WG13 61970
A Family of CIM Standards based on CIM/XML formatting (61970-552)

- Network Model Exchange for Operations and Planning Models (61970-452)
- Solved State Exchange (61970-456)
- Schematic Layout Exchange (61970-453)
- Dynamic Model Exchange
- Unbalanced Models
- Short Circuit
- …

Jay Britton
Alstom Grid
jay.britton@alstom.com

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The Basic Model Exchange Business Problem

- The members of an interconnection share a mutual necessity to achieve:
  - Accurate assessment of grid reliability.
  - Appropriate, timely response to insecure conditions.
- A pre-requisite to the above are:
  - Accurate, up-to-date network models.
  - Consistent network models (at each responsible site).
- In an interconnection, this requires:
  - Exchange of models.
  - Exchange of solved analytical results.

- 2008 NERC Real-Time Best Practices Report:
  - "Although defining the elements represented in internal network models is relatively straightforward, the task force finds that defining the elements to be represented in external models is much more complex."
  - *"Issue #5: External Modeling and Data Exchange Practices Should be Improved by Explicit Reference to the Definition of the Wide-Area-View Boundary.* A consistent, uniform set of modeling and data exchange practices, procedures, and standards are needed to support creation and maintenance of accurate external models…"
- These requirements apply in operations and planning contexts.

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There is high-level consensus about the right approach.

- Basic Modeling:
  - Each TSO is the authority for data about its own territory.
    - Each TSO exports its internal model to its neighbors and/or regional authority, *and keeps it up to date*.
  - Regional authorities assemble internal regional models from member TSO internal models.
  - All parties assemble external models from the internal models of other sites.
- These requirements apply to both operations and planning.
  - Operations focus is on as-built and near future changes.
  - Exchange of solutions between operations and planning is a key objective.
  - When operations and planning share the same modeling:
    - Operations defines the current state.
    - Planning defines the future plans.

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Key Contributing Use Cases

- Exchange of network models to maintain EMS ‘external’ models.
  - EMS A and B are neighbors in an interconnection and therefore each needs to represent the other as part of its external model.
  - Requires exchange of internal models.
  - Scope is network data, measurement placements and schematics.
- Common Modeling Source between planning and operations.
  - One network modeling application for the enterprise.
  - An EMS requires a model that covers any point in time.
  - Other targets require data for a specific “case”.
- Exchange of solved cases. Several variations…
  - Real-time exchange among different applications.
  - Real-time cases to study or planning tools.
  - Exchange of study or planning cases between different tools.
  - Import of study cases to EMS.
  - Planning ‘base case’ creation from member contributions.
- ENTSO-E Day Ahead Congestion Forecast
  - DACF cases are generated for each hour of the next day by each TSO representing the expected state of their internal network.

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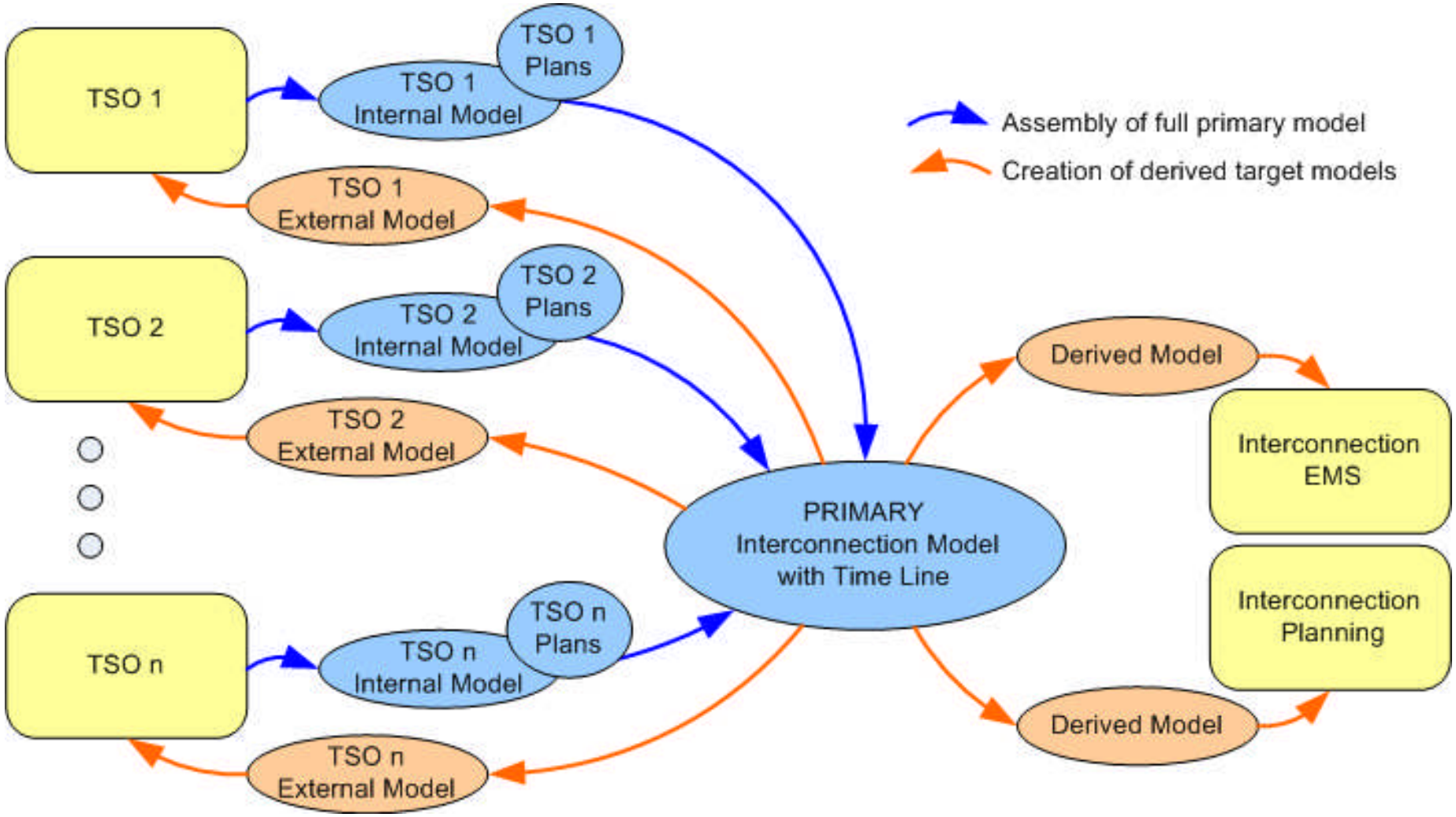
A Generic Model Exchange Business Process (ENTSO-E, ERCOT, WECC, …)



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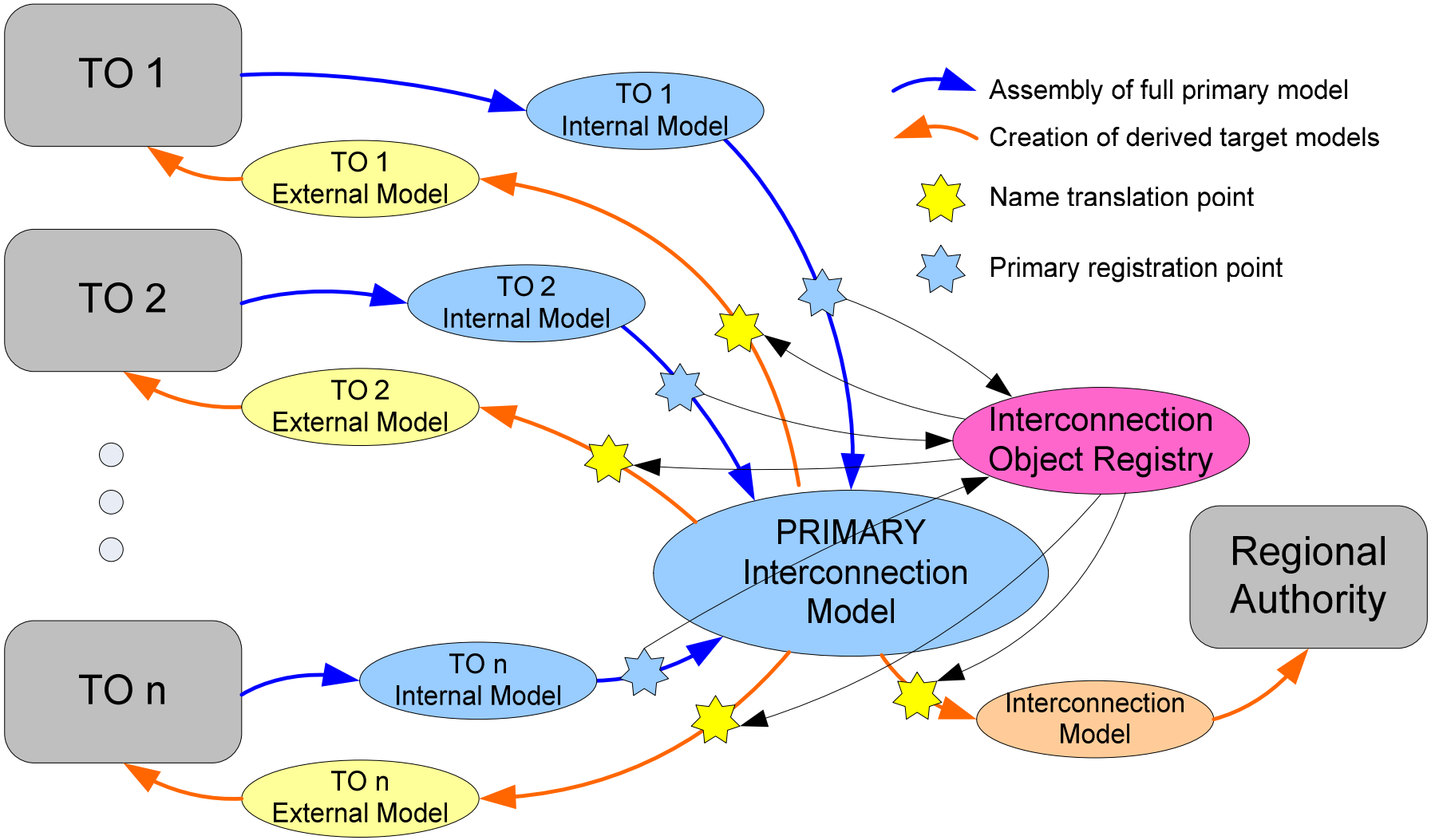
The Naming Problem



