Modeling Network Costs

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Overview

- Presentation Overview
  - Background - The Need to Estimate Network Costs
  - Data development
  - Network Design and Investment Modules
  - Expense Modules
  - Model demonstration

Background

- Telecommunications Act of 1996:
  - Established a Universal Service fund to support service in rural areas
  - Required incumbent telephone companies to provide access to unbundled network elements at cost-based rates (but not based on traditional rate-of-return ratemaking
- These requirements created a need to develop a methodology for estimating the costs of the various elements of the telecommunications network

FCC cost principles

- Cost principles were adopted by the FCC in its Universal Service and Local Competition proceedings
- FCC focus was on determining cost of basic network functions
- Also adopted principles of estimating total demand served by each function…
- …as well as determining costs based on a total replacement of the network using least-cost, forward looking technology

FCC cost principles

1) Network design using least-cost, most efficient technology
2) All network functions must have an associated cost
3) Only long-run forward looking costs may be considered
   - Current cost of purchasing network equipment and facilities
   - Long run costs - all inputs are avoidable

FCC cost principles

4) Cost based on federal or state authorized rate of return
5) Economic depreciation lives with the FCC-authorized range
6) Cost study must include demand for all services, to capture economies of scale
7) Reasonable allocation of joint and common costs

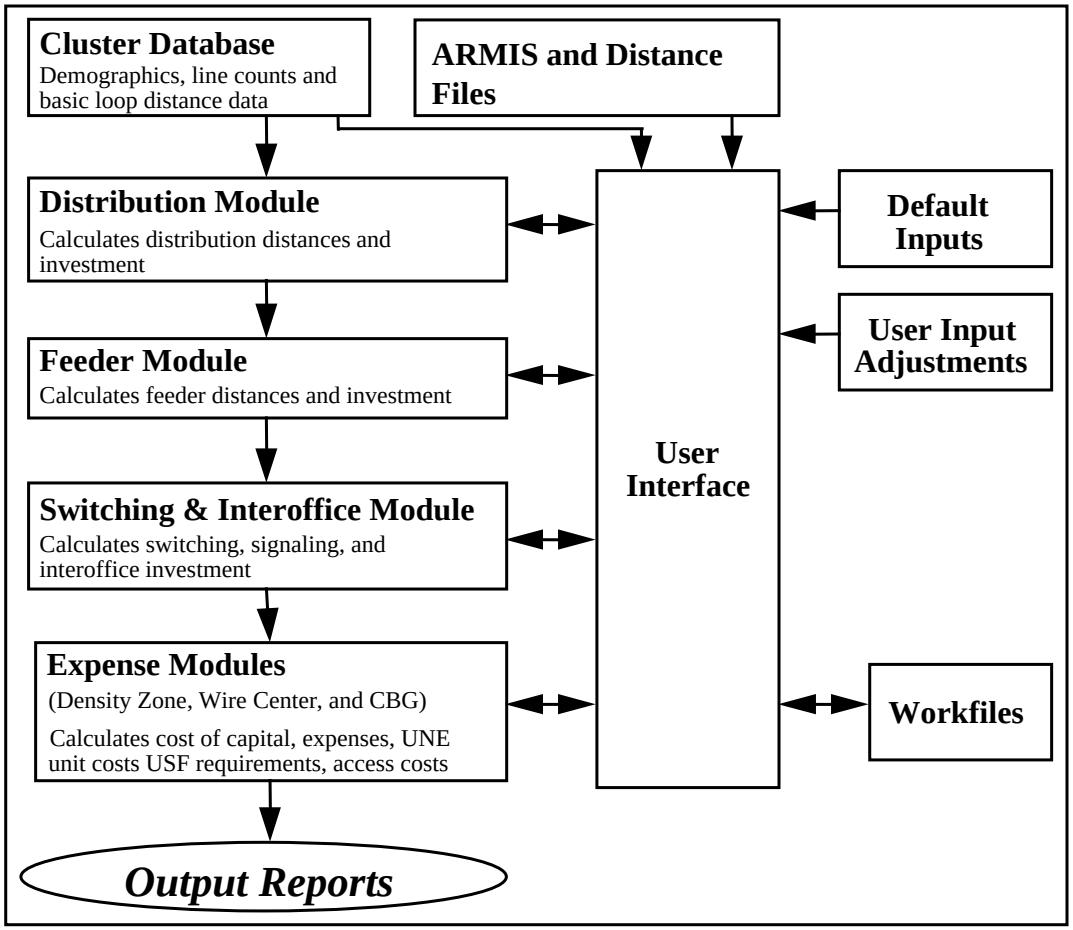
FCC cost principles

8) Cost study should be open and verifiable
9) Cost study should permit examination and modification of all assumptions and inputs
10) Examination of costs at a granular level (e.g., wire center, census block)

UNE costs produced by the HAI Model

- Network Interface Device (“NID”)
- Loop Distribution
- Loop Concentrator/Multiplexer
- Loop Feeder
- End Office Switching, including the cost of features supported by end office switch software
- Common Transport
- Dedicated Transport
- Direct Transport
- Tandem Switching
- Signaling Links
- Signal Transfer Point (“STP”)
- Service Control Point (“SCP”)
- Operator Systems
- Public Telephones
- ADSL Loops
- DS-1 Loops
- DS-3 Loops
- USF Cost (Basic Local Service)
- Per-line USF Support

HAI Model Process Flow



Need for Accurate Customer Location Data

- Design of loop plant is critically affected by…
  - ***Distance*** of customers from wire centers
  - ***Dispersion*** of customers from each other
- Each of these factors affect cable and structure cost
  - ***Distance*** determines
    - Length of feeder routes
    - Use of fiber or copper in feeder routes
  - ***Dispersion*** determines
    - Number of feeder routes
    - Number and length of distribution routes
    - Distribution cable size

Use of geocoded customer location data

- Provides most precise method of determining customer locations
- Ensures that sufficient plant is installed to reach all customer locations
- Provides an accurate basis for grouping customers into serving areas
- Permits association of customer locations with geographic units (*i.e.*, census blocks, wire centers)

If Available, ILEC records can provide actual customer locations and line counts

- Provides much higher geocoding success rate than use of “mailing list” data
- Also provides actual service counts for each location (*e.g.*, number of lines, DSL services)
- May need to be supplemented with plant records to ensure all service locations are included in the analysis

Clustering

- Once customer locations within a wire center are established, a clustering algorithm is used to group locations into clusters that can be efficiently served within a single serving area
- Clustering criteria
  - No point in a cluster may be more than 17,000 feet distant (based on right angle routing) from the cluster's centroid.
  - No cluster may initially exceed an equivalent POTS channel unit capacity of 6,451 lines in size.
  - No point in a cluster may be farther than two miles from its nearest neighbor in the cluster.

