Currie – Attachment B

Description of Unbundled Network Element Cost Studies

Ameritech Ohio

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1.0 Introduction

1.1 Purpose of this Document

The purpose of this document is to describe the studies performed by Ameritech Ohio to determine the costs of providing unbundled network elements (UNEs) in compliance with the Federal Communications Commission (FCC) order in CC Docket No. 96-98.[1] A network element is "a facility or equipment used in the provision of a telecommunications service."[2] Costs determined in these studies are used in establishing proposed unbundled network element prices. This document describes the study methods, models, input data and results.

1.2 Cost Study Requirements

According to the Final Rules of the FCC Order, "An incumbent LEC must prove to the state commission that the rates for each element it offers do not exceed the forward-looking economic cost per unit of providing the element, using a cost study that complies with the methodology set forth in this section and 51.511 of this part." (Page B-30 - B-31, Appendix B of Order.)

The FCC defined *forward-looking economic costs* as the sum of *total element long-run incremental costs (TELRIC)*, plus a reasonable allocation of *forward-looking common costs*. The Order calls for local exchange carriers to develop cost studies that compute TELRICs for network elements, forward-looking common costs and a reasonable allocation scheme for common costs.

In specifying the costing methodology for TELRIC, the FCC laid out the following conditions for cost studies.

- *Efficient network configuration*. Studies are to reflect forward-looking, efficient network technologies and configurations recognizing existing wire center locations.
- *Forward-looking cost of capital*. Capital costs are to reflect the costs of debt and equity anticipated in the future.
- *Depreciation rates*. Depreciation expense is to be based on economic depreciation rates and the economic lives of telephone plant.

Forward-looking common costs are to reflect costs efficiently incurred in providing a group of elements or services and are to exclude retail costs.

The FCC ordered that certain factors not be considered in network element cost studies. These included embedded costs, retail costs and opportunity costs, as well as revenues to subsidize other services. These are the broad requirements specified by the FCC for cost studies. *Ameritech Ohio's unbundled network element cost studies described in this document satisfy these requirements.*

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[1] CC Docket No. 96-98, "In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996," August 8, 1996.

[2] Page B-10, Final Rules, Appendix B of the FCC Order.

1.3 Overview of Study Process

The Ameritech Ohio cost study process has evolved over many years. Its primary purpose has been to determine the costs of offering new and existing services in order to set tariffed rates. The cost methodology used in such studies determines long-run service incremental cost or LRSIC of individual services. The LRSIC for a service represents the forward-looking economic cost for a new or existing service based on its total quantity demanded. This direct or product-specific cost provides a price floor for the service. The LRSIC for a service does not include costs that are shared or common to other services or network elements. Shared and common cost must be recovered by prices that exceed LRSIC.

The existing cost study process has been adapted to compute the costs of unbundled network elements consistent with the FCC requirements in CC Docket 96-98. For example, incremental costs are computed for the total demand of network elements, rather than an increment of the element. The study process also is modified to exclude certain operating expenses related to the retail marketing of services which would not apply to unbundled network elements.

However, many aspects of the study process remain the same.

- *Set of Cost Models*. Cost studies are performed using several cost models. Models such as Ameritech Facility Analysis Model (AFAM) and the Switching Cost Information System (SCIS) were used to compute the capital investment required to construct local loop facilities and switching systems, respectively.[3] Another model, the Network Cost Analysis Tool or NCAT, was used to compute the per minute and per message costs for routing different types of calls through Ameritech Ohio's switched network.[4] The Economic Cost of Network Services/Capital Cost Model or ECONS/CAPCOST is used to compute the annual or monthly costs for a given investment dollar amount. The annual cost includes costs for depreciation, the cost of money and income taxes associated with the investment as well as costs for maintenance and ad valorem expenses. In addition to these "standard" cost models, cost analysts develop worksheets, tables and other costing tools as part of the costing process.
- *Team of Cost Analysts and Subject Matter Experts*. The cost study process involves cost analysts with specialties in network cost analysis, capital cost development and other aspects of the studies. In addition, the studies require input from subject matter experts (SMEs) in marketing, engineering and operations. The team approach provides more realistic and more accurate estimates of costs.
- *Real Network Characteristics*. Cost studies are "forward-looking" in the sense that they calculate the cost to provide unbundled network elements using the latest plant technology for local loop facilities, switching, and other elements of the network. At the same time, the studies reflect relevant aspects of the existing network, such as locations of central offices and customer premises, traffic characteristics, and others. Based on these characteristics which determine the network today and influence it in the future, the studies calculate the plant investment and operating costs which would be expected using forward-looking technologies to satisfy the demand for network elements.

[3] The Ameritech Regional Partners in Provisioning Switching Model (ARPSM) was used to compute the capital investment required for switching systems in the ULS - Shared Transport Cost Study.
[4] The Network Usage Cost Analysis Tool (NUCAT) was used to develop the usage and transport costs in the ULS – Shared Transport Cost Study.

- *Forward-Looking Cost Data*. Along with using forward-looking plant technologies, the studies use plant cost data (vendor prices, labor costs, etc.), capital cost factors and operating expenses which are reflective of these forward-looking technologies.
- *Quality Assurance*. Finally, an important part of the cost study process is "quality assurance." Studies are reviewed several times for accuracy to ensure consistency in the application of costing methods, cost data, and completeness. In addition, the compliance studies in Case No. 96-922-TP-UNC were extensive reviewed by participants in that proceeding.

2.0 General Study Approach

2.1 The Cost Question

In calculating an unbundled network element cost, the cost analyst answers the following question:

> *What are the forward-looking, long run incremental costs for a network element recognizing Ameritech Ohio's existing network and using forward-looking, efficient technologies, with network maintenance and operations reflecting these technologies?*

The cost analyst calculates the cost to provide an unbundled local loop, a minute of use on a local switch or other network element, not based on existing plant, investment and operating expenses, but rather using forward-looking design for local loop facilities, all digital switching, and other plant.

The cost analyst computes these forward-looking plant costs reflecting current vendor prices and discounts for equipment, current engineering and labor costs, etc. Plant maintenance and other operations reflect systems and procedures associated with these forward-looking technologies. In summary, unbundled network element costs reflect a forward-looking network operation designed to satisfy total demand, yet reflective of the way the network has evolved, particularly with regard to wire center locations.

Costs computed in this way are referred to TELRIC. It is important to recognize that TELRIC is a special case of incremental costs. Incremental costs typically reflect differences in future plant costs and operating expenses due to relatively small differences in demand caused by introducing a new service or changing an existing service offering. TELRIC is the incremental cost of the total demand for a network element.

2.2 Study Flow

The plant investment required to provide a network element consists of several (perhaps many) plant components. For example, the plant necessary for an unbundled local loop consists of parts of the main distributing frame in the central office, distribution and feeder cables, feeder-distribution interfaces, premises terminating equipment and others. Plant investments are computed for each component reflecting the forward looking, least cost mix of equipment used to provide the component, appropriate equipment quantities, vendor prices, capitalized engineering and labor costs, support assets (such as power equipment and buildings) and others.

In the first step, plant investments per unit of a network element are computed by dividing the plant investment necessary for each component by its *expected capacity utilization*. Expected capacity utilization is simply the *physical capacity* of the plant component divided by its *fill factor* or *utilization*. This gives a measure of the amount of investment which would be required (using forward-looking technologies) to provide a network element.

In the second step, *annual or monthly costs* are calculated. These include *depreciation expense* for the recovery of plant investment over its service life, a return requirement or *cost of money* associated with investor-supplied capital used to construct the plant, and an *income tax* obligation associated with the equity portion of the cost of money. Ameritech Ohio uses the ECONS/CAPCOST model to perform the capital cost calculations.

Network element costs also include *recurring operating expenses* associated with the maintenance of plant and other operating or ad valorem taxes. Operating expenses are computed using various expense factors that are unique to each type of plant, recognizing different levels of maintenance and network administration necessary for different plant types. Network element costs then are the sum of the recurring capital costs and operating expenses associated with the plant required to provide the network element.

In Sections 3–6, the development of costs for unbundled loop, unbundled local and tandem switching, reciprocal compensation, and unbundled transport cost studies are described. The same general approach for computing network element costs is followed, although the study methods and procedures are adapted to the specific requirements of each study. Section 7 provides an overview of the development of other network element costs.