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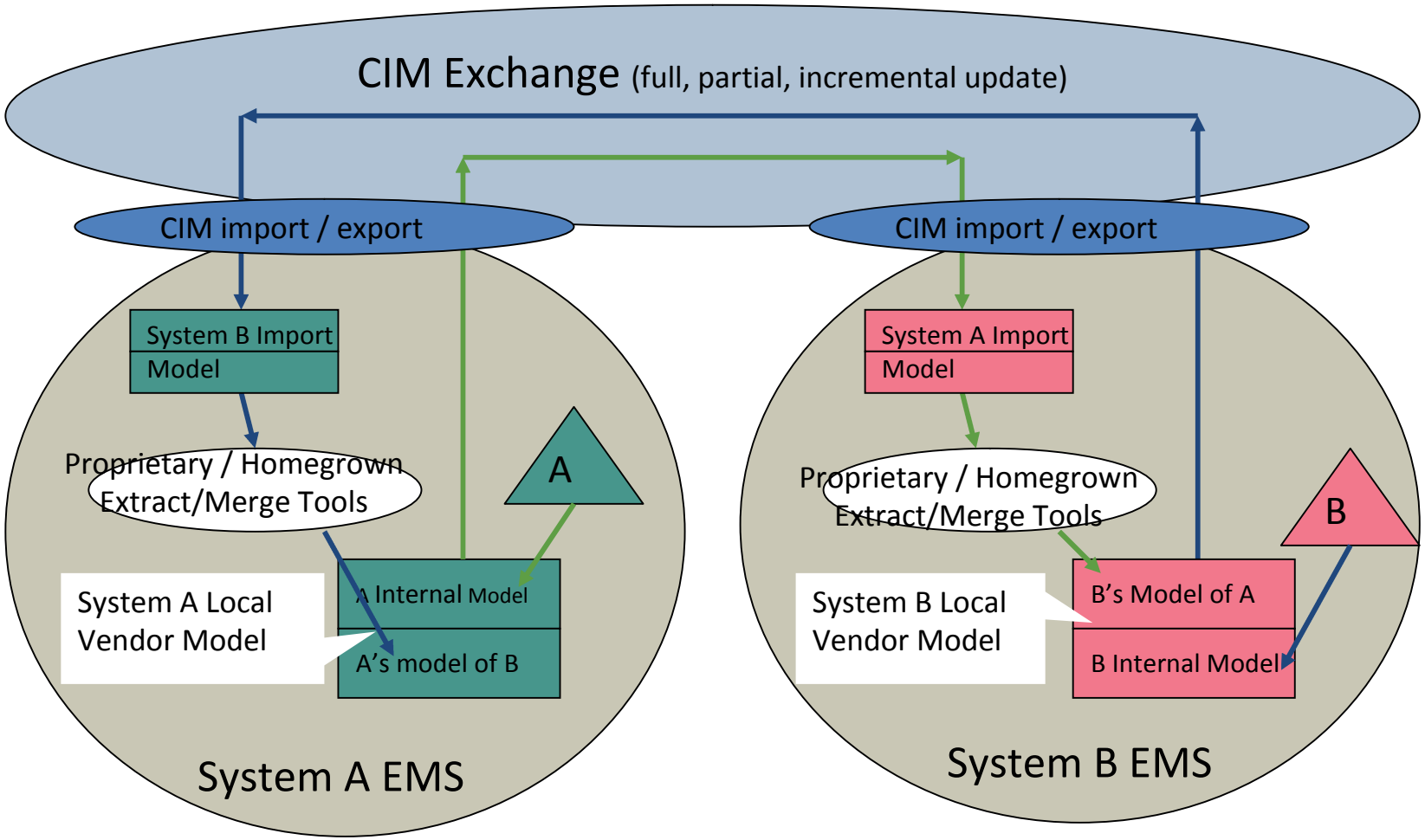
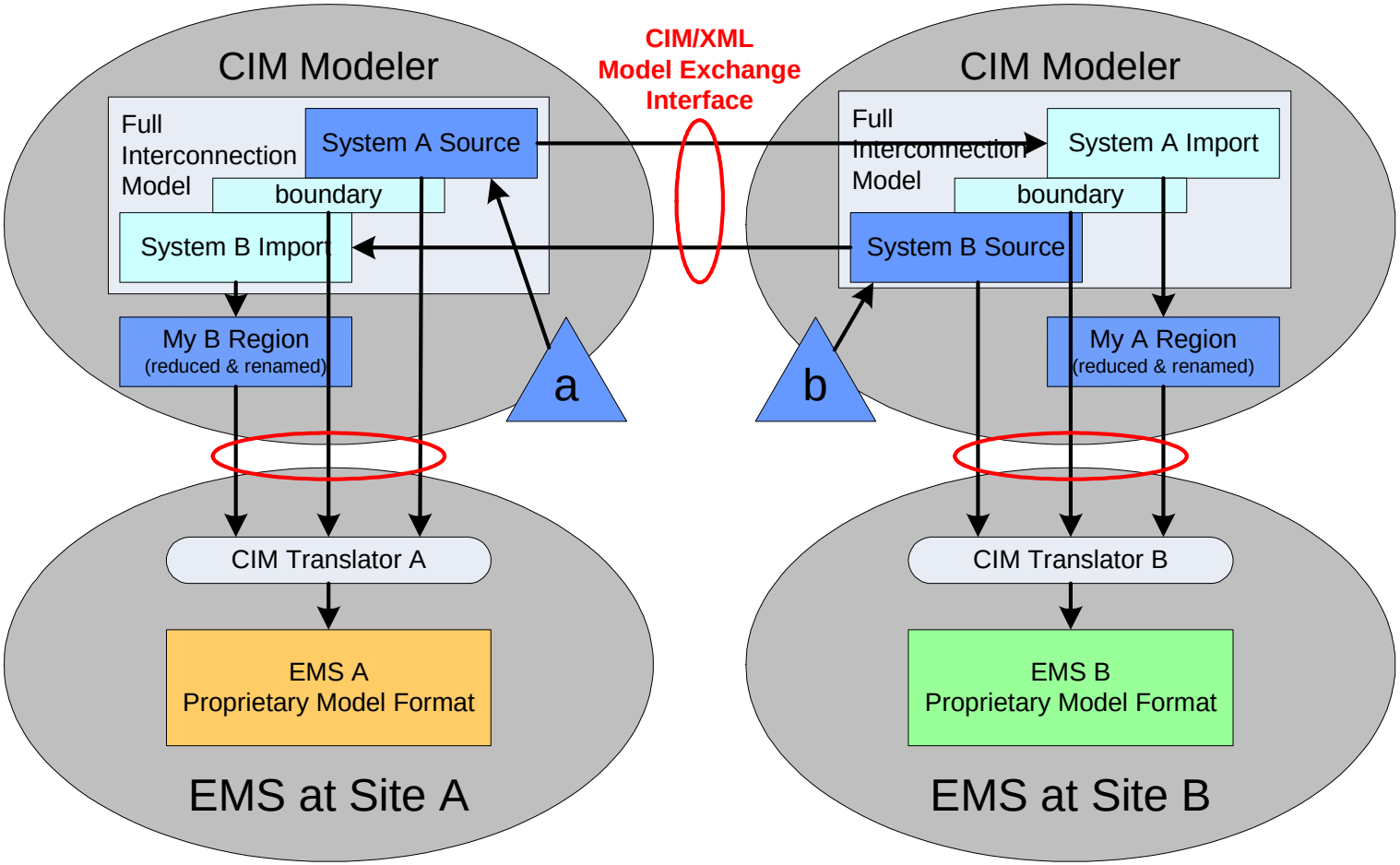
The initial CIM model exchange (61970-452) standard focused only on transfer of complete models:



A More Desirable Process

Site A makes a change:

1. A changes its ModelAuthoritySet using its CIM modeller.
2. A imports the change into its EMS.
3. A exports the change to B.
4. B receives the change (full or incremental), updating A's ModelAuthoritySet within its CIM modeller.
5. B renames any new elements and repeats any reduction of A's ModelAuthoritySet.
6. B imports the new model into its EMS.



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61970 data is modularized to address requirements efficiently.

- Partitioning by instance – ‘model authority sets’
  - Allows different parties to be the authority and source for different parts of the model.
  - Provides a means for controlling issuance of MRIDs.
- Partitioning by kind of data – ‘profiles’
  - Distinguishes data produced by different applications (e.g. modeling vs power flow solution).
  - Manages the size of exchanges in high performance situations.
  - Provides flexibility to address different kinds of business processes with a minimum number of different standards.