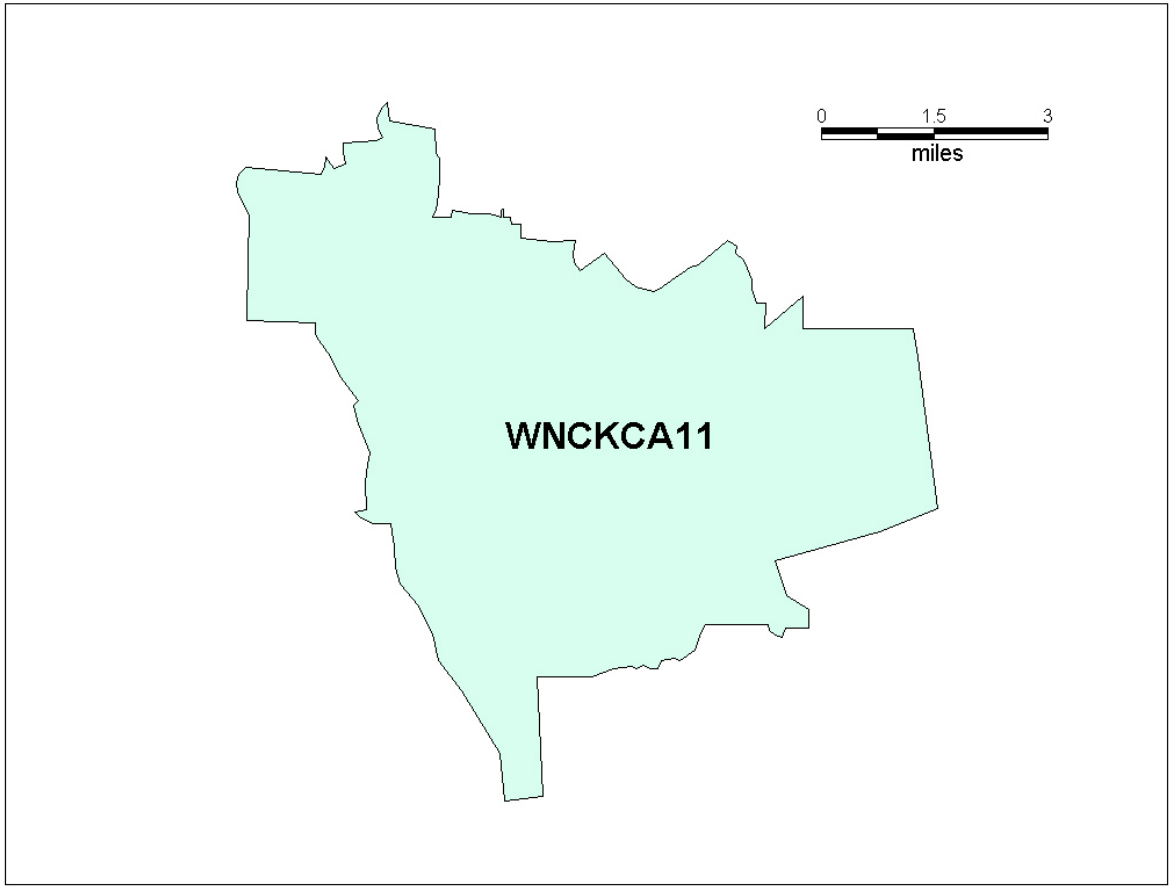
Clustering - Two Types of Clusters

- Main clusters
  - Must contain at least 20 lines, or
  - At least one all-fiber loop
- Outlier clusters
  - Are each associated with a main cluster
  - Are “chained” together considering minimum distance from one cluster to the next
- A main cluster and all of its outlier clusters constitutes a serving area

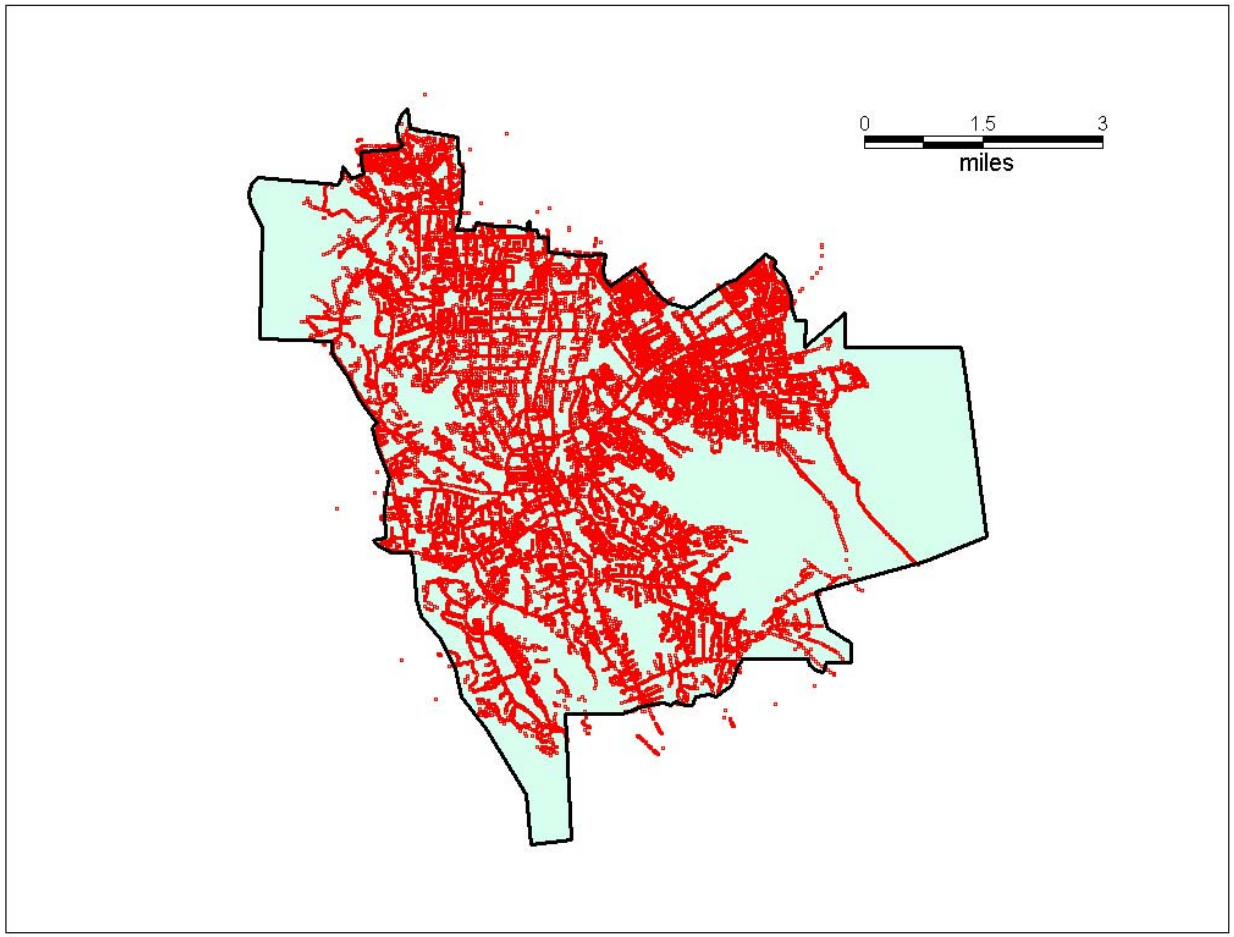
Clustering - Serving area boundaries

- The algorithm calculates the size of the minimum rectangle that covers the area formed by the convex hull containing all cluster members
- The area, aspect ratio, and orientation of the rectangle also is calculated.