3.0 Unbundled Loop Costs

3.1 Study Purpose

The Unbundled Loop Cost Study calculates the cost to Ameritech Ohio to provide an unbundled loop assuming a local network based on forward-looking plant technologies and costs of plant construction. A loop consists of the telephone plant from the *network interface device* at a customer's premises to the serving central office of Ameritech Ohio. Loop costs are calculated for the following types of loops.

- *8dB POTS Loop*. A basic "two-wire" loop suitable for regular voice telephone service. Costs also are calculated for a four-wire loop.
- *Basic Rate Interface (BRI) Loop*. An Integrated Services Digital Network (ISDN) loop.
- *DS1 Loop*. A transmission path from the customer premises to the serving wire center capable of conveying digital signals of 1.544 megabits per second.
- *Ground* Start Loop. A two-wire loop suitable for PBX ground start trunks.
- *Electronic* Key Loop. A two-wire loop that also provides for the transmission of additional information in the 8 Khz range.

- *ADSL* 2 Wire Loop. A two wire 640 Kbps ADSL compatible loop.
- HDSL 2/4 Wire Loop. A two wire 768 Kbps or four wire 1.544 Mbps HDSL compatible loop.

For each type of loop, costs are computed for three geographic access areas based on access lines per square mile. Loop costs vary among the geographic access areas due to differences in loop length, cable mixes and sizes, and other factors that vary among the access areas.

Loop costs are expressed as a *recurring monthly cost* which includes capital costs (depreciation, the cost of money and income taxes) and operating expenses for ongoing plant maintenance and ad valorem taxes. Non-recurring costs are computed for the activities necessary to order and provision unbundled loops, which are found in the Nonrecurring Costs for Service Ordering and Line Connection Cost Study.

In this document, the calculation of 8dB two-wire POTS loop cost is described, as well as the non-recurring provisioning costs for the 8dB loop. For details on the calculations for other loop costs refer to the Unbundled Loops Cost Study provided in the TELRIC Case.

3.2 Loop Components

An 8dB POTS loop includes Ameritech Ohio plant from the customer premises, through distribution and feeder cable facilities, to the main distributing frame in the serving central office. The network components of an 8dB POTS loop are described below.

- *NID, Drop Cable and Terminal*. The network interface device (NID), drop cable and terminal provide the transmission path from the last cable splice in the outside plant network to the customer's premises.
- *Distribution Cable*. Copper cable running from the feeder-distribution or serving area interface (SAI) to the terminal located near the customer's premises. The SAI is the "cross-connection" point between the feeder cable from the serving central office and the distribution cable. A mix of aerial, buried and underground non-loaded copper cables is used in the study. The cable mix varies by geographic access area. Pole and conduit investment to support distribution cable is also included in the loop cost calculation.
- *Digital Loop Carrier (DLC) System*. When loop feeder cable lengths exceed a certain distance threshold or the number of working lines in the feeder cable exceeds a size threshold for shorter cable lengths exceeding a minimum distance threshold, fiber feeder cable and digital loop carrier systems are used in the cost study as the most efficient loop design. The DLC system requires circuit equipment located in the field and at the central office as well. The DLC equipment provides multiplexing of voice channels over the fiber cable between the serving central office and the SAI. The study assumes multiple DLC system sizes. The amount of DLC investment per loop depends upon the frequency of fiber versus copper feeder, system size and expected utilization of the system (fill factor).
- *Feeder Cable*. Copper or fiber cable running from the serving central office to the SAI or remote DLC terminal. The cost study reflects a mix of copper and fiber aerial, buried and underground cables depending upon the geographic access area and overall loop length. As with distribution cable, pole and conduit plant investment is included in the loop cost calculation.

- *Main Distribution Frame*. Equipment located in the serving central office where the individual unbundled loops terminate. Includes a protector unit for loops served by copper feeder.

3.3 Study Flow - Recurring Monthly Costs

As described earlier, loop costs include the *recurring monthly costs* Ameritech Ohio incurs in providing loops and the *non-recurring costs* to order and provision the loop. In this section, the study flow for computing recurring monthly costs is described. AFAM is used to develop investments, by cable and equipment accounts, for the feeder, distribution, and drop portions of the loop using forward-looking designs and technologies. The capital investments produced by AFAM, along with other investments to complete the loop, are then converted to monthly costs using appropriate annual charge factors developed by the Economic Costs of Network Facilities/Capital Costs (ECONS/CAPCOST) model.

AFAM uses information from Ameritech's existing loop network and converts it into a forward-looking design by modeling Network's engineering practices as closely as possible. It takes a snapshot in time and builds a new/optimal network based on forward-looking technologies and guidelines.

Diagram 1 shows the components involved in an unbundled loop and defines which components are calculated in AFAM and which network components are added later on to complete the loop cost study.

Unbundled Loop

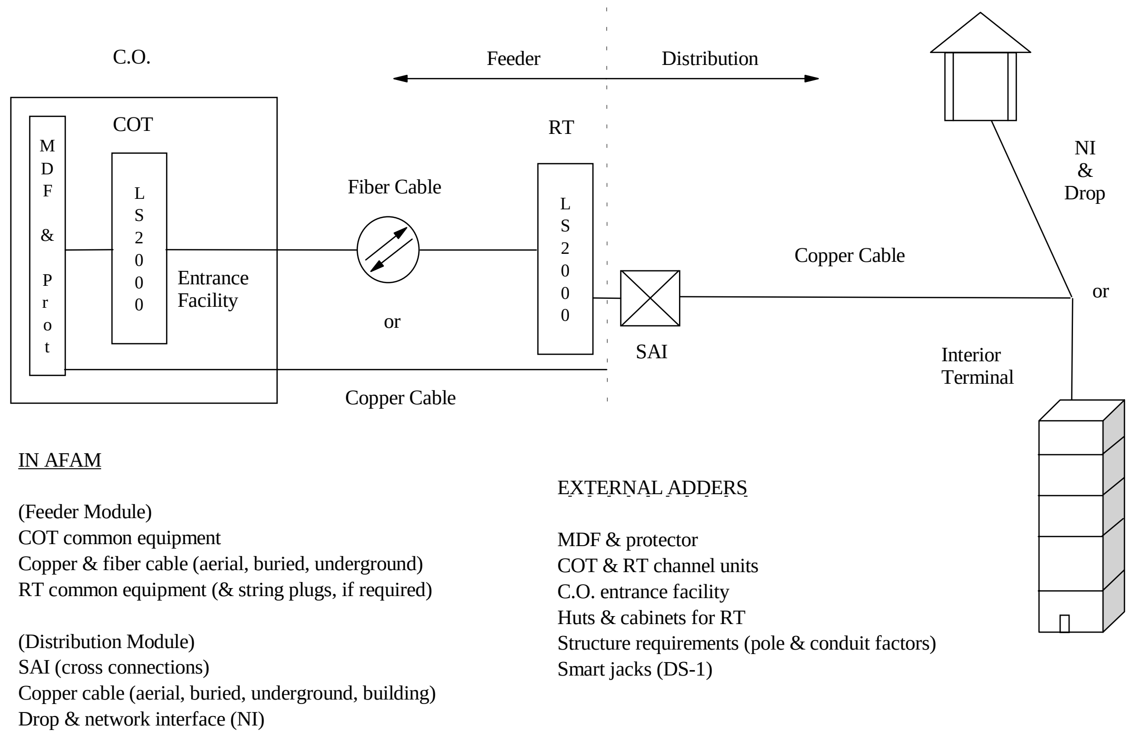

Diagram 1

AFAM currently consists of two separate cost modules: one for feeder and the other one for distribution areas (DAs), the latter of which include both distribution and drop cables. AFAM is not a static model and has been improved and updated over time.

3.4 Feeder Module Overview

The AFAM feeder model develops feeder investments for each feeder route. Prior to running the AFAM feeder module, an inventory of Ameritech Ohio feeder route facilities is extracted from Ameritech engineering databases. This information creates the foundation for an unparalleled level of accuracy in the loop cost study because it captures the actual characteristics of Ameritech's feeder network, such as cable route path and plant type, cable section lengths, and circuit demands at each location.