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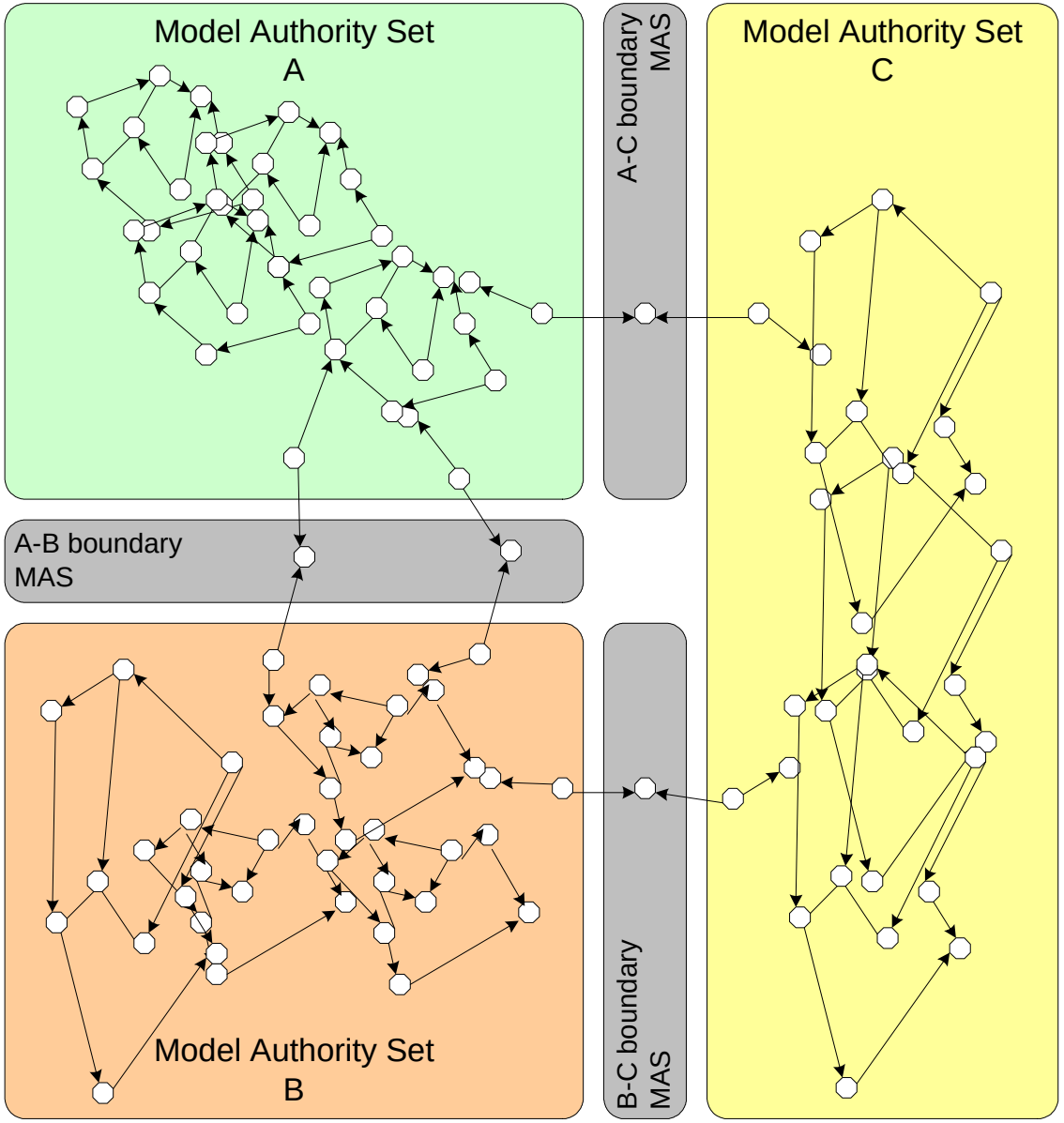
Merge/Extract with Model Authority Sets

- Each object is in one and only one set.
  - Simple labeling technique for assigning responsibility.
  - Associations connect some objects that are in different sets.
    - Currently directional from n to 1 ("foreign key" convention) – under discussion.
- Regional Sets:
  - No associations with other regional sets.
  - External associations to boundary sets only.
- Boundary Sets:
  - External associations from regional sets.
  - External associations with other boundary sets.
- A regional set may be referentially validated independent of other regional sets.
  - Modeling processes can proceed independently in each region.
- Goal:
  - Maximize independence.
  - Design boundary sets to achieve:
    - Minimum data
    - Infrequent change



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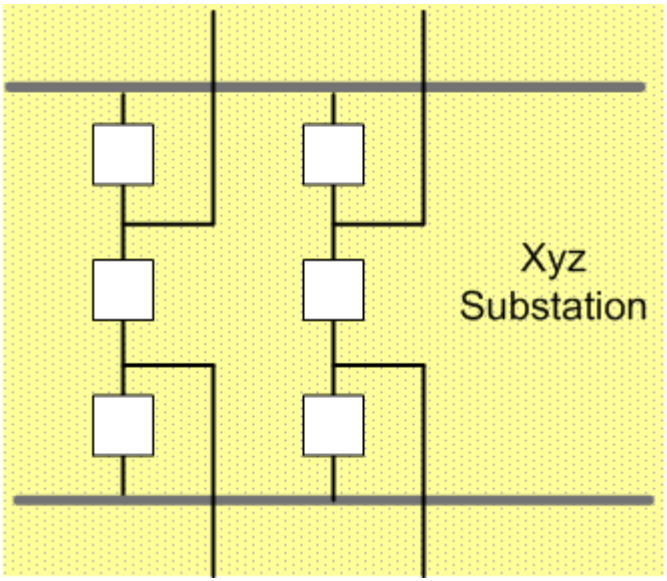
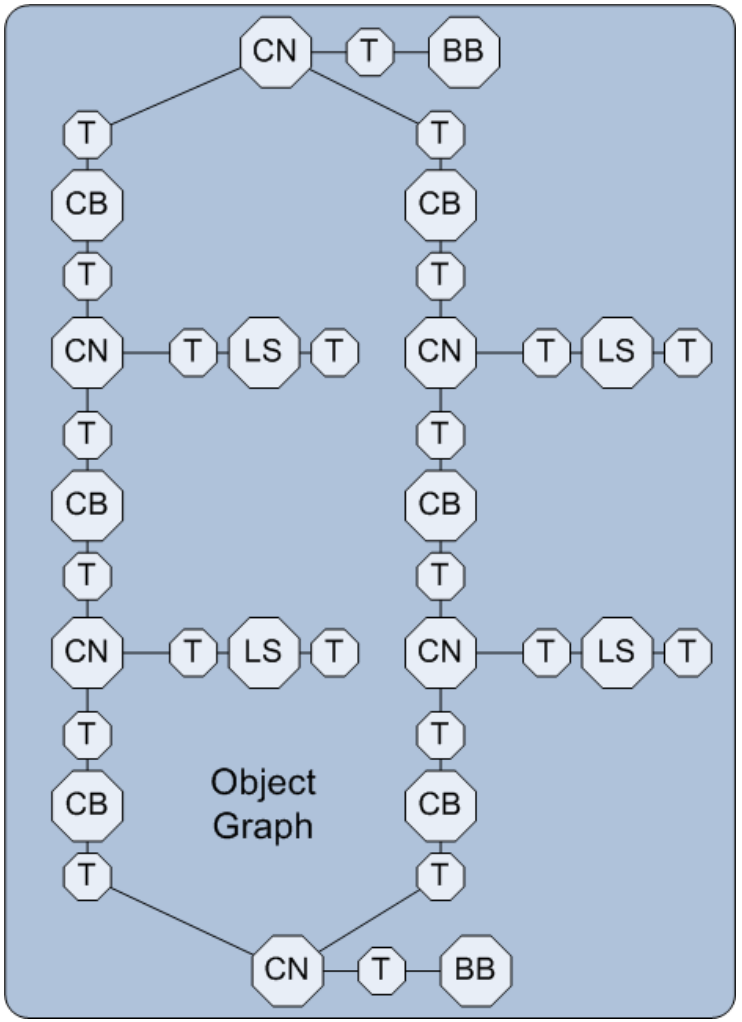
Model Instances as Graphs

- Objects are nodes.
- Relationships are arcs.

ST – station container
VL – voltage level container
T – terminal
CN – connectivity node
TN – topological node
BB – busbar section
LN – line container
LS – line segment
CB – circuit breaker
X – power transformer
XE – power transformer end