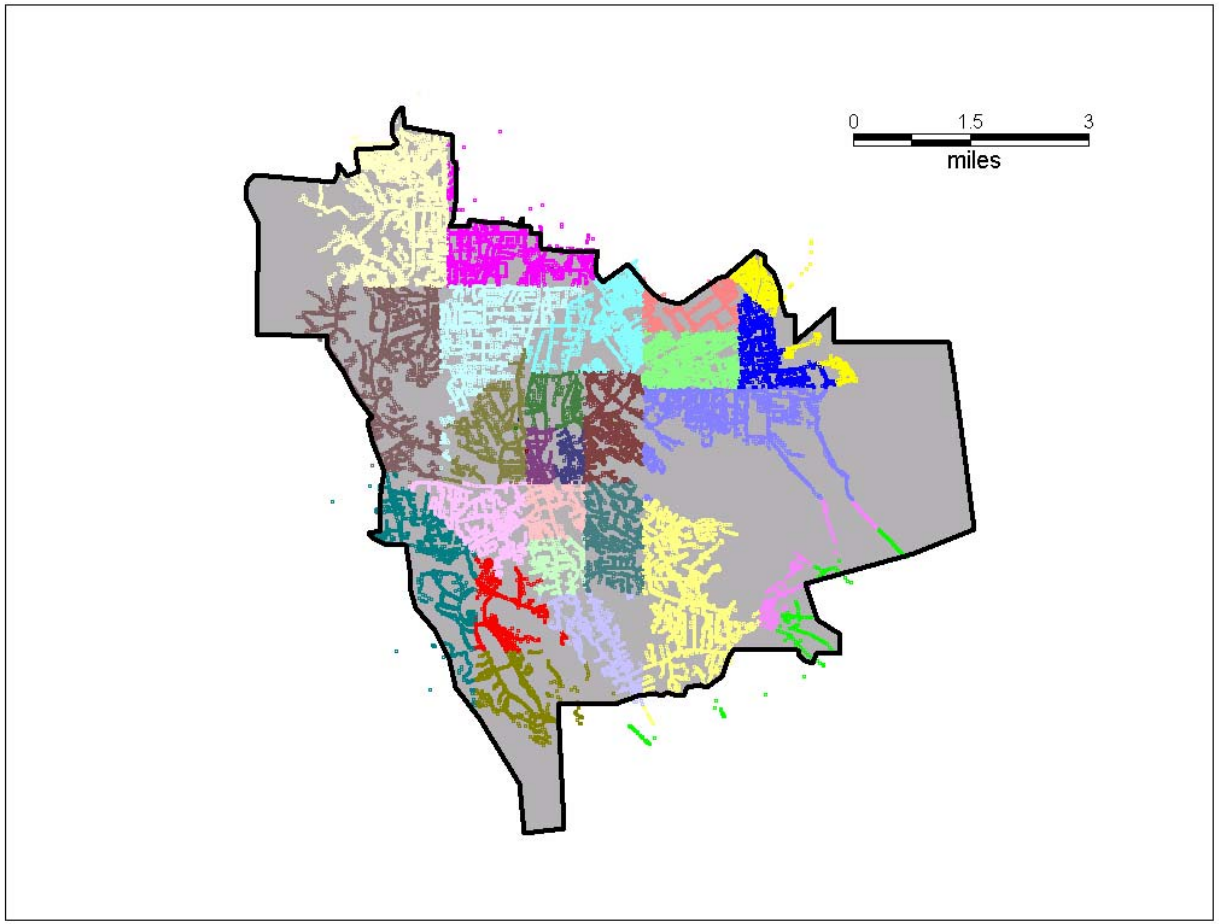
Wire Center Boundary



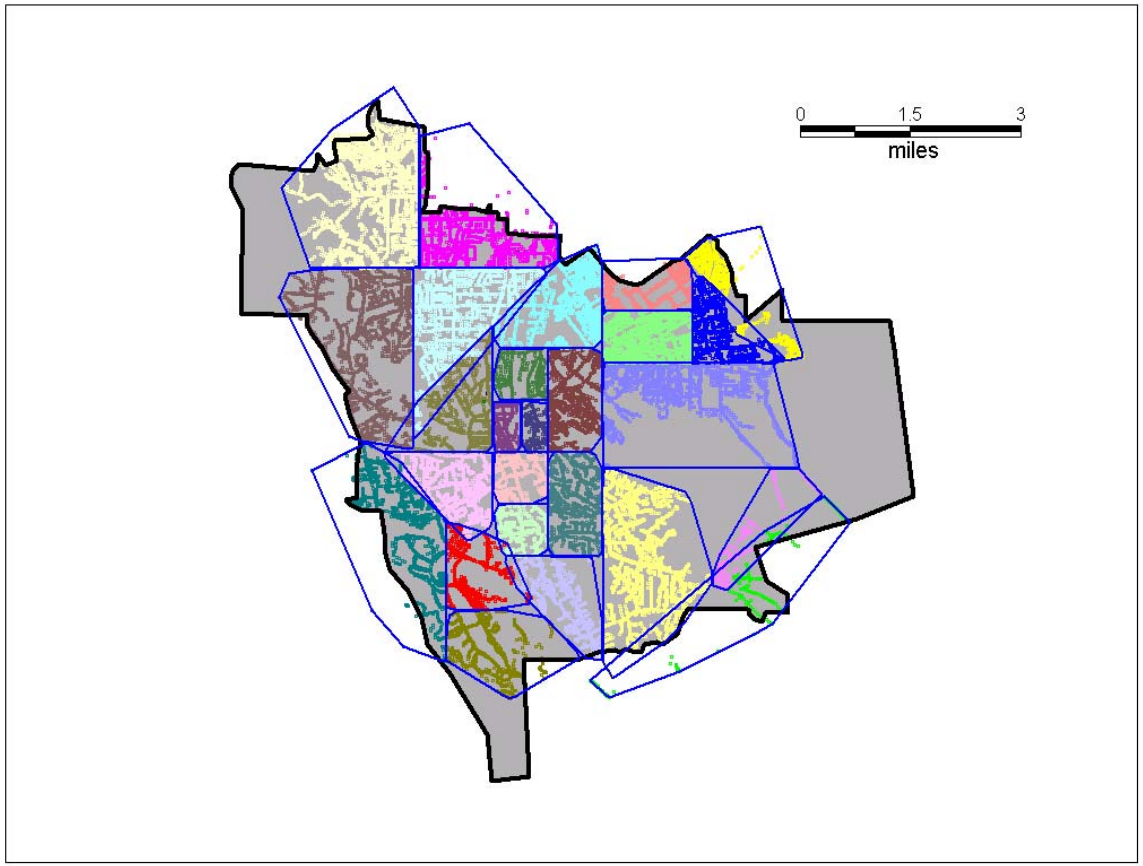
Geocoded customer locations



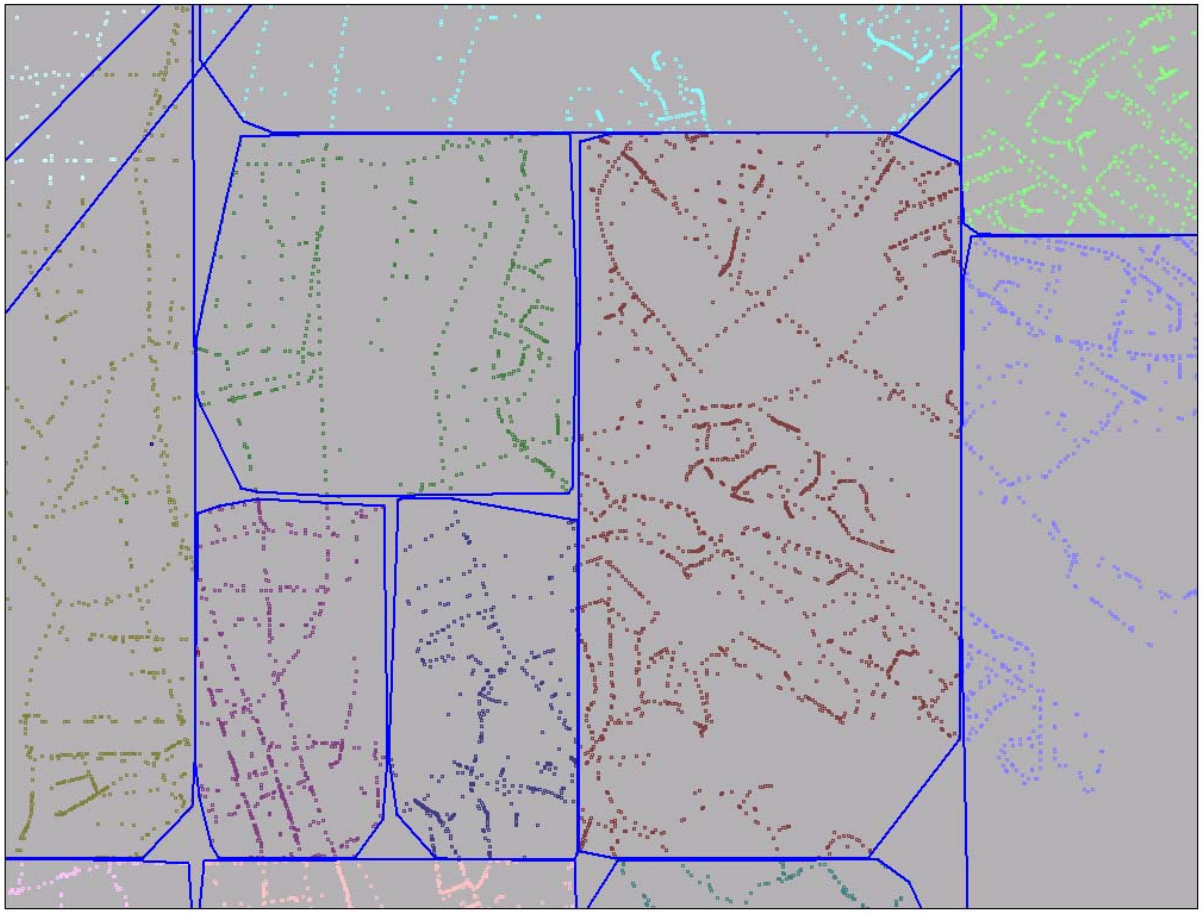
Customer Location Clusters



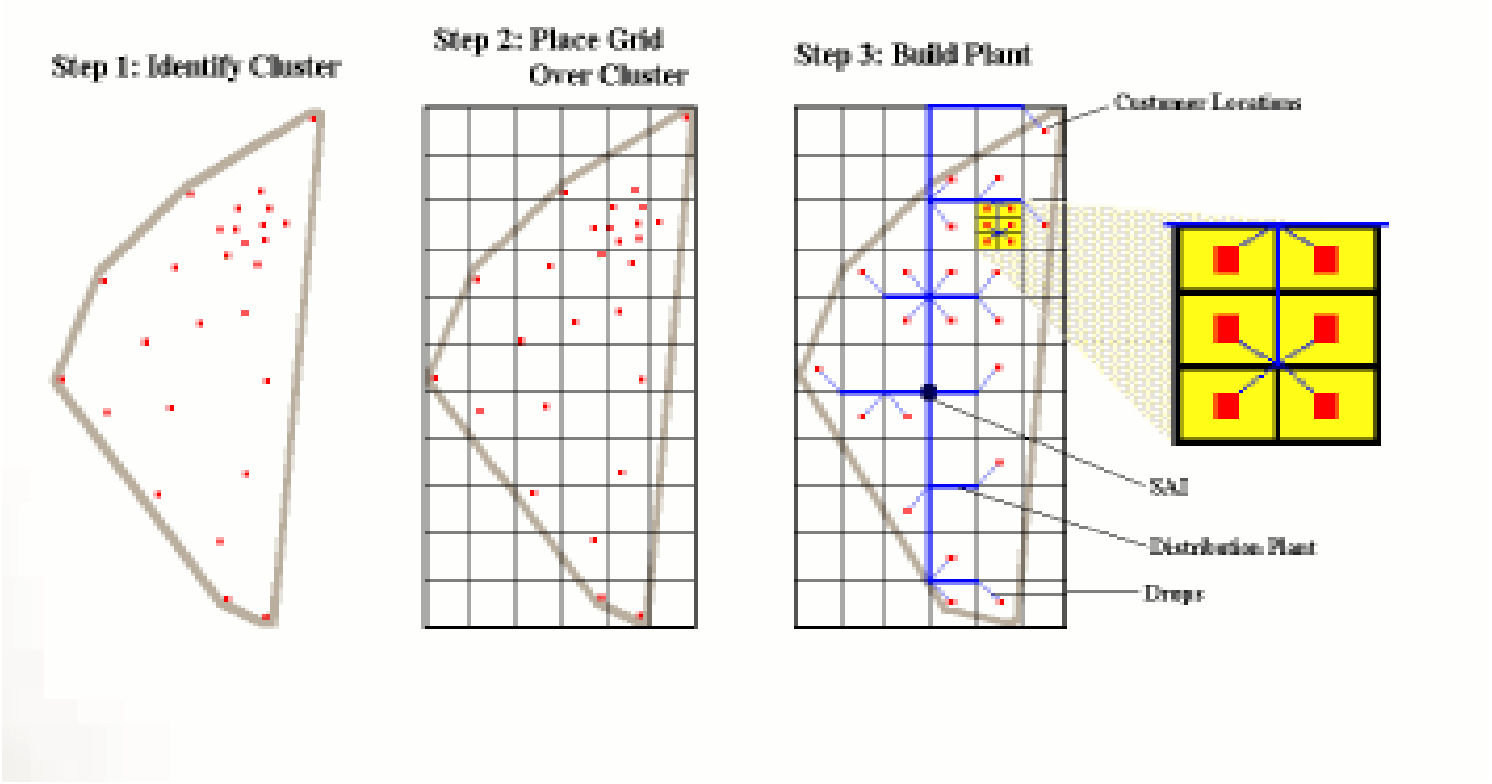
Clusters with Boundaries



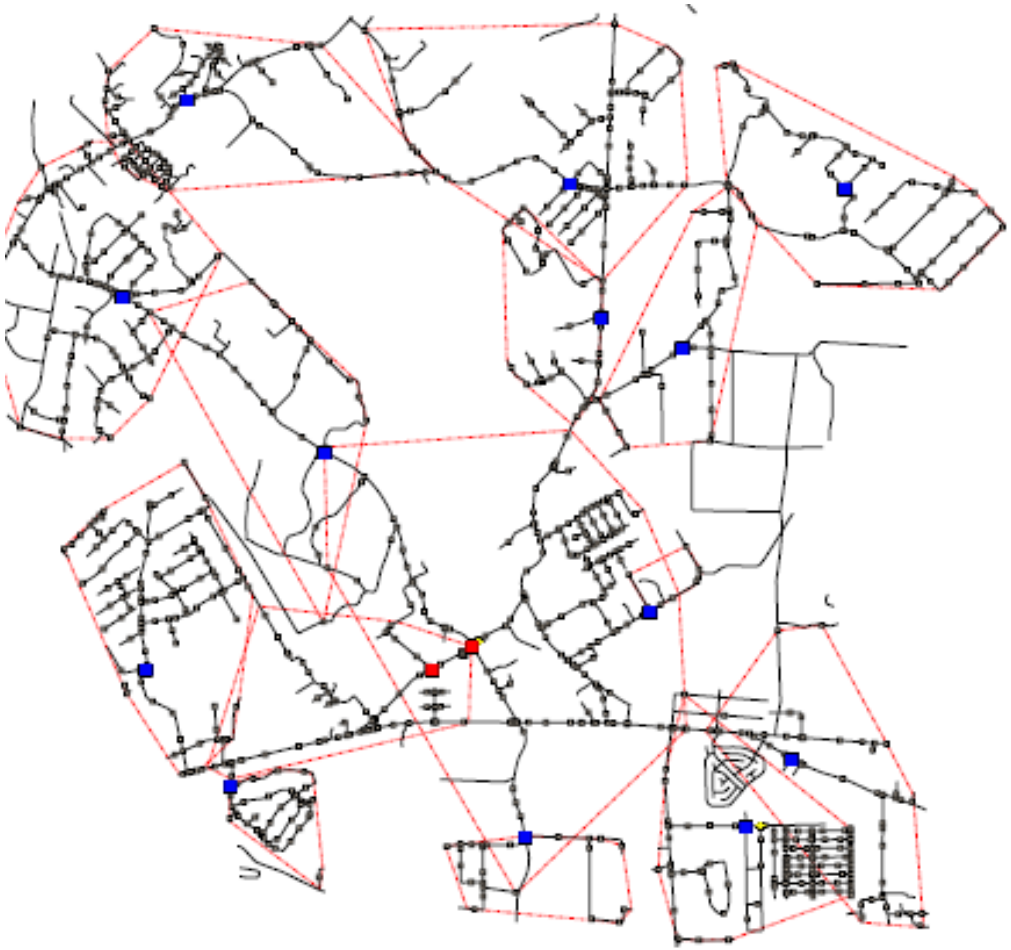
Cluster Detail



Old HAI-TNS method



New CostQuest Method



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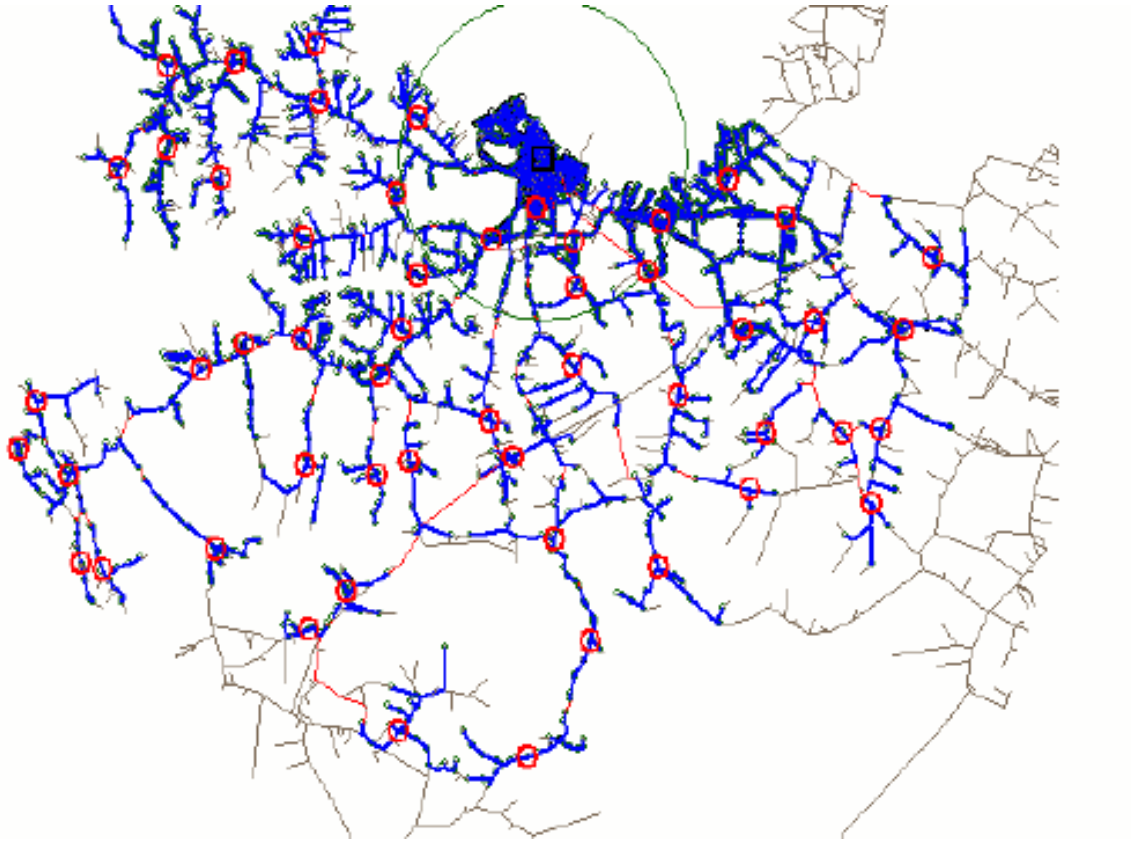
