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November 19, 1997

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OFFICE OF THE SECRETARY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M. St., NW, Room 222
Washington, D.C. 20554

RE: Ex Parte Presentation – Proxy Cost Models
CC Docket No. 96-45

Dear Ms. Salas:

AT&T and MCI are pleased to submit a preliminary release the Hatfield Model, Version 5.0 for the Commission and the Federal-State Joint Board staff's examination in CC Docket Nos. 96-45 and 97-160. As indicated in the accompanying documentation, by locating most customers to their actual latitude and longitude locations, and by engineering telephone plant to these specific locations, this new release of the Hatfield Model is a major advance over previous versions of the Hatfield Model, as well as over every other competing proxy cost model.

Because the input data files are not yet complete for the entire United States, and because the Hatfield Model developers intend to add several additional enhancements when the final release of HM 5.0 is provided on December 11, 1997, the numerical results displayed in this preliminary version of HM 5.0 should be considered illustrative only.

Two copies of this Notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's rules. Copies of the CD-ROM are being filed with the Secretary and with ITS.

Sincerely,

Richard N. Clarke

Richard N. Clarke

Paper Attachments and CD-ROM

cc: S. Todd C. Keller R. Loube N. Wales M. Kennet
A. Bush W. Sharkey B. Wimmer B. Clopton V. Gupta
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Attachment List

1. Outline Description of Changes in Hatfield Model from Release 4.0 to Preliminary Release 5.0
2. Overview of CD-ROM Contents and Model Operating Instructions
3. Selected Density Zone Expense Module Output Sheets for all NonRural LECs in FL, GA, MD, MO, MT and UT
4. Viewgraph Presentation: Hatfield Model v 5.0
5. Viewgraph Presentation: Counting, Locating, Clustering and Engineering Plant to Customers in the Hatfield Model, v5.0

Hatfield Model

Preliminary Release 5.0

Outline Description of Changes in Hatfield Model From Release 4.0 to Preliminary Release 5.0

Hatfield Associates, Inc.

737 29th Street, Suite 200
Boulder, Colorado 80303

November 19, 1997

1. Overview

This document describes the changes that have been made to the Hatfield Model, Version 4.0 (HM 4.0) to evolve it into this preliminary release of the Hatfield Model, Version 5.0 (HM pre5.0). Because this document describes only the changes that have been incorporated into HM pre5.0, it does not provide a complete description of all of the assumptions and logic in HM pre5.0. For a description of the assumptions and logic in pre5.0 that are not "new" to this version, the user should consult the extensive documentation that the Hatfield Model developers have provided on HM 4.0.

While HM pre5.0 is a fully functional model of the complete local exchange network (e.g., loop, switching, signaling, transport, expenses, etc.), it will differ from the final release of HM 5.0 in several important respects. These are as follows.

- HM pre5.0 contains data only for the five states requested for test purposes by the FCC (i.e., FL, GA, MD, MO, MT) plus UT. The final version of HM 5.0 will contain data for all 48 continental states, plus the District of Columbia, Hawaii, Puerto Rico, and Anchorage Telephone Utility, Alaska.

- The data contained in HM pre5.0 for the six selected states are preliminary. Because the data specific to each state and company cannot be finalized until the data have been prepared for all adjoining states, the data supplied for these six states in final 5.0 will vary from that included with pre5.0.

- Not all of the user adjustable inputs into HM pre5.0 are yet manipulable through the model's automated interface. While these inputs will be handled by the interface in final HM 5.0, they may be adjusted in HM pre5.0 by user edits to the Input sheets of the model's Excel logic modules.

- While the logic modules in HM pre5.0 have been designed to accommodate all of the guidance provided by the FCC in its series of Public Notices on Cost Models, there are some additional features and refinements that will be incorporated into final HM 5.0 that are not reflected in the pre5.0 modules. In addition, it is possible that the HM pre5.0 logic modules contain several inadvertent errors. While the Hatfield Model developers' intend to undertake their own intensive effort to rid the model of any such errors prior to the release of final 5.0, they also would appreciate any users finding errors or illogic bringing this information to their attention so that these may be corrected in final HM 5.0.

- Because of the preliminary nature of both the HM pre5.0 logic and data, the numerical results produced by this model should be considered illustrative, pending release of final HM 5.0.

The Hatfield Model developers expect to file final HM 5.0 with the FCC by December 11, 1997.

2. Input Data

To accommodate HM 5.0's evolution to modeling local telephone networks based on actual clusters of customer locations, the input data used in HM 5.0 have become much more granular than the Census Block Group (CBG) input data used in HM 4.0 and earlier. Flowcharts describing the development processes used to prepare these input data for HM 5.0 are attached as Appendix A to this document.

2.1. Line Type Counts by Study Area

Counts of access lines by type (i.e., residence, single line business, multiline business, public telephone and special access lines) for each distinct NECA Study Area for calendar year 1996 are developed from several data sources. These include:

ARMIS 43-08, 10/01/97;
ARMIS 43-01, 10/01/97;
NECA USF Loops filing, 1996;
USTA report, 1995;
RUS report, 1995;
1993 USF Data Request;
ARMIS-based line factors.

The criteria by which the best of these data are selected are as follows.

a) When NECA Study Area name matches exactly ARMIS Company name, populate line types directly from ARMIS data for business lines (43-08), single line business lines (43-01), residence lines (43-08), special access lines (43-08), and public lines (43-08) data.

b) For remaining ARMIS Companies, determine counts of line types for NECA Study Area name by applying ARMIS line type distributions to total reported NECA USF Loops.

c) For non-ARMIS Companies, match NECA Study Area name to best available data source (i.e., USTA, RUS or USF Data Request) for residence and business line splits.

d) When no company-specific line type data exist, apply average ARMIS line type distributions to reported NECA USF Loops for NECA Study Area name.

2.2. Wire Center List

The source of the wire center information used in PNR's National Access Line Model is Bellcore's Local Exchange Routing Guide (LERG) database, dated August 1, 1997. The Hatfield Model developers have licensed from Bellcore an extract of key data from the LERG called the Special LERG Extract Data or "SLED."

Certain switching entities (wire centers) in the SLED with Common Language Location Identifier (CLLI™) codes not marked as end offices, hosts or remotes are then removed from this wire center database. In addition, switching entities that are inactive, or owned by wireless, long distance or competitive access providers are removed as well.

In a few instances, the SLED assigns wire centers to multiple local carriers. This may result from switch collocation. Because the Hatfield Model requires wire center entries to be unique, such wire centers are assigned to the local carrier having the greatest number of active NPA-NXX codes. If active NPA-NXX codes are equal among companies, assignment is to the carrier having the greatest number of residential lines.