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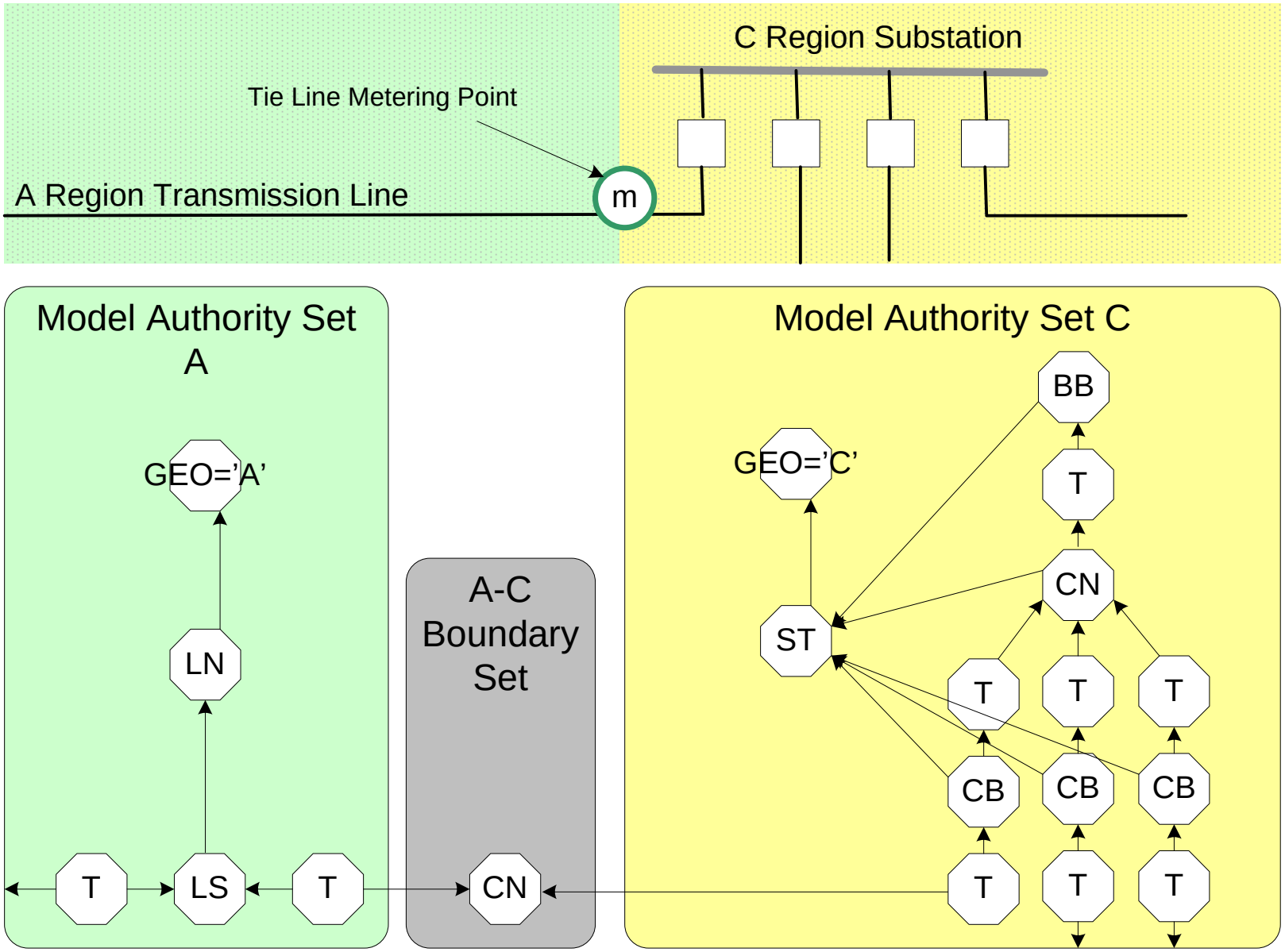
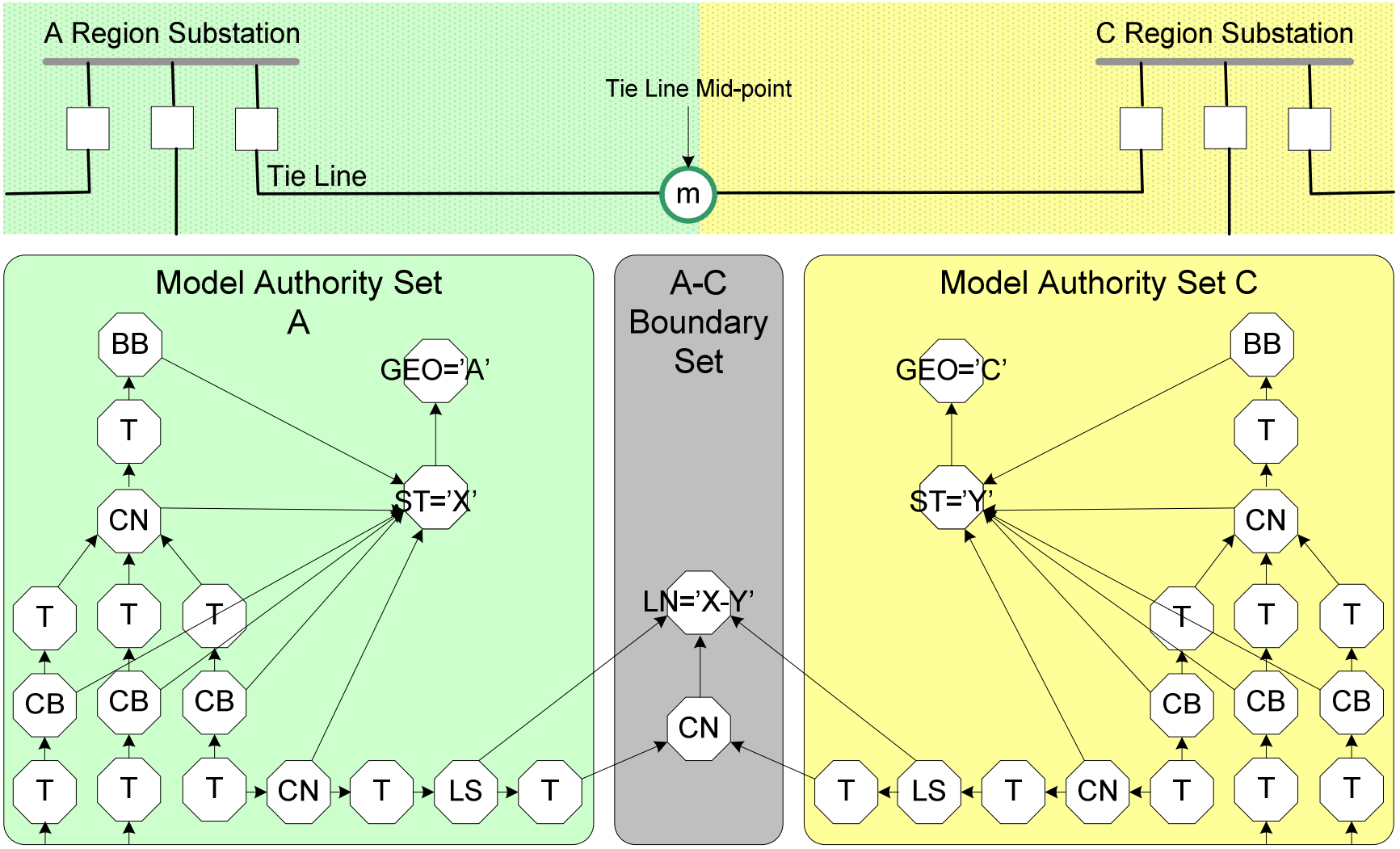
Typical North American Operations Boundary



Typical ENTSO-E Operations Boundary



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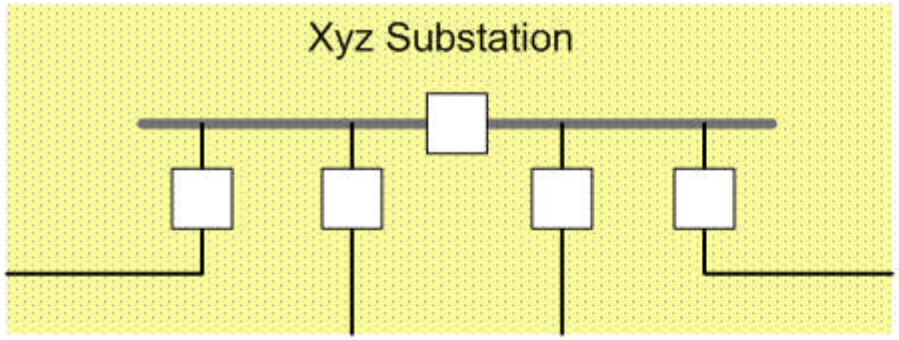
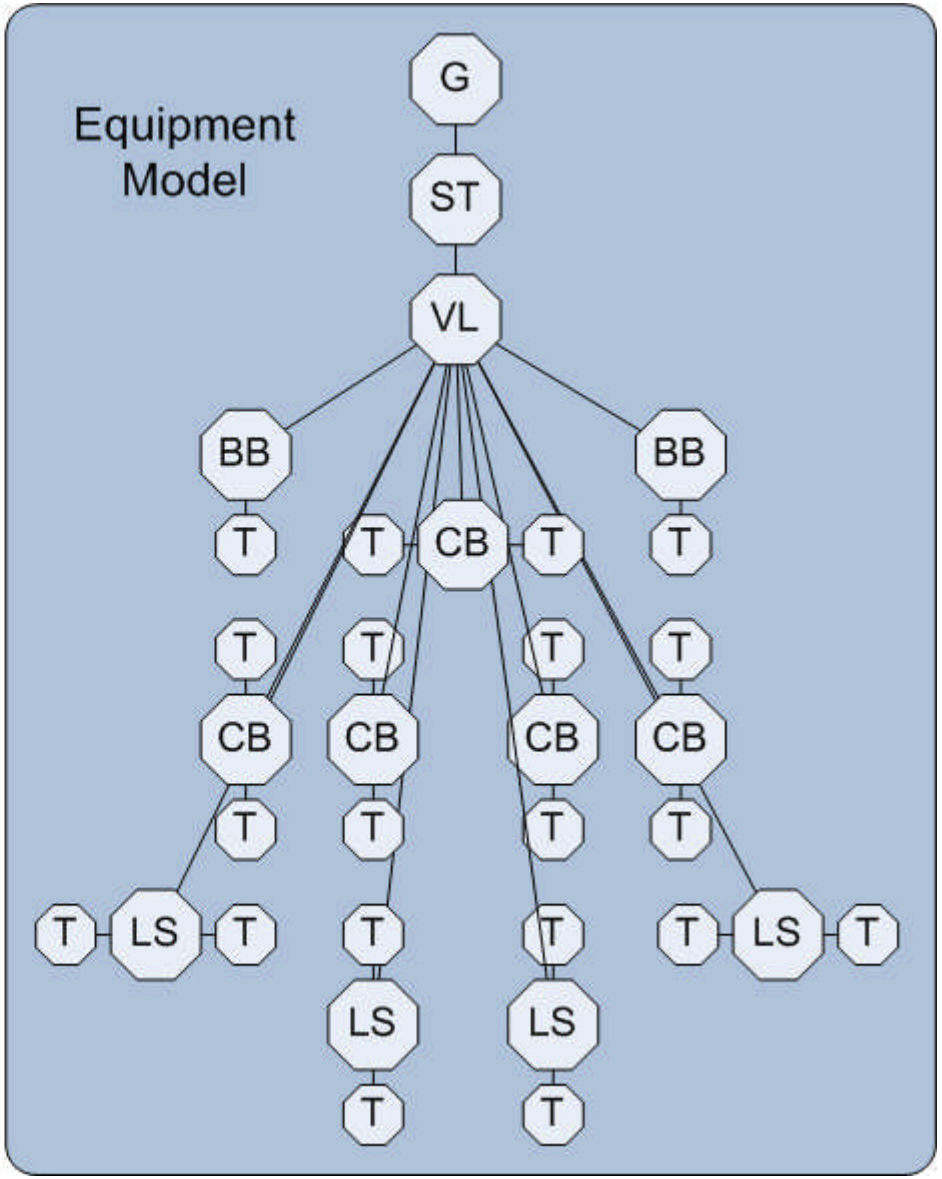
Bus-Branch vs Node-Breaker Modeling