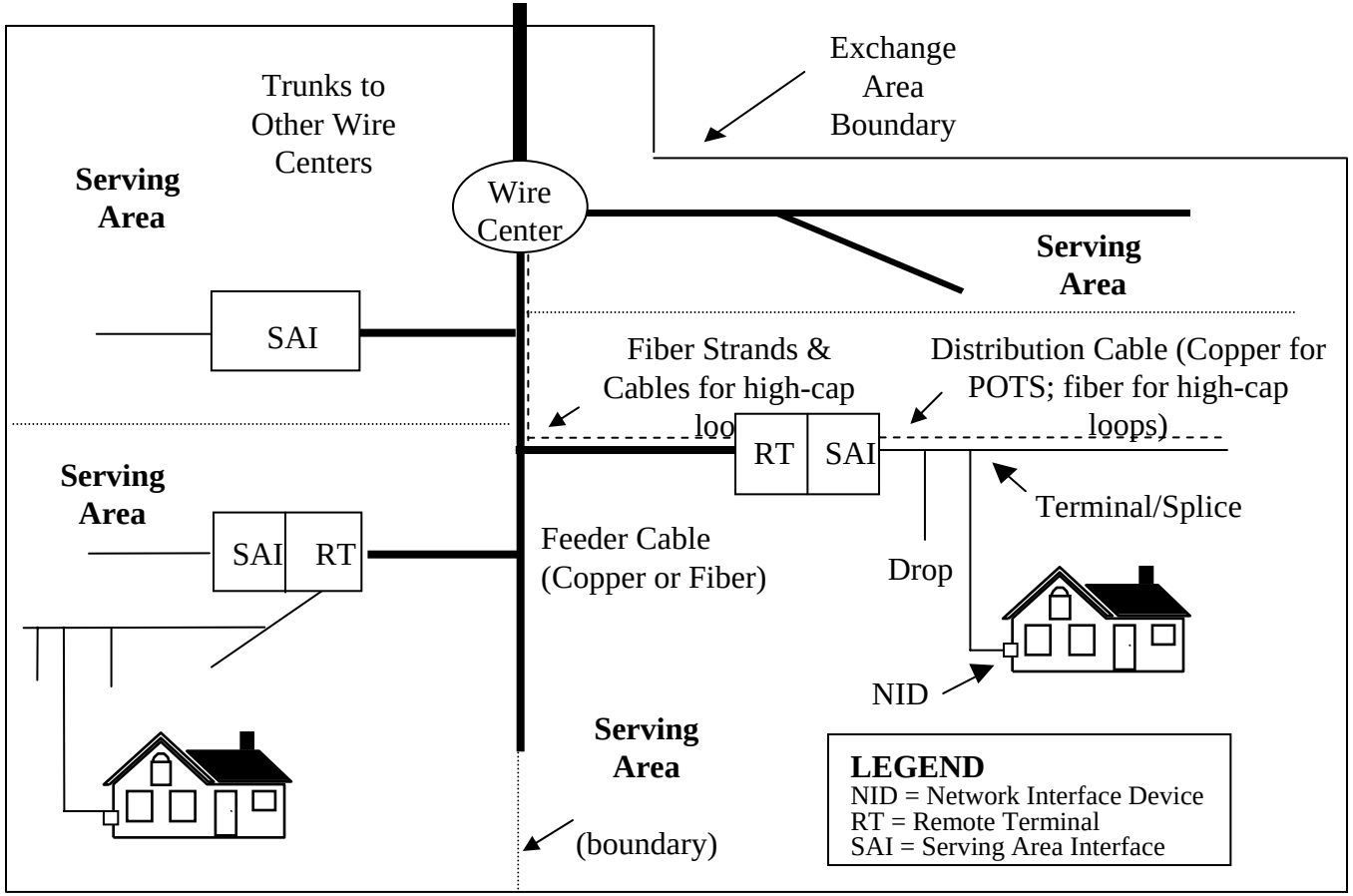


PointCode Process

- Converts the latitude and longitude coordinates for cluster centroids to the V&H coordinates used in the LERG to locate wire centers;
- Ensures that modeled distribution rectangles have an aspect ratio and area that reflects a minimum dimension equal to twice the default drop length for that cluster's density range;
- Calculates radial distances between main clusters and their serving wire center;
- Calculates radial distances between outlier clusters and main clusters, and main clusters to wire center;
- Computes angles between main feeders and the clusters they serve and computes angles between clusters and their subfeeders;
- Calculates rectilinear (right angle) distances between main clusters and their serving wire center, and between outlier clusters and main clusters.
- Assigns terrain, housing unit profile, and line density zone characteristics to the cluster based on the characteristics of the dominant CBG.