Multiple occurrences of 8-character CLLIs may also occur in the SLED due to placements of several switches at a single wire center location. Because the Hatfield Model itself engineers multiple switches in a wire center if demand requires it, duplicate occurrences of 8-character CLLIs are removed from the model's wire center list.

2.3. Customer Counts by Census Block and Wire Center

Customer locations must be associated both with Census Blocks (CBs), as well as their serving wire center (WC). The PNR National Access Line Model,Version 2.0 (NALM) performs both of these tasks. The PNR NALM uses PNR survey information, Bellcore's LERG, Business Location Research's (BLR) wire center boundaries, Dun & Bradstreet's (D&B) business database, Metromail's household database, Claritas' 1995 demographic database, and U.S. Census estimates to calculate both the number of residential and business locations and access lines in each CB, and in each wire center in the United States. This summary describes the

methodology, data and assumptions used in developing these location and line estimates in the NALM.

2.3.1. Residence Counts

Residential customer location counts are developed by applying the following process.

a) The Metromail household database (described in section 2.4.1, below) is geocoded to CB/CBG location. Duplicate household information is identified and eliminated. If two records appear with an identical latitude, longitude and phone number, one of the two records is eliminated.

b) Implied residential household counts are evaluated by comparing Metromail counts to Claritas 1995 CBG-level projections. When Metromail households exceed Claritas households, Metromail households are used. When Claritas households exceed Metromail households, Claritas households are used, and the total differences are distributed to the constituent CBs in proportion to 1990 U.S. Census household distributions.

c) Access line counts are determined from household counts using probabilities, that is, how likely is it that a household will have a first or second telephone line installed. First line probabilities are provided by Claritas based on demographic age and income profiles by CBG. Second line probabilities are based on a logistical regression using similar demographic information and developed by PNR using its ReQuest™ III residential survey. Multiplicative probability factors are applied to the household counts defined above to derive residential line counts.

d) The above derived residential line counts by CB are then normalized to sum to Study Area wide data on total residential line counts developed in section 2.1, above.

2.3.2. Business Counts

Business location counts are developed by applying the following process.

a) The D&B national business database (described in section 2.4.2, below) is geocoded to CB/CBG location.

b) From the D&B national database, the total number of business lines, as well the probabilities of these lines being single line business lines and multiline business lines such as Centrex and PBX lines are developed. This model is based on an 800,000 firm sample.

c) The above derived business line counts by CB are then normalized to sum to Study Area wide data on total business line counts developed in section 2.1, above.

2.3.3. Counts by Wire Center

HM 5.0 uses WC boundaries provided by Business Location Research (BLR) as its primary source to define wire center service areas. These boundaries conform to CB boundaries, and customer locations contained within all of the CBs associated with a WC are then assumed to be served by that WC. Telephone number information (NPA-NXX) continues to be used for backup and data scrubbing purposes when anomalies arise in the BLR geographical assignment process.

2.4. Customer Location

The customer location approach used in HM 5.0 is fundamentally different from that of HM 4.0 – or any other approach that uses arbitrarily determined geographic delineators such as CBs, CBGs or latitude and longitude grid cells. Because HM 5.0's approach identifies the actual locations (accurate to within 50 feet) of most telephone customers, it produces the most sophisticated demographic data set of its type. The process first develops a database of more than 110 million customer address records. These addresses are then geocoded (assigned latitude and longitude coordinates). These locations are then divided among wire center serving areas based on geocoded customer location and the BLR wire center boundaries.

2.4.1. Residence Location Data

Data for residence locations are provided by Metromail, Inc. The Metromail National Consumer Database© (NCDB) is a large, nationally compiled file of U.S. household-level consumer information that includes both deliverable postal addresses (and telephone numbers, when available). The file consists of over 100 million households – which constitute over 90% of the 110 million households that the U.S. Bureau of the Census reported for 1995.

To ensure that the data captured are the most current available, this file is updated 65 times per year, and undergoes numerous "hygiene" measures to ensure its continued high quality for direct marketing purposes. Such purposes require the data to reflect postal address standardization practices, incorporate National Change of Address (NCOA) processing, and permit postal geocoding to street address, ZIP+4 or Carrier Route levels.

The file is compiled primarily from telephone White Pages directory data, but also utilizes many other primary sources of information, such as household mover records,

voter registration data, motor vehicle registration information, mail-order respondent records, realty data, and home sales and mortgage transaction information, to build a large repository of verified household-level data.

2.4.2. Business Location Data

Dun & Bradstreet collects information on more than 11 million business establishments nationwide. Information is gathered from numerous sources such as business principals, public records, industry trade tapes, associations, directories, government records, news sources, trade organizations, and financial institutions. This information is validated each night. Additionally, D&B conducts millions of annual management interviews to help improve the timeliness and accuracy of its information.

The information is organized by D-U-N-S number, a nine digit identification sequence which allows for the placement of companies within larger business entities according to corporate structures and financial relationships. A D&B family tree may be used relate separate operating companies to each other, and to their ultimate parent company. D&B also provides "demographic" information on each of the firms in its database. Such information includes counts of employees and the SIC code of the establishment.

2.4.3. Geocoding

Geocoding is used in order to most accurately assign known customer locations to actual, physical locations. Geocoding is also known as location coding. It involves the assignment of latitude and longitude coordinates to actual street addresses. Geocoding software is sophisticated enough to provide information regarding the source and precision of the lat/long coordinates selected. This precision indicator allows PNR to select only those addresses that have been geocoded to a highly precise point location. Geocoding also allows customer location points to be assigned less granularly to CBs or CBGs. Almost uniformly, geographical address locations are derived from enhanced versions of the USGS' TIGER database.

To perform its geocoding, PNR uses a program by Qualitative Marketing Software called Centrus™ Desktop. The data behind Centrus is provided by GDT. Premium GDT data are updated bi-monthly to ensure accuracy. These data integrate new information from US Postal Service (USPS) databases and private sources so that new streets and additions and changes to ZIP Codes, street names, and address ranges are included as soon as possible.

Centrus™ Desktop allows geocoding on two levels. The first is a match to the actual address -- which is they only type of geocoding used in HM 5.0 customer location.

The second is a match to a ZIP code (ZIP, ZIP+4, ZIP+2) level. Because of the lesser accuracy in the second method, these geocodes are not used in PNR's process of assigning customer locations.