In the design of the AFAM feeder module, Network Engineering's currently implementable and tested forward-looking practices, guidelines, and technologies were incorporated into AFAM's algorithms. This was the result of close coordination with, and input from, Ameritech's Network organization. When the AFAM feeder module is run, it takes the inputted inventory of feeder facilities and converts it into a forward-looking design incorporating all the engineering guidelines mentioned previously. It determines where fiber and DLC electronics for Remote Terminals (RTs) and Central Office Terminals (COTs) should be placed and then optimizes the size/quantity of all the feeder components based on the circuit demand in the DAs, including objective utilization impacts. For unbundled loops, non-integrated or universal DLC service cards are used at the COT. Investments for the redesigned feeder network are then computed. AFAM aggregates this route-specific information for each of the three access areas.

3.5 Distribution Module Overview

The AFAM distribution module develops DA investments based on loop characteristics obtained from loop samples. Distribution characteristics included length and the type of cable, *i.e.*, aerial, buried, or underground, of each distribution cable section for each loop sample. Approximately 3200 loop samples were used. Drop cost information used by AFAM is based on a meld of aerial and buried drop cable facilities.

Loop length is a key driver of loop costs, because the longer the loop, the more plant investment is required. Since the object of the unbundled loop cost study is to determine the forward-looking cost to serve the total demand for loops and the distribution module only deals with distribution plant, *average loop lengths* of distribution plant must be estimated for all loops in each geographic area.

Rather than measure the lengths of all loops, a representative sample is taken at random. In random sampling, the number of samples, which must be taken to accurately measure the average of the population, depends on several factors:

- *Variability*. The more loop lengths vary within a study area, the greater the chance the average loop length of a sample is significantly different than the true average. Sample sizes must be larger when loop lengths vary significantly. On the other hand, geographic areas that have less variance in loop lengths require smaller samples. Small sample sizes often provide very good estimates of the true average.
- *Confidence Interval*. When a sample is taken and the average loop length is computed, some assurance is needed that the true average is within a reasonable range around the sample average. Typically, a 95% confidence interval is used. This means the cost analyst can assume there is a 95% chance the true average is within this range. The confidence interval can be "tightened" to a satisfactory range by increasing the sample size.
- *Size of the Population*. The larger the population of loops, the greater the chance a random sample will be representative. Loop populations typically number in the hundreds of thousands.

3.6 AFAM Modifications Ordered by PUCO

The PUCO ordered the following changes to the AFAM cost model used to calculate unbundled loop costs:

- Use the usable capacity fill factors set forth in the Ameritech Cost Analysis Resource (ACAR).
- Use the fiber utilization factor associated with the assumption that a 4-strand fiber system is used for feeder loop facilities.
- Use of telephone plant index (TPI) factors, if needed, to reflect 1996 investment values.

The Unbundled Loop Cost Study submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes. Other cost studies that use AFAM and are awaiting PUCO approval comply with the first two requirements, but use more recent investment values.

3.7 Non-Recurring Costs

The Nonrecurring Costs for Service Ordering and Line Connection Cost Study identifies the costs for activities involved in ordering and provisioning an unbundled loop and disconnecting the loop when service is discontinued. This nonrecurring cost study focused on the ordering and line connection processes for unbundled loops, while nonrecurring costs for unbundled ports are found in the Local Switching Cost Study. These nonrecurring cost studies were developed during the second half of 1996 based on input from various SMEs.

The functions involved in providing UNEs to CLECs are ordering, monitoring, central office provisioning, engineering, dispatch, and installation. The work groups that perform these functions and their descriptions are set forth below:

- The Ameritech Information Industries Service Center, known now as the Local Service Center (LSC), receives all UNE service orders. Service representatives then process and release the orders to downstream work groups for order completion and for entry in the billing, assignment, and maintenance systems.
- The Unbundling Service Center (USC), known now as the Network Element Control Center (NECC), coordinates, monitors, and resolves problems with work groups responsible for translations, dispatch, central office work, and outside plant in order to support timely and accurate processing of UNE service orders. The NECC serves as the single point of contact to the CLEC for provisioning and maintenance.
- The Circuit Provisioning Center – Loop Assignment Center, when necessary, is responsible for the assignment of cables and pairs for unbundled loop orders.
- The Circuit Provisioning Center (CPC) – Design receives the service order via the Trunk Integrated Record Keeping System (TIRKS). Usually, the order will be designed in TIRKS and flow through with no manual involvement. Occasionally, even in simple dispatch situations, the order will require manual involvement. This could occur, for example, when the connecting facility assignments are either incorrect or associated with "already occupied" facilities. In those situations, the CPC personnel will spend time resolving the TIRKS problem, reverifying the data, and making any necessary changes before re-inputting into TIRKS.
- The Recent Change Memory Administration Center performs all switch translation work that activates an unbundled local switch (ULS) port, including adding, changing, or rearranging all line features.
- The Centralized Translation Group writes and inputs translations, or "logic tables," for ULS when a carrier requests routing that is not already available (custom routing). They are also responsible for translations required for ULS line and trunk ports.
- The Network Administration Center is responsible for assignment of telephone numbers and simulated facilities groups in provisioning ULS line ports.

- The Ameritech Facilities Resolution Center receives a request for manual assignment from the service center when there is a facilities conflict. The work group determines if spare facilities exist before cable pairs are provided for an unbundled loop.
- The Field Dispatch Center dispatches and monitors central office technicians in order to perform central office work related to unbundled network element orders.
- The Centralized Operations Group dispatches and monitors outside plant technicians when outside field work is required in simple dispatch situations.
- Central office technicians (Field Operations Group) are responsible for installation and maintenance activities taking place within Ameritech central offices. These technicians disconnect the Ameritech end user facilities at the main distribution frame and then run jumpers to the carrier's connecting facility assignment.
- The Customer Provisioning and Maintenance Group is responsible for any outside field work required for unbundled network elements.

The Nonrecurring Costs for Service Ordering and Line Connection Cost Study accounts for only those instances where an order is distributed to the installation field forces in simple dispatch situations. The field technician normally will drive to the customer's premises and, in the simplest case, terminate the customer's drop at the network interface device. In other situations, if the existing loop terminates on DLC at the customer's premises, additional work is required to switch the loop to an existing copper-based facility. Also, this cost study does not account for the additional work required for more complex dispatch situations.

SMEs provided average durations for every major process or step that was expected to occur based on plans then existing. However, not every step or activity occurs on each order. As a result, the durations must be weighted based on a "probability of occurrence" factor. The probability of occurrence information was obtained based on certain common scenarios (i.e., type of unbundled element or type of order) to account for the fact that service orders can vary in terms of the steps required to complete them. Consequently, a forward-looking work group time is the average duration of a group's work activity multiplied by the relative occurrence of the activity.

The forward-looking work group times are then multiplied by an appropriate hourly labor rate to develop the cost of that work group.

The nonrecurring costs for unbundled ports were developed in the Local Switching Cost Study. Again, SMEs were used to identify the process flow and work groups required for provisioning ULS orders. A description of the work groups and their functions was discussed earlier in my affidavit.

The same processes, functions, and work groups that were studied to develop unbundled loop nonrecurring costs, served as the starting point for this analysis. SMEs were asked to review the processes, functions, and work groups and identify those that would apply in provisioning ULS, which would not apply, and which time estimates would differ. They were then asked to provide average time estimates for processing a service order and provisioning for a basic line port. The average time estimates for processing a service order were on a per-order basis, while average time estimates for provisioning a line port were on a per-port basis.

3.8 Non-Recurring Costs for Entrance Facilities

Non-recurring costs have also been completed for the administrative, design and central office connection, and carrier connection activities for unbundled digital entrance facilities used to provide unbundled local transport. The development of these costs are found in the Reciprocal Compensation Cost Study.

The administrative costs are for the activities performed to initiate the service request by the service center and for any order-related activities performed by the "downstream" work groups. The costs associated with these tasks are incurred on a per order basis.

The design and central office connection costs are for the activities associated with analyzing the CLEC's request for service, design of the circuit to meet transmission requirements, selection and assignment of local facilities, connection of equipment at the central office, and testing of the connections within the central office. The costs associated with these tasks are incurred on a per termination basis.

The carrier connection costs are for the activities required to make the physical connections from the serving wire center to the CLEC or end user, including the coordination and testing necessary to ensure that all transmission parameters have been achieved consistent with specifications set forth in the tariff and associated technical references. The costs associated with these tasks are incurred on a per termination basis.