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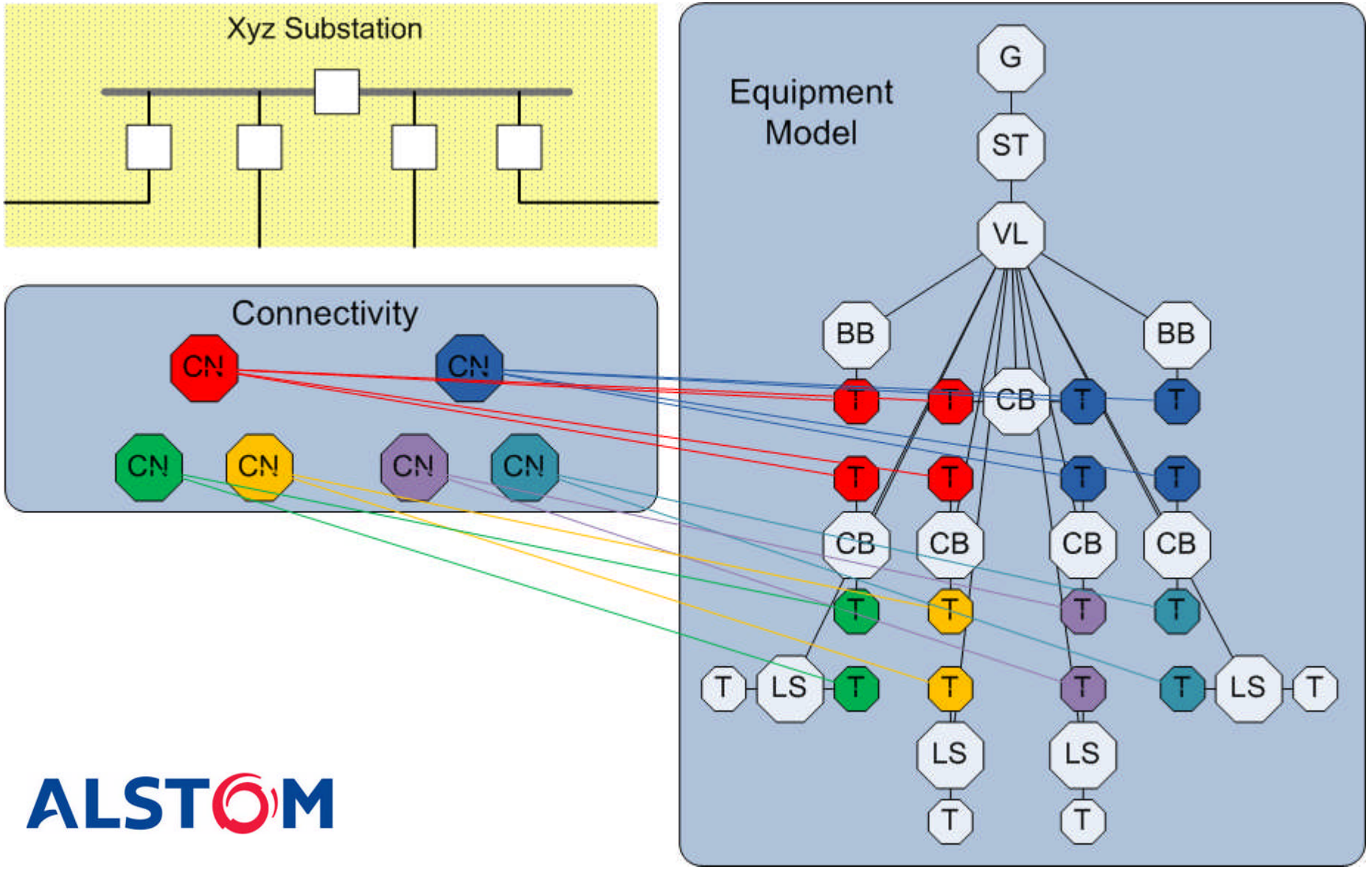

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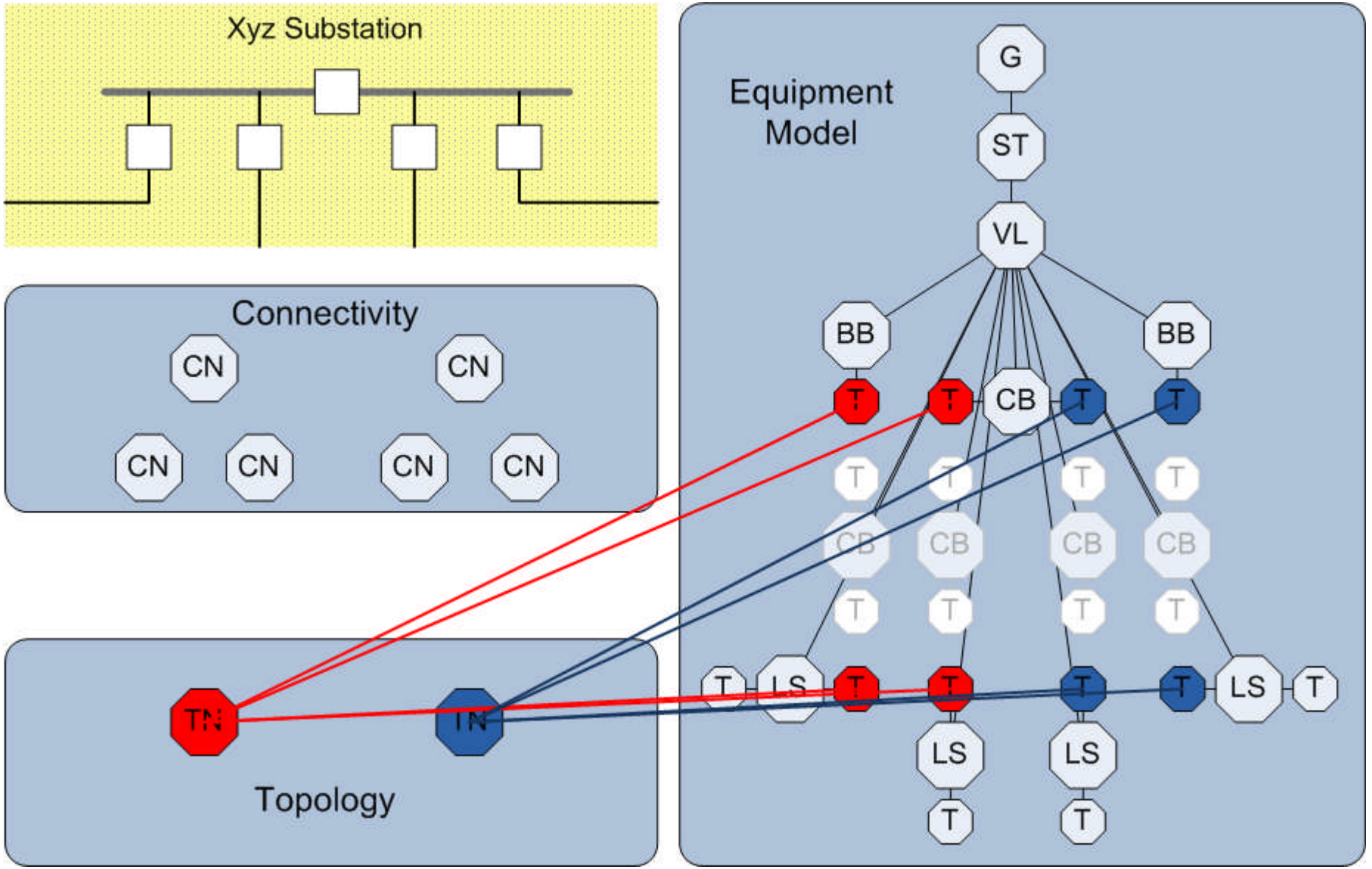
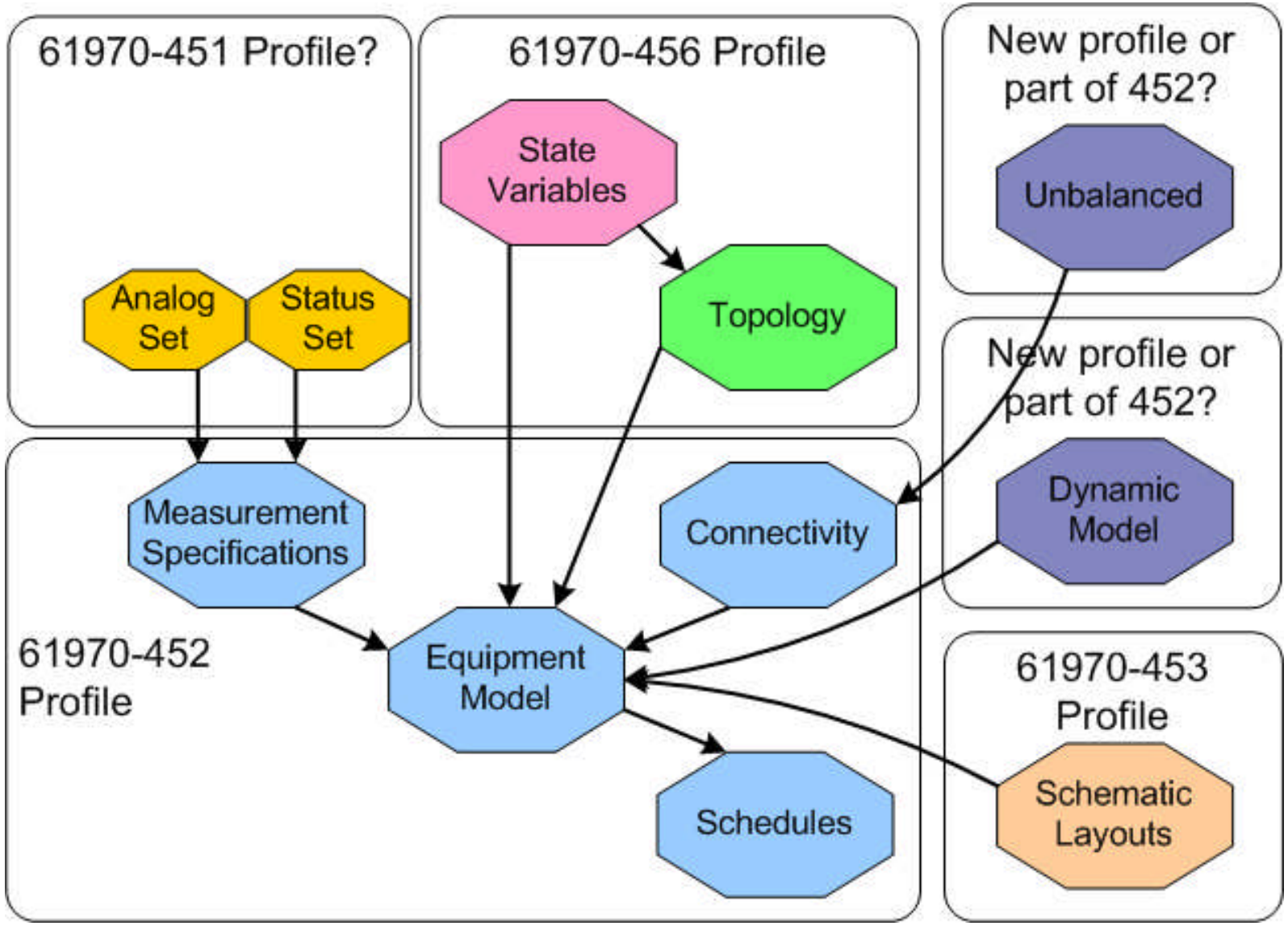
Bus-Branch vs Node-Breaker Modeling



