I) A) SWITCH COST MODULE METHODOLOGY

A. Overview

The purpose of the study is to develop the Total Service Long Run Incremental Cost (TSLRIC) plus common cost of End Office switching, Tandem switching and Switching Cost per R1, B1 Access Line. The cost results were developed specific to EMBARQ and are only applicable for End Office Switching, Tandem Switching and Switching Cost per R1, B1 Access Line.

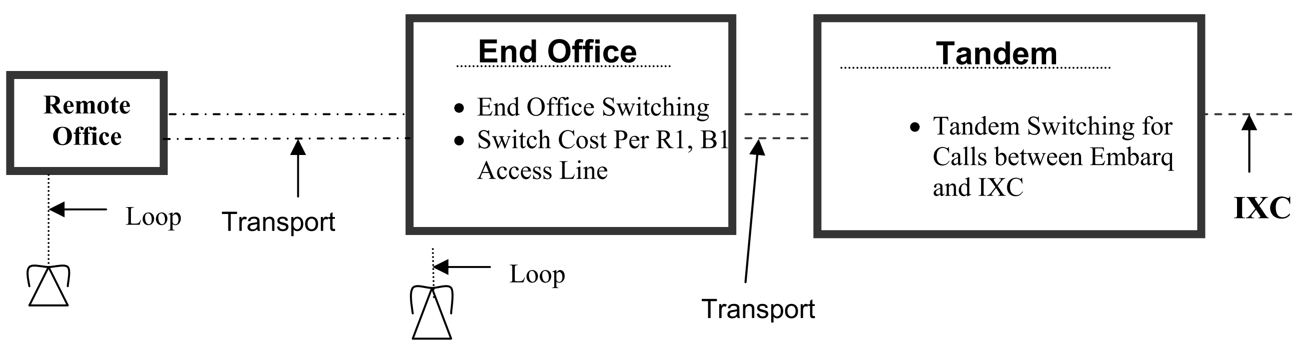
B. Introduction

The Switch Module develops the TSLRIC for switching. The switching cost development is based on the following key items, all of which are incorporated into the Switch Module:

- Utilize Forward Looking Technology
- Develop Digital Circuit Switching Equipment Investments
- Develop Digital Circuit Switching Component Costs
- Develop Switching Network Element Costs
- Use Existing LEC's Wire Centers

C. Switch Module

1. Network Element Diagram of Switch Costs



Switching elements included in the switching study:

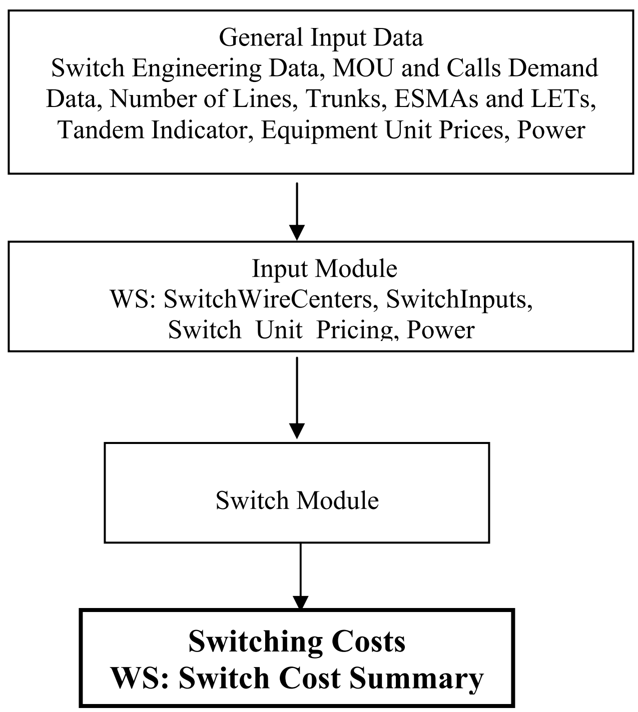
- End Office Switching
- Tandem Switching
- Switching Cost Per R1, B1 Access Line

2. Major Determinants of Cost

The major determinants of switching costs are:

1. Host and remote quantities
2. Access lines (host, remotes)
3. Line usage and call attempts
4. Trunk usage and trunk attempts

Inputs Module & Switch Module Flow Chart
(WS = Worksheet)



3. Switch Module Definition

The Switch Module calculates investments for switches and remotes based on company and central office specific data. The switch investments calculated provide the investment inputs used in the cost development portion of the Switch Module to calculate average switching costs. The Switch Module relies upon data populated in the Inputs Module. The detail network element diagram below identifies the major components of the switch and the specific cost category of the component. The categories are:

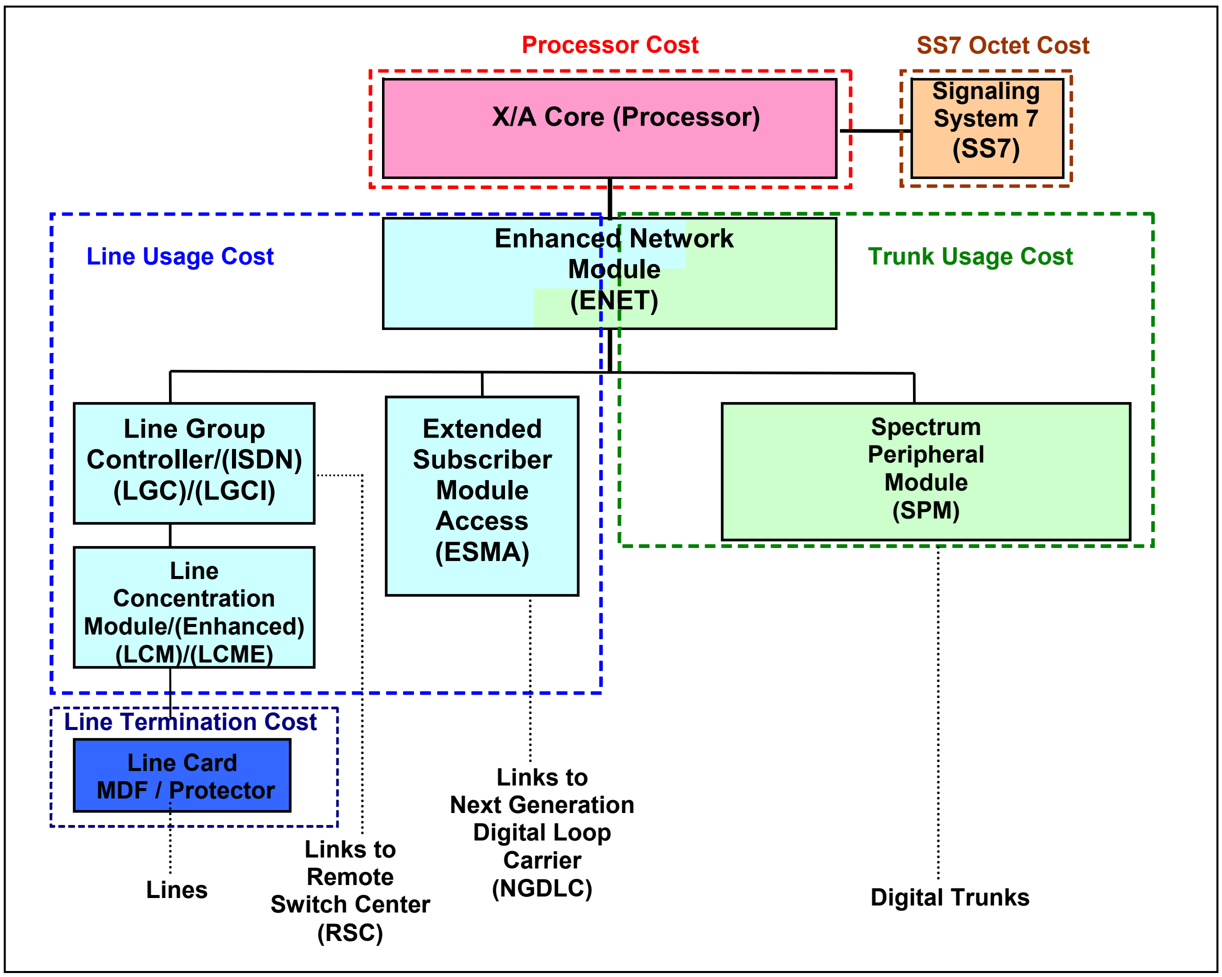
- Processor Cost
- Signaling System 7 (SS7) Octet Cost
- Line Usage Cost

- Trunk Usage Cost
- Line Termination Cost

The Switch Module develops costs for switching based on circuit switch technology. The following diagram represents the network elements for circuit switching.

4. Network Diagrams

Detail Network Element Diagram (Circuit)



5. Inputs Module - Switching

The inputs into the Switch Module are contained in several worksheets within the Inputs Module. The "Switch Wire Centers", "Switch Inputs", "Switch Unit Pricing" and "Power" worksheets contain information necessary to calculate switching investments and costs within the Switch Module.

- The "Switch Wire Centers" worksheet contains central office identification information such as CLLI, exchange name, and host or remote identifier. Inputs include minutes-of-use, call attempts, access lines, GR303 lines, busy hour usage, Extended Subscriber Module Access (ESMA) and LETs (DLC) counts, and trunk quantities.
- The "Switch Inputs" worksheet contains input for Engineered, Furnished and Installed (EF&I) factor, call set-up octets, summary of annual charge factors (ACF), common factor and sales tax. The fill factor input for Line Concentration Modules (LCM/LCME), Line Group Controllers (LGC/LGCI), Extended Subscriber Module Access (ESMA) and trunk Spectrum Peripheral Module (SPM) are included in this worksheet. Additional engineering limits for the Network Module (NM) are provided.
- The "Switch Unit Pricing" worksheet provides equipment descriptions and equipment unit costs.
- The "Power" worksheet contains the power matrix where power investment by network element is calculated.

6. Switch Module

The Switch Module calculates switch investments and then uses these investments to calculate costs.

<u>Investments</u>
The investment calculation outputs for switch complexes are done within several worksheets in the Switch Module, with the totals being posted to a "Summary" worksheet. The following worksheets within the Switch Module calculate the investments for switch equipment components.

1. LCM Calc (Line Concentration Module Calculation)
2. LGC Calc (Line Group Controller Calculation)
3. ESMA Calc (Extended Subscriber Module Access Calculation)
4. Trunk Calc (Trunk Calculation)
5. ENET Calc (Enhanced Network Calculation)
6. Central Processor Calc (Central Processor Calculation)
7. SS7 LPP Calc (Signaling System 7 Link Peripheral Processor Calculation)
8. Spares

9. Software

The "Investment" worksheet combines the host and remote equipment component investments including power, software, EF&I, and sales tax to calculate a total complex switching investment. Investments are categorized into the following:

1. Processor Investment - is the initial processor (XA-Core) investment and spares.
2. Line Termination Investment - this investment category reflects the cost of serving lines in an office. The investment components include the primary elements of line card, main distribution frame (MDF) and protector for analog and digital lines.
3. Line Usage Investment - is the investment associated with the line usage equipment including the LCM, LCME, LGC, LGCI, ESMA, ENET and spares.
4. Trunk Usage Investment - is the investment associated with the local trunk usage for interoffice calls that are recovered in the Trunk Usage category, which represents the trunk investments. This includes the SPM, DTC, ENET and spares.
5. Service Switching Point (SSP) - the investment for Link Peripheral Processor (LPP) providing Signaling System 7 (SS7) signaling capability at the end office or tandem switch.

<u>Costs</u>
Based on investments per central office complex, the Switch Module calculates costs for each switching component within the following worksheets.

1. Expenses – Converts the Investments to Costs per component.
2. Duration - Calculates the cost per line usage (LU) and trunk usage (TU) Per MOU.

7. Switch Module Functional Process

The following describes several major steps taken to generate switching investments and costs using the Switch Module.

<u>Step 1</u>: Input data by wire center complex, general switch fill factors, utilization factors and engineering data is required in the Inputs Module to be used to calculate the switch investments. These input worksheets are "Switch Wire Centers" and "Switch Inputs". These inputs are generally obtained from central office engineering and resources that provide wire center specific traffic and network design data.

<u>Step 2</u>: The Switch Module calculates investments which are converted to weighted average costs for each switching element. The investments include all

hardware investment in the central office and base load software required to provide basic switching functionality. Investments also include EF&I, sales tax, and an allocation of power. The average costs represent circuit technology.

Step 3: The demand data from the input file is summarized in the "Demand" worksheet and line side and trunk side minutes are categorized. The Switch Module calculates the monthly expense per investment category by multiplying the net switching investment by the appropriate forward-looking annual charge factor (ACF). This calculation is shown in the "Expenses" worksheet.

Step 4: The Switch Module calculates the duration cost per MOU by determining the total costs for line and trunk call types and dividing by the appropriate MOU (actual studied MOU demand). The result is a cost per MOU for both the line side and trunk side of the office. The calculations are shown in the "Duration" worksheet, and are the cost components for line usage (LU) and trunk usage (TU).

Applied where appropriate to calculate costs are EF&I, ACF, power, sales tax and common costs.

Step 5: The Switch Module program links the results of calculations completed in worksheets described in Steps 1-4 above into the following worksheet(s) for specific cost element calculations:

- Tandem Switching
- End Office Switching
- SW_Xport Cost Per Line

Step 6: Cost elements developed within the Switch Module are linked to summary/results worksheets.

II) A) TRANSPORT COST MODULE METHODOLOGY

A. Overview

The Embarq Transport Cost Module (TCM) studies are completed through a series of calculations that develop investment and cost for transmission facilities between Embarq's wire centers. The TCM builds a forward-looking, least cost, most efficient network using existing wire centers. A full description of the TCM and how it integrates with the Embarq Economic Cost Model (ECM) is provided below.

B. Introduction

TCM determines the Total Service Long Run Incremental Cost (TSLRIC) of interoffice transmission facilities associated with dedicated and common transport. The transport cost development is based on the several key criteria: 1) utilizes forward looking least cost technology, 2) is based on optical transmission equipment, 3) is capable of producing costs for OC3, OC12, OC48 and OC192 transport rings, and 4) reflects the use of existing Embarq wire centers. The TCM produces monthly fixed costs (fixed termination) and per mile costs including a common cost per MOU, access elements per MOU and multiplexing cost.

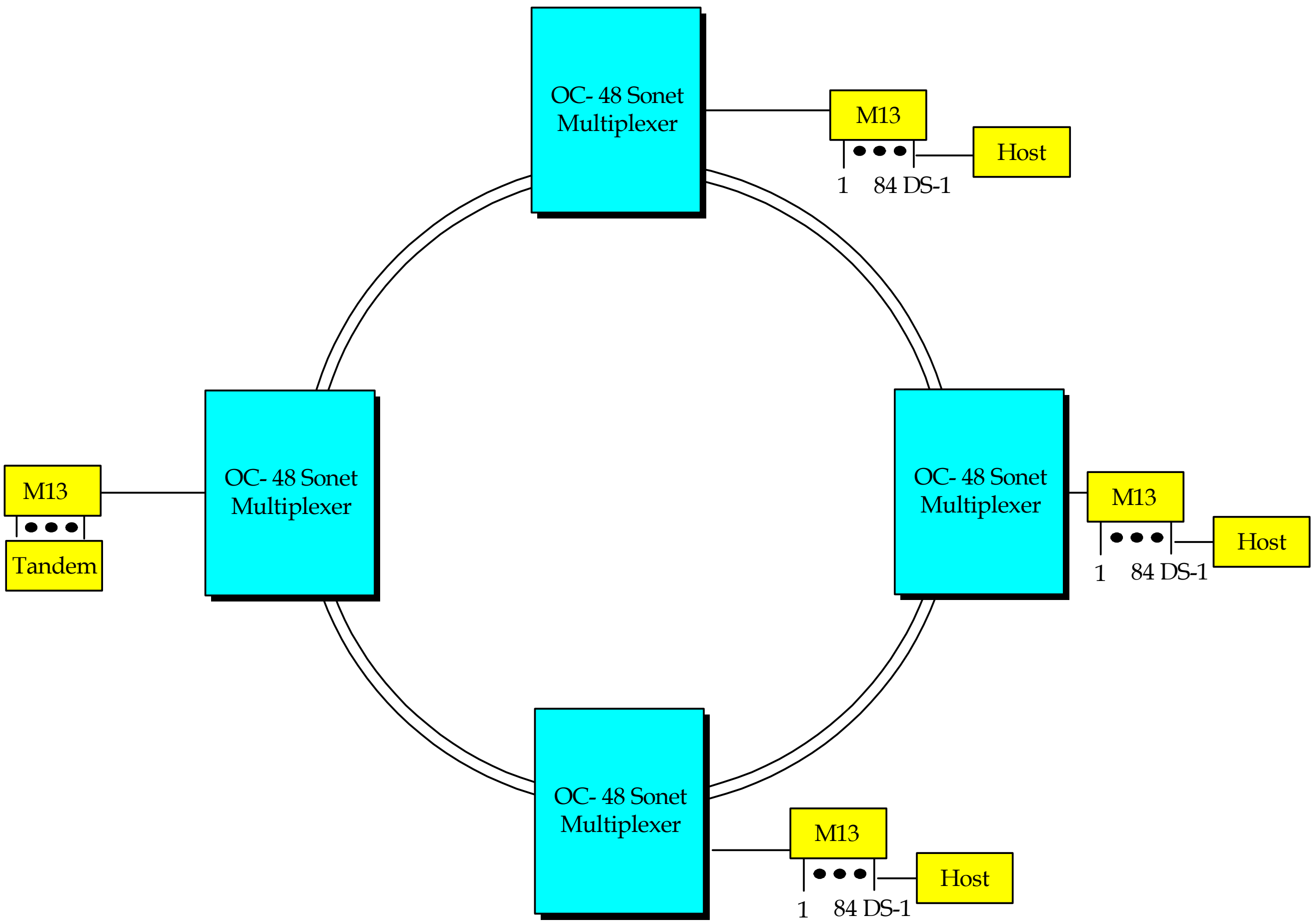
C. Transport Cost Module

1. Transport Definition

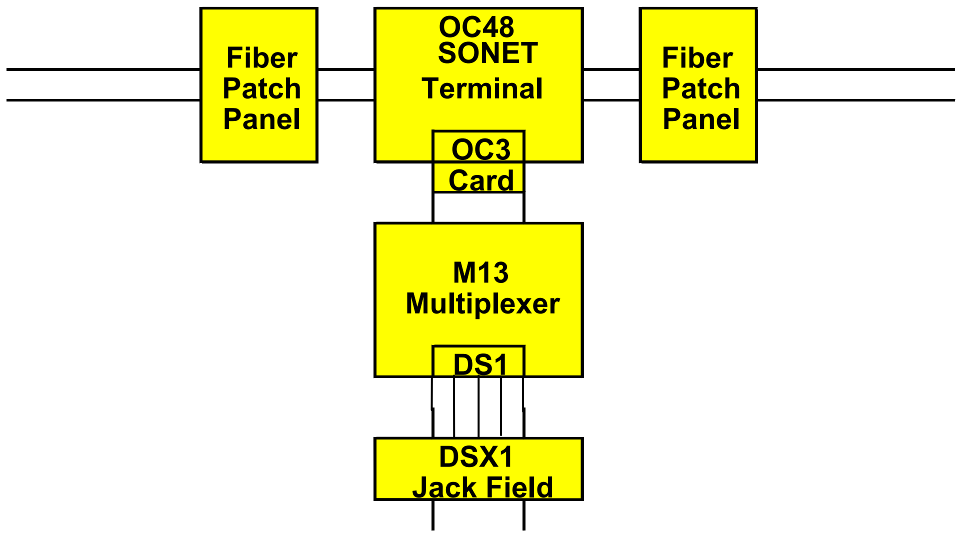
Tandem-switched transport means transport of traffic between the telephone company office containing the tandem switching equipment and the end office. Interoffice transport provides the transmission paths (facilities) between two ILEC's wire centers, including host to host and host to tandem locations. The interoffice transport cost elements include the fixed termination cost (includes both ends) and the per mile cost.