Within the geocode process, there are a number of options available to the user. Each of these options determine the quality of the matches allowed in the end-use geocode. For purposes of customer location, addresses are always matched to the "Close" setting. "Close" allows for minor misspellings in addition to incorrect or missing directionals (North, East, etc.) or street types (street, road, etc.). There is also an option to select the level of ZIP code geocoding. The "9-digit best location" option is always selected. Although these geocodes are generally accurate enough for most applications, they are not considered good enough for actual customer locations and are not used to develop and locate customer clusters in HM 5.0.

Data hierarchy in address geocoding starts with the State. The hierarchy continues with City, Street Name, Street Block, and finally, House Range. Typically, a Street Block is the same as an actual physical block but it can also represent a partial block as well. The House Range displays address information from the USPS. Additionally, where there are gaps in the actual address range, the House range will account for these gaps.

Initially, the address coding module in Centrus™ Desktop compares the street addresses from the input file to the records contained in the USPS ZIP+4 directory and the enhanced street network files. If the address is located in the USPS files, the address is standardized and a ZIP+4 is also returned. If this address is also found in the street network files, Centrus™ Desktop determines a latitude and longitude for the location. Optionally, if the address is not found in the street network files, location information may be applied from the ZIP level.

Location codes generated by Centrus™ Desktop indicate the accuracy of the geocode. For purposes of customer location clustering in the HM 5.0, only those geocodes assigned at the 6-decimal place point location made directly to the street segment are used.

While the software and data used allow for a much more comprehensive output of data elements, for use in HM 5.0 customer location, the following addressing elements are extracted:

Address
City
State
ZIP
ZIP+4
Latitude

Longitude
Census Block
Match Code
Location Code

2.4.4. Gross -up

The geocoded location counts within each CB are next compared to target total line counts for that CB derived in section 2.3, above. If the geocoded location counts are less than the target count, the residual number of customer locations is then generated by a "gross up" process. These additional (or "surrogate") locations are then assigned geocodes that place them uniformly along the CB's boundary. While these assumed locations for the gross-up points are plausible because most CBs are bounded by roads, this is also the most conservative placement of the gross-up points because it assumes they are maximally separated from one another.

2.5. Customer Location Clustering

The input development process next identifies all customer locations within a wire center's boundaries that are close enough together to be efficiently engineered as a single telephone plant distribution area. This process is called clustering. Customer locations must meet the following criteria to be considered members of a particular cluster.

- No point in a cluster may be more than 18,000 feet distant (based on right angle routing) from the cluster's centroid.
- No cluster may exceed 1800 lines in size.
- No point in a cluster may be farther than 1 mile from its nearest neighbor in the cluster.

Note that other than for the wire center boundary restriction, these criteria do not include any arbitrary geographic restrictions, such as clusters being restricted to lie within a single CBG, CB, or latitude/longitude grid cell. Thus, clusters developed pursuant to this process are likely to be the most closely representative of actual telephone distribution areas as determined by outside plant engineers.

Clusters that contain 5 or more customer locations are classified as "main" clusters. Clusters that contain from 1 to 4 customer locations are called "outlier" clusters. Each outlier cluster is then associated with the nearest main cluster, on which it "homes." Outlier clusters may be linked to their "home" main cluster via "chains" that string together other outlier clusters that home on the same main cluster.

The description the HM 5.0 Distribution Module in section 3.2 below provides greater detail on the model's engineering of outside plant to serve main and outlier clusters.

2.6. PointCode Translation Processes

PointCode is a Microsoft Access '97 database process that translates between coordinate systems, computes distances and assigns additional characteristics to cluster records. Among the activities executed by PointCode are the following.

a) Convert the latitude and longitude coordinates provided by PNR for cluster centroids to V&H coordinates. Calculate radial distances between main clusters and their serving wire center. Calculate radial distances between outlier clusters and main clusters.

b) Compute omega angles between main feeders and the clusters they serve and compute alpha angles between clusters and their subfeeders. Calculate rectilinear (right angle) distances between main clusters and their serving wire center, and between outlier clusters and main clusters.

c) On the basis of the characteristics of the covering CBG, assign terrain and lines density zone characteristics to the cluster.

3. Model Logic

3.1. Outside Plant Selection

The HM 5.0 Distribution and Feeder modules automatically adjust buried and aerial structure fractions to account for the plant placement costs occasioned by local soil and bedrock conditions. The user specifies nominal buried and aerial fractions, along with an "at risk" portion of the buried cable fraction that unfavorable cost conditions can cause to be shifted to aerial. The model calculates the relative costs of each type of structure -- including both the additional placement costs arising from local terrain conditions as well as the life-cycle maintenance and capital carrying costs of the different structure types. The model then adjusts the aerial fraction up or down (and buried fraction in inverse fashion) from its nominal default value by up to the full amount of "at risk" structure, depending on the degree of difference in the life-cycle costs.

While shallow water tables generally do not affect the cost of underground or buried cable placement, a high water table may cause problems in the installation of manholes. HM 5.0 Feeder Module now increases manhole placement costs whenever

the local water table depth is less than a user-specified threshold value. The user may also set the level of this placement cost increase.

3.2. Distribution

3.2.1. Main Clusters

HM 5.0 lays distribution plant directly over the identified locations of customer clusters. The configuration of these backbone and branch distribution cables within main clusters assumes a regular arrangement of rectangular lots – similar to HM 4.0. Rather than being assumed to be square, clusters may be rectangular, with their aspect ratio (height-to-width ratio) determined by the data input development process for each cluster. The distribution module arranges lots within clusters to reflect the aspect ratio input for each cluster. (In HM pre5.0, the Distribution Module defaults to presume that aspect ratios equal unity.)

Within a main cluster distribution plant is all analog copper cable. The Distribution Module also determines whether copper or fiber feeder cables should be constructed to link a main cluster with its wire center. The Distribution Module will choose fiber feeder if *any* of the following criteria are met:

a) the total distance from the WC to the furthest point of a main cluster exceeds a user-settable maximum analog copper distance, whose default value is 18,000 feet;

b) the main cluster has outlier clusters subtending it;

c) the distance from the wire center to the main cluster centroid exceeds a user-settable copper-fiber crossover distance (default value of 9,000 feet); or

d) an analysis of the life-cycle costs of copper versus fiber feeder, as described below, indicates that fiber feeder is the more efficient choice.

Copper feeder is used if none of the above criteria are met. If fiber feeder is used, the module places DLC remote terminals at the center of the main cluster, or disperses these remote terminals throughout the cluster to keep the maximum analog copper distance within the user-settable maximum value.