61970 Profile Modularity



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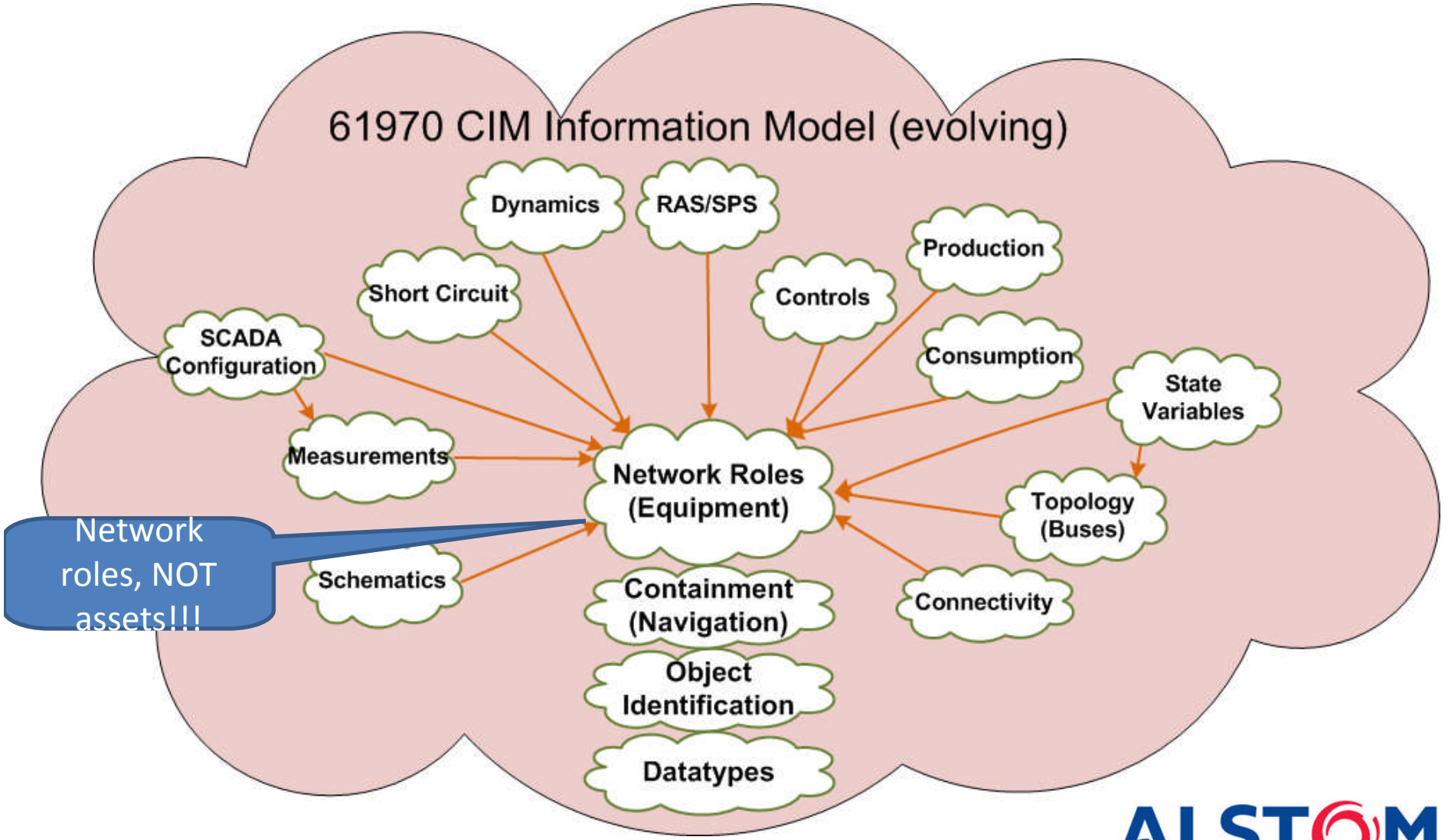
Conceptual Overview of 61970 CIM



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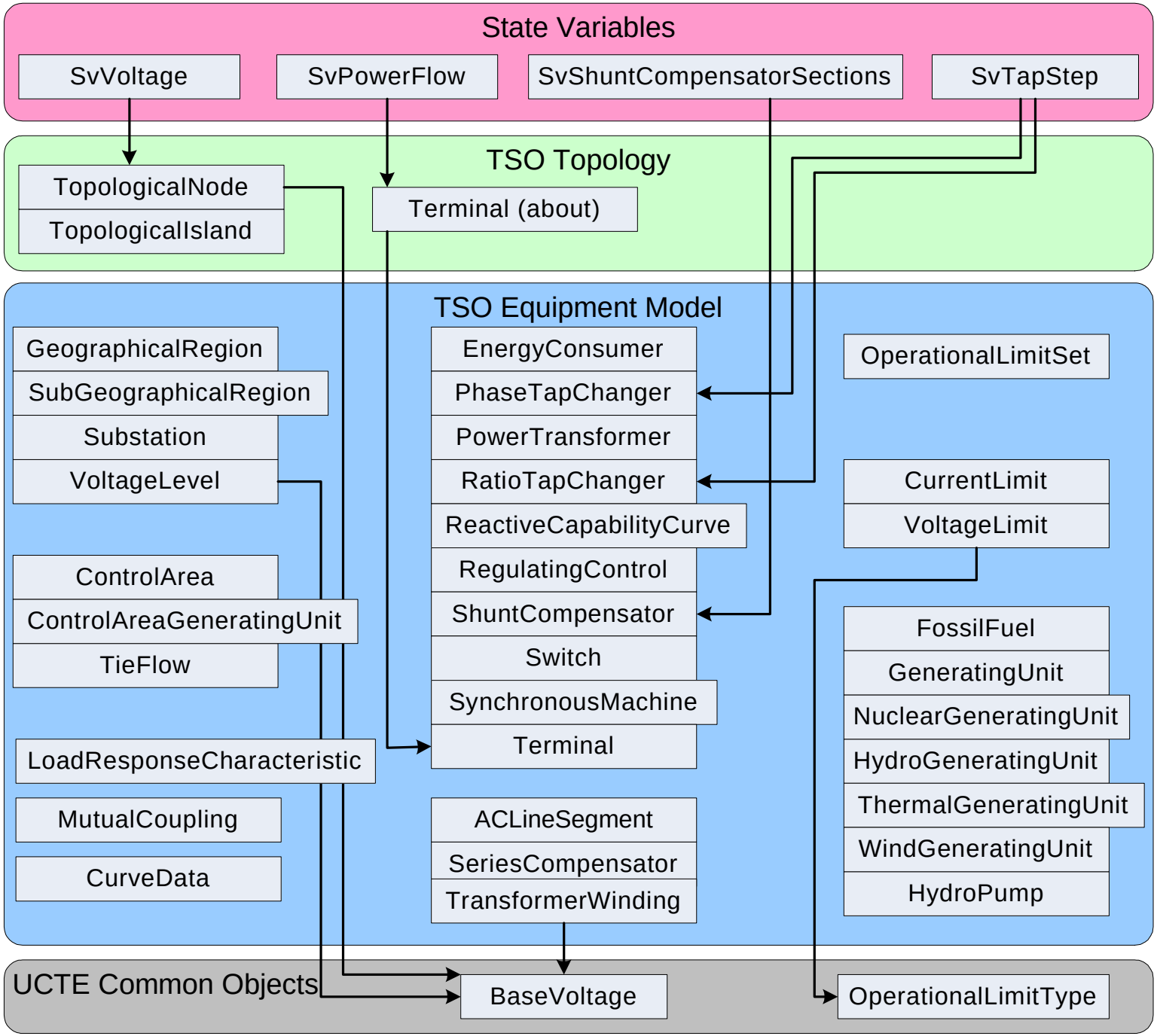
Combining profiles into a complete solution description.