2. Detailed Transport Network Element Diagram

NETWORK RING DIAGRAM



Transport Cost Model Node Configuration



3. Multiplexing Definition

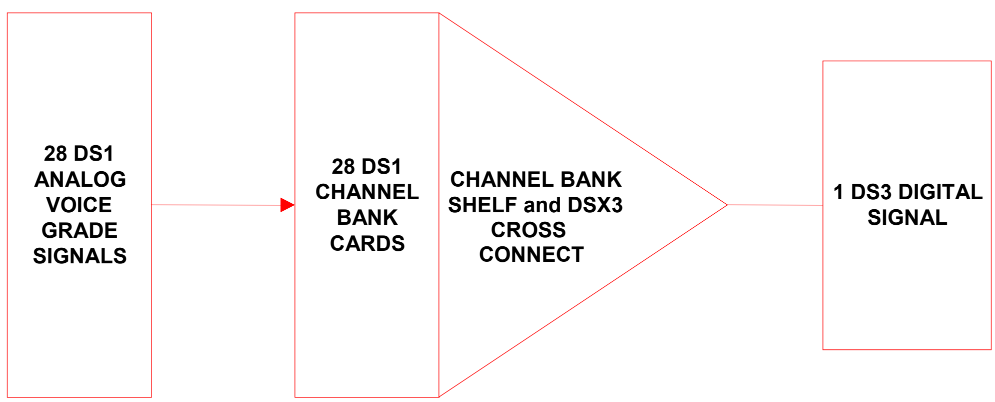
3/1 Multiplexer (M1/3)

A device which joins DS1 channels to combine them into a single 45 megabit per second stream. (The bit stream is actually 44.736 megabits). A 3/1 Multiplexer separates the bit stream of a DS3 into 28 DS1 channels. One DS3 cable, from a DS3 cross connect, is linked to this equipment and 28 DS1 channels are made available.

See following illustration.

Detailed Network Element Diagram

3/1 Multiplexer



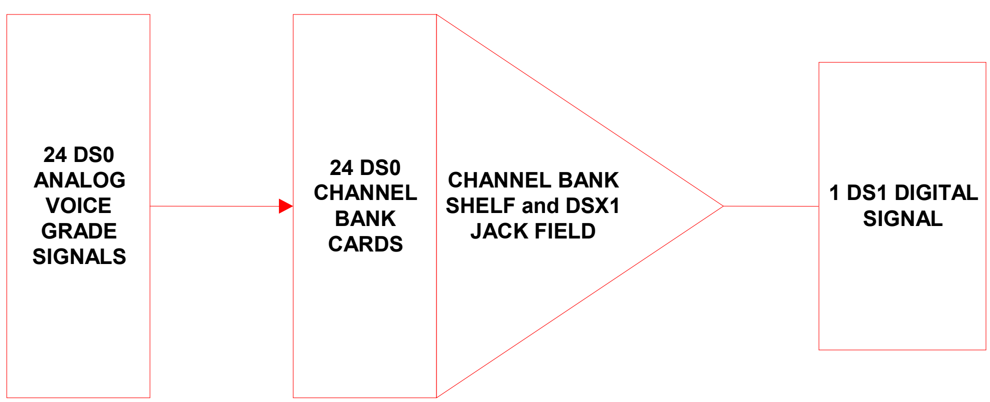
4. 1/0 Multiplexer

A device which combines multiple voice and/or data channels onto one high-speed link. A 1/0 Multiplexer takes 24 voice grade inputs and combines them into a single 1.544 megabit per second stream. (The bit stream is actually 1.544 megabits.)

See following illustration.

Detailed Network Element Diagram

1/0 Multiplexer



5. Major Determinants of Cost

The major determinants of cost in the TCM study are Engineered, Furnished and Installed (EF&I) investments, terminal bandwidth, utilization and mileage. EF&I Investment per Unit is the sum of Material, Engineering/Installation Labor and Sales Tax. The inputs to the transport cost study, which form the basis of the major determinants of cost, are presented in detail in the following Inputs Module section.

6. General Study Procedures

The transport cost study process contains five steps.

1) The first step in the transport cost study process is to review the interoffice fiber ring detail for the study area. This consists of reviewing interoffice drawings, fiber ring capacity data and fiber ring demand data.
2) The second step in the transport cost study process is to calculate the SONET terminal utilization percentage based on the capacity and total demand for circuits on each specific interoffice fiber ring.
3) The third step in the transport cost study process is to obtain the current terminating equipment material prices and labor hours from Embarq's network department and obtain the fiber cable material and labor costs that are supported by the loop cost study process.
4) The fourth step is to input the data as determined in Steps 1 – 3 into the TransInputs, TransTermConfig, TransTermMaterial, Trans Rings, M13 and Channel Bank tabs of the input file.
5) The fifth and final step is to run TCM which uses the specific worksheets in the Inputs file.

7. Inputs Module - Worksheets

a. <u>TransInputs</u>

The TransInputs worksheet includes sections for inputs of Termination Equipment, Mileage Equipment, Fiber Cable Investment, Annual Charge Factors and Miscellaneous Factors. The Annual Charge Factors, Common Cost Factor and Sales Tax Rate are calculated in the Annual Charge Factor Module. The Power Factor is calculated in the Power worksheet of the Inputs Module. Installed Fiber Investment per mile and Fiber Plant Mix factors are calculated in the Loop Module. The Material Investment and Engineering/Installation Labor are calculated and pulled from the TransTermConfig worksheet.

i. <u>Material Costs Terminal Equipment</u>

Material cost inputs include termination and mileage equipment costs. The Material column represents the total dollar investment amount for each piece of equipment itemized in the Termination Equipment column. The values for fiber tip cable and fiber patch panel are expressed on a "per fiber" basis. The terminal equipment investments represent the investment for the entire shelf and the common equipment. The related terminal card investments represent the cost per card by bandwidth option (DS1, DS3, OC3, OC12, and OC48). The material investment amounts have been developed by Embarq engineers familiar with Synchronous Optical Network (SONET) transmission equipment. SONET transmission equipment is the forward-looking, least cost transport network configuration utilized in the transport study. All investment amounts reflect Embarq's vendor costs for equipment configured for typical usage. Shipping and handling are included in the investment amount.

The Engineering/Installation Labor column for the fiber optic terminals represents the total dollar amount of engineering and installation labor for each terminal in the Terminal Equipment column. These were determined using engineering and installation hours for each piece of equipment as developed by Embarq Engineering based on actual work durations. State specific labor rates were applied to the work duration. Engineering work includes:

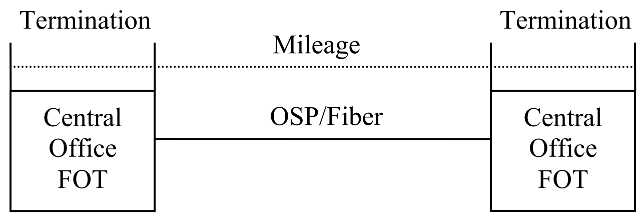
- project research
- prepare material estimate and order
- prepare installation drawings in NED (Network Document System)
- load equipment in CIRAS (Circuit Administration System)
- obtain any required assignments (i.e., IP addresses, alarm assignments, NNET (Network's Network) assignments) that are required to turn-up the new devices and the monitoring of the job through installation and project closing processes.

Installation labor reflects specific work activities for various types of central office equipment. Labor includes for example the following work activities:

- prepare and mount DS1 or DS3 panels
- install, terminate, test power and chassis ground
- wire wrap DSX
- install fan, cards, heat baffle
- download software
- provision and test equipment
- install relay rack, fuse panels, cable rack, fuse trays, slot cards
- run fiber jumper
- run and terminate cables
- travel time, inspect final job

The mileage equipment costs are developed in the Loop Cost Module and used in TCM.

TCM develops costs for two basic categories. The first category is termination cost which is comprised of fiber optic terminal equipment, and the associated equipment located in the central office. The second category is mileage cost which is comprised of outside plant fiber. The following drawing illustrates the two cost categories associated with transport in the network.



The following is a list of TCM inputs for termination cost:

- **Fiber Tip Cable**
  The fiber tip cable connects the SONET terminal to a fiber patch panel. These costs are included in the monthly termination costs calculated for all size SONET facilities.

- **Fiber Patch Panel**
  All fibers coming into or out of a SONET terminal are connected to a patch panel in the central office. These costs are included in the monthly termination costs calculated by the module for all size SONET facilities.

- **SONET Terminal Shelf (OC3)**
  The OC3 terminal line item includes the shelf, bay, transmitters, receivers, spares, cabling, and all other supporting equipment such as software used in a typical OC3 SONET terminal configuration. The costs associated with this item are included in the monthly termination costs for OC3 rings.

  <u>DS3 Interface Card (OC3 Terminal</u>) - is the card required to terminate traffic on an OC3 terminal at the DS3 bandwidth level. The costs associated with this item are included in the monthly termination costs per DS3 for an OC3 terminal.

  <u>DS1 Interface Card (OC3 Terminal)</u> - is the card required to terminate traffic on an OC3 terminal at the DS1 bandwidth level. The costs associated with this item are included in the monthly termination costs per DS1.

- **SONET Terminal Shelf (OC12)**
  The OC12 terminal line item includes the shelf, bay, transmitters, receivers, spares, cabling, and all other supporting equipment such as software used in a typical OC12 SONET terminal configuration. The costs associated with this item are included in the monthly termination costs for OC12 rings.

  OC3 interface Card (OC12) - is the card required to terminate traffic on an OC12 terminal at the OC3 bandwidth level. The costs associated with this card are included in the OC3 termination costs for OC12 rings.

  6 DS3 Card Interface Card (OC12) - is the DS3 card that is required to terminate traffic on an OC12 terminal at the DS3 bandwidth. The costs associated with this card are included in the DS3 termination costs for OC12 rings.

  DS1 Multiplexer (28 DS1s) - is required to terminate traffic on a DS1 bandwidth level. The associated costs are included in the monthly termination costs per DS1.

- **SONET Terminal Shelf (OC48)**
  The OC48 terminal line item includes the shelf, bay, transmitters, receivers, spares, cabling, and all other supporting equipment used in a typical OC48 SONET terminal configuration. The costs associated with this item are included in the monthly termination costs for the OC48 rings.

  OC12 Interface Card (OC48) - is the card required to terminate traffic on an OC48 terminal at the OC12 bandwidth level. The costs associated with this card are included in the OC12 termination costs for OC48 rings.

  4 OC3 Interface Card (OC48) - is the card required to terminate traffic on an OC48 terminal at the OC3 bandwidth level. The costs associated with this card are included in the OC3 termination costs for OC48 rings.

  12 DS3 Interface Card (OC48) - is the card required to terminate traffic on an OC48 terminal at the DS3 bandwidth level. The costs associated with this card are included in the DS3 termination costs for OC48 rings.

  DS1 Multiplexer (84 DS1s) - is required to terminate traffic on an OC48 or OC192 terminal at the DS1 bandwidth level. The associated costs are included in the DS1 termination costs for OC48 rings.

- **SONET Terminal Shelf (OC192)**
  The OC192 terminal line item includes the shelf, bay, transmitters, receivers, spares, cabling, and all other supporting equipment used in a typical OC192 SONET terminal configuration. The costs associated with this item are included in the termination costs for OC192 rings.

  OC48 Interface Card (OC192) - is the card required to terminate traffic on an OC192 terminal at the OC48 bandwidth level. The costs associated with this card are included in the OC48 termination costs for OC192 rings.

  8 OC12 Interface Card (OC192) - is the card required to terminate traffic on an OC192 terminal at the OC12 bandwidth level. The costs associated with this card are included in the OC12 termination costs for OC192 rings.

  8 OC3 Interface Card (OC192) - is the card required to terminate traffic on an OC192 terminal at the OC3 bandwidth level. The costs associated with this card are included in the OC3 termination costs for OC192 rings.

  SONET Terminal OC48 Interface for OC192 - the OC48 terminal line item includes the shelf, bay, transmitters, receivers, spares, cabling, and all other supporting equipment used in a typical OC48 SONET terminal configuration. The costs associated with this item are included in the termination cost at the DS3 and DS1 bandwidth level.

  24 DS3 Interface Card (OC192) - is the card required to terminate traffic on an OC192 terminal at the DS3 bandwidth level. The costs associated with this card are included in the DS3 termination costs for OC192 rings.

  DS1 Multiplexer (84 DS1s) - is required to terminate traffic on an OC48 or OC192 terminal at the DS1 bandwidth level. The associated costs are included in the DS1 termination costs for OC48 rings.

- **DSX3 Cross Connect Shelf**
  The Cross Connect Shelf item comprises all the common equipment of a DSX3 cross connect. This is used for arranging, rearranging, and testing circuits at the DS3 level.

  DSX3 Cross Connect Card – is the card used in the DSX3 cross connect which has a capacity of one DS3.

- **DSX1 Cross Connect Jack Field**
  The Cross Connect Jack Field is a cross connect used for arranging, rearranging, and testing circuits at the DS1 level. The entire cross connect used has a total capacity of 84 DS1s.

- **Channel Bank Shelf**
  The Channel Bank is required to convert digital signals to analog signals at the voice channel DS0 (64 kbps) level. The channel bank line item consists of the common equipment for providing DS0 circuits.

  Channel Bank Card - each DS0 requires one card in the channel bank. The input cost is representative of voice grade service.

ii. **Repeater Equipment**

Fiber Repeaters (OC3, OC12, OC48, OC192) – are optical regenerators used when the distance between terminals exceeds recommended limits. The need for regenerators is a ring specific input.

iii. **Installed Fiber Cable Investment per Mile**

Installed fiber cable investment per mile is calculated in the Loop Module.

iv. **Annual Charge Factors**

The annual charge factors are input from the ACF worksheet.

v. **Miscellaneous Factors**

The miscellaneous factors listed below are inputs to address various costs necessary to the development of the transport cost elements.

- Common Cost Factor – input from the ACF worksheet
- Power Factor – input from the Power worksheet, Inputs
- Fiber Mix – input from the Loop worksheet
  Aerial, Underground, Buried
- Sales Tax – input from the ACF worksheet
- DS1 Monthly MOU – Monthly minutes of use per DS1

vi. **Fixed and Per Mile Ratios**

- MultiRing Termination Ratio (DS1) and (DS3) – inputs calculated in the Fixed and Per Mile support file, MultiRing worksheet
- Route to Air Mile Ratio (DS1) and (DS3) – inputs calculated in the Fixed and Per Mile support file, Route to Air worksheet

- Miles per DS1 – input calculated in the Fixed and Per Mile support file, Miles per DS1 worksheet

b. **TransTermConfig**
The TransTermConfig worksheet configures the terminal equipment material investment for input into the TransInput, M13, and Channel_Bank worksheets by using unit investments provided in the TransTermMaterial List worksheet. The engineering and installation labor costs and labor time estimates provided by Network Engineers are state specific fully loaded labor rates calculated based on input from the Labor_Rates worksheet. The engineering and installation labor hours were determined using engineering and installation hours as developed by Embarq Engineering as typical work durations and are considered appropriate for this module.

c. **TransTermMaterial**
The TransTermMaterial worksheet is a master list of material, showing the part number, item description and unit cost. The material investment amounts have been developed with the assistance of Embarq engineers familiar with specific equipment. All investment amounts reflect Embarq's vendor costs for equipment configured for typical usage. Shipping and handling are state specific, and are included in the investment amount shown.

d. **Trans_Rings**
The Trans_Rings worksheet is used to input the configuration characteristics for each ring. Rings are designed using forward-looking plans and known traffic demand. The inputs include the following ring-specific information:

1. Ring Number - each ring is given a unique ring number.
2. Ring Name - each ring is assigned a unique ring name.
3. Ring Type - this input indicates the type of ring ("S" for a Self-healing Ring, or "F" for a folded ring). A self-healing ring design provides reliable and efficient network protection from cable cuts or node failures by transporting circuits over separate fiber routes between SONET terminal nodes. In a folded ring, circuits are transported over a single fiber route between two SONET terminals.
4. Terminal Size (OC3 - OC192) - this input identifies the terminal size for each ring. The model is capable of costing four terminal sizes: OC3, OC12, OC48 and OC192.
5. Ring Utilization - ring utilizations are developed using a ratio of actual traffic demand to total facility capacity. The utilization is then verified to determine if the ring bandwidth selected is within

6. Total Ring Miles - this input identifies the total ring miles for all segments in each ring.
7. Number of Repeaters - this input identifies the number of repeaters or regenerators utilized on the ring.
8. Avg. Number IX Systems per Cable - is a ring specific weighted average number of Inter-exchange Systems per fiber cable segment.
9. Number of Nodes - is the count of the number of fiber optic terminals (nodes) on each ring. A node is a wire center location on a ring with a fiber optic terminal.
10. Number of CLLIs - is the count of the total number of Common Language Location Identifier (CLLI) in each ring. The CLLI code is an 11-character geographic identifier that uniquely identifies the geographic location of wire centers.
11. Ring Configuration - the CLLI name for the beginning of each segment of each ring. This input also identifies the type of terminal connection: SONET Nodes (N), Fiber Pass Through (F) or Point of Connection (P).

e. M13

The 3/1 Multiplexer Inputs include Material Costs and Miscellaneous Factors. Material Costs and Miscellaneous Factors are inputs to the TCM.

I. Material Costs

The TransTermConfig worksheet configures the M13 multiplexing equipment material investment for input into the M13 worksheet by using unit investments provided in the TransTermMaterial List worksheet.

- Units Required is an input of the number of each piece of equipment that is required for the 3/1 Multiplexer.
- DS3 Capacity is the capacity amount of DS3s for each piece of equipment itemized in the Material Description column.
- The Unit Material Investment input column represents the total dollar investment amount for each piece of equipment itemized in the Material Description column from the TransTermConfig worksheet.

II. Description of Equipment: 3/1 Multiplexer – Per DS3

A 3/1 Multiplexer separates the bit stream of a DS3 into 28 DS1 channels. One DS3 cable, from a DS3 cross connect, is linked to this equipment and 28 DS1 channels are made available. See Diagram D.3.