3.2.2. Outlier Clusters

HM 5.0 engineers distribution plant to outlier clusters in a fashion similar to how HM 4.0 engineers plant to rural subscribers located along "road cables." If, as will commonly be the case, the distance from a main cluster centroid to the farthest point in an outlier cluster is greater than the user-settable maximum analog copper distance,

the outlier cluster will be served by a digital T1 signal on copper cable. This T1 signal will originate at the optically-fed DLC remote terminal located at the centroid of the main cluster to which the outlier cluster "homes." As was the case in HM 4.0, the model engineers drop/insert multiplexers at the centroids of these outlier clusters to serve (on analog copper cable) the customers located in these outlier clusters. In HM 5.0, the T1 signals to an outlier cluster are carried on copper cables separate from those carrying the analog voice signals to the customers within the outlier cluster. This is because the subscribers in these outlier clusters are not assumed to lie along the same "road" as carries the T1 signal from the main cluster to the outlier cluster's centroid. It is thus unnecessary to install a single large cable with sufficient pairs for the T1 and voice signals. In HM 4.0, outlying subscribers were assumed to be uniformly distributed along these routes.

3.3. Feeder

Main feeder on shared feeder routes, with subfeeder cables branching to individual main clusters, is arranged much as in HM 4.0. In HM 5.0, however, the unit of population served by feeder/subfeeder cable is now an individual main cluster and its subtending outlier clusters, not a CBG.

The user may elect to have the HM 5.0 Feeder Module "steer" feeder routes toward the preponderance of main clusters within a quadrant. The model computes an angular offset from the default values of 0°, 90°, 180°, or 270° by weighting each main cluster's angular coordinate by its radial distance from the wire center location, and then determining the weighted average angular displacement. When feeder cable is steered in this fashion, the Feeder Module also applies a route-to-airline (R/A) distance multiplier. The value of this multiplier may be specified by the user within an allowed range of R/A values. Subfeeder cables branch off in efficient perpendicular fashion from the main feeder route, both when feeder routes go in the cardinal compass point directions as well as when the feeder is steered at an angular offset from these cardinal directions. Alternatively, the user may elect to "turn off" feeder route steering and have the Module calculate feeder distances using "right angle routing" in the four cardinal compass point directions --as employed in HM 4.0.

As indicated in section 3.2 above, the HM 5.0 Distribution Module will direct that the Feeder Module always equip a feeder route with fiber-fed DLC equipment whenever certain distance, quality, or life-cycle cost criteria are met. Similarly, section 3.1 indicates the process that the Feeder Module uses to determine the fractions of outside plant structure that will be buried versus aerial.

3.4. Switching

The Switching and Interoffice Module of HM 5.0 is capable of engineering and costing end office switching systems comprised of explicit combinations of host, remote and standalone switches. But, because accurate data on the purchase prices of a portfolio of host, remote and standalone switches of varying capacities may not be available to the user, the HM 5.0 Switching and Interoffice Module defaults to computing end office switching investments using input values that average per-line investments for an efficient portfolio of host, remote, and standalone end office switches. Thus, the model's calculated end office switching investments and corresponding costs either specify explicitly on a wire center by wire center basis, or implicitly subsume on an overall basis a mixture of host, remote, and standalone switches within the modeled network.

If the user selects the explicit host, remote, standalone option, the user must specify for each wire center whether the housed switches are hosts or remotes, as well as assign correspondences between hosts and remotes. The model will designate all remaining wire centers as housing standalone switches. The model then places the hosts and their remotes on SONET rings separate from the interoffice rings discussed in section 3.5 below. Host switches may therefore appear on two rings -- their local host/remote ring, and (if the host directly serves more than the user-specified small office line limit) a larger interoffice ring interconnecting end offices and tandem locations. The model sizes the host-remote rings to accommodate host-remote umbilical trunk and control link requirements. It then computes investment in SONET add/drop multiplexers (ADMs) and digital cross connects (DCSs) for the host/remote ring and calculates the average ADM and DCS investment per line for all lines in the system. The host interoffice calculations also are adjusted to account for the increased trunk and signaling capacity requirements imposed by the remotes served by the host.

End office switching investment calculations obtain common equipment and per-line investments for all three switch types from a user-adjustable investment table, which contains end office investment entries for both large and small LECs. Once the model computes investments for each switch in a host/remote system, it calculates the average investment per line for all of the lines in the system.

In more detail, the costing process is as follows. When the host-remote option is selected, switching curves that correspond to host, remote and standalone switches are used to determine the appropriate switching investment. These new switching curves incorporate a fixed plus variable investment per line for each switch type. It is recognized that there are large and small host and standalone switch technologies, and that remotes are available in multiple line sizes. Remote switches cause incremental variable investments primarily associated with the umbilical trunk ports necessary to

carry traffic originating and terminating on the remote lines to the host switch. The fixed and variable investments for host, standalone and remote switches have been scaled accordingly. These investments are user adjustable, and it is expected that the final input values will be determined by the FCC's input review process during the first half of 1998. To reflect the smaller footprint requirements of remotes, appropriate reductions to the wire center building space required by remotes will be made in the final release of HM 5.0.

In accordance with the FCC's Public Notice guidelines, the cost of an entire switching system consisting of a host and its associated remotes, is allocated evenly over all lines served by the host-remote configuration.

3.5. Transport

HM 5.0 incorporates a program written in Visual Basic for Applications (VBA) that uses existing wire center locations to compute a set of SONET fiber rings to form the interoffice network. There are two types of rings in HM 5.0: host/remote rings and tandem/host/standalone switch rings. Host/remote rings interconnect remote switches with their serving hosts, and tandem/host/standalone switch rings interconnect host and standalone end offices with their tandems. The methodology that the HM employs is the same for both classes of rings, with hosts serving as the homing point in the host/remote rings, and tandems serving as the homing point in the tandem/host/standalone rings.

To compute the set of interoffice rings, HM 5.0 assumes an initial configuration in which all wire centers are directly connected to their serving tandem via redundant paths. Each wire center is then examined to determine whether it is more advantageous to leave the wire center directly connected to the tandem or incorporate it into a ring that connects the wire center to two adjacent wire centers. To make this determination, the HM 5.0 compares the direct tandem distance to the distance associated with placing the wire center on a ring, and calculating the savings, if any, of the latter configuration compared to the former. The HM 5.0 then places the offices that produce the greatest efficiencies on the ring first. The process then recurses, placing additional offices on the ring, and possibly creating new rings if the capacity of the pre-existing rings becomes exhausted. The process of creating rings is complete when no further efficiencies are possible.

Rings may not always contain a tandem location. The ring modeling process ensures that all end offices can communicate with their tandems by constructing a set of ring connectors, each of which provides a path between two rings or between a ring and the tandem. The location of each ring connector is determined by identifying the smallest distance from each node on that host/standalone ring to the tandem itself, or

to any other ring that has tandem connectivity. All ring connector distances are doubled to allow for route diversity.