The nonrecurring costs were developed based on a task oriented costing (TOC) methodology. The weighted mean duration for provisioning unbundled digital entrance facilities for each work group was calculated. Theses time estimates were then multiplied by the appropriate directly assigned hourly labor rate to determine the costs for each work group. The nonrecurring costs for each major activity, i.e., administrative, design and central office connection, and carrier connection activities, is the sum of the costs of all of the work groups involved in that activity.

3.9 Other Unbundled Loop Cost Studies

In addition to the 8dB 2 Wire and 4 Wire POTS unbundled loops, monthly costs are also computed for ISDN basic rate interface (BRI), DS1, Ground Start, Electronic Key, 2 Wire ADSL –compatible and 2 Wire and 4 Wire HDSL unbundled loops. The study methodologies are similar to the methodology used in the 8dB POTS unbundled loop cost study, although cost data are unique to each type of unbundled loop. For details on the cost calculations for these loops refer to the Unbundled Loops Cost Study provided in the TELRIC Case.

3.10 Nonrecurring Cost Study Modifications Ordered by PUCO

The PUCO in the TELRIC Case ordered that the changes shown below be made to the cost studies originally submitted by Ameritech Ohio. Ameritech Ohio complied with the Commission order and revised its cost studies accordingly.

- Ensure that the machine cost associated with connecting to Ameritech Ohio's network is consistent across all studies.

- Ensure that the machine cost associated with disconnecting to Ameritech Ohio's network is consistent across all studies.
- The coordination activity time estimates should be reduced by 50%.

The nonrecurring cost development submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes.

4.0 Switching Costs

4.1 Study Purpose

A purpose of the Local Switching Cost Study is to determine the costs for the unbundled line-side and trunk-side ports. The monthly cost for tandem trunks is found in the Unbundled Tandem Switching Cost Study. While these studies also determine switch usage costs, that discussion is deferred to the next section.

4.2 Study Flow

The development of recurring monthly costs for local switching and tandem switching starts with identifying switching investments as developed by SCIS. Switching investment included in theses studies is assumed to be all digital switching. Switch investments are developed for three central office switch vendors used by Ameritech: Lucent technologies (5ESS), Nortel (DMS 100). Siemens Public Switching Systems Inc. (EWSD). Feature-related hardware and investment loadings are also developed using SCIS. An averaging of these investments is done outside of SCIS, based on the existing line distribution among switch vendors. Because SCIS only identifies the costs of material and vendor engineering and labor, other construction costs, such as sales taxes, telephone company (telco) engineering and plant labor, miscellaneous equipment, power equipment and buildings, are included through investment loadings.

Although a switching system consists of numerous functional components, for purposes of computing network element costs the switch is divided between two categories of plant — line driven plant and usage driven plant. Line driven plant includes equipment necessary to terminate access lines. The number of lines equipped on the switch, rather than usage or the amount of calling over the lines determines the amount of line equipment. SCIS separately identifies line driven investment.

In addition to the line driven investments for ports with features, investments for the "switch-side" of the MDF and a protector are included for line-side ports. After investments are converted to monthly costs by applying annual carrying charge factors, other operating and support expenses such as intercept and telephone numbers is included. The trunk port also includes investment for digital cross-connect equipment.

4.3 Switching Cost Information System

Telcordia Technologies, which licensed SCIS to Ameritech, describes SCIS as,

> "an interactive computer system that determines the basic switching unit resource investments of a particular type switching system. SCIS may be used to analyze the cost of a single office, or group of similar offices…" [5]

Hence, SCIS is a large scale PC software model. It includes a family of modules which analyze and calculate the unit investments for central office functions (SCIS/MO) and features (SCIS/IN) provided by Ameritech's three central office switch vendors. For each of these technologies, SCIS is used to determine the investments for the complete product line of features and functions available including those provided via remote switching and tandem switching entities.

SCIS incorporates the use of vendor-specific switch architecture information in order to develop these investments. It also requires as additional inputs various traffic and access line data for each digital central office switch in each state in the Ameritech Region. From these data, it produces an Ameritech Ohio model office for each of the three digital switch technologies used in Ohio today. SCIS is kept current through the repeated attention and interaction between Telcordia, the switch vendors and the users.

In developing SCIS models for individual switch technologies, Telcordia selects actual switching systems representing a range of line and trunk sizes and usage characteristics. The sample switches are engineered according to the vendor's engineering rules, and switch costs are computed based on actual vendor prices. A detailed analysis of switching system equipment is performed to categorize equipment and costs in functional categories. Following this functional categorization of equipment and costs, costs per unit of capacity of each category are developed. These unit costs are representative of the model office. Unit costs then are used by SCIS to compute the costs of switching systems of different sizes and usage characteristics.

The developers of SCIS routinely test the model to assure that it accurately calculates switching system costs. These tests indicate the model produces switching system costs, which are within one - two percent of costs developed using the switch manufacturer's switch provisioning models.

In addition, SCIS has been reviewed by the FCC and several state commissions over the years. In 1992 the FCC discussed its findings regarding SCIS in its Order on Open Network Architecture Tariffs of Bell Operating Companies (CC Docket No. 92-91).

> "SCIS is a forward-looking model that calculates investments based on switch replacement costs rather than historical or embedded costs, and the more recent SCIS software provides the most up-to-date design and pricing basis from which to estimate future BSE-specific investments."" (para. 21)

The Commission also expressed an opinion regarding the validity of SCIS.

> "Andersen [independent reviewers of the SCIS model] concluded in its report that, although, SCIS permits users fairly wide discretion in selecting variables, the SCIS model itself is fundamentally sound. This finding is consistent with the findings of the Commission's review of the SCIS models submitted to us in camera in December 1991." (para 82.)

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[5] "Bellcore Switching Cost Information System," Section 2 - Introduction, page one.

The bottom up approach used in SCIS provides the necessary level of detail to distinguish the use of the switch resources by feature application. Such detail is considered a prerequisite if shared equipment is to be properly assigned to individual services. Thus, one of the underlying principles of SCIS is the development of a list of basic common denominators of cost causation that define switch usage in such a way that feature costs can be generated via a mapping sequence based on the latest technology, up-to-date vendor pricing and engineering information. This approach provides the desired effect of reducing cost fluctuations resulting from lumpy investments that are placed during the life of the switch.

Cost results developed by SCIS are based on relative usage. That is, the model expresses the cost of the shared switching equipment as a function of the capacity consumed to perform the various features and functions studied.

The Model Office Equation (MOE) Module of SCIS is needed to analyze all switching components for purposes of identifying equipment costs associated with the least common denominators of costs (i.e., basic investment drivers of the switch). This process, in turn, permits the identification of service specific costs. Examples of investment drivers, sometimes referred to as SCIS "cost primitives" or "resource costs", are (1) the cost of a central processor millisecond; (2) the cost of a distributive processor millisecond; (3) the non-usage sensitive cost per line termination; (4) the cost per originating and terminating (O + T) CCS; (5) the cost per outgoing and incoming (O + I) CCS and (6) the cost per call set-up function, *e.g.,* originating call function that includes recognizing dial tone, and digit collection.

The MOE analysis may involve a single office or multiple offices. If multiple offices are involved in the user's study, the model analyzes each office individually and provides a weighted average output for each cost primitive the technology requires. If any office studied serves as hosts for remote switching entities, costs of the remotes are also analyzed and weighted in with that of the host office.

This weighting process was the basis for the term Model Office Equation. In other words, the results of the MOE analysis reflect a "model" office for the complete study. This approach produces a cost for a particular investment driver (or ultimately a portion of a service) which is the same, regardless of the specific switch entity serving the customer, or the particular technology used to implement the service (e.g. analog or digital line termination).

The second module developed for each switch technology is the Vertical Service Module. It performs the aggregation of the cost primitives, or resource costs quantified by the MOE with the required resources (such as real time, memory, CCS, signaling packets, etc.) to implement a specific service in the switch. The output of each feature costing algorithm may be expressed on a per call basis, per line, per customer, per group, etc.

Each module in SCIS requires similar but unique user specific inputs, which allow for accurate representation of the underlying investment required to provide the specific feature or function. Three data types are required by the MOE module to develop the basic resource costs:

- Standard inputs that apply to all switches in the study, which include vendor discounts, cost of money and switch generic program version.
- Switch-specific parameters, which include line and trunk quantities, processor utilization data and line concentration ratios.