III. <u>3/1 Multiplexer Miscellaneous Factors</u>

Miscellaneous Factors are inputs to address the following:

- Power Factor: The power factor is based on the ratio of allocated power investment to support circuit investment based on the ratio of circuit investment to total central office equipment investment. The Power Factor is calculated in the Power worksheet within the Input Module.
- Sales Tax Rate: This percentage is the state specific sales tax. Application of the sales tax to material only or material and labor is also an input.
- The Engineering and Installation Labor Rates are state specific fully loaded labor rates. The Engineering and Installation Labor Hours were determined using engineering and installation hours for a 3/1 Multiplexer per DS3 as developed by Embarq Engineering as typical work durations and are considered appropriate for this module.
- The Annual Charge Factors are calculated in the Annual Charge Factor Module.

f. <u>Channel Bank</u>

The 1/0 Multiplexer Inputs include Material Costs and Miscellaneous Factors. Material Costs and Miscellaneous Factors are inputs to the TCM Module.

I. <u>Material Costs</u>

The TransTermConfig worksheet configures the 1/0 multiplexing equipment material investment for input into the Channel Bank worksheet by using unit investments provided in the TransTermMaterial List worksheet.

- Units Required is an input of the number of each piece of equipment that is required for the following: MUX 1/0 Common Equipment and Channel Units.
- DS1 Capacity is the capacity amount of DS1s for each piece of equipment itemized in the Material Description column.
- The Unit Material Investment input column represents the total dollar investment amount for each piece of equipment itemized in the Material Description column from the TransTermConfig worksheet.

II. <u>Engineering and Installation Labor Rates</u>

The Engineering and Installation Labor Rates are state specific fully loaded labor rates. The Engineering and Installation Labor Hours were determined using engineering and installation hours for the MUX 1/0 Common Equipment and D4 Channel Unit as developed by Embarq Engineering as typical work durations and are considered appropriate for this module.

III. <u>Description of Equipment: 1/0 Multiplexer</u>

The 1/0 Multiplexer is used to multiplex 1 DS1 digital signal into 24 DS0 analog voice grade signals. One 1/0 Multiplexer accepts one DS1. Each end office DSO termination requires one 1/0 Multiplexer card. See Diagram D.4.

IV. <u>Miscellaneous Factors</u>

Miscellaneous Factors are inputs to address a variety of factors and caps.

- Common Cost Factor – input from the ACF Module.
- Power Factor: The power factor is based on the ratio of allocated power investment to support circuit investment based on the ratio of circuit investment to total central office equipment investment. The Power Factor is calculated in the Power worksheet within the Input Module.
- Sales Tax Rate: This input is the state specific sales tax. Application of the sales tax to material only or material and labor is also an input. Sales Tax Rates are inputs from the ACF Module.
- The Annual Charge Factors are calculated in the Annual Charge Factor Module.

8. Transport Cost Module (TCM) - Worksheets

a. <u>Introduction</u>

The Introduction worksheet is a title page providing the module name, workbook name, worksheet names and the worksheet content.

b. <u>Summary</u>

The Summary worksheet provides the final monthly cost results for: Intrastate Access per Minute of Use, Dedicated Termination and per Mile, Common Cost per Minute of Use.

c. <u>Termination Costs</u>

This Termination Costs worksheet converts total utilized investment for each type of transmission equipment into a cost per DS1. The following is an illustration of the calculation:

*Equipment Component Investment / DS1 Capacity / Utilization Factor * (1 + Power Factor) * Annual Charge Factor = Annual Cost per DS1 by Equipment Component*

The termination costs are weighted based on the total working DS1s and applied with the Multi Ring Termination Ratio to develop a monthly fixed cost for two terminations per DS1 and DS3.

d. Mileage Costs

The Mileage Costs worksheet determines the mileage cost of a ring using the information in the Unit Inputs worksheet. Total annual investment per mile and total annual cost per mile for DS1, and DS3 transport are calculated by bandwidth. The ring costs per mile are weighted on working DS1s times total ring miles. The route to air mile ratio is applied to convert the route mileage cost for DS1 and DS3 monthly cost to a per airline mile cost.

e. Total Ring Costs

The Ring Costs worksheet determines the total monthly cost on each ring using the information in the Termination Costs and Mileage Costs worksheets.

f. Unit Inputs

The Unit Inputs worksheet provides the calculation of the EF&I Investment per Unit. This calculation is based on material cost, engineering and labor and sales tax inputs from the TransInputs worksheet in the Inputs file. The DS1 System Capacity, Utilization Factor, Card Counts & Terminal Counts, and Number of Fibers per Node are shown in several columns for each of the following equipment types and subcomponents:

Material

- Fiber Tip Cable
- Fiber Patch Panel
- SONET Terminal Shelf (OC3, OC12, OC48, OC192)
  - Interface Cards (DS3, OC3, OC12, OC48)
  - DS1 Multiplexer
- DSX3 Cross Connect Shelf
- DSX3 Cross Connect Card
- DSX1 Cross Connect Jack Field
- Channel Bank Shelf
- Channel Bank Card

The EF&I Investment per Unit for repeater equipment are calculated including sales tax based on inputs from the TransInputs worksheet. The calculation of the weighted installed fiber investment per mile is completed in this worksheet based on fiber mix for aerial, underground and buried fiber types.

Several other factors from the TransInputs worksheet that are used in the TCM are shown in summary from the Unit Inputs worksheet. The factors include:

- Annual Charge Factors
- Common Cost Factor
- Power Factor

- Sales Tax Rate
- DS1 Monthly MOU
- MultiRing and Route to Air Ratios

g. **Investment Summary**

The Investment Summary worksheet calculates the investment for circuit electronics for each ring. These are totaled to produce the total investment in circuit equipment associated with the transport network.

NOTE: Ring characteristics are listed at the beginning of the Termination Costs, Mileage Costs, Total Ring Costs and Investment Summary worksheets in the TCM. These ring characteristics reference key inputs contained or used in calculations within that particular worksheet.

Inputs used for ring characteristics include:

1. Ring Name
2. Ring Type (Self Healing Ring/Folded Ring)
3. Terminal Size (OC3, OC12, OC48, OC192)
4. Ring Utilization
5. Total Ring Miles
6. Number of Repeaters
7. Average Number of IX Systems per Cable
8. Number of Nodes (Terminals)
9. Number of CLLIs

h. **Channel Bank**

MUX 1/0 Common Equipment Monthly Cost

i. **M13**

M 1/3 Multiplexer - Per DS3 Monthly Cost

9. Results

The TCM calculates the monthly recurring cost of Intrastate Access per Minute of Use, Dedicated Termination and per Mile, Access Elements, Common Cost per Minute of Use, 3/1 multiplexer and a 1/0 multiplexer; all without common costs and with common costs.

III) A) LOOP COST MODULE METHODOLOGY

Overview

The Embarq Loop Module investment studies are completed through a series of calculations that result in investments by service and by loop type for each wire center. The Loop Module (LM) is a state-of-the-art, outside plant modeling tool that builds a highly efficient, least-cost technology, forward-looking network and applies material and labor costs to determine loop investments. These investments are then fed into other modules of the Embarq Economic Cost Model (ECM), where cost is calculated. A full description of the LM, and how it fits into the ECM, is provided below.

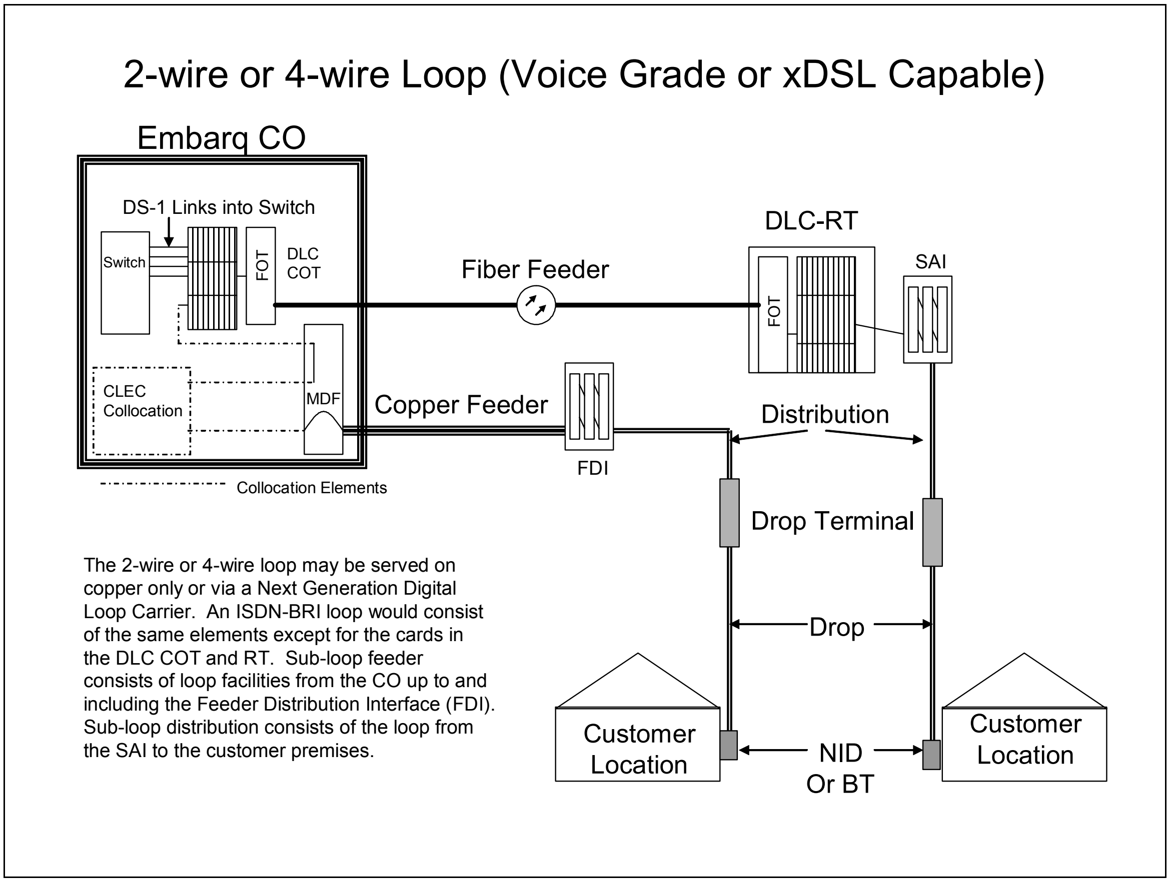
Introduction

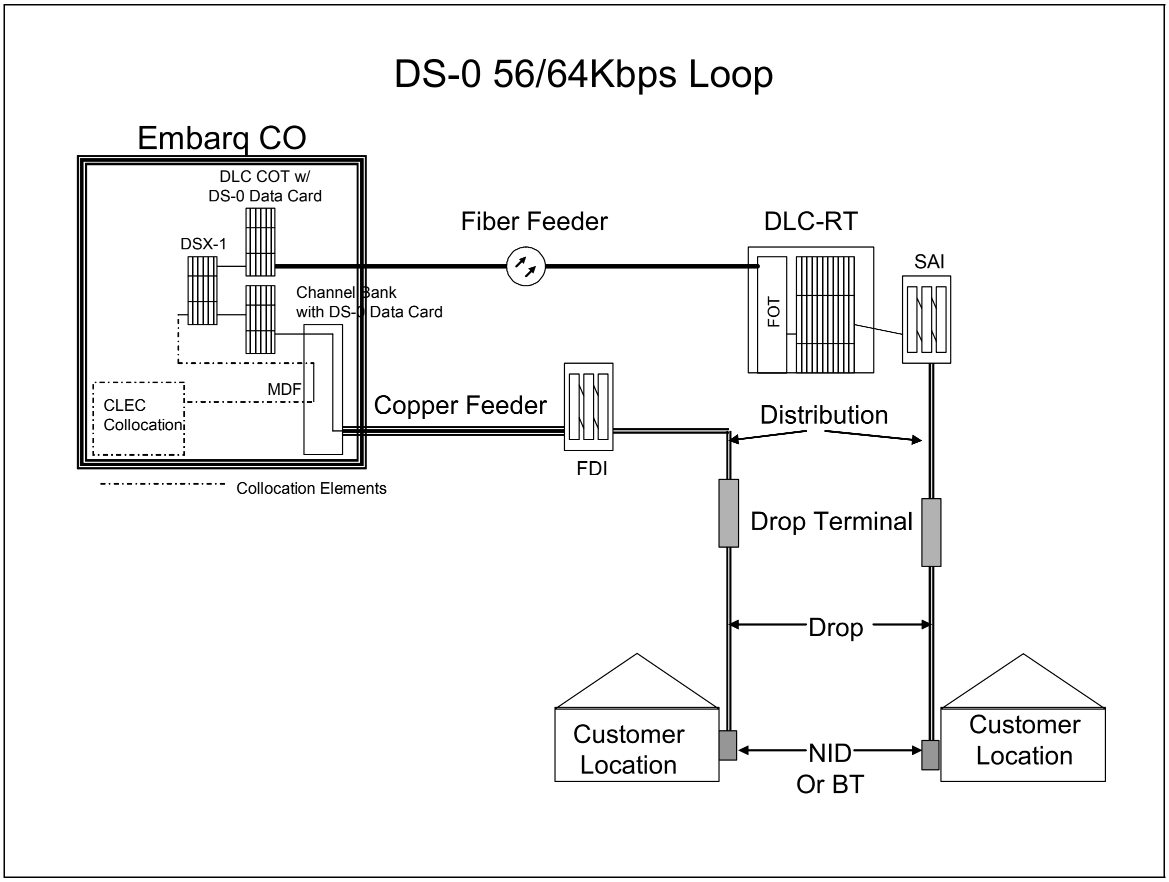
The LM is a next-generation, investment-development calculator for telecommunications outside plant and loop circuit equipment costs. This Loop Module is comprised of a Geographic sub-Module (GM) and a series of Microsoft Excel worksheets. The first step in the overall modeling process is the preparation of a map file that includes geocoded customer locations for all services by service address. A geocode is a geographical code used to identify a point or area at the surface of the earth. This mapped customer location file becomes a key input file for the Geographic sub-module. Within the Geographic sub-module, drop and building terminals are placed to serve the geocoded customer locations, after which optimized cable routes are built from the customer locations to the Feeder Distribution Interface (FDI), then to the Next Generation Digital Loop Carrier (DLC), and finally to the Central Office (CO) using a Minimum Spanning Road Tree (MSRT) routing. Remote DLC terminals and FDIs are optimally placed based upon industry standard carrier serving area (CSA) design. Within the Excel workbooks, demand quantities are calculated for each segment of plant, and material and labor costs are applied to the cable segments and other network components, to calculate forward-looking investments. The investment results are based upon a least-cost, most technically efficient design. The investment results reflect what Embarq would expect to incur on a forward-looking basis for rebuilding its outside plant network were it all to be done today. When used in conjunction with Embarq's other investment and cost calculators, costs for an entire local exchange network may be ascertained.

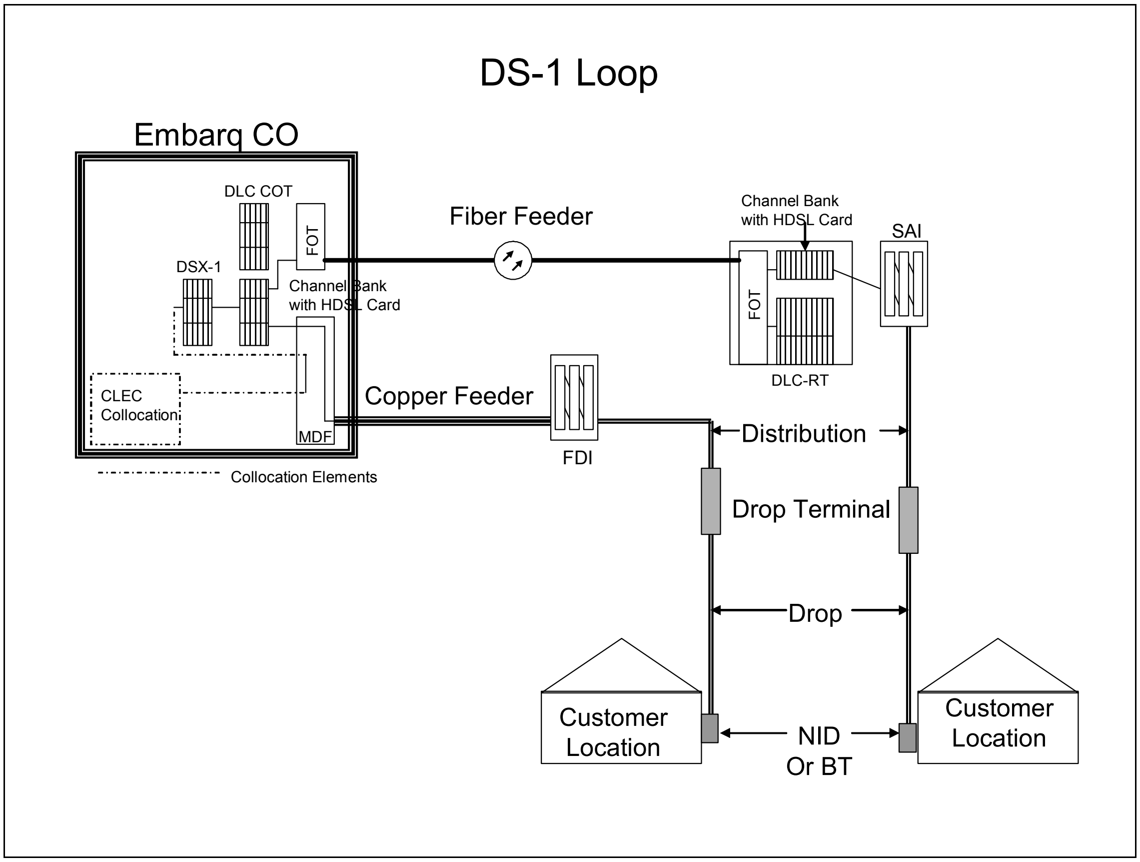
Network Element Diagrams

All loop elements DS-1 level and below have the same basic form. From the central office, the loop passes through the main distribution frame (or central office terminal) and proceeds along a copper feeder route to the FDI for an all-copper route, or along a fiber feeder route to the DLC and then on copper feeder to the FDI for a combined fiber and copper route. From the FDI, the loop continues along a distribution route to a drop terminal (DT), which connects the distribution facility to the drop, or directly to a Building Terminal (BT). The drop extends from the DT to the customer premises Network Interface Device (NID). All routing between these points are optimized using a road constrained minimum spanning tree.

Following are diagrams that depict voice grade loops, DS-0 56/64K loops, and DS-1 loops.