The user may specify the maximum number of wire centers on a ring. A second input parameter controls the minimum number of lines a wire center must serve before it is eligible to be placed on a ring. Note that the user can ensure that all offices are placed on rings by setting this threshold at one line. As in HM 4.0, wire centers that serve fewer than the threshold number of lines will still be directly connected to their serving tandem via redundant fiber routes.

3.6. Expense Modules

The HM 5.0 density zone Expense Module now includes a Uniform System of Accounts (USOA) Detail worksheet that breaks out the HM 5.0 investments and expense results by Part 32 account for comparison with embedded ARMIS data. There is also an Expense Assignment worksheet that allows the user to vary the proportion of total expenses that are assigned to loop network elements (NID, distribution, concentration and feeder) based on relative number of lines versus based on the relative amount of direct expenses (direct expenses include maintenance expenses and capital carrying costs for specific network elements). The USF sheet now contains separate state and federal fund calculations. These permit separate state and federal cost benchmarks; as well as the opportunity separately specify the particular services (e.g., primary and secondary residential lines, single line business, etc.) to be supported.

4. Model Operation and Interface

The HM 5.0 interface has been modified from the HM 4.0 version to accommodate additional user inputs and to include new operating features. Principal new inputs include user-selectable host/remote assignments as well as an option selection that enables host/remote calculations. There are several minor input changes reflected in the interface, including the deletion of the town factor inputs from HM 4.0. These are no longer applicable because the HM 5.0's demographic database automatically classifies subscriber locations as being within main or outlier clusters, as described above. Other new inputs include user specification of T1 repeater spacing, indoor NID case investment, host/remote/standalone switch investments, among others.

The new interface allows the user to select an unlimited number (limited only by hard drive space) of companies from one or more states to be run in automatic sequence. The model then runs all of the selected companies, and produces individual Expense Modules and Workfiles. The Expense Modules will be stored in the Results subdirectory. Workfiles, by default, will not be saved during the Multi-Company

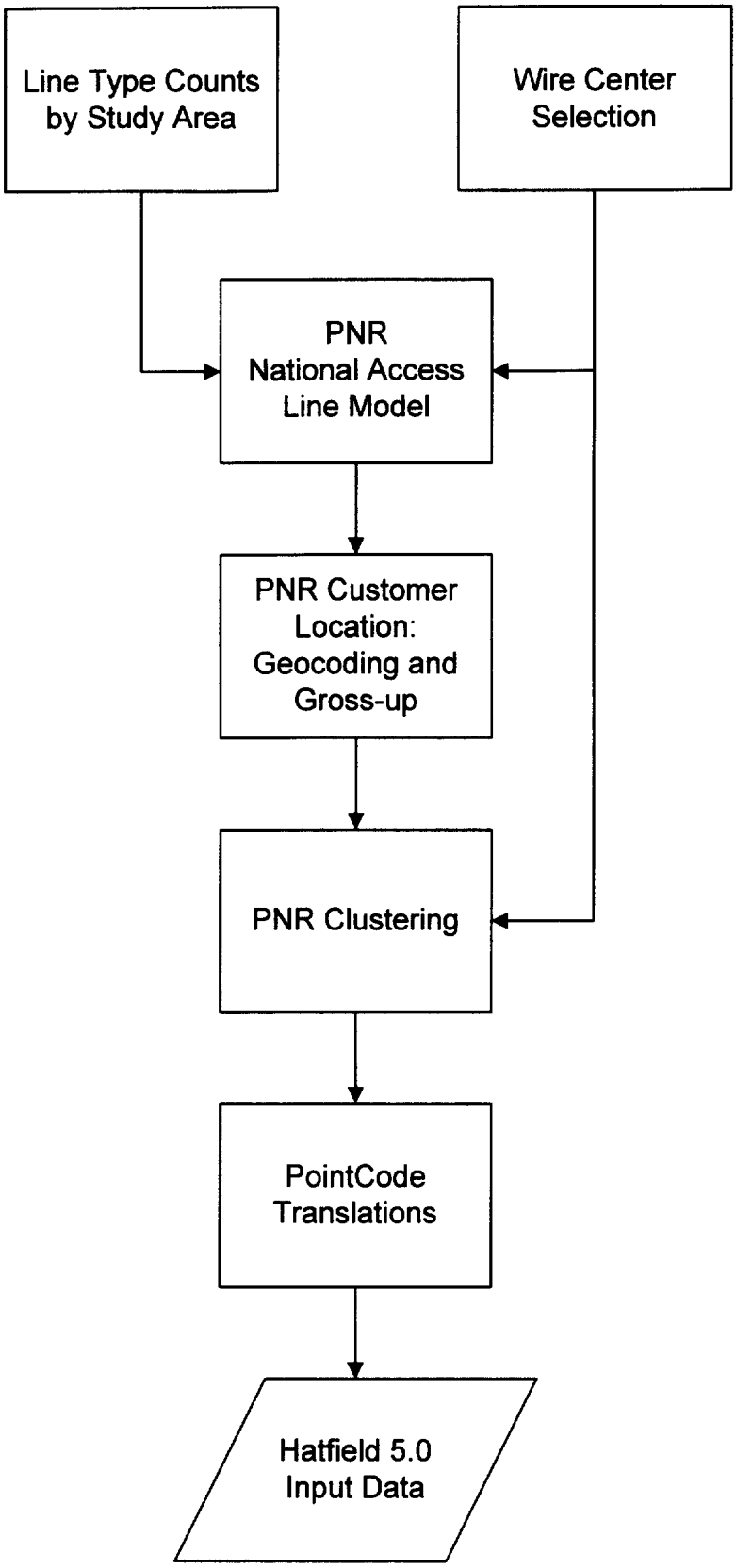
runs. The user must explicitly request that the Workfiles be saved by checking this option in the Multi-Company Selection form.

Because of several lingering incompatibilities of Microsoft Office '97 with Office '95, the model may terminate abnormally the first time that the HM pre5.0 model is executed after its installation. Thus, the user should select a small LEC for a "break-in" run of the model. After the abnormal termination of this run, simply exit the model and re-enter it. Also, be sure that all instances of the Excel application are closed before running the model again. From this point on, all runs should pass through to successful completion. In any event, no incorrect outputs are ever produced by this systems "bug."