- Host-remote information, which includes host office interface parameters (umbilical CCS), and usage and quantities of lines served at the remote office.

A fourth category of inputs is associated with vertical services. Each vertical service requires a unique data set that is relevant to the specific analysis requirements of the feature. Typical inputs include busy hour attempts and holding times for specific vertical service functions. The Intelligent Network (IN) portion of SCIS contains the separate algorithms for each feature that enable these inputs to be combined with MOE calculated resource costs to develop feature specific costs.

4.4 Changes Ordered by the PUCO for Unbundled Ports and Trunks

The PUCO ordered the following changes to the costs for unbundled line-side and trunk-side ports, and tandem trunks:

- Use the usable capacity fill factors set forth in the Ameritech Cost Analysis Resource (ACAR).
- Use of telephone plant index (TPI) factors, if needed, to reflect 1996 investment values.

The cost studies submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes. Usable capacity fill factors have been used in other cost studies awaiting PUCO approval.

5.0 Unbundled Local Switching, Reciprocal Compensation, and Unbundled Tandem Switching

5.1 Study Purpose

A purpose of the Local Switching Cost Study, the Reciprocal Compensation Cost Study, and the Unbundled Tandem Switching Cost Study is to develop the usage costs for unbundled local switching, reciprocal compensation, and unbundled tandem switching. These studies used NCAT to develop these per minute of use costs.

5.2 Cost Study Flow

NCAT produces set up costs per call and duration costs per minute for six basic usage network cost categories. These categories are the end office switch; tandem office switch; interoffice facility; facility termination; SS7 signaling; and measurement costs. Billing related expense per message is then added to the network costs produced by NCAT. NCAT calculates the incremental usage costs by dividing the incremental investment, translated to annual costs, over the traffic load to derive a precise approximation of the incremental cost per message or per minute.

NCAT is a Telcordia developed and maintained model that has been used in the past by Ameritech to develop both LRSIC and TELRIC costs associated with network usage. It determines the network resources required based on the busy hour usage of the network components. The model then calculates the cost associated with using these resources on a minute-of-use (MOU) basis for all calls. The developed costs include those for switching at end offices and tandems including the cost of recording details for billing as well as the cost of trunking between switches including SS7 costs.

The system consists of a database and a calculator. The database contains information regarding network configuration end office and tandem switches, facilities between these switches, and the procedures for routing calls over these facilities. The database also contains the forward looking unit investments for these resources. The switching and SS7 investments are developed in SCIS and CCSCIS respectively. Facility and termination investments are developed outside the NCAT model for the unit investment in cable and wire facilities as well as the related electronics required to connect the various switches. The database also contains usage data, some assumptions regarding the network (for example, complete SS7 deployment), and factors which relate these investments to costs.

The calculator portion of the system completes calls between each pair of originating and terminating points for each traffic record in the usage data. Based on the routing priorities, the routes actually available, and their capacities the traffic for the studied service is routed over the network using the time of day usage generated by the service and busy hour resource requirements are determined.

Costs are based on the busy hour capacity of the various resources consumed by the particular service being studied. The final costs are then a composite representative of the traffic between all pair points in the studied network developed as a MOU for all calls.

By studying the forward-looking investments associated with carrying traffic over the actual network configuration that is used in providing service, the system provides costs specifically related to the service being studied.

NCAT develops these costs in a very granular form. The overall cost per MOU can be separated into costs associated with setting up the call and the duration of the call. These can further be broken into various switching, facility, termination, measurement, and SS7 components. This allows flexibility in examining the various piece parts of the network and ensures that only the appropriate components are included in the development of costs for any studied service.

5.3 Unbundled Local Switching Usage

The starting point for developing this “per minute of use” cost is the NCAT analysis performed for business and residence local usage. The end office trunk termination cost component was then “zeroed out.” This was done since the cost for the trunk termination is associated with a different UNE. The resultant end office switching costs were then combined with the measurement, SS7 signaling, and the billing expense costs to produce an overall average cost per minute for this UNE.

5.4 Reciprocal Compensation

The starting point for this study is an NCAT analysis performed for Feature Group D (FGD) service. The NCAT cost categories were then mapped to the reciprocal compensation elements as follows:

- End Office Local Termination – End office switching, measurement, SS7 signaling, billing expense.
- Tandem Switching – Tandem switching only.
- Tandem Transport Facility Mileage – Facilities only, per mile.
- Tandem Transport Termination – Facility termination only.

5.5 Unbundled Tandem Switching

The starting point for this study is the NCAT analysis performed for reciprocal compensation. The tandem office trunk termination cost component was then "zeroed out." This was done since the cost for the trunk termination is associated with a different UNE. The resultant tandem switching cost was then combined with the measurement, SS7 signaling, and bill inquiry portion of the billing expense costs to produce the overall average cost per minute for this UNE.

5.6 Other End Office Switching Costs

The Local Switching Cost Study also includes the costs for other network elements. They include the following:

- *Basic Rate Interface Port and Primary Rate Interface Port*. Basic rate interface (BRI) and primary rate interface (PRI) ports provide access to end offices for the use of Integrated Services Digital Network (ISDN) features and functions. The BRI port provides the capability for two 64 kilobit per second channels and one 16 kilobit per second channel. The PRI port provides for 23 64 kilobit per second channels and one 16 kilobit per second channel. The two ports are elements of ISDN services that can be used to provide end-users with voice and data communications.
- *Two-Wire Analog Trunk Port (Direct Inward Dial).* The study determines the recurring and non-recurring costs to provide an end office trunk connection capable of providing direct inward dialing (DID). DID is a central office feature which enables incoming calls to private branch exchanges (PBXs) located on customers premises to be handled without the assistance of an attendant. Calls are routed directly to the PBX that provides answering and supervision of calls. The study determines the incremental investment and recurring monthly costs for equipment necessary to provide this feature. Non-recurring costs for providing switch translations at service activation also are included in the study. Recurring and non-recurring costs also are developed for unbundled DS1 trunks.

The study documentation for each of these network elements provides details on input cost data, calculations and results. In each case, the general approach described in section 2 is followed. Refer to the individual study documentation for additional information.

5.7 Changes Ordered by the PUCO to the Unbundled Local Switching, Reciprocal Compensation, and Unbundled Tandem Switching Costs

The PUCO ordered the following changes used to calculate usage costs:

- Use the usable capacity fill factors set forth in the Ameritech Cost Analysis Resource (ACAR).
- Use the fiber utilization factor associated with the assumption that a 4-strand fiber system is used for inter-office fiber transport.
- Use of telephone plant index (TPI) factors, if needed, to reflect 1996 investment values.

The cost studies submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes. Usable capacity fill factors as well as using the fiber utilization factor associated with a 4-strand fiber system have been used in other cost studies awaiting PUCO approval.

6.0 Transport Costs

6.1 Study Purpose

Transport refers to cable facilities, circuit equipment and other plant providing communications paths among Ameritech Ohio's central offices. Transport facilities are used to provide *dedicated transport* for private line and other special services and *shared transport* for local and toll message traffic. Dedicated transport unbundled network element costs are computed in the Reciprocal Compensation Cost Study, and common transport costs are computed in the Unbundled Local Switching-Shared Transport cost study. The studies provide recurring costs and non-recurring costs for service activation of transport network elements.

6.2 Unbundled Inter-Office Transport

The unbundled inter-office transport costs were developed in the Reciprocal Compensation Cost Study, which calculates the cost to provide network elements for dedicated entrance facilities of varying bandwidths and lengths and inter-office transmission facilities between Ameritech Ohio's central offices. The network elements included in the study are:

- *Entrance Facilities*. Cable and circuit equipment for access from a customer's premises to the Ameritech Ohio serving central office. Access is provided via a dedicated channel with bandwidth at the DS1 level (1.544 megabits / second), the DS3 level (45 megabits / second or equivalent to 28 DS1 channels), OC3 (155Mbps), OC12 (622 Mbps) and OC-48 level. The DS-1 and DS-3 entrance facilities costs are geographically deaveraged by three access areas.
- *Interoffice Transmission Facilities*. Inter-office (IO) facilities are the cable and circuit equipment between Ameritech Ohio's central offices that provide communications paths among the offices. Fiber optic transmission facilities are assumed. Costs are computed

for the DS1 DS3, OC3, OC12 and OC-48 bandwidths. Interoffice facilities require circuit equipment at each central office. Between central offices are fiber optic cable facilities. The amount of cable depends on the route mileage between offices. Recognizing these factors, the study determines interoffice facilities costs per central office termination and per mile.