DS-0 56/64Kbps Loop
Embarq CO
DLC COT w/
DS-0 Data Card
DSX-1
Channel Bank
with DS-0 Data Card
MDF
CLEC
Collocation
Collocation Elements
Fiber Feeder
DLC-RT
FOT
SAI
Copper Feeder
FDI
Distribution
Drop Terminal
Drop
Customer
Location
Customer
Location
NID
Or BT



Determinants of Investment

Loop investment is a function of customer density, distance from the central office, terrain, weather, local market conditions, material costs, and loop type. Each variable is explained below.

Customer Density

Customer density is the single largest factor impacting the cost of local loops. Customer density is commonly expressed in terms of customers or access lines per square mile. The density of customers impacts loop cost in an inverse manner: the higher the customer density, the lower the incremental cost of the local loop. This relationship is linked to a few fundamental facilities, such as the requirement for a trench, conduit or aerial pole route regardless of whether a 25 pair or 2400 pair cable is placed. It is readily apparent that the greater the customer density, the more customers that can be served along a feeder or distribution cable route. Therefore, customer density ultimately determines how many customers or loops there are among which to spread the cost of digging a trench, placing conduit and/or placing an aerial pole line.

Customer density also drives the unit cost of other equipment components associated with loops. Loop components such as Feeder Distribution Interface (FDI), Digital Loop Carrier (DLC) devices, and Drop Terminals (DT), as examples, are all similarly impacted by customer density and exhibit lower per unit costs as customer density increases.

Structure type, or plant type, has a major impact on the cost of loops. Embarq researched its network databases and developed per foot installation costs for all plant types. Embarq also varies structure inputs by density zone, due to the fact that different work activities will occur in a rural area compared to an urban area. For example, more sidewalks and streets must be dealt with in an urban area compared to a rural area. The more obstacles encountered when installing cable, the greater the cost.

Distance

The distance of a given customer location from the central office directly increases loop costs as the distance increases. This relationship results from the obvious need to place more cable, trenches, conduit and/or aerial pole lines as the distance or length of the loop increases. Loops over 12,000 feet require the addition of digital loop carrier equipment. Distance adjusts the required investment regardless of changes in customer density or terrain. As distance increases, it generally increases the overall cost and need for maintenance. Assuming constant customer density, longer cables have more splice points and resulting exposure to risk. Greater numbers of splice points means there are more areas for possible failure due to lightning, water, rodents, vandalism, and accidents.

Terrain

The type of terrain in which cable is placed impacts both the cost of the initial cable placement and the maintenance of the cable. The cost of below ground cable construction increases with the presence of rock or water within the placement depth, the hardness of the rock encountered, or a soil type that interferes with normal placement. Terrain factors such as the depth of the water table, the slope of the ground, dense tree areas, lakes, rivers, mountains, etc. all affect both the initial construction cost of loops and subsequent maintenance expense.

Weather

The extremes of weather affect the cost of maintaining cable, and therefore, figure significantly into the type of cable placed (buried, aerial or underground). The cost of maintaining aerial plant in geographic areas that frequently experience ice storms or tropical hurricanes is certainly greater than in those areas that seldom encounter these conditions.

Local Market Conditions

Issues such as local zoning laws requiring below-ground plant, screening and landscaping around FDI and DLC sites, construction permits and restrictions, heavy presence of concrete and asphalt, traffic flows, and local labor costs all impact the construction and maintenance costs of loop plant and will vary among locations.

Material Costs
Embarq uses current vendor material costs for cable and electronics. Material costs are a determinant of the cost of the network in that they are the basic components that make up the network, such as those for cable, DLCs, multiplexers, FDIs, drop terminals, and drops.

Module Overview

The Loop Module (LM) calculates investments for all loop plant items from the NID or building terminal at the customer premises to the DLC and SONET equipment in the central office. The LM uses a series of calculations to develop loop investments. Geographic data as well as material and labor data are fed into the worksheets, which triggers calculations to be performed that build the network and apply material and labor investments. The LM workbooks and the Geographical sub-module utilize current telecommunications industry standard engineering criteria for carrier serving area (CSA) design. This design uses 12,000 feet of cable to provide voice grade and higher bandwidth services. Embarq uses engineering criteria and design standards when building its own network that are consistent with the industry standard practices. The GM identifies the locations of the drop and building terminals. From there, it produces the optimized routing to connect all terminals with their respective Feeder Distribution Interfaces (FDIs). It then optimizes the copper feeder cable routes from the FDI to either the Central Office (if within the CO CSA), or the DLC for all other CSAs. Optimal fiber feeder routes are then built from the DLC to the CO.

CSA Design
Carrier Serving Area (CSA) design is the national standard used by carriers to design and build the network and by manufacturers to build electronics equipment to provision the network. CSA design underlies the technical criteria for ISDN and xDSL services such as ADSL and HDSL.

CSA design includes the use of a remote terminal (RT) within the CSA that was connected by carrier to a Central Office Carrier Terminal (COT). This would make all loops appear to the CO switch as if they were within the 12k ft. limit, and give every customer access to higher speed data. The remote terminals used in the LM are fiber-fed to comply with forward-looking standards.

Loop Module Structure

Two modules make up the development process for loop investment - the GM and the LM. The GM is an automated process that develops geographically related input data for the LM. The GM is run using MapInfo software. The LM contains Excel workbooks that accumulate units and calculate loop investment for all loop elements. The LM uses a combination of Microsoft Access and Microsoft Excel. Data are stored or moved between workbooks with MS Access.

Customer Location and Cable Routing Methodologies

The customer location methodology used within the GM and LM utilizes actual CO locations, actual wire center boundaries, optimized CSA boundaries, optimized DLC and FDI locations, and actual customer locations within each Embarq wire center.

Customer geocoding uses data from Embarq's billing systems, data from publicly available sources, and MapInfo MapMarker software to geocode customer locations. Customers that did not meet at least a "ZIP+4" (5-digit zip code plus the four appended address digits) address status were given surrogate locations. These geocoded locations are then used to determine the placement of drop and building terminals.

Algorithms for building the local network were developed by Stopwatch Maps using logic they call "Minimum Spanning Road Tree" (MSRT), which builds optimized feeder and distribution routes along roads. The MSRT is based on the generally accepted Minimum Spanning Tree (MST) logic that calculates the shortest distance required to connect a series of points. MSRT connects all customer points to the applicable FDI, the FDI to its DLC, and the DLC to the CO using MST logic with an additional constraint that all pathing must follow roads. Local exchange networks, including Embarq's, contain cable routing along roads to provide the least-cost access to the physical plant. The result is a network that is forward-looking, least-cost, highly efficient, and follows current plant design parameters.

Surrogation Process

For any customer service point that falls outside of the GM's strict first requirement for placement, the GM establishes a surrogate location. The goal of the surrogation process is to place these customer service points at a location that is reasonably approximate to the location expected to serve the customer. The surrogate locations are placed in expected areas using a combination of actual Census Block residential household data and Dun & Bradstreet business data within the Census Block.

Cable Routing

Once all customer locations are assigned, the next step is building the network. The network is built from the customer location to the central office starting at the NID, then the drop, drop terminal, distribution cables, Feeder Distribution Interface (FDI), copper feeder cables, fiber feeder cable, and finally the central office. In a distribution area (DA), customer locations are connected to distribution or building terminals (DTs or BTs). The DTs or BTs are connected to the FDI with distribution cable. To model the DA, the GM must first generate and place the DTs and BTs and connect them to their customer locations. Next, the GM must determine, for each DT or BT, the FDI from which it is to be served. Within each CSA, the GM determines the FDI to which a DT or BT belongs by determining the shortest road path from that DT or BT point to any FDI of that CSA.

Once the GM establishes each distribution area within a CSA, the distribution cables are routed from each FDI to all the DTs and BTs that FDI serves. This routing is also strictly along roads. This process of efficiently determining the cable routes is referred to it as a Minimum Spanning Road Tree (MSRT).

Terminal Placement
The GM is responsible for placing the Distribution Terminals (DTs) and Building Terminals (BT) that feed the service locations for a wire center. A DT typically serves up to eight service locations and is located in close proximity to those service locations. Each service location is connected to a DT by a drop that, to meet loop transmission requirements, is no more than 500 ft. in length. DTs are in turn fed by distribution cable that originates at an FDI.

Feeder and Distribution Routing
After the DTs and BTs have been placed and assigned to customers, the GM must route the feeder and distribution cable for the wire center. The DTs and BTs are connected to an FDI via distribution cable. The FDIs are connected to a DLC by copper feeder cable. For the Carrier Serving Area around the CO (the CO CSA), the FDIs are connected directly to the CO with copper feeder cable. And finally, the DLCs are connected to the CO by fiber feeder cable.

Interoffice Routes
In addition to feeder and distribution cable, the GM calculates cable lengths *between* central offices through inter-exchange cable routing. The offices to be connected are specified and geocoded points established at boundaries indicating the actual crossing point of inter-exchange cable from this wire center's CO to the connected wire center. This location record is similar to a customer location, but contains a unique "class of service" indicator and the quantity of fibers that route between the offices.

Geo-processing Results
The result of the GM processing is a series of tables with customer location data and network component data. Within the Service Locations table, a service location represents a single structure having one or more customers. Customers (and their lines) are rolled up by address during pre-processing to produce these service locations. The Outside Plant Elements table is a MapInfo table with point objects representing the location of the outside plant elements for a wire center. Elements that appear in this table include the CO switch location, DLCs, FDIs, and feeder and inter-exchange routing points.

Records in the results are interrelated to designate each segment or element in the distribution and feeder cable paths that connect the customer to the CO switch. Every element is assigned a number. The next segment in line toward the central office that it connects to is its parent. Each record includes the field side element and the segment of cable on its CO side. The parent/child relationships for each element can be identified to trace a cable route and identify the characteristics of each segment of the cable route. The record for a CO switch does not have a parent element because it is at the top of the network hierarchy. In turn, the very last terminal on a distribution leg has no child since it is at the very end. Often a cable path splits into multiple directions to reach its target elements. Such splits are represented by an element record called a splice. Splice records are necessary to denote the location cable splits and indicate where service counts are aggregated.

A pictorial example will help explain the relationship. In this example, five elements are depicted. An FDI has a section of cable that ends in a splice. Two distribution cables exit the splice. One cable segment ends at a distribution terminal. The other segment ends at a distribution terminal which, in turn has another segment of cable with its distribution terminal.

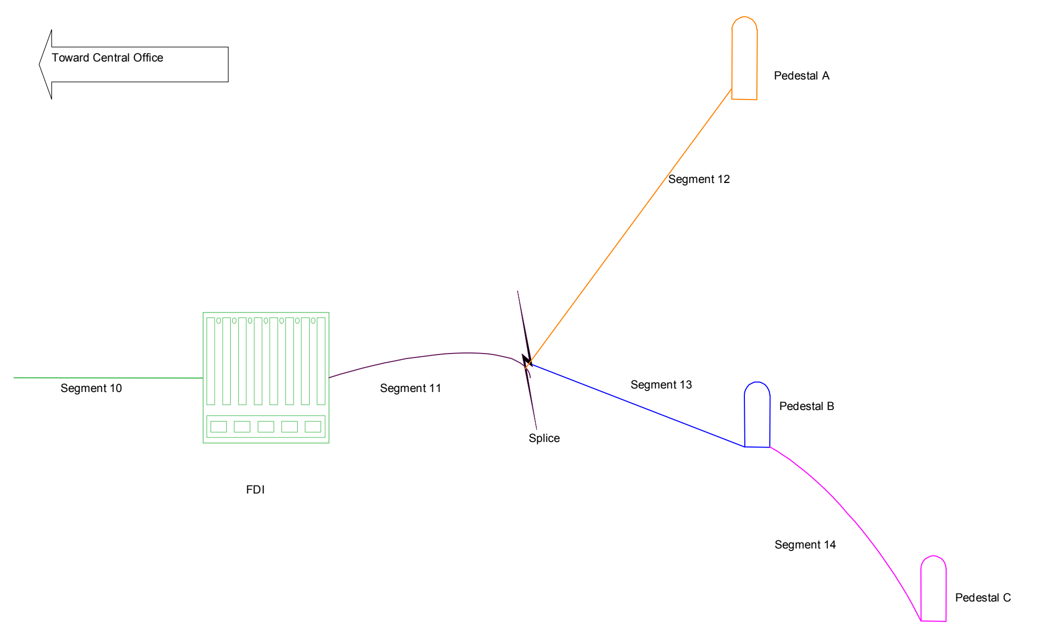


Figure 1

Segment 10 is a segment of cable ending with the FDI. Segment 11 is a segment of cable ending with a splice. Segment 10 is the parent of 11. Segment 11 is the child of segment 10 and the parent of both segment 12 and segment 13. Segments 12 and 14 are children but have nothing to parent.

Loop Module Organization

Once the GM has completed its processing, the results are fed into a Microsoft Access database. During the investment processing, the results of the GM are queried by wire center, and fed into Microsoft Excel templates, where investments are calculated for each cable segment and the attached item of plant if present. (Splices, routing points, and interexchange points have no plant items attached to the cable segment.) Once investments are calculated, they are passed to other modules within the ECM for costing.

The LM pulls in both data from the GM processing, and data from the cost and assumption input files. The GM output contains a row of data for each cable segment and attached plant item in the wire center. That data is entered into a tab in various loop workbooks used to calculate the investment for each item, the demand placed on that segment and item either from itself or all of its accumulated children, and ultimately the total loop investment associated with each service class in the wire center. The loop assumption input file contains inputs related to material prices, labor prices, and factors related to plant mix and plant utilization. Excel workbooks are organized with multiple worksheet tabs. These workbooks are processed automatically in sequence by the LM as it steps through the investment modeling procedure.

LM Input

An overview of the types of inputs used within the model is presented below to complete the discussion of how the model is organized. Inputs for each scenario are stored in MS Access and pasted into the workbooks as needed during model processing.

Loop Cost Inputs

Material costs for drop, NID, terminals, copper and fiber cable, indoor and outdoor FDIs, and the strand for hanging aerial cable are contained here. Inputs for cable, NID, and FDI include labor for installation and engineering.

Structure

Structure represents the cost of the trench, conduit system, or pole line where the copper or fiber cable runs. The inputs related to burial activities, trenching for conduit systems, and cost of poles are developed here.

Manholes

Manholes inputs account for material costs for various sized handholes, manholes and conduit. Labor for engineering and installation are included in the inputs. The LM selects the appropriate sized manhole based on the number of ducts needed for the route.

Spacing
The table contains the average spacing between manholes, poles, and anchors.

Percentages
Inputs related to the proportion of plant that is aerial, buried, or underground are contained here. Inputs related to cable utilization are also presented.

Miscellaneous Inputs
This tab contains a series of individual input values for key assumptions such as cable placement depth, electronic fill, maximum system and cable sizes, etc. These values were set in the input phase of the process and are pulled from the comparable values in the input module.

Miscellaneous Tables
The tables found within this tab contain data relating to the sizing of SONET systems and DLC cabinets, capacity and configuration of DS-1 channel banks within the DLC cabinet, labor hours for installs, and the pair and bandwidth requirements for each of the circuit types. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Unit By Density Tables
This tab contains tables that designate cost for any given plant unit by size and by density. Sizing and costs are included for items such as fiber and copper cable, drop terminals, drops, NIDs, and indoor and outdoor FDIs. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Density By Unit Tables
The tables within this tab contain factors used to configure the loop network such as cable fill, plant mix (aerial, buried, or underground), pole and manhole spacing, and structure costs by surface condition. All tables contain values that vary by density. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Fixed Tables
The tables within this tab contain tables that relate: 1) The many soil types to a placement difficulty indicator (0 is normal and 1 is difficult); 2) The density to a reference column for lookups in other tables, and 3) Central office information to the wire center reference number. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Master Price List

The Master Price List is used by the loop module and transport module for material costs related to DLCs, channel banks, and SONET terminals. This table is pasted into the loop module as needed and the data is aggregated into functional DLCs, channel banks, and SONET terminals based on vendor specific configurations that Embarq deploys in its network.

Loop Plant Methodology

The LM calculates investments for all loop plant items from the NID or building terminal at the customer premises to the DLC and SONET equipment in the central office.

Accumulations of Distance and Service Counts by Segment

All accumulations are based on the segment identifier number and parent-identifying number developed by the GM and input into the respective data tabs of the LM workbooks.

Distances

The data transferred into the LM from the GM contains the length of each cable segment. To determine the total loop lengths, feeder lengths, or distribution lengths, these segment distances are accumulated from the appropriate starting parent through any intermediate segments that occur in the specific segment's lineage to it. The starting parent is the CO for any fiber feeder serving DLCs, customer SONET locations, and interexchange routes, or for the copper feeder in the CO CSA. The starting parent is the DLC for copper feeder in DLC served CSAs. The FDIs are starting parents for all distribution.

Pair, Fiber, and Service Counts

In order to determine the capacity requirements for all units of plant, these counts are aggregated from the most distant child through the lineage to the segment in question. Distribution and Building Terminals at the extremes of the plant are the starting children. Counts are aggregated to the associated parent. Cable splices will have more than one child to aggregate, as will most FDIs and DLCs. Working pairs or fibers are accumulated to size each cable segment. Pairs and services are accumulated to size FDIs and DLCs.

NID

A NID is placed at each customer location that requires six or less pair terminations using drop wire. Fiber and certain service types are not terminated on NIDs. Locations that require more than six pair and are not fiber based will terminate on a building terminal.

Drop Terminal

The criteria for placement of the drop terminals (DTs) are input by the user in the GM's parameter table. Parameters include the maximum drop distance and the maximum number of drops/NIDs served per terminal. The maximum drop distance is set by default to 500 feet to meet transmission requirements for the loop signal. The GM places the correct number of terminals to meet these two criteria. Each drop terminal is sized to meet the capacity specified in the data inputs passed from the GM.

Building Terminal

Building terminals (BTs) are placed at the customer location and set back from the distribution cable along the road with a connecting cable sized to match the terminal capacity. They are used for all copper cable terminating customer locations that exceed 6 pair or require pair separation, such as DS-1s.

Outside building terminals are sized in increments of 25 pair, to a total capacity of 150 pair, and include the appropriate grounding. If the BT capacity exceeds 150 pair, an indoor FDI is placed at the BT location. BTs are sized to the total capacity required for all customers at that customer location.

Customer SONET Terminal & High Capacity Services

Each customer location that originates one or more DS-3s or higher bandwidth services is configured for SONET fiber optic termination at that location. The customer SONET terminal is sized for the total bandwidth specified by the sum of the high capacity circuits. All capacities are converted to DS-3 equivalents to derive the overall bandwidth needed. To the base SONET terminal or terminals configurations, the required number of interfaces by service type is added. For example, if a customer location specifies four DS-3s and an OC-3, the correct number of both DS-3 and OC-3 interfaces are placed into the terminal configuration. Where multiple interface card options exist within the terminal, the least-cost alternative is calculated and used. A corresponding CO terminal is placed. The CO terminals takes advantage of equipment frame sharing by assigning the number of frame inches needed for each system, thereby, reducing the CO SONET based costs. All SONET systems assume the typically customer specified redundant transceiver and fiber capacity.