Network Overview



Adapted from Engineering and Operations in the Bell System, 2nd Edition, 1983

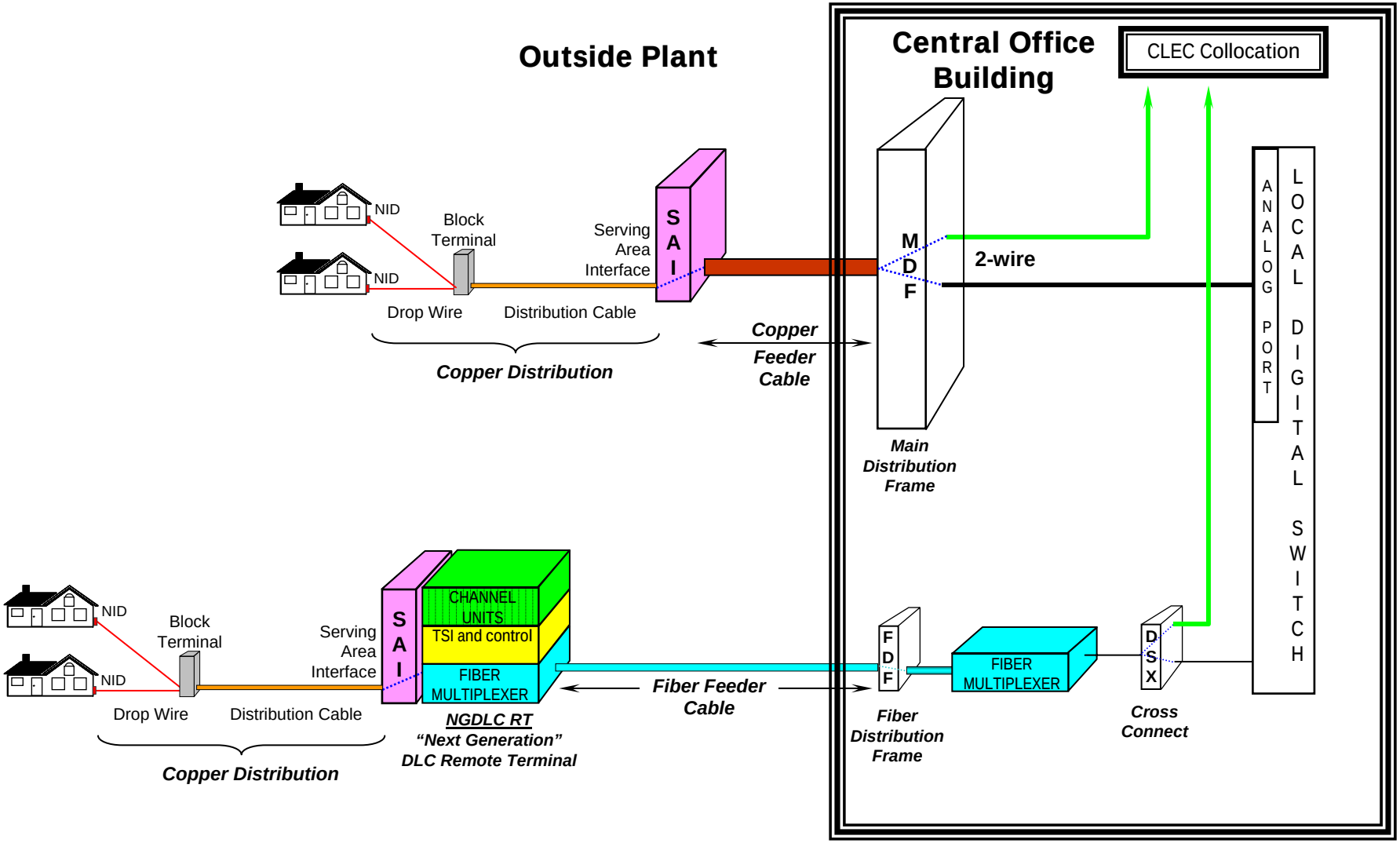
Distribution Module

- Calculates feeder and distribution cable lengths required to serve all customer locations
- Selects feeder technology
  - Copper feeder
  - Fiber feeder with Digital Loop Carrier if certain criteria are met
- Calculates investment in loop components
  - NID
  - Drop
  - Distribution cable and supporting structure
  - Serving Area Interface
  - DLC equipment, if applicable

Feeder Module

- Assumes four main feeder routes
- Sub-feeder branches from main routes to reach serving areas
- Module calculates cable sizes required on main and sub-feeder routes to serve all serving areas
- Feeder cable tapers as sub-feeder routes branch to serving areas
- Calculates cable investment associated with each serving area

