transmission path between switching offices and/or serving wire centers.

1. Dedicated Transport Basic Level: A full period Basic Level interoffice transmission path between switching offices and/or serving wire centers.

   Each BNF consists of a basic level interoffice transmission path, for a particular distance (e.g., 1, 2, ... miles), for a particular system size. Termination and facility costs are separately identified.

2. Dedicated Transport DS-1 Level: A full period DS-1 interoffice transmission path between switching offices and/or serving wire centers.

   Each BNF consists of a DS-1 interoffice transmission path, for a particular distance (e.g., 1, 2, ... miles), for a particular system size. Termination and facility costs are separately identified.

3. Dedicated Transport DS-3 Level: A full period DS-3 interoffice transmission path between switching offices and/or serving wire centers.

   Each BNF consists of a DS-3 interoffice transmission path, for a particular distance (e.g., 1, 2, ... miles), for a particular system size. Termination and facility costs are separately identified.

H. **Switched Transport -** A temporary duration sensitive interoffice transmission path between switching offices.

Each BNF consists of a basic level interoffice transmission path, for call setup and MOU by time-of-day, for a particular distance (e.g., 1, 2, ... miles), for a particular system size. Termination and facility costs are separately identified.

I. **Network Interface Device (NID)** - The subcategory of BNFs that provide a termination for a single line or circuit. This device provides the point of separation between the end-user customer and the provider's network. The NID includes connection points for the provider and the end-user customer, and also provides a protective ground connection. The connection points are capable of terminating cables such as twisted pair cable.

Each BNF consists of a device for one or more two-wire connection points.

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

J. The **Signaling System Seven (SS7)** network is the subcategory of BNFs that provides an internationally standard-purpose Common Channel Signaling (CCS) system. The SS7 network is a dedicated digital network used for telephone call setup and control. Each signaling point is uniquely identified by a numeric point code. Point codes are carried in signaling messages exchanged between signaling points to identify the source and destination of each message. The signaling point uses a routing table to select the appropriate signaling path for each message.

There are three kinds of signaling points, and three data links in the SS7 network:

1 Service Switching Points (SSPs) are stored program controlled switches that originate, terminate or tandem calls.

SSP BNFs are included in the switching BNFs for interoffice calls.

2. Signal Transfer Points (STPs) route network traffic between signaling points. An STP routes each incoming message to an outgoing signaling link based on routing information contained in the SS7 message.

STP BNFs consist of the STP Ports which are the interface to the SS7 network.

3. Service Control Point (SCP) are database repositories which provide routing information.

SCP BNFs consist of a Standard Query or Octet.

4. Data Links are 56 Kbps connections between STPs and between an SSP and an STP.

Each BNF consists of a four-wire loop supported by 56 Kbps circuit equipment.

GTE TELEPHONE OPERATIONS

BASIC NETWORK FUNCTION (BNF) DEFINITIONS

APPENDIX 2.6 TO PREFACE 1

ORIGINAL
FILE COPY

GTE

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January 24, 1997

Re: Docket No. 961537-TP
Petition by American Communications Services, Inc., and its local exchange operating subsidiaries, for Arbitration with GTE Florida Incorporated pursuant to the Telecommunications Act of 1996

Dear Ms. Bayo:

Please find enclosed for filing an original and fifteen copies of the direct testimony of Kirby D. Cantrell, Michael J. Doane, Gregory M. Duncan, Donald W. McLeod, Beverly Y. Menard, William E. Munsell, Bert I. Steele, and Dennis B. Trimble on behalf of GTE Florida Incorporated in the above matter. Service has been made as indicated on the Certificate of Service. If there are any questions regarding this matter, please contact me at (813) 483-2615.

Very truly yours,

Cantrell - 00930-97
Doane - 00931-97
Duncan - 00932-97
McLeod - 00933-97
Menard - 00934-97
Munsell - 00935-97
Steel - 00936-97
Trimble 00937-97

Anthony P. Gillman
APG:tas
Enclosures

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that copies of the direct testimony of Kirby D. Cantrell, Michael J. Doane, Gregory M. Duncan, Donald W. McLeod, Beverly Y. Menard, William E. Munsell, Bert I. Steele, and Dennis B. Trimble on behalf of GTE Florida Incorporated in Docket No. 961537-TP were sent via overnight delivery on January 23, 1997, to the parties listed below.

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