Feeder Distribution Interface

Feeder Distribution Interfaces (FDI) are sized for total distribution and feeder pairs required to be terminated. The total count of distribution pairs terminated is added to feeder cable(s) sized to meet the total working pairs in the FDI, and divided by the feeder fill. Should the maximum cabinet capacity be exceeded, the number of fully occupied cabinets is calculated along with one that is sized for the residual pair count. If, for example, 8500 pair terminations are needed, a maximum cabinet of 7200 terminations is assigned along with one that serves the residual 1300 pair, i.e. an 1800 pair cabinet which is the next standard size that is stocked to serve 1300 or more pairs.

DLC Terminal Location

The DLC terminal location is comprised of one or more DLC cabinets that contain standard DLC equipment serving voice and DS-0 services via the DLC equipment. A SONET terminal is configured within each DLC cabinet with sufficient bandwidth to serve the total capacity requirements of the DLC equipment and all attached DS-1 channel banks. The appropriate DS-3 and/or OC-3 interfaces are placed in the SONET terminal. The SONET terminal cost is allocated between the VG, DS-0, and DS-1 services on respective bandwidth required.

DLC cabinets are selected from a table with the various cabinet configurations supporting voice shelf and DS-1 counts needed within the cabinet. The number of DS-1 units is first determined. Then the voice capacity is looked up and matched to the column in the cabinet table with the number of channel shelves. This cabinet configuration is then used for the DLC costing at that location. Should the location demand exceed the maximum capacity of a DLC cabinet, the number of fully populated cabinets is calculated along with the capacity of the overflow or residual cabinet. The cabinet and all equipment shared by the total spectrum of services are allocated to those services using the respective bandwidth or shelf and frame space requirements.

DLC TDM Equipment

The TDM equipment is sized to meet the total VG and DS-0 demand after the application of the electronic fill factor. Space utilized by the TDM equipment and the space cost is first allocated to the common equipment and the individual service cards. The common equipment cost including transceivers is then allocated to the services based on the bandwidth demanded by each.

Channel Bank Equipment

The channel banks provisioned in the DLC are electrical DS-1 to optical multiplexers. The multiplexer optics are routed with fiber jumpers to the cabinet SONET terminal. The quantity of channel bank shelves placed is based on the total DS-1 equivalent demand at the location. If multiple shelves are required, shelves will be added in single shelf increments. The first shelf in a group uses a DS-3 optical transceiver. An OC-3 transceiver is used for 2 or 3 shelf configurations. When more than 3 shelves are needed, an overflow group of 1, 2, or 3 shelves is placed.

Distribution Cable

Distribution cables are placed from all BT and DT locations to their assigned FDIs. Cable routing is determined within the GM using a distance minimizing algorithm called Minimum Spanning Road Tree (MSRT). This algorithm computes the routing to minimize the overall total distance to connect all points within the FDI served distribution area similar to a Minimum Spanning Tree or MST calculation. In the MSRT, a road constraint is added to recognize that cable plant is normally routed along roads to allow ready access for plant maintenance personnel. This ensures that a minimal but reasonable distance applies. This causes structure costs, a key driver of the distribution cost, to be minimized, yet subject to the road constraint. When copper distribution cables are placed along the same route as optimized feeder cables, the cables share a common structure for the distance that overlap occurs, and are each allocated a portion of the shared structure. This also contributes to the model's ability to produce the least-cost solution.

When copper cable is sized, the accumulated total terminated pairs are used to look up the appropriate cable size. As the routing progresses from terminal to terminal or through a splice, the total number of pairs required for each segment is used to size the cable. Because distribution cable is sized based upon terminated pairs, the fill factor used in the calculation is defaulted to 100 percent fill.

Copper Feeder Cable

Copper feeder cable is built from the FDIs in the network to the DLCs, or in the case of the CO CSA, the central office. Routing is again computed to a minimum total distance solution using the MSRT algorithms, discussed above, for all copper feeders. Any customer fibers that appear at an FDI are jointly routed with the copper to its DLC location where it joins other fiber feeders. Fiber and copper cables are aggregated along the route when they join in a common route.

Copper cables are sized to the total working pairs along each segment after application of the copper feeder fill factor. When the total pairs required are matched to the cable sizing table, the achieved fill factor will normally be less than the input objective, since the sheath size almost always exceeds the required pairs. To make the cable closely approximate the target once cable sizes are determined, the achieved fill is matched to the target fill. An adjustment is calculated to the fill input and applied to a second calculation of cable size. With the adjustment in place, the achieved fill is very close to the target fill – in effect removing the fill adjustment caused by moving to the closest actual cable size. It is this adjusted cable size that is used in calculating the cost of the cable segments.

With the minimized distance algorithms and fill maximization in place, these copper cable calculations produce a highly efficient, least-cost feeder network. Copper costs are allocated to the services on the basis of pairs used to total pairs in use.

Fiber Feeder Cable

Fiber feeder cables serving customer locations with SONET terminals are sized to match the capacity requirements of each of the customer SONET systems. The number of fibers per system is an input set by the user in the input phase of the modeling. Working fibers have the fiber fill factor applied to calculate the required sheath size for any customer fiber only cable segments. Customer fibers are routed from the customer locations to the CO.

Fiber feeder cable is also placed from the DLC locations to the CO. Cable segments are sized to carry the DLC SONET fibers found at each DLC location.

Fiber feeder cables also contain the capacity requirements for all interexchange (IX) fibers. Actual fiber boundary “crossing points” are entered into the GM along with other customer geocoded points. The GM routes the IX cable from the boundary to the nearest DLC or the CO – whichever is closer. If the IX fibers are routed to the CO and pass a DLC, the IX fiber load is added to the other DLC and customer fiber requirements that share the route segment.

Fiber cables are routed from the customer, DLC, and IX locations to the CO using the same MSRT total route distance minimization algorithms discussed previously. As the name implies, the road constraint continues to be applied to the distance calculations. Where fiber cables follow the same route as copper feeder cables, the cable structure is allocated between the two for the common distance.

Fiber sizing calculations use the accumulated customer, DLC, and IX fiber counts by segment. Cables are sized to meet the fibers required after the “grossing up” application of the fiber fill factor. The aggregation of fibers, the sharing of structure with copper, and the minimizing of total route distance makes the fiber cable costing highly efficient and produces the least-cost alternative.

Poles

Poles are placed along all aerial segments of cable. Pole cost, the sharing with other utilities or providers, and maximum spacing inputs are set by the user in the inputs phase of the process and carried forward into the LM. A pole is placed at each end of a segment. If the segment is greater than the pole spacing user input, additional poles are added to maintain the spacing interval on all but the final span.

Conduit

The number of ducts in the underground cable segments is computed for both copper filled and fiber filled ducts. Full sized ducts are used for each copper cable. Ducts used for fiber cables include innerducts. The number of innerducts in a 4” conduit is specified by the user in the input phase. The number of ducts includes one for each copper cable and a maintenance spare plus sufficient fiber/innerducts to match the fiber cable count plus one. For example, if the number of innerducts per 4 inch conduit is three, and two fiber cables and two copper cables are required, the total number of ducts will be four, with one of the four equipped with innerducts. (Two plus a spare plus one fiber duct with two of the three innerducts occupied.) Since there is no spare capacity in the duct run, no sharing of the ducts is permitted. Structure sharing is permitted in the duct trench and in the manholes.

Once the number of ducts is calculated, the manholes are sized to the total number of ducts in the cross-section. If more than nine ducts are required, manhole extensions are added to reach the full capacity. Manholes are spaced according to the spacing interval user input set in the inputs phase of the process.

The cost of ducts is directly assigned to the cable type that uses the duct. Manhole and trench cost is allocated to fiber and copper based on the proportion of total ducts placed. Fiber and copper total conduit costs are allocated to the services that ride each on the basis of cable usage.

Structure Sharing

Any facility segment that contains both fiber and copper cables, multiple copper cables, or multiple fiber cables either through multiple cables along the same segment or an overlap of fiber feeder, copper feeder, or distribution cables, has its structure allocated to the cables in the segment. All cables share all structure costs between the multiple cables that have a common routing. For example, fiber from customer high capacity circuits may parallel some length of distribution copper or copper feeder between the DLC-RT and the FDI. The structure costs are allocated to all parallel cables in the segment or portion of the cable segment that utilize that structure. Where the total number of cables exceeds the capacity of the structure, additional structure costs are added for the additional capacity. Structure costs reflect the density and terrain characteristics for each CSA, through which it passes or serves. Figure 2 illustrates the Loop Module's approach to structure sharing.

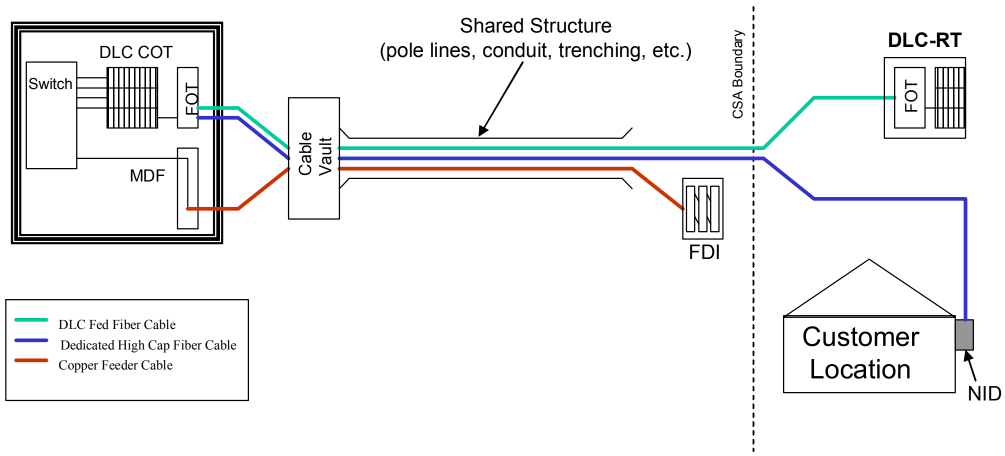


Figure 2

The GM is able to determine where the layers (fiber feeder, copper feeder, and distribution) overlap. This is reported to LM with the GM outputs. To complete the sharing calculations, parallel cables within the same layer share the cost of the common structure. (When sharing capacity exists in a layer's structure and sharing is completed between layers, each layer reduces the shared portion of the segment distance by half of its shared distance for structure calculations only.) In that way, each layer receives one half of a structure that when added together recognize the complete structure cost.

Loop Cost Calculations

Once investments for outside plant and loop circuit equipment are calculated for all wire centers, the results are loaded into the cost input file of the ECM. Within ECM, cost factors are built and then applied to the investments to determine costs. Common cost is also built and applied. The following discussion focuses on the Loop component of the ECM.

Loop Summary Cost Methodology

The following discussion applies to 2-wire loops. Further discussion is provided for other types of loops. Global results and exchange-specific results are obtained from LM and are then fed into the ECM. The investment data includes

- Circuit Equipment or Electronics Investment
- Buried Cable Metallic
- Aerial Cable Metallic
- Underground Cable Metallic
- Buried Metallic Drop
- Buried Fiber
- Underground Fiber
- Buried Fiber/Fiber Drop
- Conduit
- Pole Lines
- Aerial Fiber
- Total lines served in the wire center

At a statewide level, these results are utilized to calculate Annual Charge Factors (ACFs) that reflect annual cost recovery requirements. For the loop annual charge factors, the investment for DS-3 loops and IX dark fiber are included to calculate weighted annual charge factors for those services. For a discussion on the methodology of ACF calculation, please refer to the separate section on ACFs.

The wire center specific variables entered into the ECM also include the above referenced variables. However, at a wire center level, average investment per line is used. CO Termination inputs are based on data found in the Embarq Switching Module.

The ECM is used to calculate cost by wire center using the investments developed in LM. In the LoopSummary.xls file of the ECM, multiple tabs contain the cost calculations for various types of loops. Within each tab, ACFs are multiplied by the investment to determine annual cost recovery requirements for each plant account. Once annual cost recovery requirements are determined for each account, the results are summed and divided by 12 to obtain monthly cost. Common cost is also applied.

Once monthly cost by wire center is identified, the costs are grouped into rate bands. Within the Loop Banding tab of LoopSummary.xls, the exchange-specific results are sorted from lowest cost to highest. The wire centers may then be grouped to develop deaveraged loop costs.

4-wire Loops
Using the 2-wire loop cost as a base, the cost for 4-wire loops is the incremental cost of an additional pair of copper wires.

To determine investment for 4-wire loops, overall investment in copper, fiber, and circuit equipment is identified from the LM. The additional cost of 4-wire loops is based upon the circuit card required and the additional cable pair for any copper portion of the loop and the expanded bandwidth on the fiber.

DS-0 56/64K Loops
The purpose of the DS-0 loop study is to determine the economic cost of a DS-0 56/64Kbps grade loop.

To determine the economic cost of DS-0 56/64K loops, the costs for providing DS-0 on copper and fiber are identified. The cost to serve DS-0s on copper includes channel bank capacity and DS-0 cards. DS-0 56/64K loops served through digital loop carrier systems require additional investment to account for cards in the DLC. The costs for DS-0 loops served through DLCs represent the line cards in the central office terminal and remote terminal necessary for DS-0 loops. Average investment per DS-0 loop is obtained from LM and the monthly cost is calculated using methodology described above.

DS-1 Loops
Assumptions:

- Costs for providing the loop on copper and behind a DLC are included in the study.
- Loop conditioning costs are not included in the monthly recurring charges.
- A DS-1 loop is a dedicated facility that provides 1.544 Mbps of bandwidth.
- A DS-1 loop may be used to provision ISDN-PRI. Additional costs related to switching are required for ISDN-PRI and are not accounted for in the DS-1 loop cost study.

The monthly cost is calculated using the methodology described above.

ISDN-BRI/IDSL Loop
The following assumptions were used in the ISDN-BRI/IDSL loop cost study:

- ISDN-BRI/IDSL provides 144Kbps bandwidth.
- The cost does not include customer premises equipment.
- IDSL is the digital subscriber line equivalent of ISDN-BRI.
- The ISDN-BRI loop does not include any investment for switching functionality.

The costs for ISDN-BRI loops served through DLCs represent the line cards in the central office terminal and remote terminal necessary to ISDN-BRI loops.

Average investment per ISDN-BRI loop is obtained from the LM, and the monthly cost is calculated using the methodology described above.

NID

Inputs for material and installation are identified and entered into the LM, which determines the number of NIDs and total investments. Smart jack investments are included as part of the DS-1 loop. Investments are then fed into the ECM, where cost is calculated. All loops include NID as part of the cost.

III) B) LOOP INPUT METHODOLOGY

Loop Module Inputs

The information contained below defines the development of the Embarq Loop Module (LM) inputs that are used to determine investments related to outside plant, digital loop carrier, and high capacity loop SONET terminals. The inputs are discussed in the order in which they are found in the inputs to LM.

Embarq's company-specific inputs reflect the realities of providing local service in its operating territory. Embarq's recent experience with actual purchase, installation, and ongoing maintenance of telephone plant equipment provides the best information for predicting the forward-looking costs within Embarq's service territory. The material inputs are based upon current vendor prices for material and equipment, plus Embarq-specific labor costs for engineering, plant supervision, and installation. State-specific sales tax is also included in the material calculations.

Recent factual and objective data provides the best basis for predicting the forward-looking cost of constructing telephone plant in Embarq's service territory. Inputs developed in this fashion provide the most verifiable data possible for estimating the cost of rebuilding a network in that same market. After the inputs are developed, they are entered into the Loop Module.

Loop Cost Inputs

Drop

The drop connects the end user's Network Interface Device (NID) to the drop terminal.

Buried Drop

Buried drop costs are the costs of the drop that is buried from the pedestal (drop terminal) to the NID attached to the customer's premises. Inputs are the material cost per foot for the drop wire only.

Aerial Drop

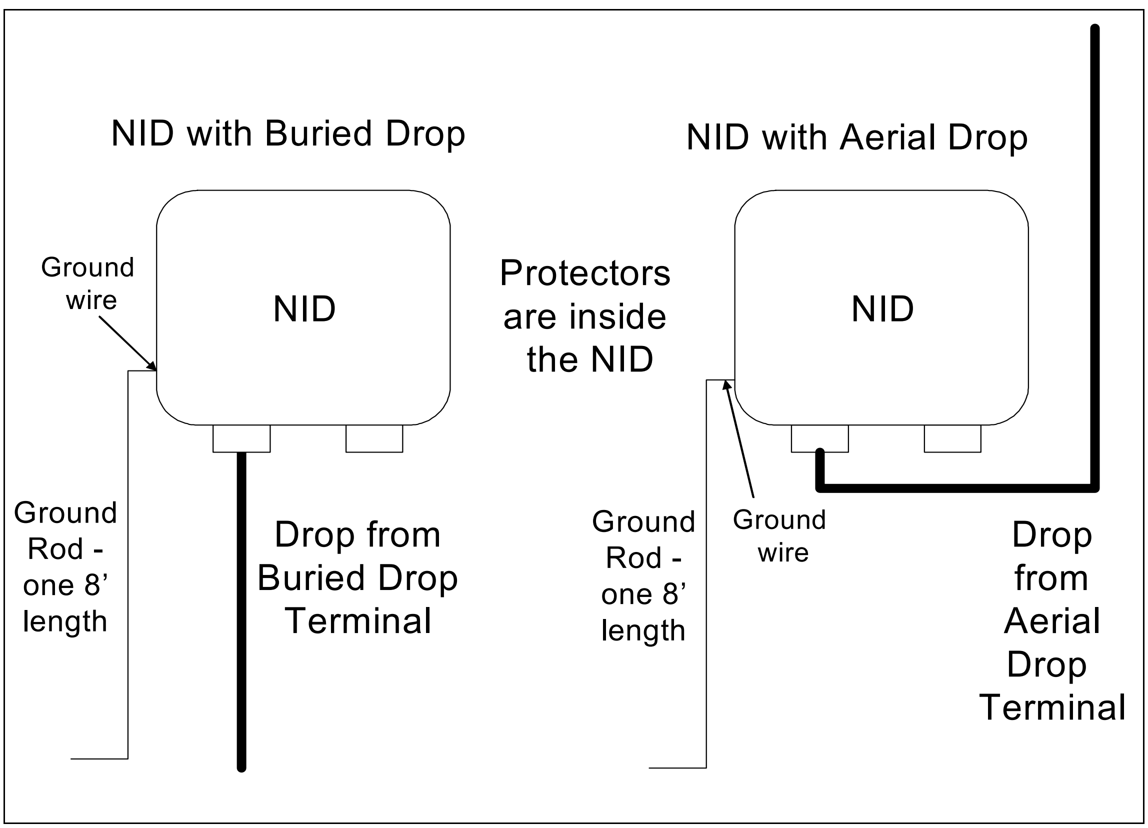
Aerial drop costs include the cost of the drop wire that is placed from the terminal, on or near a pole to the customer's location, terminating at the NID. Included in this cost are the attachment devices and the labor to install the drop. Inputs are the material cost per foot for the drop wire only.