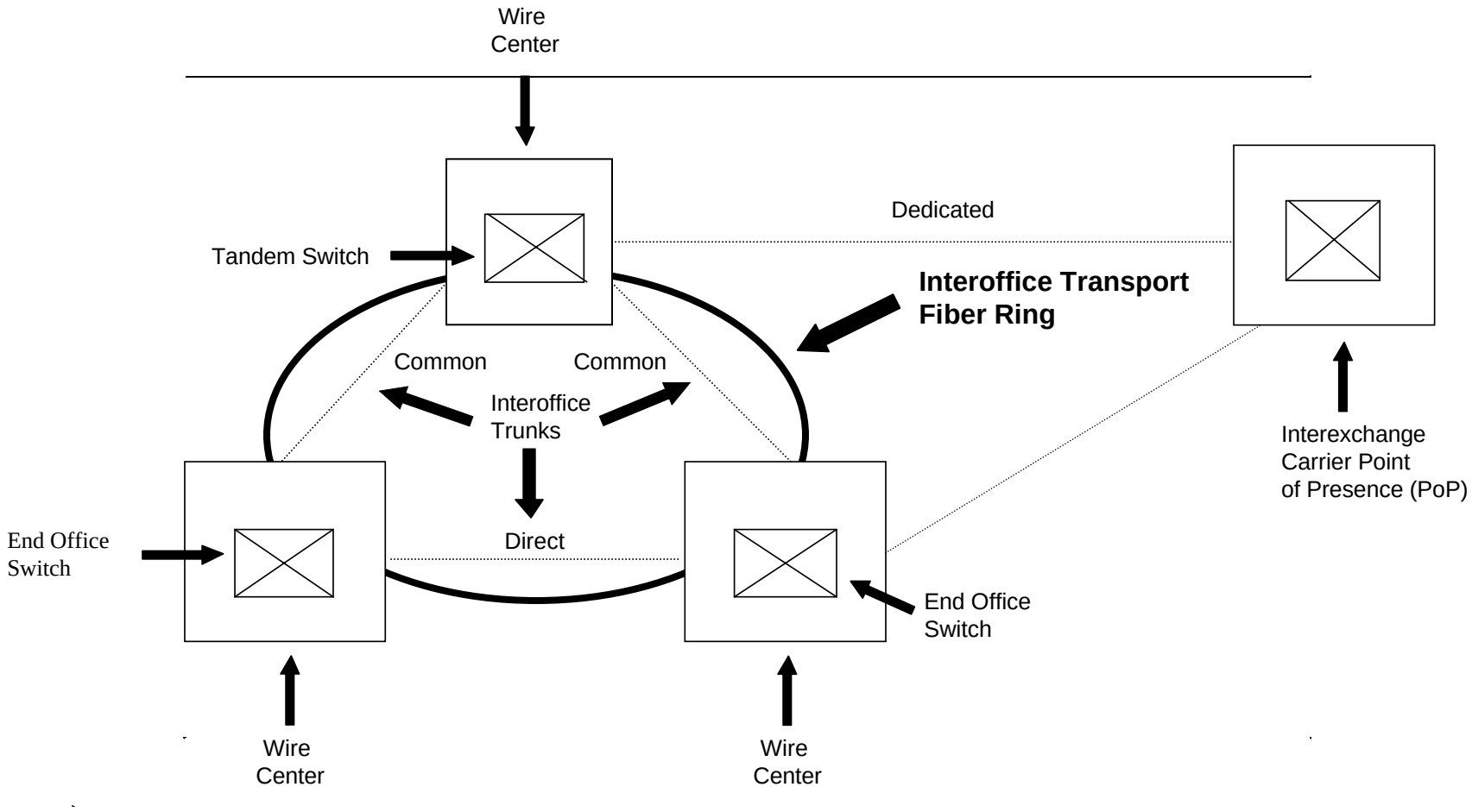
Loop Outside Plant Components



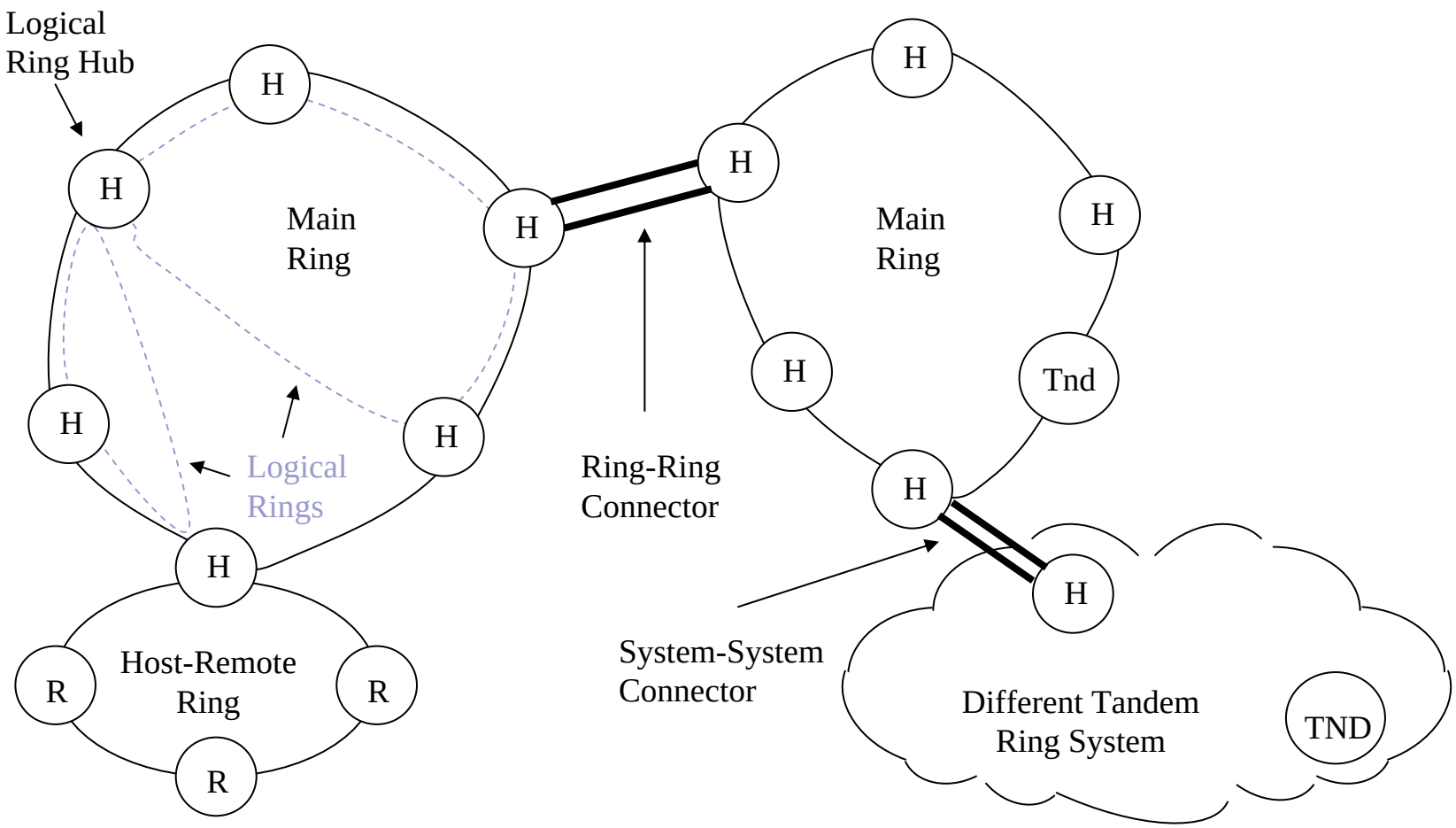
Switching and Interoffice Module

- Determines number of switches required in each end office
- Sizes interoffice trunks and signaling network
- Calculates investment in:
  - Switches
  - Multiplexing and transmission equipment
  - Interoffice cable and supporting structure
  - SS7 links, STPs, and SCPs
  - Operator systems