- *Multiplexing*. The capability of combining multiple transmission channels over the same transmission facilities. Costs are provided for DS1 to DS0 multiplexing (i.e., combining 24 voice grade channels to form one 1.544 megabit channel) and DS3 to DS1 multiplexing (28 DS1s for one DS3), OC-3 to DS-3, OC-12 to OC-3 and DS-3, and OC-48 to OC-12, OC-3 and DS-3.

6.3 Entrance Facilities Costs

Entrance facilities consist of loop plant from a customer's premises to the Ameritech Ohio serving central office and circuit equipment located at the customer's premises and the central office. For a DS1 entrance facility, examples of circuit equipment include DLC equipment, office repeaters and smart jacks.

The development of entrance facilities costs relied on investments for three geographic areas from a 1994 High Capacity Cost Study. The investments for each field reporting code associated with entrance facilities were brought forward to 1997 using TPIs. Annual carrying charge factors were then applied to yield the transport costs. Entrance facilities costs were developed for DS1, DS3, OC-3, OC-12, and OC-48.

6.4 Inter-office Transport Costs

The development of unbundled interoffice transport costs relied on investments from a 1994 High Capacity Cost Study. The investments for each field reporting code associated with inter-office transport and termination were brought forward to 1997 using TPIs. Annual carrying charge factors were then applied to yield the transport costs. Transport costs were developed for DS1, DS3, OC-3, OC-12, and OC-48.

6.5 Changes ordered by the PUCO to the Unbundled Inter-Office Transport Costs

The PUCO ordered the following changes to the AFAM cost model used to calculate usage costs:

- Use the usable capacity fill factors set forth in the Ameritech Cost Analysis Resource (ACAR).
- Use the fiber utilization factor associated with the assumption that a 4-strand fiber system is used for feeder loop facilities.

The cost studies submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes. Usable capacity fill factors as well as using the fiber utilization factor associated with a 4-strand fiber system have been used in other cost studies awaiting PUCO approval.

6.6 Unbundled Local Switching-With Shared Transport (ULS-ST)

The ULS-ST Cost Study, which was submitted to the PUCO in Case No. 00-1368-TP-ATA, combines two unbundled network elements, local switching and shared transport. Local switching provides access to the features, functions and capabilities of the local switch while shared transport provides access to the local transmission facilities that connect Ameritech Ohio's network of end office and tandem switches. This study used ARPSM, which is a switching model developed by Ameritech to replace SCIS, and NUCAT, which is a usage cost tool developed by Ameritech to replace NCAT, to develop costs. Both ARPSM and NUCAT, like their predecessors, are consistent with the FCC's forward-looking cost rules.

6.7 Non-Recurring Transport Costs

Non-recurring costs are computed for the entrance facilities used for unbundled inter-office transport as described in Section 6.3. These non-recurring costs are for the administrative, design and central office connection and carrier connection cost elements.

Activity times are applied to direct labor rates for each work group to calculate activity costs, and these amounts are adjusted by the probability the activity occurs each time a network element is ordered. Activity costs for all work groups are summed to compute the non-recurring cost.

6.8 Non-Recurring Transport Cost Modifications Ordered by PUCO

The PUCO in the TELRIC Case ordered that the changes shown below be made to the cost studies originally submitted by Ameritech Ohio. Ameritech Ohio complied with the Commission order and revised its cost studies accordingly.

- Ensure that the machine cost associated with connecting to Ameritech Ohio's network is consistent across all studies.
- Ensure that the machine cost associated with disconnecting to Ameritech Ohio's network is consistent across all studies.
- The coordination activity time estimates should be reduced by 50%.

The nonrecurring cost development submitted and approved in the compliance phase of the TELRIC Case reflected these ordered changes. The ULS-ST Cost Study is awaiting PUCO approval.

7.0 Other Network Element Costs

7.1 Overview

The FCC Order requires incumbent local exchange carriers to provide access to a number of unbundled network elements besides local loops, end office switching and transport.[6] Ameritech Ohio has completed cost studies for these other network elements, and in this section, a brief description of the studies is provided. For further information, refer to the documentation for each study provided in Case No. 86-922-TP-UNC.

7.2 Access To Signaling System 7 (SS7)

Access to SS7 provides the ability for CLECs to obtain access to the Company's SS7 network including access to signaling ports and links.

Cost studies have been completed for elements of Ameritech's SS7 network.

- *SS7 Transport*. The Signaling System 7 (SS7) Cost Study determines the *cost per octet* for use of signal transfer points (STPs) and links in the SS7 network. An octet is the measure of usage in a packet data network such as the SS7 network. An STP is a packet switch that routes signaling messages among the points in the SS7 network. SS7 transport is required by local exchange carriers for call processing and other networking functions.
- *STP Port*. The Signaling System 7 (SS7) Cost Study also computes the *recurring monthly cost per port* for a termination on a signal transfer point through which signaling messages enter Ameritech's signaling network. The study also includes non-recurring costs for activities necessary to establish the port connection.
- *Queries*. Costs are determined for SS7 queries on a *cost per query* basis. First, the Access to Line Information Data Base (LIDB) Cost Study develops costs that provides access to billing validation data to support alternate billing services such as calling card, collect and third number billing. Second, the 800 Access Service develops costs that provides access to the Company's 800 Service which is an originating offering that provides a carrier identification function for numbers using toll free service access codes. The carrier identification function is performed using queries, which are routed using the Company's SS7 network to the Company's Service Control Point.

The Telcordia Technologies Common Channel Signaling Cost Information System (CCSCIS) is used extensively in the SS7 cost studies to compute investments per unit of demand (octets, ports and queries).

CCSCIS is an interactive PC based computer model which develops investments of the Signaling System 7 (SS7) network that is used to both establish the connection of various types of calls and provide Advanced Intelligent Network (AIN) services.

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[6] See paragraph 51.319 of the FCC Order (Appendix B, pages B-20 - B24) regarding specific unbundling requirements.

CCSCIS contains seven models. These models include two Signal Transfer Point (STP) models, three Signal Control Point (SCP) models, an SS7 link model and an aggregation model. The system models STPs manufactured by two different vendors: DSC Communications Corp. and Nortel. The SCPs modeled include three versions of SCPs: Lucent Technologies, Digital Equipment Corporation (DEC) and Ericsson. The Link Model examines several types of CCS links, each of which can contain many different transmission technologies. The Aggregation Model combines the outputs of each of the other models to determine combinations useful to calculate costs for various services or UNEs. Cost results are based on relative usage. That is, the model expresses the cost of the shared switching equipment as a function of the capacity consumed to provide various features and functions studied.

CCSCIS incorporates a "bottom up" approach to provide detailed forward looking costs of individual parts of the CCS network. The objective is to develop basic common denominators of cost that can be combined in various ways to obtain the costs of various services or UNEs

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Equipment prices are regularly updated, and the models are revised to include additional functions and engineering changes necessary to keep pace with the rapid evolution of the SS7 network and services that require its use. The investment drivers or "cost primitives" calculated by CCSCIS are: the cost of transporting one octet (8 bits) of an SS7 message on various types of links, the cost of processing one octet of a message by STP link termination equipment, the cost of processing some special types of messages (database queries of various services, global title translations, and gateway screening), the costs of storing database records in SCPs, and the costs of terminating SS7 links on STPs.

A CCSCIS model study is used to calculate costs for either a single piece of STP or SCP equipment as well as for all or part of an entire CCS network. If multiple STPs or SCPs are present in the network, weighted averages are calculated in the CCSCIS Aggregation Model using weights derived from user data entered in the individual studies. These values are combined using network parameters entered by users or derived from input data. The final outputs of the aggregation process are combined unit investments. These values are calculated for messages between switching entities, for SCP database queries from switches or from outside the company's SS7 network. These investments are then translated into monthly or annual costs using annual cost factors obtained from the ECONS/CAPCOST model.

8.0 ECONS/CAPCOST

8.1 Overview

A computer program called Economic Costs of Network Services (ECONS) performs the calculations required to develop the investment and recurring incremental costs for the product or service under study. At a point during its processing, ECONS accesses the Capital Cost (CAPCOST) program to perform capital cost calculations. CAPCOST is a program that determines capital costs using cost of money rates, and federal and state tax regulations. Ameritech Ohio has used ECONS for many years.