Network Interface Device

The Network Interface Device (NID) is a device that is necessary for connecting a loop to an end user's premises. The NID is the point of demarcation between the local exchange carrier and the customer, and additionally serves to provide the customer with electrical surge protection. One NID houses up to six cable pairs, so its primary use is for residences or small businesses. A typical NID is pictured below.

Network Interface Device (NID)

Separate inputs for additional protectors may also be populated. The NID input includes a ground rod, ground wire and labor for installation. The components of the NID are shown following, with the drop added for clarity.



Building Terminal

A building terminal has functionality comparable to that of the NID, only with greater capacity. Building terminals house cable pairs in 25 pair increments, up to 150 pair, and are primarily utilized for business locations or multi-tenant dwellings. Ground rods and ground wire are also included in the inputs. For quantities greater than 150 pair, an indoor Feeder Distribution Interface (FDI) is used. The inputs include the cost of material per building terminal unit and labor for installation.

Cable – Fiber and Copper

Overview of Cable Cost Development

Cable cost inputs are a function of material and labor. LM uses either all copper cable or a combination of copper and fiber cables to build the loop network. Cable refers to the copper or fiber media used to carry the call signal from the central office to the end user. Sales tax is the state-specific sales tax, when applicable.

Cable labor is comprised of engineering, placing, and splicing. Each type of labor is determined by plant type based on work order data drawn from recent actual construction done in Embarq's serving areas. The labor required to build additional plant in Embarq's current network will reflect the labor required to build the network on a forward-looking basis. Splicing labor varies by cable size as described below.

Engineering accounts for the activities required to design the cable route and to ensure that all industry standard engineering specifications are met. Engineering is calculated on a per foot basis because engineers typically design by route, rather than by cable size increment. For example, along the route the engineer must work within rights of way, account for any obstacles, and ensure that the cable can be placed at the proper depth (for buried and underground) or at the proper clearance (for aerial cable).

Placement accounts for the cost of installing the cable on a pole line, in a trench or in a conduit. Placing is determined on a per foot basis because the entire cable sheath is placed at once. Placement is restricted to the placement of aerial cable onto the support strand or the rodding of the ducts and the pulling of underground cable into its duct, since buried cable placement cost is included with the structure costs (i.e., the cost of digging the trench). Embarq does not include placement in buried cable labor inputs to reflect the fact that buried cable is placed simultaneously with the creation of the buried structure (i.e., trench), thus, the cost of buried structure includes the cost of placing the cable.

Splicing refers to the joining of two or more cables by connecting each individual copper pair or fiber strand. Splicing labor increases as the pairs to be spliced increases and thus will increase by cable size. If Embarq placed 500 feet of 100 pair cable, 50,000 total pair feet would be placed

In addition to the labor activities of engineering, placing, and splicing, overheads are a related cost that must be included in the total cable cost. Overheads are the support costs associated with activities that are not directly related to engineering or construction, but are necessary components of outside plant construction. An example of overhead is supervision labor for engineers. Overheads are added as a per foot cost and do not vary with cable size for most cable types.

The Exempt/Other Material loading accounts for small, non-reportable items such as screws, nuts and bolts, and material not captured by other inputs, but still necessary to the construction process. A loading of costs related to these materials are therefore included in the total cost of cable.

Engineering, placing, splicing and overhead labor costs, and the exempt material loading, are then added to the cable material cost to determine the total cost of cable per foot.

Cost Components – Aerial Cable
Aerial cable costs include the cost of the cable, splice closures, miscellaneous materials, such as lashing wire and mounting hardware, the cost to purchase and ship the cable, acceptance testing as needed, engineering, and the cost of procuring any permits. Splicing occurs at cable junctions, cable size changes, where side legs intersect, where the reel ends, or at cable closures. The cost of engineering includes route layout, obtaining permits, securing rights-of-way and joint use coordination. Embarq obtains this information from recent state-specific work orders.

Cost Components – Buried Cable
The cost of buried cable includes cable material, miscellaneous minor material such as connectors, splice closures and clamps, permits, right of ways, flagging or other safety personnel or materials as needed, engineering, splicing, and any equipment necessary to facilitate the placement of buried cable. As described above, any costs related to the actual buried cable placement is included in the structure inputs. The cost of engineering includes route layout, obtaining permits, securing rights-of-way and joint use coordination.

Cost Components – Underground Cable
The costs of underground cable include the cable material, miscellaneous minor materials, splicing, engineering, and placing. Splicing can occur at cable segment ends and junctions. Placement costs for underground cable include:

- work site make ready and safety
- equipment set up
- testing for poisonous gases in each manhole
- pumping and ventilating each manhole
- rodding and cleaning the duct
- pulling in the cable

- pick up and delivery of cable and materials to the work site
- procurement of any permits
- pressure testing of splice cases

The cost of placing underground cable is calculated on a per foot basis and generally does not vary in relation to cable size. Splicing is calculated on a per pair (or fiber) foot basis to capture the increasing cost of splicing as pair increments increase, as explained above. The cost of engineering includes route layout, obtaining permits, securing rights-of-way and joint use coordination with other utilities. The cost of these engineering activities is calculated on a per foot basis and does not vary by cable size.

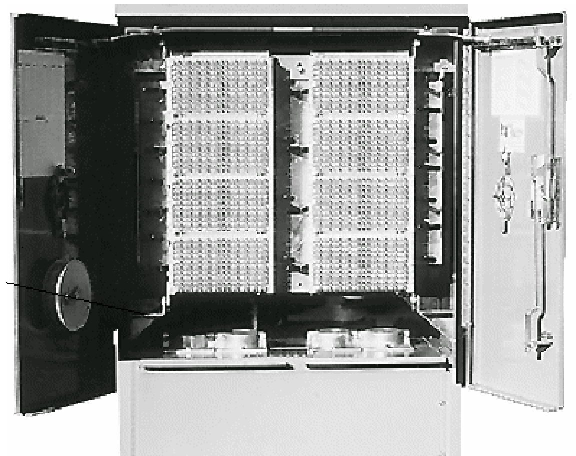
Embarq uses filled fiber cable for all fiber applications. Per foot costs are developed for standard size aerial, buried and underground fiber cables ranging from 12 to 288 fibers.

Feeder Distribution Interface

Feeder Distribution Interfaces (FDI) are used as the interfaces between feeder and distribution cables, and are also known as cross-connects. The FDI connects copper feeder and copper distribution and are used to increase the utilization of the pair count in the feeder. It may be located at the feeder/distribution connection point in an all copper loop, or between the copper feeder stub extending from a fiber-fed digital loop carrier (DLC) and the copper distribution cables. The FDI is the location where the jumper connections are made between the feeder and distribution cables. Embarq uses ready access cabinets for its FDIs, which give quick access to both the feeder and distribution cables terminations. Jumper wires are able to connect any feeder pair to any distribution pair, and jumpers are changed as necessary when service is requested. FDIs provide a reduction in cost when compared to direct cable splicing since maximum use can be made of all available feeder pairs without any re-splicing. The inputs to the model include all material necessary for a FDI and labor for installation and engineering.

Outdoor Feeder Distribution Interface

The outdoor FDI is the interface between copper feeder cables and copper distribution cables. FDI sizes range from 25 to 7200 pairs, with the number representing total pairs in and out of the device. A typical pad-mounted outdoor FDI is shown below.



Outdoor Feeder Distribution Interface (FDI)

The material cost for outdoor FDIs includes the following components: a cabinet, template, punch down blocks, and frame as seen in the diagram above. The labor costs include workplace setup, protection time, the time to place the cabinet, terminate the feeder and distribution cables, and travel. The cost for a concrete mounting pad that is installed by an outside vendor is also included. State specific labor rates and tax rates are utilized in calculating the investment for FDI.

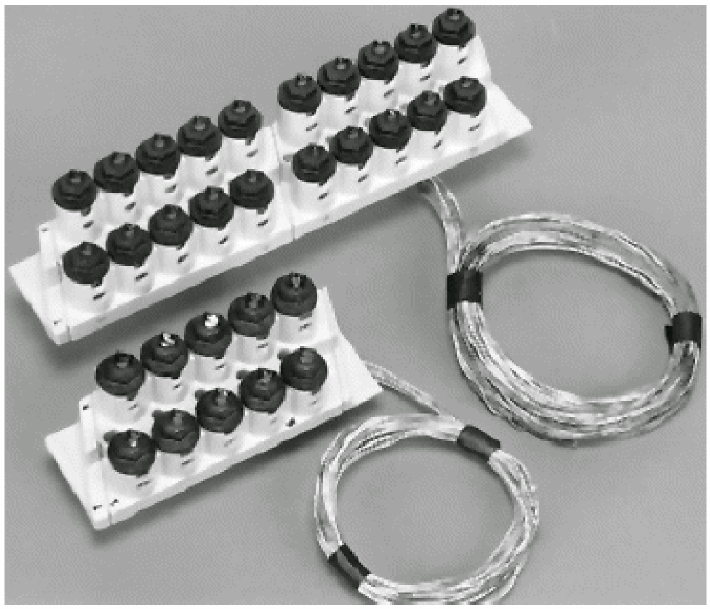
Indoor Feeder Distribution Interface
Indoor FDIs are placed in multi-tenant buildings and are sized for the number of lines terminated at that location. Indoor FDIs generally consists of terminal blocks fastened to a plywood board or metal frame located in the basement of a building. Since the indoor FDI is a cable entrance point into a building, electrical surge protection is included in the indoor FDI design and cost.

Material costs include terminals (or Distribution Frames for very large pair sizes) with 40-foot tip cables, wall-mounted brackets, 5-pin protection modules, splice cases, tie cables, and punch down blocks. The labor times include splicing and installation of the terminals and travel time. Embarq-specific labor rates and tax rates are utilized.

Aerial Drop Terminal
Aerial drop terminals, shown below, provide the point of interconnection between the cable pair in an aerial distribution cable and an aerial drop wire. The terminal mounts on the cable suspension strand near the pole, or on the pole, and consists of a weatherproof cover that contains binding posts, which are spliced via a stub cable to the distribution cable. The aerial drop wire connects to one set of binding posts on a terminal block within the terminal.

Terminal costs in the model reflect ready access enclosures that will accommodate up to 48 pair terminal blocks. Terminals placed by the model are sized according to the number of connecting drops, and will contain terminal blocks in 6 pair increments, from 6 to 48 pair.

The installed cost of the aerial drop terminal includes the splice closure, terminal blocks, and labor for installation and splicing.



Aerial Drop Terminal

Buried Drop Terminal
Buried drop terminals, shown below, provide the point of interconnection between the cable pair in a buried or underground distribution cable and a buried drop wire. Terminal blocks are placed in an airtight and watertight, re-enterable enclosure constructed of high impact, thermoplastic material in which the distribution cable is accessible. Similar to aerial drop terminals, terminal blocks in the buried drop terminal are spliced to the buried or underground distribution cable via a stub cable. Buried drop wires are then connected to one set of the binding posts on the terminal block.

Terminal costs in the model reflect accessible enclosures that will accommodate up to 48 pair terminal blocks. Terminal blocks placed by the model are sized based on the number of connecting drops and will be in 6 pair increments, from 6 to 48 pairs.

The installed cost of the buried drop terminal includes the closure, terminal blocks, and labor for installation and splicing.

Buried Drop Terminal

Strand
Strand is the wire used to support the aerial cable; the cable is lashed to the strand. The strand is necessary for the support of aerial cable and attachments such as strand-mounted terminals. The cost of the strand investment includes the material cost.

Structure Inputs

Structure Inputs Overview

Structure costs are those costs related to the construction supporting the copper and fiber cables comprising the telephone loop and transport network. These structures are the poles and anchors/guys for aerial plant, the conduit and manhole systems for underground plant, and the trenching or other placement cost for buried plant. Structure costs for aerial and underground plant include the labor per foot required for placement of the structure as well as the related materials (e.g., poles, anchors/guys, conduit, and manholes), while structure costs for buried plant include the labor necessary to create the opening in the ground and restore the earth. These costs vary with surface terrain characteristics (e.g. soil vs. rock

Underground Structure (Feeder/Distribution Conduit)
The cost of underground structure includes the costs for opening and closing any ground or surface necessary to place the conduit and manhole system. This may include cutting and restoring asphalt or concrete streets and sidewalks. The material and installation costs of the conduit and the manholes and/or handholes are also determined. Costs specific to manholes and conduit are further delineated in the Manhole Inputs. Underground structure inputs represent the costs per foot to perform the activities necessary to build the structure in which the conduit system is placed.

Buried Structure

The cost of buried structure consists of the costs for opening and closing the ground, including any surface restoration required. The inputs represent the cost per foot of the activities necessary to open, close, and restore the trench where the cable is placed.

Aerial Structure

Aerial structure costs consist of the material and installation cost of poles and the associated anchors and guys. They are converted to a per-pole cost based on the frequency of anchors and guys input (expressed in terms of the number of poles between each placement of an anchor and guy).

The cost of the poles is calculated by summing the loaded material and installation costs per pole and applying the percent assigned to telephone fraction to recognize that other entities (power, CATV) share the cost of the pole structure.

The percent of pole costs assigned to telephone was calculated based on the number of poles owned by Embarq versus the number of poles owned by other entities on which Embarq has attachments.

The pole, anchor, and guy material costs are the current prices Embarq pays for those materials. Sales tax is calculated using the appropriate state tax rate. Installation costs are based on actual contract costs for the total activities comprising pole, anchor, and guy placement. Engineering and plant supervision overheads are derived from actual company accounting and productive hour data.

Pole spacing inputs range with the closer spacing occurring in more densely populated areas because of street clearance requirements and support requirements for larger cables. Anchor and guy spacing inputs range by density zone primarily due to right-of-way curvature or changes in elevation. Anchors and guys are placed only where horizontal or vertical direction changes occur or a pole line ends. Similar to poles, the spacing is closer in more dense areas because of the greater number of pole line terminations necessary in urban areas. The spacing inputs are based on company experience in placing aerial plant.

Manhole Inputs

The cost of manholes consists of the loaded material and installation cost of appropriately sized manholes and/or handholes. The manholes are sized based on the required number of ducts in the conduit system. Manholes and handholes are spaced at user-defined distances. Manhole and handhole spacing is based upon the average distance between access points (manholes and handholes). This is calculated by dividing total actual trench feet by the total number of actual access points (manholes and handholes). The manhole inputs account for the manhole material and labor to engineer and install the manhole.

The cost of conduit consists of the loaded material cost of one foot of 4" PVC conduit. The cost of installing the PVC pipe is included in the structure costs discussed in Underground Structure.

Spacing Inputs

The Feeder and Distribution Spacing Tables reflect the incremental spacing of structure support facilities (e.g. manholes, poles) in accordance with population density zones.

Loop Percent Tables

Plant Mix Tables

Cable plant mix inputs are the percentages of aerial, underground and buried cable placements within each of the density groups. Separate inputs can be developed for cable type (copper or fiber), usage (distribution or feeder), and terrain (normal, medium rock, or hard rock).

Plant mix is driven by many region-specific factors. Factors weighed in selecting the type of outside facilities include state/county/city code restrictions, market growth rates, maintenance cost considerations, potential service disruptions, and initial first cost considerations. These considerations apply to both feeder and distribution cables.

Maintenance cost considerations are evaluated for each type of cable facility before a cable type is selected. Acts of nature and acts caused by man become important considerations when evaluating potential maintenance costs. Aerial cables are subjected to many types of damage including fallen trees or limbs, animals, high winds, automobile accidents and lightning. Underground or buried cables are subject to rapid deterioration in an area having a high water table.

Service disruptions differ from maintenance considerations. In the case of buried cable or underground cable, a common example would be a cable cut by digging or trenching by a contractor without having existing cable locations identified. This damage usually results in a temporary loss of service for customers served by the cable.

The cost to build the job without considering the future costs or benefits is defined as the initial first cost. Although this is an important consideration because it involves current outlays, initial first costs are only one consideration. The evaluation of the remaining considerations may indicate a low initial first cost but higher future maintenance costs. For example, the initial first cost of an aerial cable would be far less expensive compared to an underground cable requiring the construction of a conduit. However, if facilities were placed in a high growth area, underground facilities would probably be more conducive to continual reinforcement.

The source of data for plant mix calculations are Embarq's outside plant record system. Sheath miles by type and size of cable are extracted from the records by wire center for the service territory.

Density zone level plant mixes are calculated. To determine the plant mix for each density zone, the density for each CSA within the study area is obtained from the geographic inputs to the model. The wire center specific sheath miles are matched to each CSA within a wire center. When summed, a weighted amount of sheath miles results. The sheath miles for aerial buried and underground cable are then summarized by density zone. Plant mix percentages are then calculated by dividing each plant types' weighted amount of sheath miles by the total weighted sheath miles for each density zone.

Density Cable Sizing Factor Table

Cable sizing factors reflect the percentage of available network capacity utilized by feeder and distribution cables. Proper cable sizing allows uninterrupted provision of new service and maintenance between cable additions. This means that cables are sized larger than initially needed so as to efficiently fill service requests until the next cable addition.

Care must be used in selecting cable capacity to avoid under sizing, which results in costly re-work, or over sizing, which results in capacity not being used. There are additional factors to consider in cable sizing. One is the lag time required to engineer and construct a new cable. Cable additions are added far enough in advance of cable pair exhaustion to enable the continued provision of new service.

Another factor to consider is the standard pair sizes of cables. Cables are available in a wide range of pair complements; cables of larger pair sizes increase by 300 pair increments (600, 900, 1200, and 1500). This means that if the forecasted demand for a new cable called for 950 pairs, a 1200 pair cable would be placed. This limitation caused by standard cable sizes will increase unused capacity.

Cable sizing factors are developed separately for feeder, distribution and fiber cables.

Distribution cables are sized to allow for pairs per housing unit (see Miscellaneous Inputs, Cable and Wire Inputs).

Structure Allocation Table

Structure allocation reflects the amount of the shared route structure allocated to copper cable facilities and fiber facilities, based upon cable size. For example, if a route is shared by both a copper and fiber facility, the fiber and copper would each be allocated a percentage of the structure cost.

Miscellaneous Inputs

This tab contains a series of individual input values for key assumptions such as cable placement depth, electronic fill, and maximum system and cable sizes.

Normal Underground/Buried Cover (Copper)
This input represents the depth at which copper cable is to be buried. Embarq uses a placement depth of 30 inches. The table indicates that copper feeder and distribution cables should be covered by a minimum of 30 inches of ground.

Normal Fiber Cover
This input represents the depth at which fiber cable is to be buried. The placement depth choice is confirmed in the engineering guidelines set by AT&T on the table labeled *Recommended Depths for Placing PIC Cable*[2].

Pairs Per Residential Unit
This input is used in the calculation to determine distribution cable sizes. Embarq uses current engineering guideline standards to build lines per residential housing unit, which will allow for maintenance and spare pairs.

Pairs Per Business Location
This input is used in the calculation to determine distribution cable sizes. As noted in the model methodology guidelines, if the actual business line count per location is greater than this input, then the actual line count per location will be used. The utilization line per business unit represents the current engineering guideline minimum being used by Embarq for provisioning lines to business areas.