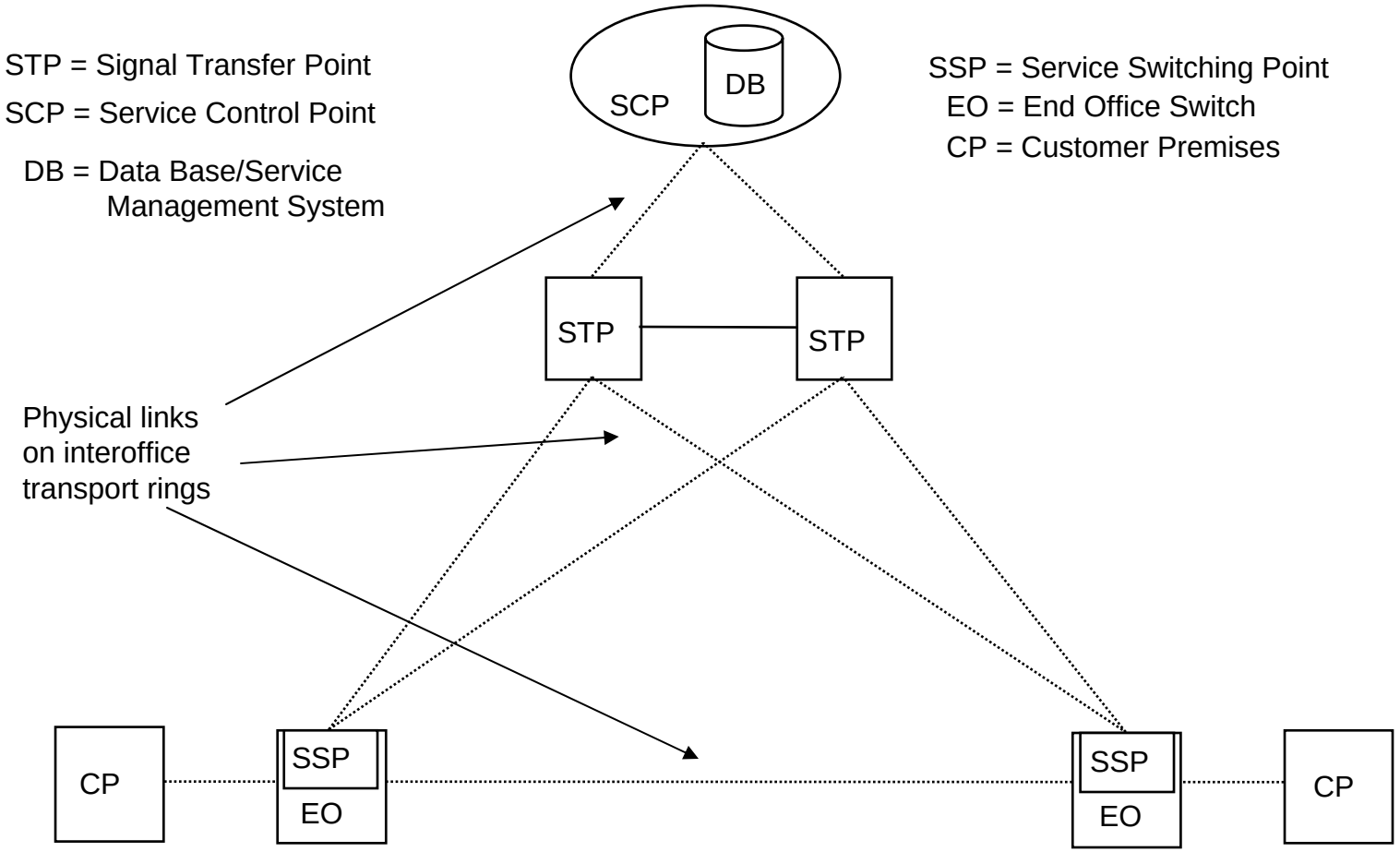
Interoffice Network



Interconnected Rings



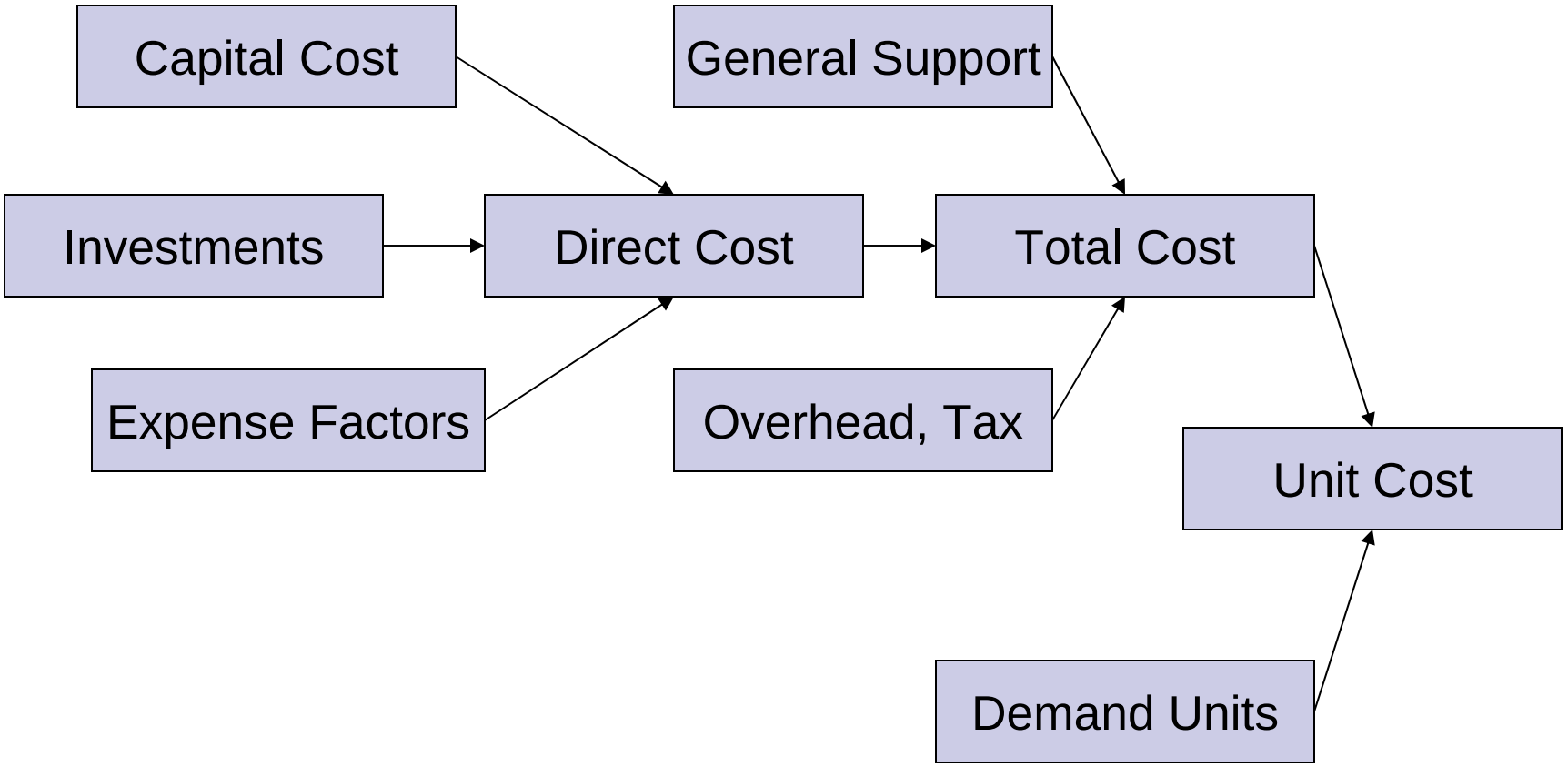
Signaling Network



Enhanced Calculations in HM5.3

- 4-wire, DSL, DS-1, and DS-3 loop UNEs
  - Distribution fiber for high-capacity loops
  - Multiple DLC line card types
- Sharing of cable and structure costs between loop UNEs
- Use of fiber rather than T1 on copper to serve remote clusters

Expense Module overview



Direct Costs

- Capital Cost
  - Includes equity return, interest on debt, income taxes on return, and depreciation
  - Accounts for tax effect of IRS depreciation schedules
  - Can accommodate straight-line/square life schedules or the Equal Life Group method used by the FCC
- Operating Expenses
  - Generally are based on expense to investment ratios calculated from most recent ARMIS data for the company and state under study
  - Applied to investment by plant account as calculated by the model

General Support

- Includes items such as non-switch land & buildings, motor vehicles, general purpose computers
- Calculated by taking ratio of these accounts to plant accounts in ARMIS, then applying inverse of this ratio to investment calculated by the model
- May be assigned by line or according to direct expenses at user's option

Total Annual Cost

- Total Annual Cost is the sum of:
  - Direct Cost
  - Assignment of General Support Costs
  - Company overhead expenses
  - Taxes other than federal income tax
  - Allowance for uncollectibles

Unit Cost

- Total Cost is divided by appropriate units (lines, minutes, etc.) to estimate unit cost
- Display of cost is by Unbundled Network Element
  - By Wire Center
  - By Groupings of Wire Centers
  - By Line Density Zones
- Information is contained in the model's workfiles that permits more granular analysis
  - By census block, census block group
  - By individual serving area (cluster)

Questions?

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