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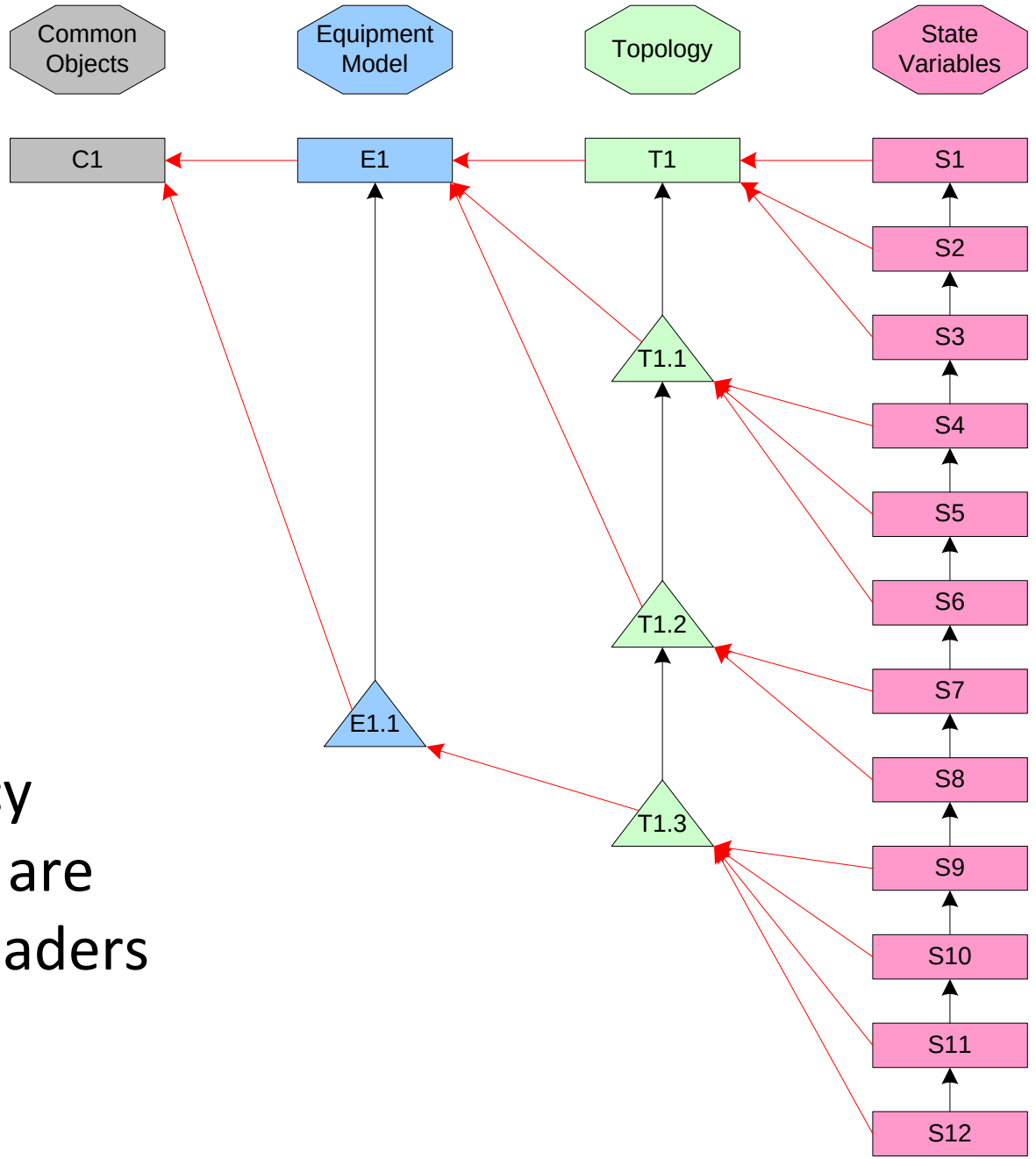

Dependency Relationships are Expressed in Headers

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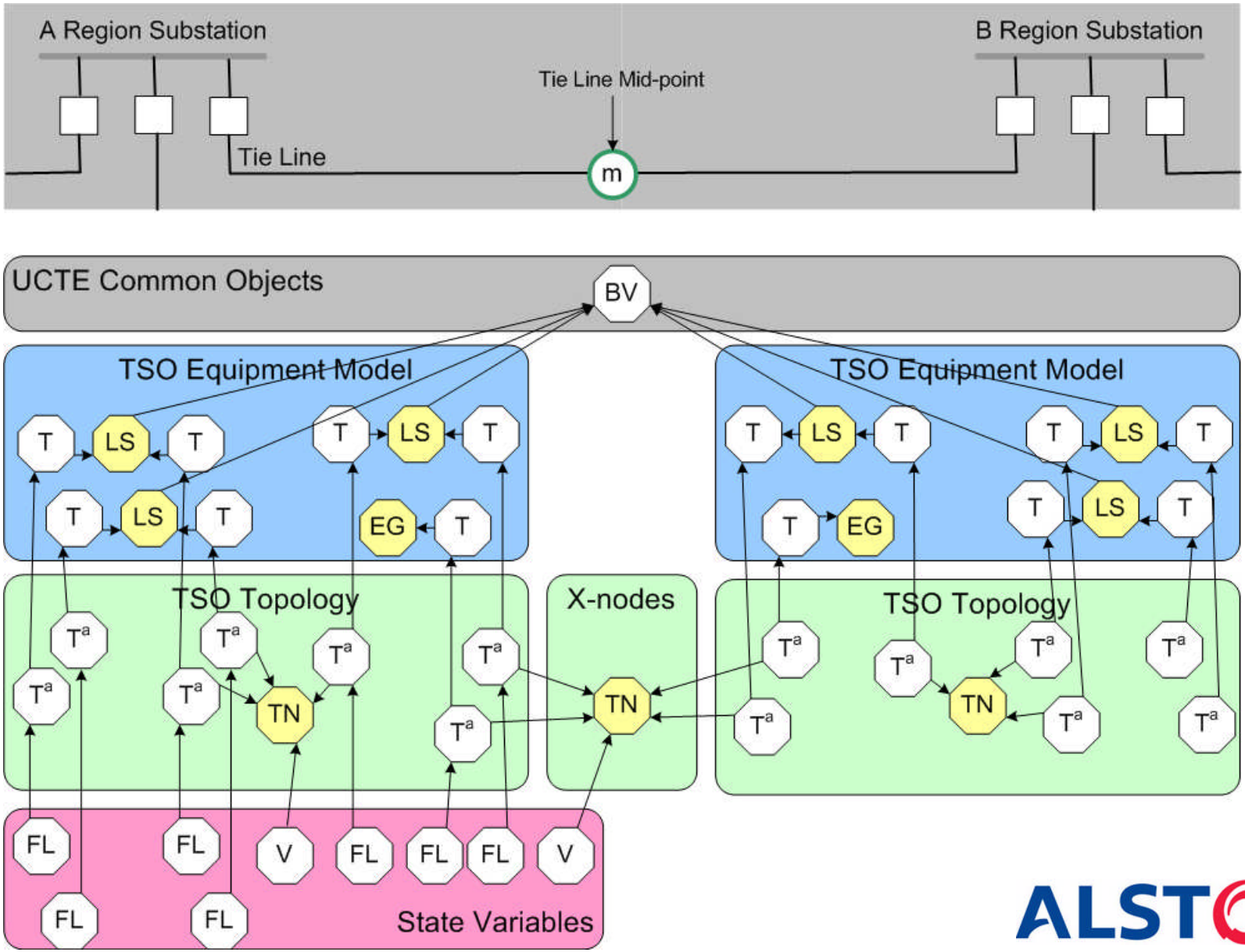
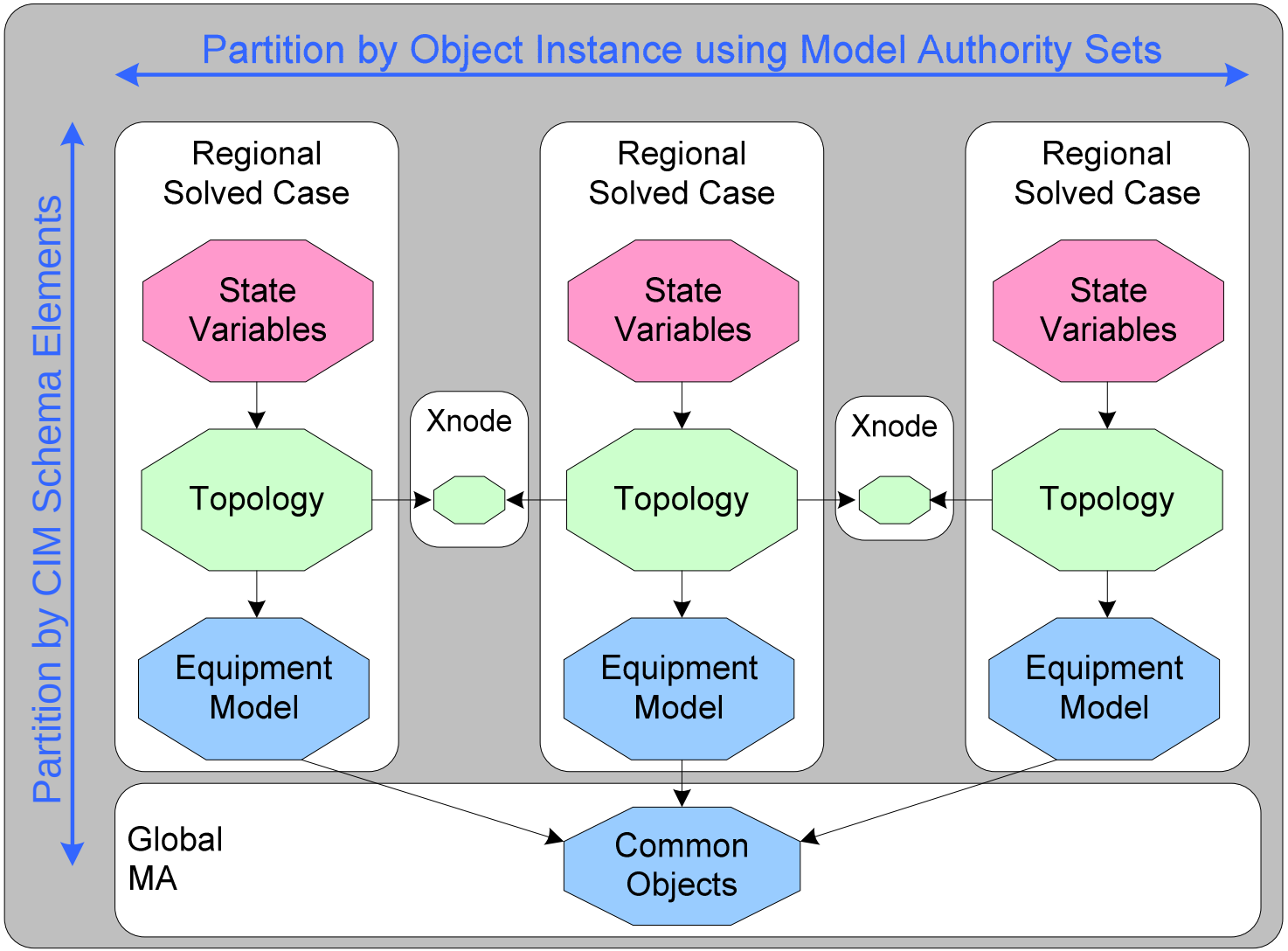
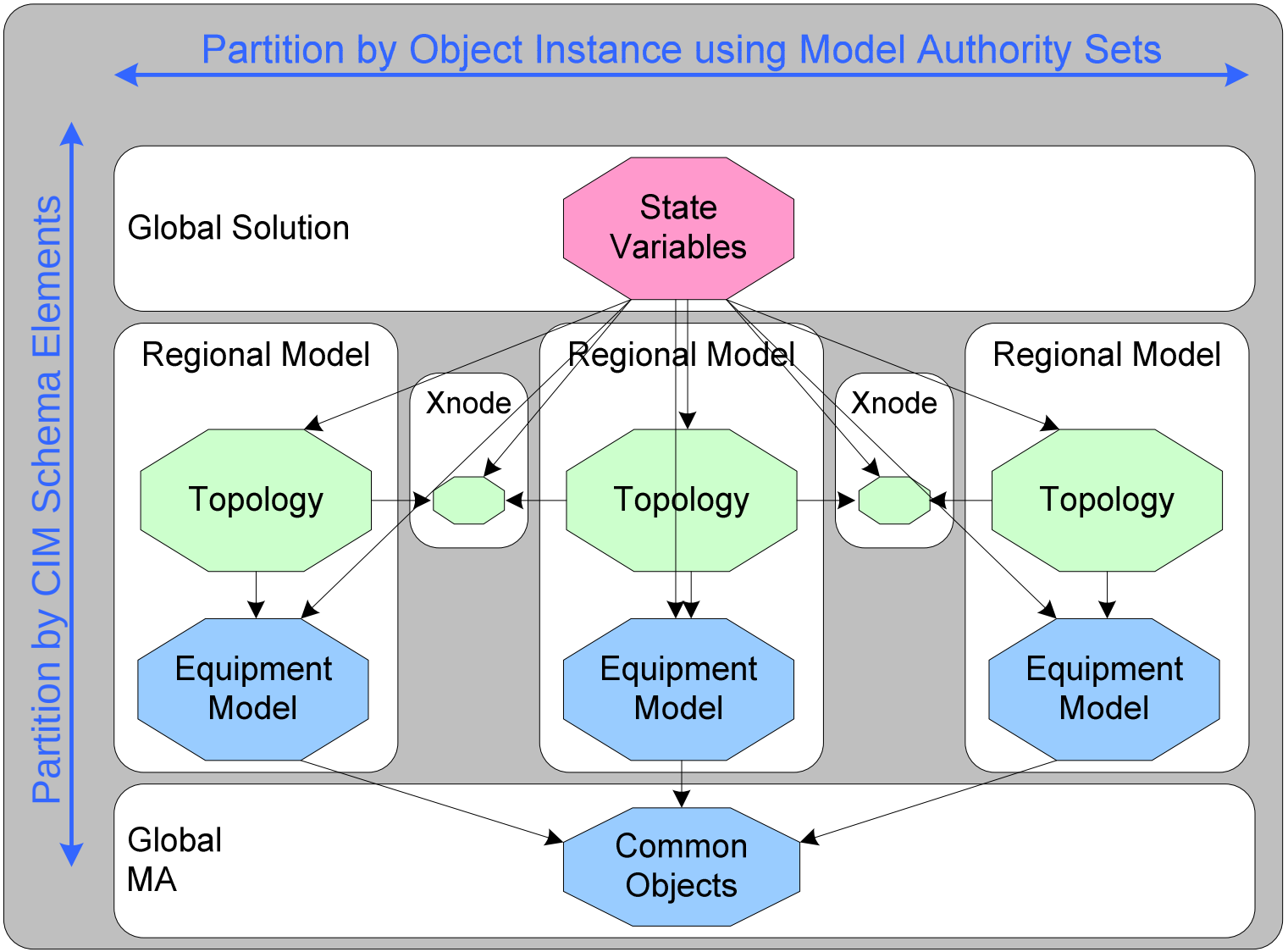
Partitioning into Files by TSO