Maximum Size Feeder Distribution Interface
This input allows the user to enter the company's maximum size FDI normally deployed, as long as it does not exceed 7,200 pairs.

Maximum Fiber Size
This input allows the user to enter the company's maximum fiber size normally deployed, as long as it does not exceed 288 strands.

Maximum Feeder Size
This input allows the user to enter the company's maximum copper feeder cable size normally deployed, as long as it does not exceed 4,200 pairs

Maximum Distribution Size
This input allows the user to enter the company's maximum copper distribution cable size normally deployed, as long as it does not exceed the maximum copper cable size.

Innerduct Per Foot Cost Delta
This input is for the incremental cost per foot for innerduct placed inside a 4" standard conduit. Innerduct allows for easier fiber cable installation and better cable organization.

Number of Innerducts Per Duct
This input is the quantity of innerducts placed within a 4" conduit.

Fiber Route Sharing Ratio
This input is the ratio of sharing for fiber and copper when sharing a route. Embarq uses an equal sharing factor of 50%.

Concurrent Copper Feeder Cables
This input is the average number of concurrent copper feeder cables per feeder segment. The default Embarq input of "1" will build the optimal network. Any input greater than "1" may result in additional cables being built in the same segment.

Concurrent Fiber Feeder Cables
This input is the average number of concurrent fiber feeder cables per feeder segment. The default Embarq input of "1" will build the optimal network. Any input greater than "1" may result in additional cables being built in the same segment.

Concurrent Copper Distribution Cables
This input is the average number of concurrent copper distribution cables per segment. The default Embarq input of "1" will build the optimal network. Any input greater than "1" may result in additional cables being built in the same segment.

Concurrent Fiber Distribution Cables
This input is the average number of concurrent fiber distribution cables per segment. The default Embarq input of "1" will build the optimal network. Any input greater than "1" may result in additional cables being built in the same segment.

Critical Water Depth
When the water table depth of the area is at or closer to the surface than the critical water depth, additional costs will be required to build the structure. Any placement of facilities in water-saturated area incurs additional cost either for the water placement or additional distance to place the cable around the water.

Water Factor
This input represents the percent of additional cost associated with the placement of facilities in or around the water occupied area.

Minimum Slope Trigger
Minimum slope is the LEAST amount of slope present in each geographical area. The minimum slope trigger is set at the point where slope causes facilities to be placed along the contours of the slope rather than in a point-to-point placement. This is one of three different slope triggers used within the model to adjust distance. The minimum slope trigger is set at an input in degrees. When this average is exceeded the distance is adjusted by the minimum slope factor (see below). For example, if the average terrain within a given grid is equal to or less than the input in degrees, no additional adjustment for cable distance, and hence cost, is required.

The slope information is taken from the U.S. General Soil Map (STATSGO) produced by the United States Department of Agriculture's Natural Resources Conservation Service[1].

Since more cable and structure are required when winding along contours of hillsides rather than cable placement in straight flat terrain, this input allows for the additional distance that facilities will require when traveling along this higher sloped terrain. This is comparable to building a road up a mountain. If a hill is too steep, then switchbacks are required which adds to the total distance traveled.

Minimum Slope Factor
Slope factors are the multipliers used to add the additional distance that the facilities must travel as they wind their way across the higher slope terrain. This factor comes in to play ONLY when the minimum slope trigger is exceeded, thereby, adjusting the cable distance using this minimum slope factor.

Since more cable is required when winding along contours of hillsides rather than cable placement in straight flat terrain, this input allows for the additional distance that facilities will require when traveling along this higher sloped terrain.

Maximum Slope Trigger
The maximum slope data shows that there are one or more points within the geographical area that may rise rapidly or peak while the area around this terrain may be flat or more gently sloped. The maximum slope trigger sets the degrees of slope at which facilities must be placed along the contours of the large slope with much greater variation in the direction than with the minimum slope terrain

[1] STATSGO has been renamed to the U.S. General Soil Map. The U.S. General Soil Map consists of general soil association units. It was developed by the National Cooperative Soil Survey and supersedes the State Soil Geographic (STATSGO) dataset published in 1994. It consists of a broad based inventory of soils and non-soil areas that occur in a repeatable pattern on the landscape and that can be cartographically shown at the scale mapped.

or in a point-to-point placement. The maximum slope trigger is set at an input in degrees. When this maximum is exceeded, the distance is adjusted by the maximum slope factor. For example, if the maximum terrain within a given grid is equal to or less than the input, no additional adjustment for cable distance above that which comes from the minimum slope adjustment is required. However, if the slope in that grid is greater than the input, then additional cost is required

Since significantly more cable is required when transversing steep slopes rather than cable placement in straight flat terrain, this input allows for the additional facility distance required.

Maximum Slope Factor
This value is the distance multiplier when maximum slope causes cables to be extended to “switchback” on a slope or go around sharply sloping areas. Since this tends to be a small area within the geographical grid, its impact on cost is generally less than an entire area sloping as happens with the minimum slope.

Since more cable is required when winding along sharply sloping contours, this input allows for the cost of the additional distance required.

Combination Slope Factor
This combination factor comes into play when both the minimum and maximum slope triggers are exceeded. The cable distance is adjusted by the combined slope factor. The combination of both triggers indicates that the terrain within the area has a major slope overall but also contains one or more rapid changes in even the general slope. This can best be described as severely undulating terrain with significant cost penalties when placing facilities. Often there is not any road access to the placement area, causing further increased costs.

DLC-Small Electronics Discount
This input is used in concert with the small DLC Investment inputs and represents any normal discounts that a company may receive. Since Embarq has applied its discounted material costs in the DLC inputs, this input is set at 100%.

DLC-Large Electronics Discount
This input is used in concert with the large DLC Investments and represents any normal discounts that a company may receive. Since Embarq has applied its discounted material costs in the DLC inputs, this input is set at 100%.

Fiber Cost Ratio
This input is used in concert with the fiber cable investment and represents any normal discounts that a company may receive. Since Embarq has applied its discounted material costs in the DLC inputs, this input is set at 100%.

Copper Cost Ratio
This input is used in concert with copper cable investment and represents any normal discounts that a company may receive. Since Embarq has applied its discounted material costs in the DLC inputs, this input is set at 100%.

Redundant OC3 Optics
This input is used in to indicate if customer's with OC3 optical services require redundancy.

Copper Gauge
This input is used select the gauge of copper cable.

FOT System-to-Spare Ratio
This input reflects the number of Fiber Optic Terminal (FOT) systems that are sharing one set of spare cards.

Inches Per FOT Frame
This input indicates the number of usable inches per Fiber Optic Terminal Frame (FOT).

Number of Customer Fibers Per Location
This input indicates the number of fibers per customer SONET location.

DLC System-to-Spare Ratio
This input reflects the number of DLC terminals that are sharing one set of spare cards.

Electronic Fill
This input represents the amount of fill allowed to occur in DLCs and channel banks used to provide non-voice services. At the fill specified, Embarq begins planning for reinforcement.

HiCap Fill
This input represents the amount of fill allowed to occur in high capacity optical multiplexers. At the fill specified, Embarq begins planning for reinforcement.

Maximum Central Office Terminal DLC-Large
This input represents the largest Central Office Terminal that will be placed to serve one or more Large DLCs. After this point, an additional terminal would need to be added. This input is based upon the largest terminal capacity normally purchased.

Maximum Remote Terminal DLC-Large
This input represents the largest Remote Terminal that will be placed. After this point, an additional terminal would need to be added. This input is based upon the terminal capacity normally purchased.

Maximum Central Office Terminal DLC-Small
This input represents the largest Central Office Terminal that will be placed to serve one or more Small DLCs. After this point, the model will switch to a large terminal.

Maximum Remote Terminal DLC-Small
This input represents the largest small DLC that will be placed. After this point, the model will switch to a large terminal.

CLLI Length
This input reflects the standard alphanumeric 11-character value for the wire center Common Language Location Identifier (CLLI) code.

CO Install Labor Rate
This input is the state-specific hourly rate for Central Office installation labor.

OSP Install Labor Rate
This input is the state-specific hourly rate for Outside Plant installation labor.

Engineering Labor Rate
This input is the state-specific hourly labor rate for Engineering.

Buried Drop Install 150
This input is the labor cost to place the first 150 feet of buried drop.

Per Ft. Buried Drop Adder
This input is the cost per foot adder for installation of buried drop lengths over 150 feet.

Aerial Install Hours
This input is the number of labor hours required to install aerial drop.

DrpAdditive
This input represents the number of feet of drop or drop cable that extends beyond the minimum premises setback distance.

DrpCblAdditive
This input represents the number of feet of drop cable to an indoor FDI required inside the customer premises.

Miscellaneous Tables
The tables found within this tab contain data relating to the sizing of SONET systems and DLC cabinets, capacity and configuration of DS1 channel banks within the DLC cabinet, labor hours for installs, and the pair and bandwidth requirements for each of the circuit types.

Services Configuration Table
This table shows cable pairs, drop pairs and termination costs, per unit, by service type.

System Indicator Table
This table lists indicator reference numbers for various optical service types within the SONET system.

SONET Frame Table
This table lists frame inches, per system, for optical services within the SONET system. This allows for efficient use of racking for shelves.

Plugin Bandwidth Table
These inputs identify the DS-0 equivalents of various services. Voice grade equals one DS-0, while a DS-1 is equivalent to 24 DS-0s. Inputs are populated for 4-wire, DS-0, DS-1, and ISDN-BRI. This input is used in calculating the bandwidth required to serve a DLC that provides these services.

Fiber Electronics Table
This input table defines SONET system requirements for providing DS-3 service to customers. The least cost, most efficient system is used to provide various numbers of DS-3s. The optimal number of fibers is used to determine how many fibers will be utilized to provide the DS-3 service. Any excess fiber capacity to those customers that is not used in providing other services is classified as dark fiber.

Factor Table
This table indicates the state-specific sales tax, the power factor to account for recovery of backup power at the central office, and the concentration ratio applied to unbundled element platforms.

Labor Hours Table
This table documents number of engineering and installation hours required, by equipment type.

DS-1 Pointer Table
Based upon the quantity of DS-1s, the table indicates which column should be referenced in the DS-1 Cabinet Lookup Table to determine appropriate DS-1 cabinet/shelf size.

Cabinet Lookup Table
This table designates appropriate cabinet size/type, according to voice grade lines and DS-1 quantities.

Fixed Tables

The tables within this tab contain tables that relate: 1) The many soil types to a placement difficulty indicator (0 is normal and 1 is difficult); 2) The density to a reference column for lookups in other tables; and 3) Central office information to the wirecenter reference number. Values in these tables are set in the input phase of the process and are pulled from the comparable tables in the input module.

Surface Texture Table
This table documents all varieties of surface textures, as defined by the U.S. General Soil Map (STATSGO), and the impact of each particular terrain type.

Wire Center CLLI Table
This table contains Embarq data on CLLI code, wire center name, and primary NPA-NXX of wire center.

Density Pointer Table
This table contains the set of columns denoting density level inputs. This table provides column pointers for look up formulas.

Surface Condition Table
This table contains the numeric value of the condition of the surface denoted by the surface texture and rock hardness.

Summary Fiber Tables

This tab contains tables that summarize the cost of fiber by plant type. The values within the tables on this table are used within LM to calculate investments.

Summary Cable Tables

This tab contains tables that summarize the cost of copper cable by plant type and cable gauge. The values within the tables on this table are used within LM to calculate investments.

Summary Other Cost Tables

This tab contains tables that summarize the cost for any given plant unit by size and by density. Sizing and costs are included for items such as fiber and copper cable, drop terminals, drops, NIDs, and indoor and outdoor FDIs. The values within the tables on this tab are used within LM to calculate investments.

Summary Structure Tables

The tables on this tab summarize the inputs for structure. The values within the tables on this tab are used within LM to calculate investments.

Appendix – Master Price List

The Master Price List includes all necessary equipment to build digital loop carriers, channel banks for non-voice services, and high capacity SONET terminals.

Digital Loop Carrier

The Digital Loop Carrier (DLC) is network transmission equipment that is used to reduce the number of copper feeder pairs or cables needed to activate the necessary distribution pairs. It multiplexes multiple voice grade channels onto one fiber facility to the central office. The cost of a DLC is broken down into three components:

- DLC Central Office Terminal (COT) Investment
- Fixed DLC Remote Terminal (RT) investment
- Variable Digital Loop Carrier Remote System investment (cards)

The size of the DLC will depend on access line demand within the Carrier Serving Area (CSA) and the user defined utilization rate. For example, if there are 90 POTS lines within a CSA and the utilization rate is 75%, then Embarq will place a remote terminal capable of serving 120 lines with the appropriate number of line cards and shelving.

The DLC COT looks much like other central office equipment, being comprised of relay racks. Each shelf will hold various card types. A COT DLC is picture below.

DLC Central Office Terminal

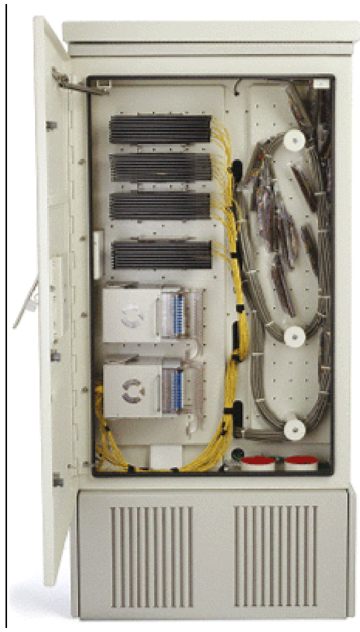
The Remote Terminal DLC is an environmentally controlled, aluminum and steel enclosure. The outdoor cabinet can be configured for purely copper, fiber, or a combination of both. A typical DLC Remote Terminal is pictured below:

Outside view of the DLC Remote Terminal

The main cabinet houses three compartments, an equipment compartment, splice compartment, and a copper protection and fiber compartment.

Front inside view of the DLC Remote Terminal

The front equipment compartment contains the service shelves, a rectifier shelf, and a remote testing unit. The compartment also contains the AC load center and the DC distribution box.



Side view of the DLC Remote Terminal

The side splice compartment contains subscriber cable entry holes, an AC cable entry hole, and two peg boards for mounting all splice equipment and fiber distribution options.

Rear inside view of the DLC Remote Terminal

The rear compartment houses the copper protection panels. The panels are hinged to support easy maintenance and access to the backs of the service shelves. Each protection block provides protection for two copper plug-in cards.

Protection blocks terminate with MS2 connectors for interface in the splice compartment.

Material investment for DLC systems includes the central office and remote common equipment and cards. State specific sales tax was added to the material cost. Labor costs for the DLCs include the engineering, outside plant technician, and central office technician labor necessary to install and test the equipment. Another remote terminal cost component is site preparation. Site preparation includes installation of a concrete pad and any landscaping or protection required by local ordinances.

DLC Configuration

Remote terminal configurations will depend on several variables including access line and high capacity special access demand within the CSA. In small CSAs with little or no high capacity demand, the remote terminal configuration will consist of a remote terminal cabinet that contains a primary shelf and, if demand warrants, a secondary shelf.

In larger CSAs or CSAs with numerous high capacity special access facilities, a remote terminal cabinet consisting of a DLC terminal, a fiber optic terminal (FOT), and a channel bank. The channel bank is used to terminate end user DS-1s so shelf capacity on the DLC can be more effectively used for voice grade services. Both the DLC terminal and the channel bank interface with the FOT terminal at the DS-3 level.

DLC central office investment includes material and labor costs for installing central office DLC equipment. Additional investment is required for larger systems that also require OC-n fiber optic terminals.

DLCs systems have been modeled to economically provide an unbundled loop to a CLEC. Using advanced provisioning methodology, loops can be provisioned between the local exchange terminals (LET) to the DLC. This provisioning methodology will assign loops that are cross-connected at the ILEC Main Distribution Frame (MDF) to the CLEC collocation. The Embarq Customer Loop Assignment System (CLAS) creates a loop that is enabled from the DLC to the CLEC collocation. This provisioning methodology provides flexibility and allows the ILECs to provide unbundled loops to CLECs by providing the ability to break out or hand off an individual voice or data circuit coming from the DLC-RT to a CLEC at the central office.

OCn Fiber Optic Central Office Terminal equipment is installed with the central office terminal and is required to provide the optical capacity from the COT to the RT. This equipment sends and receives the optical light signals on the central office end of the DLC system fibers.

Digital Loop Carrier Remote System Fixed Cost includes material and labor for the remote DLC terminal that is equipped with an OCn Fiber Optic Terminal, the

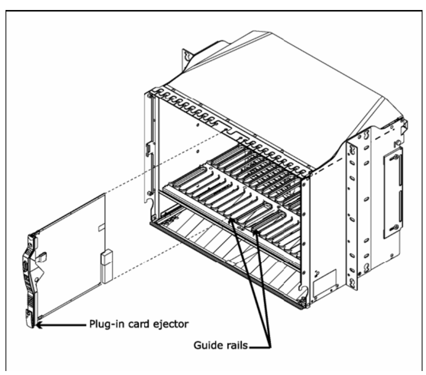
DLC cabinet, equipment shelves, batteries, cable termination blocks, and concrete mounting pad. `

The OCn fiber optic equipment is the remote end of the system. This equipment is located at the DLC cabinet and is used to provide OCn fiber capacity from the COT to the RT. This equipment sends and receives the optical light signals on the subscriber end of the DLC system fibers. It performs the optical/digital signal conversion.

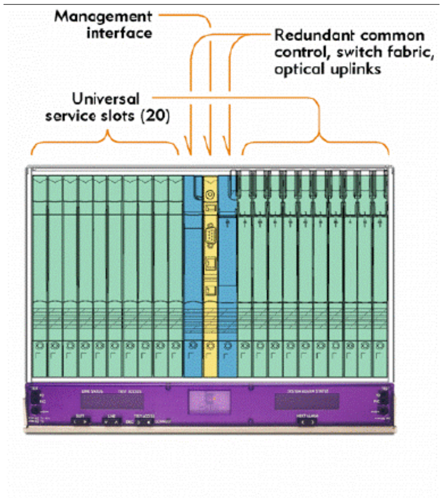
The DLC cabinet is an environmentally hardened enclosure that houses the field end DLC terminal electronics and batteries. It is generally located in easements on a concrete pad. The site preparation is part of the DLC cabinet cost and is based upon Embarq-specific costs and local zoning ordinances.

Batteries are for emergency power backup in the event of a commercial power outage. A charger installed in the DLC cabinet recharges the batteries.

DLC Line Cards are plug-in printed circuit boards that provide either analog voice grade or digital data interfaces for private or public network use. Although there are various card types listed in the input tables, only the voice grade or POTS card is used in calculating the cost of a POTS loop. Other service type cards are used in calculating ISDN-BRI, DS-1, and DS-0 loop costs.