8.2 Investment

ECONS derives total unit investment from material and labor related inputs.

If the material investment is circuit equipment, an inventory factor is applied to the projected material price to account for the material held for anticipated service requirements. The factor may be product specific, or it may represent an account average value.

Sales tax expenses are calculated by applying a sales tax factor to the material price and the inventory loading. The last consideration related to material investment is supply expense. Supply expense is the cost incurred by Ameritech for delivery of material from the distribution center to company-specific and customer locations. Supply expense is calculated in ECONS by applying a factor to the material cost and sales tax expense components derived above.

Labor related investment inputs consist of plant installation hours, engineering hours, plant labor rates, plant vehicle rates, engineering labor rates and installation factors. For many products, work times for the specific installation function are obtained from engineering evaluations and special studies. Engineering activities include design and ordering of equipment configurations and job scheduling. Hourly labor rates include the basic operational salary, plus loadings for Social Security, Relief and Pension, and motor vehicles used by the motorized plant forces who perform installation activities. ECONS computes total labor costs by multiplying the product specific work time by the appropriate labor rate, or by applying a factor to material cost. Estimates of labor rates were derived from special studies. ECONS will then capitalize the labor costs to reflect the appropriate accounting treatment. Capitalized labor costs are added to the material investment to obtain the total unit investment.

When the investment is obtained directly from other cost models such as SCIS, AFAM, CCSCIS, or FIC, the investment is often multiplied by an annual cost factor derived from ECONS rather than run separately through the ECONS model. The annual cost factor captures the capital cost and operating expenses related to the investment under study.

When applicable, a power and floor space factor is applied to the material price to account for the investment related to power equipment such as generators and the investment related to the floor space required to support central office switching and/or circuit equipment.

8.3 Definition of Capital Costs

Capital costs include *depreciation expense*, the *cost of money* and *income taxes*.

- *Depreciation* is the annual expense of recovering the original construction cost of telephone plant, less any net salvage, over the service life of the plant. Depreciation is computed for each plant account based upon the prospective lives and expected net salvages.
- *Cost of money* is the annual return required on investor supplied capital used to construct telephone plant. The return requirement includes the prospective costs of debt and equity, weighted by the proportion of debt and equity anticipated in Ameritech's forward-looking capital structure.

- *Income taxes* represent the amount of income taxes that would be owed on taxable income from revenues sufficient to cover the cost of equity after taxes.

When revenues from offering a network element are sufficient to recover its operating expenses and capital costs, revenues are said to recover all direct costs, including the costs of capital recovery and the return required on investor capital.

8.4 Capital Cost Calculation

The first component of capital cost is book depreciation expense. Leading to this calculation, CAPCOST first calculates plant investments for the total demand units in each vintage year of the forecast period. Book depreciation amounts are determined by total investment, less future net salvage, and the estimated economic life characteristics. The depreciation reserve accrues the book depreciation expense amounts and at a given time represents the total of all prior accruals.

CAPCOST - Cost of Money

The second component of capital cost is the cost of money, which is based on the net investment. Before it can be computed, a deferred tax reserve due to accelerated depreciation must be considered since it impacts the net plant investment. With accelerated tax depreciation, tax deduction amounts are claimed in greater amounts during the earlier years of an asset's life than during the later years. The Accelerated Cost Recovery System (ACRS) is the method of accelerated depreciation used by CAPCOST. With ACRS, the cost of plant is recovered over a 3 year, 5 year, 7 year, or 15 year tax life depending on the type of plant. CAPCOST computes the annual ACRS tax depreciation deduction by multiplying the tax basis of the investment by a statutory percentage. The percentage to be applied depends on the plant's ACRS property class. The deferred tax reserve is computed by subtracting the annual tax depreciation deductions that would have been declared if book depreciation had been used for tax purposes, from the deductions arising from accelerated depreciation (ACRS). The deferred tax reserve and the book depreciation reserve are subtracted from the gross plant investment to produce the net plant balance. The annual cost of money is then computed by multiplying the net plant balance by the forward-looking cost of money rate.

CAPCOST - Income Tax Expense

The last component of capital costs is income tax expense. Income tax expense is computed by multiplying the income tax rate by the equity portion of the cost of money. The annual debt interest portion of the cost of money is not taxable.

Further Steps in the ECONS Process

At this point, CAPCOST has computed the capital costs, year-by-year, for the cumulative sum of investments required to serve the forecast demand. Its last function is to time-value average these annual costs over the life of the asset. These capital costs are then passed back to the ECONS program.

8.5 Operating Expenses Calculations

Next, the ECONS program will calculate the recurring operating expense of *ad valorem* taxes and maintenance. *Ad valorem* taxes are directly related to the level of investment on a factor basis; i.e., *ad valorem* taxes equal the unit investment times the factor. The *ad valorem* tax factor is a ratio of property taxes paid to investments for plant in-service.

Other expenses such as marketing, advertising and sales expenses are identified for each service studied and are summarized and displayed outside of the ECONS model.

Maintenance expenses consist of labor and material costs incurred in the upkeep of plant. Where specific maintenance information is not available, maintenance factors are multiplied by investment to compute annual maintenance costs. This is generally the case with outside plant and central office studies. These factors are derived by dividing average annual maintenance dollars by average annual investment on a plant account basis.

The total annual cost is the sum of all recurring cost components; i.e., depreciation, cost of money, income tax expense, *ad valorem* taxes, maintenance expense, power, and floor space costs. Where applicable, non-recurring expenses may be identified as separate cost items.

8.6 Input Changes Ordered by the PUCO

The PUCO ordered the following changes to ECONS/CAPCOST inputs:

- For purpose of conducting TELRIC studies, the cost of capital should be 9.74%.
- Use the prescription depreciation lives adopted by the FCC in its Order of January 25, 1996 in CC Docket 96-22,

The cost studies submitted and approved in the compliance phase of the TELRIC Case reflected annual carrying charge factors using these ordered changes. Cost studies awaiting approval also incorporate the PUCO's cost of capital and life assumptions in the development of the annual carrying charge factors used in those studies.

9.0 Investment Loadings

9.1 Definition of Investment Loadings

In performing unbundled network element cost studies, much of the effort goes to computing the *primary plant construction costs*. These include material costs of major equipment components, vendor engineering and installation labor costs, and others. The studies also focus on the *primary plant accounts*, such as cable and wire facilities, central office switching and central office transmission. A significant portion of the investment necessary to provide network elements is attributable to other construction costs, such as sales taxes, Ameritech (telco) engineering and labor, miscellaneous materials, power equipment and buildings. These construction costs typically are included in the cost study by using *investment-loading factors*.

Investment loading factors represent the ratio of these additional costs to the primary plant construction costs, such as the ratio of power equipment cost for switching systems to the cost of the switching system itself.

9.2 Description

Investment loading factors are used in the unbundled network element cost studies. The factors are based on special studies of financial and engineering records and vary by state.

- *Inplant factors*. These factors are used to translate material prices into installed component unit investments. The in-plant factors are developed separately for hardwired and plug-in equipment and includes telco engineering and installation, sales tax, supply expenses, shipping and common equipment. The factors are based on a special study using data from the Plug-in Inventory Control System and Detailed Continuing Property Record database for a three consecutive year period.
- *Investment Weighting factors*. These factors are used to compute the portion of total installed costs or investment that is material, contractor installation, contractor engineering and telco specific labor and engineering. The factors are based on special studies utilizing information in the Ameritech Standard Detail Transaction File database.
- *Loop Installation factors.* These factors are similar to In-Plant factors in that their application translates outside plant cable (copper and fiber) material prices into total installed costs. These factors are based on a special study using data from the Financial Common Presentation System for a three consecutive year period.
- *Power equipment factor*. The power equipment factor is used to compute the costs of electrical equipment, such as generators, batteries, etc., needed to operate central office switching and central office transmission equipment. It is based on a special study.
- *Floorspace factor*. A floorspace factor is used to calculate the forward-looking investment in building space needed for central office switching and transmission equipment.

10.0 Operating Expense Factors

10.1 Definition of Operating Expenses

Operating expenses are the *maintenance and ad valorem recurring* costs attributable to a network element. Recurring expenses are generally computed using operating expense factors applied to network element investments, although recurring expenses may be computed based on special studies of recurring work activities and associated costs.