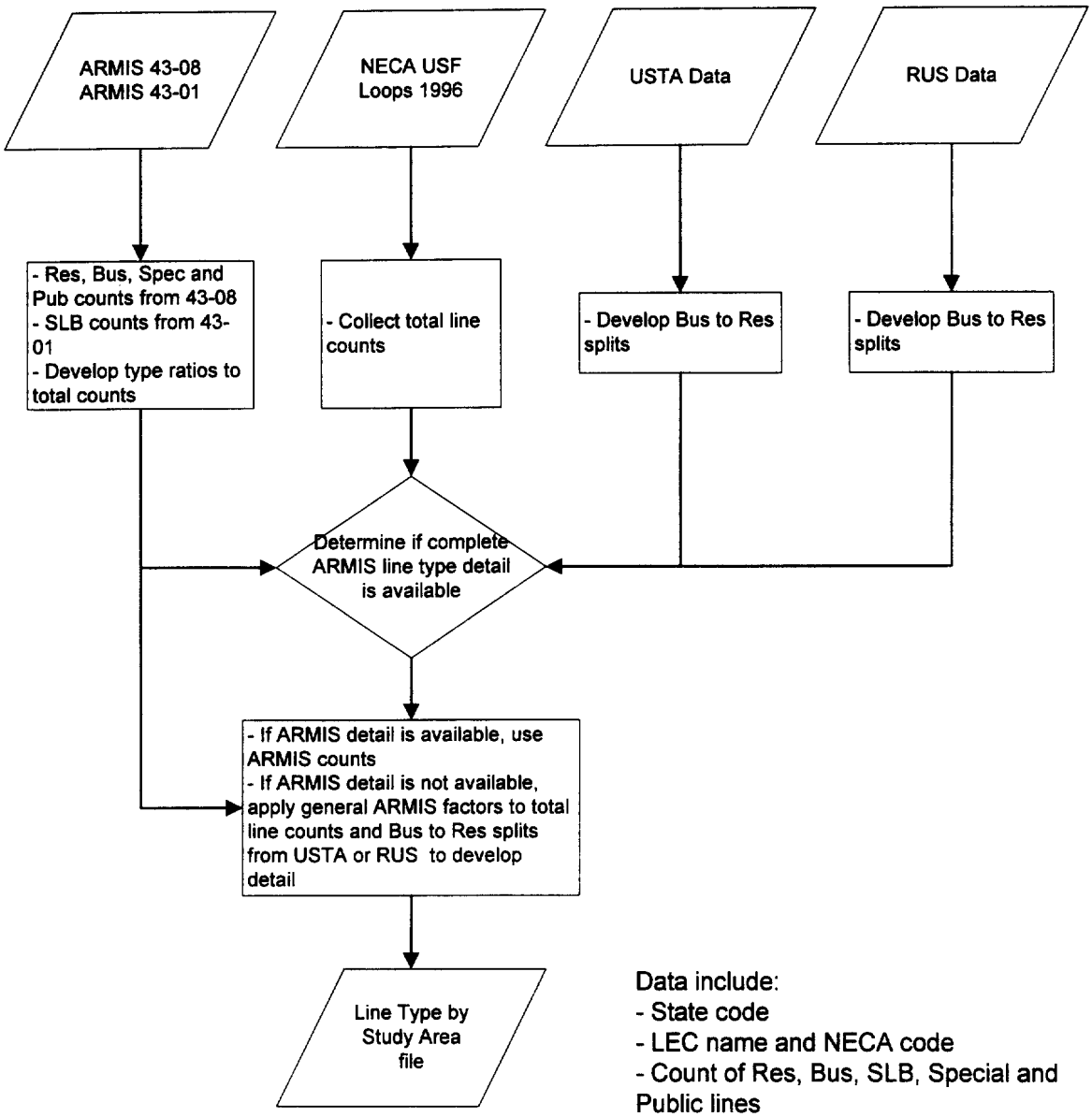
Appendix A

Flowcharts of the Input Data Development Process for HM 5.0

OVERALL INPUT DATA DEVELOPMENT PROCESS

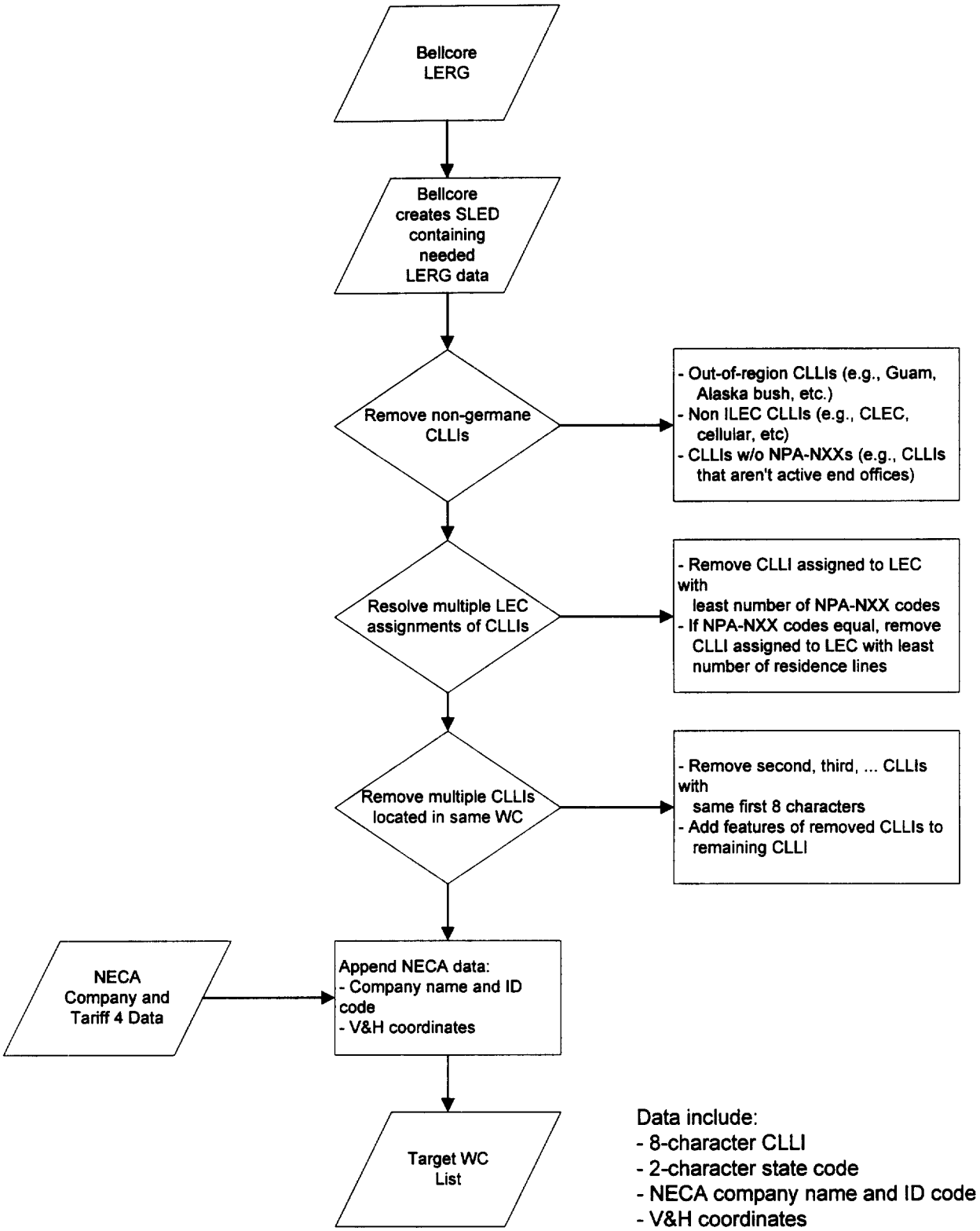