View of the DLC Card Slots



DLC Card Slots per Shelf

For loops served via DLC, different pieces of equipment are required to provide various services. The inputs and calculations in LM reflect that different equipment is required for different services. For voice grade loops, common equipment is determined and is allocated by capacity. For example, if a DLC RT serves 672 lines, each of those 672 lines would incur 1/672 of the common equipment cost. Likewise, DS-1s will use a portion of the common equipment and have separate equipment (i.e. channel bank) needed to provide those services. For equipment common to all services, the allocation is based on space capacity. For the equipment used only for DS-1s, the capacity of the equipment is spread over the DS-1s in the system. Optical equipment is allocated based on bandwidth requirements. For example, a DS-1 will require 24 DS-0s worth of bandwidth, ISDN-BRI will require 3 DS-0s, and a voice grade loop requires only 1 DS-0. By calculating inputs and investment in this manner, each service is allocated its share of the DLC equipment and allocated its share of the feeder facility.

The Master Price List is used by both the LM and the Transport Cost model. The components of the electronics equipment modeled in LM are defined below.

Remote Terminal Costs - Fixed

a) Remote Cabinet Costs - DLC remote cabinet costs include the cabinet, 12 position fiber splicing tray, mounting hardware, battery compartment base, fan tray, fan tray filter, 5-PIN protectors, pour in place template, backup batteries and site prep. Larger cabinets also include fiber distribution panel, 84 circuit DSX-1 panel, DS-1 connecting cable, power harness and jumpers. Cabinet costs vary by size and are equipped with primary and secondary shelves. The number of secondary shelves varies by cabinet size.

b) DLC Card - Fixed card costs which contain the system switch matrix, real-time processor and memory, and timing source. The RAP card contains one optical interface to be used as the network interface.

c) Administration and Maintenance Processor Card (AMP) – The AMP card hosts system administrative software and provides the access point for craft and element management systems. It also contains test access and contact closure alarms and controls.

d) Adtran TA3000 Channel Bank - Fixed costs for the Adtran unit includes the Total Access© shelf, dual BNC adapter and enhanced system controller unit (SCU).

e) Adtran TA3000 Card Costs - Fixed costs consist of a DS-3 ATM MUX. An OC-3 MUX can be used in lieu of the DS-3 MUX when three units are linked or when a SONET interface is required.

Central Office Terminal - Fixed

a) Central Office Terminal (COT) Costs - Fixed COT costs include the COT frame, primary shelf, fan tray, fan filter, and secondary shelf when required.

b) Adtran TA3000 Channel Bank - Fixed costs for the Adtran unit includes the Total Access© shelf, dual BNC adapter and enhanced system controller unit (SCU).

c) Adtran TA3000 Card Costs - Fixed costs consist of a DS-3 ATM MUX. An OC-3 MUX can be used in lieu of the DS-3 MUX when three units are linked or when a SONET interface is required.

DLC Line Cards

The following cards can be used with the central office or remote terminal on an incremental basis:

a) DS-0-DP - The Digital Signal Zero Data Port (DS0-DP) card provides full duplex, synchronous data interface at 64kbps with 6 interfaces per card. The DS-0-DP card can be plugged into any of the 20 universal slots on a shelf.

b) RU2W-24 - The RU2W-24 plug-in card provides 24 two-wire, analog interfaces. The first four interfaces are for Coin service and each interface supports POTS, UVG, or 2WTO. The RU2W-24 card can be plugged into any of the 20 universal slots on a shelf.

c) RPOTS-24 – The RPOTS card, used in the remote DLCs, provides 24 two-wire analog interfaces which can be configured for POTS. The RPOTS-24 card can be plugged into any of the 20 universal slots on a shelf.

d) HPOTS-24 – The HPOTS card, used in the central office, provides 24 two-wire analog interfaces which can be configured for POTS with a switch interface. The HPOTS-24 card can be plugged into any of the 20 universal slots on a shelf.

FOT Cards

a) DS-1 Floating Drop Interface (DMI102) - The DMI102 card provides interface between low speed (1.e. DS-1) traffic and STS-1 bus.

b) DS1WW 202 DS1 Wire Wrap Panel - The DS1WW serves as interconnection input/output panel for terminating the tip and ring wires of DS-1 ABAM cable using wire wrap pins.

c) Virtual Group Interface (VTG102) - The VTG102 is a low speed interface between the DS-1 facility and the DMI102. The VTG102 can support up to four DS-1 signals to a VT group bus on the DMI unit.

d) Quad DS-3/STS-1 Interface (LIF502) - The LIF502 provides a quad DS3 or STS1 I/O low speed interface between the VT/STS-1 cross-connect matrix (CCM) plug-in unit and the LDR plug-in unit. Each of the 4 circuits on the LIF 502 can be provisioned independently as either DS-3 or STS-1.

e) HD 12 DS-3/STS-1 Interface (LIFD01) - The LIFD01 provides 12 DS-3 or STS-1 low speed interfaces between the CCM plug-in unit and the LDR plug-in unit. The I/O circuits on the LIFD01 can be provisioned as either DS-3 or STS-1.

f) LDR101 Line Driver/Receiver - provides the facility interface between l9ow speed interface (LIF) plug-in units and the coaxial I/O panel (CIOP20x) that mounts on the rear of the shelf assembly. The LDR101 can support either DSX-3 or STSX-1 facilities.

g) LDR501 Dual Line Driver/Receiver - the LDR501 provides the facility interface between the DS3/STS1 low speed interface (LIFD01) plug-in unit and the CIOP 401/501.

h) Coaxial Input/Output Panel (CIOP401) - the CIOP401 serves as an interconnection I/O panel for terminating either DS-3 or STS-1 external cabling. It provides the electrical and physical interface between the DSX-3 or STSX-1 cross connects and the LDR plug-in unit.

i) Fiber Expansion Panel (FES201) - The FES201 provides patch panel capabilities for up to 32 fiber optic cables. This allows use of up to four LIFF01 plug-in units in the SMX shelf drop groups.

j) OC-3 Low Speed Interface (LIF404) - The LIF404 is an intermediate reach low speed optical interface. LIF404 units are equipped with front panel mounted FC/PC optic connectors. The SMX can accommodate up to two LIF404plug-in units for each of the 4-drop groups.

k) Low Speed Quad OC-3 Interface (LIFF01) - the LIFF01 is an intermediate reach low speed optical interface equipped with front panel mounted LC optic

l) Low Speed OC-12 Optical Interface (LIFA01) - The LIFA01 is an intermediate reach low speed optical interface. LIFA01 units are equipped with front panel mounted FC/PC optic connectors. The SMX can accommodate up to two LIFA01 plug-in units for each of the 4-drop groups.

m) High Speed OC-3 Optical Interface (HIFB01) - the HIFB01 plug-in units provide the optical interface between the customer's fiber transmission link and the SMX's cross connect/drop module. The HIFB01 has built in fiber optic transmitter and receiver assemblies that operate at the OC-3 line rate. The SMX shelf can accommodate up to two HIFB01 plug-in units for each of the two line groups.

n) High Speed OC-12 Optical Interface (HIFA01) - the HIFA01 plug-in units provide the optical interface between the customer's fiber transmission link and the SMX's cross connect/drop module. The HIFA01 has built in fiber optic transmitter and receiver assemblies that operate at the OC-12 line rate. The SMX shelf can accommodate up to two HIFA01 plug-in units for each of the two line groups.

o) High Speed OC-48 Optical Interface (HIFF01) - the HIFA01 plug-in units provide the optical interface between the customer's fiber transmission link and the SMX's cross connect/drop module. The HIFF01 has built in fiber optic transmitter and receiver assemblies that operate at the OC-48 line rate. The SMX shelf can accommodate up to two HIFF01 plug-in units for each of the two line groups.

IV) A) OTHER DIRECT AND COMMON COST MODULE METHODOLOGY

Introduction

The purpose of the Other Direct & Common (ODC) Module is to calculate an additional component of the annual charge factor: this component is intended to recover the Other Direct expenses associated with unbundled elements. In addition, per line expense amounts are developed for Customer Operations and Common expenses.

The Other Direct factor is developed for each unbundled element and then added to the Annual Charge Factor (ACF) to arrive at a Total Economic Cost ACF.

Major Determinants of Cost

Direct expenses, such as maintenance expenses, are a component of the ACF, and therefore are not included in the expenses that are represented by the Other Direct factors. Additionally, expenses that are non-UNE related are also excluded from the expenses that are represented by the Other Direct factor.

Inputs (Input Module, ODC Worksheet)

The Input Module (ODC worksheet, Expenses worksheet, Revenue worksheet) contains all of the necessary inputs for the ODC Module. The inputs stored in the Input Module are described below.

a. **Access Lines (ODC tab)**
Input value.

b. **State specific regulatory fees (ACF tab)**
Input value.

c. **Telephone Plant in Service Account Balances (ODC tab)**
Input values.

d. **Building Investment Inputs (ODC tab)**
Forward-looking investment per a special study.

e. **Economic Investment Inputs (ODC tab)**
Economic investment for Loop, Switching, SS7, NID, and Transport is calculated by their respective cost modules.

Outputs

The ODC Module uses forward-looking economic investment amounts, actual General Ledger investment and expense information to create the Other Direct factor.

The ODC Module consists of seven worksheets, which are described below.

Summary Worksheet

The “Summary” worksheet is a one-page exhibit which shows the results of the other direct and common cost factor calculations in an abbreviated form.

Expenses Worksheet

The ODC methodology consists of four steps. The first step is to identify each General Ledger account as a direct cost, other direct cost, or a per line cost. Each account is labeled “D”, “O”, or “P”, accordingly.

Examples of direct costs include:
- Central office switching (621X)
- Operator systems (6220)
- Central office transmission (623X)
- Cable & wire facilities (64XX)
- Depreciation associated with direct investment (656X)

Examples of Other direct costs include:
- Network support (611X)
- Provisioning (6512)
- Network operations (653X)
- Portions of General Support (612X)

Examples of Per Line costs include:
- Portions of General Support (612X)
- Portions of Customer Support (66XX)
- Executive and Planning (671X)
- General and Administrative (672X)

Note that some accounts identified as direct costs are not UNE-related and are excluded from further calculations. Excluded expenses include:
- Station apparatus (6311)
- Large PBX (6341)
- Public Telephone Terminal Equipment (6351)
- Other terminal equipment (6362)
- Access expense (6540)

Common Expenses Worksheet

Common costs cannot be logically allocated to individual network elements. Thus the ODC Module develops a single per line common cost amount which is added to the final per line calculated costs.

Other Direct Worksheet

This worksheet assigns all General Ledger other direct expense accounts to the network elements based upon one of several drivers, as indicated in the "Assignment Driver" column. The assignment drivers themselves may be a driver found on the "Drivers" worksheet or an investment account. Return on land and building and other direct investments are also accounted for in this spreadsheet.

The total other direct expenses associated with each network element is divided by the economic investment (found on the "Drivers" worksheet) associated with that network element to derive the other direct factor. Since this is stated as a percent of investment, it can be added to the direct expense factor developed in the ACF Module to derive a total Annual Charge Factor.

Investment Worksheet

This worksheet assigns General Ledger investment accounts to one or more of the individual unbundled network elements. The General Ledger investment accounts are identified as direct, other direct, or per line, in the same manner as the expense accounts. Each investment account is assigned to a network element based upon one of several drivers, as indicated in the "Assignment Driver" column. The drivers themselves are found on the "Drivers" Worksheet.

Drivers Worksheet

The "Drivers" worksheet shows the five main drivers used to assign expenses and investments to the individual network elements. These five drivers are:

- Economic Investment – The economic investment associated with each network element.
- Annual Charge Factors – The annual charge factor associated with the network element.. Land and building annual charge factors are used to apportion land and building costs, including return and taxes, to common and other direct expenses.
- Economic Cost – The total direct expenses associated with the network element, including return and taxes.
- Building Usage Analysis – Building investment associated with each network element.
- Land Usage Analysis – Land investment associated with each network element.

IV) B) ANNUAL CHARGE FACTOR COST MODULE METHODOLOGY

Introduction

The Annual Charge Factor (ACF) is a rate which converts an investment amount into an annual recurring cost that includes capital recovery, return on investment, income taxes, ad valorem taxes, and direct maintenance expenses. A monthly recurring cost is obtained by dividing the annual recurring cost by twelve.

ACFs are developed for each type of plant included in the cost studies (e.g., circuit equipment, underground metallic cable). They therefore reflect the unique attributes of the underlying asset such as varying economic and tax lives, maintenance expenses, and salvage values.

Detailed Network Element Diagram

Not applicable.

Major Determinants of Cost

The ACF calculation is a three-step process. First, the annual direct costs per dollar of gross investment for each year of the economic life of the asset are determined. These costs, net of any tax benefits, are discounted back using Embarq's weighted cost of capital. The ACF is then calculated by taking the average of all of these discounted costs. Therefore, the ACF represents the average of the annual levelized direct costs for each dollar of investment in a given asset.

Inputs (Input Workbook, ACF Worksheet)

The input workbook contains all of the necessary inputs for the ACF Module. Those inputs are stored in a worksheet entitled ACF.

Column A. Row #

Column B. Description

Column C.

Item A. Cost of Capital
Input value equal to the overall weighted cost of capital.

Item B. Debt Ratio
Input value.

Item C. Equity Ratio
100% minus the Debt Ratio input.

Item D. Debt Cost
Input value.

Item E. Federal Income Tax Rate
Input value.

Item F. State Income Tax Rate
Input value, state specific.

Item G. Composite Tax Rate
This factor combines the federal and state income tax rates into a single composite rate. This calculation is described in "Engineering Economy, A Manager's Guide to Economic Decision Making", by American Telephone and Telegraph Company, Third Edition, 1977, page 174. The actual formula is on that page (equation 8.7)

Item H. Income Tax Factor
This factor determines the amount of income taxes necessary for each dollar of return. This calculation is described in "Engineering Economy, A Manager's Guide to Economic Decision Making", by American Telephone and Telegraph Company, Third Edition, 1977, pages 178 - 180. The actual formula is on page 179.

Ad Valorem Tax Rate
Input value, state specific.

Column C. Maintenance Expenses
Maintenance expenses as a percent of average investment.

Column D. Economic Life (Years)
The economic life of each plant category.

Column E. Salvage Value
Value of the asset at the end of its book life, stated as a percent of original value. A negative net salvage value indicates that the cost of removal is greater than the salvage.

Column F. Tax Life (Years)
The tax depreciation life of each plant category.

The applicable inputs are linked into the ACF module for final cost study calculations. The resulting charge factors developed by the module are linked back into this input worksheet to be applied to network investments in the remaining element-specific modules of the Embarq Economic Model.

Outputs

The ACF module workbook contains all of the calculated outputs (ACF factors). This module calculates and stores annual charge factors for each of the classes of plant.

Summary Worksheet

This worksheet compiles the ACF for each of the classes of plant found in the study.

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Total Economic Rate Depreciation
This is the sum of the "Economic Depreciation Net Salvage" and the "Economic Depreciation First Cost" columns shown on the Cost of Capital worksheet.

Column D – Cost of Capital
Represents the total cost of the investment less depreciation and net salvage. The total cost of investment represents the annual cost of carrying the investment, which includes return of invested capital, return on invested capital, and the cost or benefit of removal or salvage value respectively. The cost of capital is calculated on the Cost of Capital worksheet of this module.

Column E – Income Tax
Accounts for the affect of state and federal income taxes on the return on investment. This factor takes into consideration the effect of differences in economic and tax depreciation lives as well as the company's capital

structure. The income tax rate is calculated on the Income Taxes worksheet of this module.

Column F – Maintenance Expenses
This factor represents the annual maintenance expense for each dollar of investment. The Maintenance Expense factor is based on actual maintenance expense activity recorded in the general ledger of the company.

Column G – Ad Valorem Taxes
Accounts for the annual property tax paid by the company on investments located in the state.

Column H – Annual Charge Factor
This is the sum of columns C through G of this worksheet.

Cost of Capital Worksheet

This worksheet arrives at the cost of capital portion of the annual charge factor.

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Economic Life (Years)
This column lists the life by which the asset is depreciated in the study.

Column D – Salvage Value
This column lists the value of the retired asset, net of any cost of removal, as a percent of gross investment.

Column E – Economic Depreciation First Cost
This column calculates the straight-line depreciation rate without regard to any future salvage value or cost of removal. The Total Economic Depreciation Rate minus the Economic Depreciation Net Salvage.

Column F – Economic Depreciation Net Salvage
This column calculates the straight-line depreciation rate of the net salvage value. Salvage Value divided by Economic Life (Years).

Column G – Total Economic Depreciation Rate
This is the sum of the straight-line depreciation rate of the asset and the straight-line depreciation rate of the net salvage value appearing in columns E and F, respectively.

Column H – Investment Annual Cost
Investment Cost represents the annuity needed to recover $1 of investment and the associated net salvage value.

Column I –Annual Cost of Capital
Cost of capital is the difference between the investment annual cost percent in column H and total economic depreciation percent in column G.

Income Taxes Worksheet

Column A – Row #
Provides the worksheet row number.

Column B – Description
Lists the categories of plant under study.

Column C – Economic Life (Years)
This column lists the life by which the asset is depreciated in the study.

Column D – Total Economic Depreciation Rate
This is the sum the straight-line depreciation rate of the asset and the straight-line depreciation rate of the net salvage value and is calculated in the Cost of Capital worksheet.

Column E – Salvage Value
This column lists the value of the retired asset, net of any cost of removal, as a percent of gross investment.

Column F – Tax Life (Years)
This column lists the appropriate tax life for each class of plant.

Column G – PV Tax Depreciation
Present value of tax depreciation is equal to the present value of the annual tax depreciation. Since tax depreciation is not straight line, a table appearing on the Tax Dep worksheet is used to calculate the present value.

Column H – Annual Cost Tax Depreciation
Represents the annuity necessary to arrive at the present value of tax depreciation appearing in column G.

Column I – Annual Cost of Salvage
Annual cost of salvage represents the annuity necessary to arrive at the future net salvage value.

Column J – Investment Annual Cost
Investment Cost represents the annuity needed to recover $1 of investment and the associated net salvage value and is calculated in the Cost of Capital worksheet.

Column K – Income Tax Annual Cost
Income tax annual cost represents the income tax on the equity portion of return on investment taking into consideration the effect of economic and tax depreciation life differences.

Tax Depreciation Worksheet

This worksheet presents the **Modified Accelerated Cost Recovery System** (MACRS) depreciation rates and calculates the present value of these depreciation rates. MACRS is the current method of accelerated asset depreciation required by the United States income tax code. Under MACRS, all assets are divided into classes which dictate the number of years over which an asset's cost will be recovered.

Column A – Year
This column indicates the year.

Column B – Discount
This column calculates the present value of $1 given the number of years appearing in column A and assumed cost of capital.

Columns C – I – Tax Depreciation Rates
These columns list the MACRS yearly depreciation rates for each of the given tax lives.

Columns J – P – Present Value of Tax Depreciation
These columns represent the present value of the MACRs yearly depreciation rates appearing in columns C-I. The discount factor appearing in column B is multiplied by MACRS depreciation rate.