10.2 Description of Operating Expense Factors

There are *two* operating expense factors used in cost studies.

- *Maintenance factor*. The maintenance factor includes *plant specific* expenses for a type of plant (expenses of maintaining and repairing) telephone plant in service), power expense, and testing expense. Special studies are performed to identify the portions of power and testing expenses attributable to switching, circuit, cable and wire, and other types of plant. Maintenance factors vary by plant account recognizing, for example, that aerial and underground cables have different maintenance requirements and costs. The maintenance factors are computed as the ratio of prior year maintenance expenses to average book investment for three consecutive years of data, *adjusted to a current cost basis*. Current cost to book cost ratios are used to express plant investments in terms of current costs.

- *Ad Valorem expense factor*. A single factor is applied to all plant types to compute property taxes.

11.0 Forward-Looking Common Costs

11.1 Definition of Forward-Looking Common Costs

The total element long run incremental costs of network elements include only costs directly attributable to the individual network elements. There are substantial resources and business activities that are not directly attributable to a single network element, but rather are either shared by more than one UNE or are common to all network elements or services. The costs of these resources and activities also must be recovered for the business to sustain itself. In its Order, the FCC used the term common costs to apply to what are commonly called shared and common costs and recognized the need for unbundled network element prices to recover a "reasonable allocation" of *forward-looking common costs* which it defined as,

> "economic costs efficiently incurred in providing a group of elements or services which may include all elements or services provided by the incumbent LEC that cannot be attributed directly to individual elements or services."[7]

The FCC also indicated forward-looking common costs are to exclude retail costs. Ameritech Michigan's methodology for computing these costs is consistent with the FCC's definition and requirements for a reasonable allocation of common costs.

11.2 Common Cost Calculation and Allocation

In order to identify and assign joint and common costs, Ameritech retained the accounting and consulting firm of Arthur Andersen (Andersen). Andersen was engaged by Ameritech to analyze and attribute shared and common costs to unbundled network elements, to physical and virtual collocation, and to transport and termination of local services (collectively referred to as UNEs) for the purposes of network interconnection with new entrant carriers. Ameritech directed Andersen to analyze its forward-looking total costs in order to identify costs that are shared among UNEs or common to UNEs and other services. Andersen's task was to then attribute such shared and common costs to individual UNEs based on measures of cost causation when possible or accepted measures of allocation when measures of cost causation do not exist.

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[7] FCC Order, paragraph 51.505 (c), Appendix B, page B-30.

After developing its study approach, Andersen, based on interviews of Ameritech personnel and its analysis of Ameritech's operations, determined that shared and common costs attributable to UNEs originated primarily from four business units serving wholesale customers of Ameritech:

- Ameritech Information Industry Services, now known as the LSC, serving wholesale customers of Ameritech's local exchange services and products;
- Network Services, the business unit that plans, constructs, operates, maintains, and manages Ameritech's integrated wireline telecommunications network;
- Centralized Services, which provides to Ameritech Ohio and other Ameritech entities administrative and other services on a centralized basis, e.g., information technology, real estate, and purchasing services; and
- Corporate, the headquarters group that provides Ameritech Ohio and other Ameritech affiliates services such as finance, legal, and investor relations services.

Ameritech directed and Andersen's approach was specifically designed to exclude all retail costs from shared and common costs attributed to UNEs. Consequently, to the extent retail costs were identified in one of the aforementioned business units, such retail costs were to be excluded. Andersen also excluded from further consideration of shared and common costs any capital-related costs associated with fixed assets identified in the four business units examined. The exclusion of such costs will understate the shared and common costs attributable to UNEs.

Andersen used 1997 budgeted data for its analysis. The use of 1997 budget data was desirable, because calendar year 1997 budget data strikes an appropriate balance between a forward-looking examination period during which the anticipated cost impacts of unbundling and interconnection are reflected in Ameritech's financial planning but is not so distant in the future to be speculative.

After obtaining preliminary 1997 detailed budgets for the four Ameritech business units identified as potential sources of shared and common costs for UNEs, Andersen was left with detailed budget data totaling roughly $4.5 billion. Andersen continued its analysis by next interviewing appropriate Ameritech personnel to identify more fully the nature of the activities performed within the four Ameritech business units and the cost relationship of each activity to UNEs. These interviews, together with analyses performed by Ameritech and Andersen, as well as Andersen's own review of Ameritech's TELRIC studies, enabled Andersen to assign 1997 budgeted costs to the following seven categories:

1. Volume sensitive costs already reflected in TELRIC studies of individual UNEs (Category 1 costs);
2. Non-volume sensitive (NVS) costs not included in TELRIC studies of individual UNEs but attributed to a particular UNE or UNEs (Category 2 costs);
3. Costs directly attributable to retail services (Category 3 costs);
4. Costs directly attributable to non-UNE wholesale services (Category 4 costs);
5. Costs shared among UNEs (Category 5 costs);
6. Costs shared among UNEs and other wholesale products and services (Category 6 costs); and
7. Costs common to UNEs, other wholesale products and services, and retail services (Category 7 costs).

Category 1 costs, which include maintenance of network assets as well as the labor and benefit costs of technicians, first level supervisors, and clerical support involved, are already included in the TELRIC studies and thus, are not further apportioned to UNEs. Category 2 costs consist of relatively minor non-volume sensitive costs primarily involved with upfront planning for the deployment of certain UNEs. These NVS costs were added directly to the TELRIC amounts for the associated UNEs. Category 3 (exclusively retail-related) and Category 4 (primarily associated only with non-UNE wholesale activities) costs have no relationship to UNEs and were thus excluded. Category 5 costs, e.g., technical planning costs incurred by AIIS for the family of UNEs, relate only to UNEs, but are shared among two or more individual UNEs. Costs in Category 6 are shared among all wholesale services provided by AIIS to new entrants. Examples of Category 6 costs include legal and regulatory costs incurred by Ameritech to negotiate interconnection agreements covering UNEs, resale, and other arrangements with new entrants. The last group, Category 7 costs, represent the common costs of operating Ameritech's retail and wholesale businesses. Costs within this category include planning, operating, monitoring, and maintaining Ameritech's integrated wireline network as well as corporate costs such as shareholder services and treasury management. Categories 5, 6, and 7 were the only shared and common costs attributed or apportioned to UNEs.

Category 5 shared costs are attributed to individual UNEs by applying to these costs a ratio of extended TELRIC costs. Extended TELRIC costs serve as the common denominator to attribute costs among UNEs based on different measures of unit cost, e.g.., monthly cost per loop versus cost per minute of use. Extended TELRIC costs were computed by multiplying the TELRIC volume sensitive unit cost for each UNE by the forecasted 1997 demand in units for the UNE. For unbundled loops, Category 5 costs were first attributed to unbundled loop UNEs for each of the five Ameritech states based on the respective "extended TELRICs" of all unbundled loops in the particular state, divided by the "extended TELRICs" of all UNEs region wide. These state-specific, aggregate costs were then further assigned to each type of loop within the state, e.g., 2-wire analog, 4-wire analog, and ISDN, and among loops in each of the three access areas (B, C, and D) using an equal dollar amount per loop based on the forecasted relative number of loops for the state.

As for Category 6 shared costs, these costs were first divided between UNEs as a group and other AIIS wholesale products and services, based on the relative direct expenses of such categories within AIIS. The resulting shared costs assigned to UNEs as a group were then further attributed to individual UNEs in the same manner as Category 5 costs. Category 7 common costs were first divided between Ameritech's retail and wholesale businesses based either on measures of cost causation or the relative total expenses of the pertinent products and services, as applicable. The amount assigned to wholesale (AIIS) was then further attributed to UNEs in the same manner as shared wholesale costs in Category 6.

11.3 Common Cost Calculation and Allocation Modifications Ordered by PUCO

The PUCO in the TELRIC case ordered that the changes shown below should be made to the shared and common cost allocations originally submitted by Ameritech Ohio. Ameritech Ohio complied with the Commission order and revised its shared and common cost allocations accordingly.

- Reduce the joint cost pool by 20%.
- Recalculate TELRIC studies consistent with the Commission’s modifications and use the results to arrive at new extended TELRICs for the shared and common cost allocations.