LINE TYPE COUNTS BY STUDY AREA

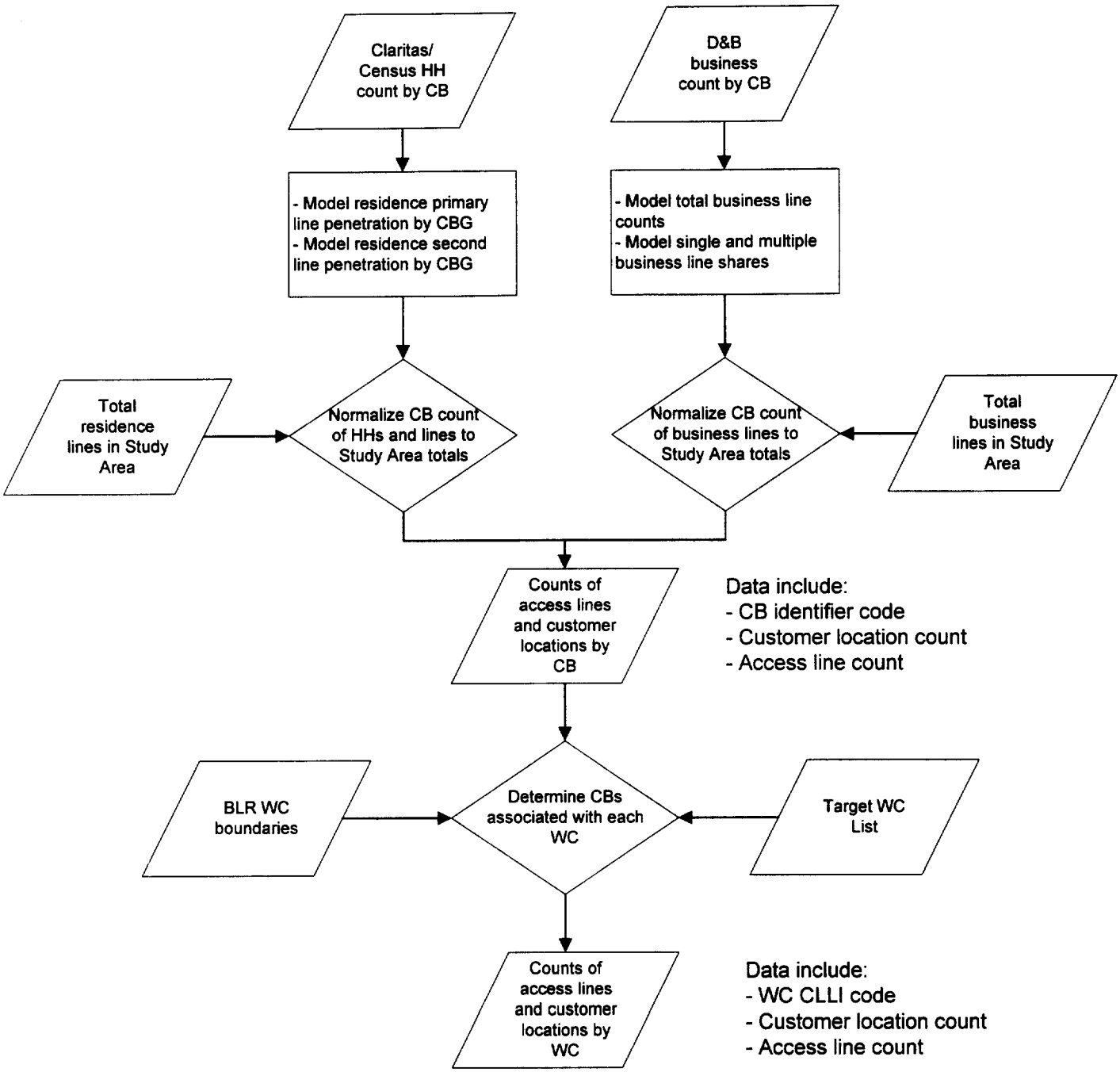


Data include:
- State code
- LEC name and NECA code
- Count of Res, Bus, SLB, Special and Public lines

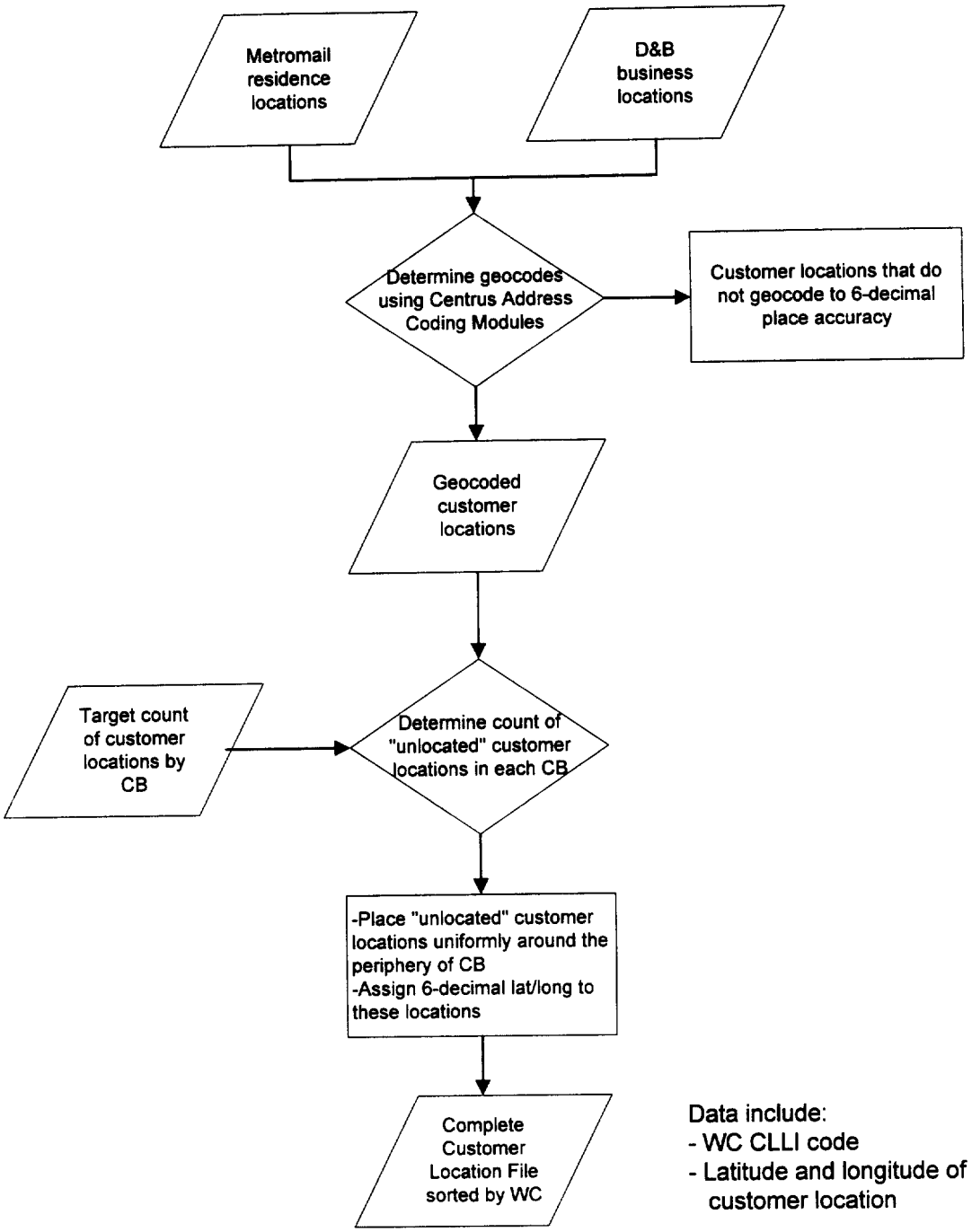
WIRE CENTER SELECTION PROCESS



PNR NATIONAL ACCESS LINE MODEL DEVELOPMENT PROCESS

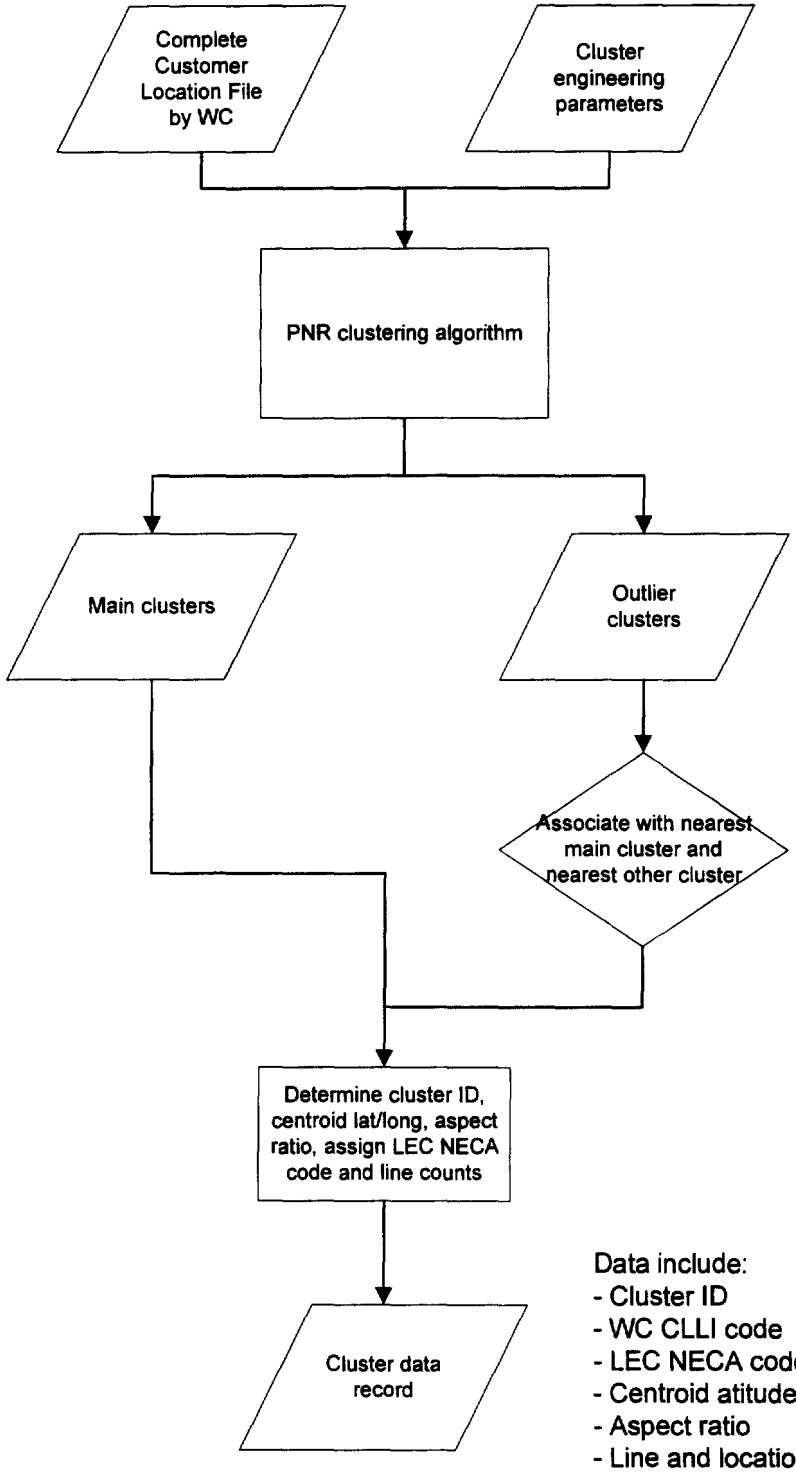


GEOCODE AND GROSS-UP PROCESS



Data include:
- WC CLLI code
- Latitude and longitude of each customer location

CLUSTERING PROCESS



Data include:
- Cluster ID
- WC CLLI code
- LEC NECA code
- Centroid atitude and longitude
- Aspect ratio
- Line and location counts
- Identity of nearest other cluster