Complete View of Partitioning Into Files



ENTSO-E Interconnection Solution



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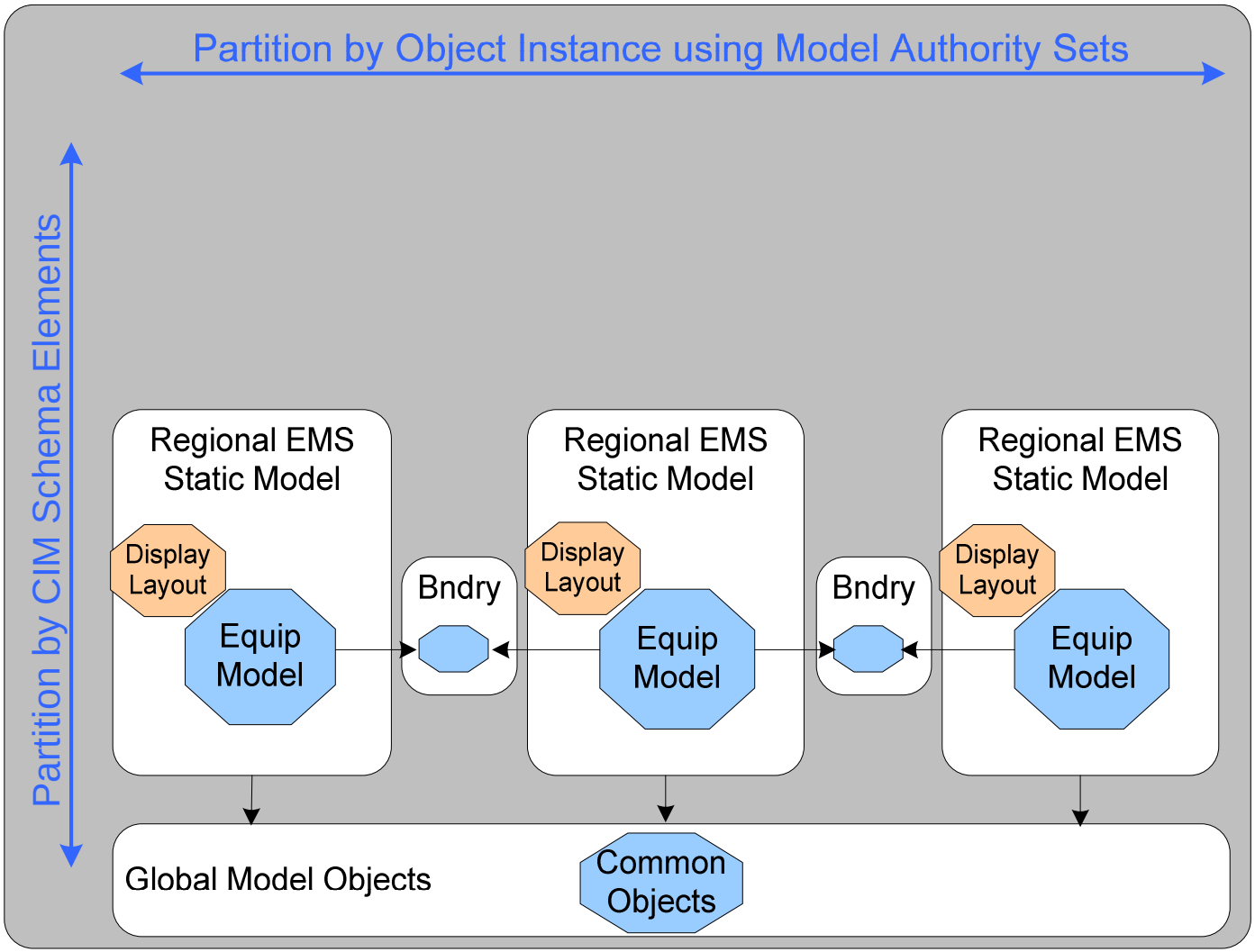
Partitioning of EMS Static Model



61970-453 Display Layout Exchange

- Purpose:
  - To exchange schematic display layouts accompanying model or solution exchanges.
  - Corresponds to the part of display maintenance work that normally goes with model maintenance.
- Defines graphic objects used in the sender's displays:
  - Usually linked to a model object, but can also be background.
  - One or more location coordinates. (Optional glue points.)
  - Graphic style reference.
  - Does not define Interpretation of graphic style references.
- Usage
  - Sender describes diagram.
    - Senders disclose the way their system uses graphic styles.
    - Object placements describe sender's diagram as is.
  - Receiver must decide how to render the diagram in its system.
    - Create interpretation of sender's styles.
    - Receivers are not expected to duplicate functionality.
    - Receivers may break apart complex styles or combine simpler styles.
  - Receiver provides the graphic style interpretation models for their display management software.
- Result:
  - Layouts and names of things should be familiar.
  - Exact replication graphically is likely only when sender and receiver applications are the same.
  - Exact replication functionally is likely only when sender and receiver applications are the same.

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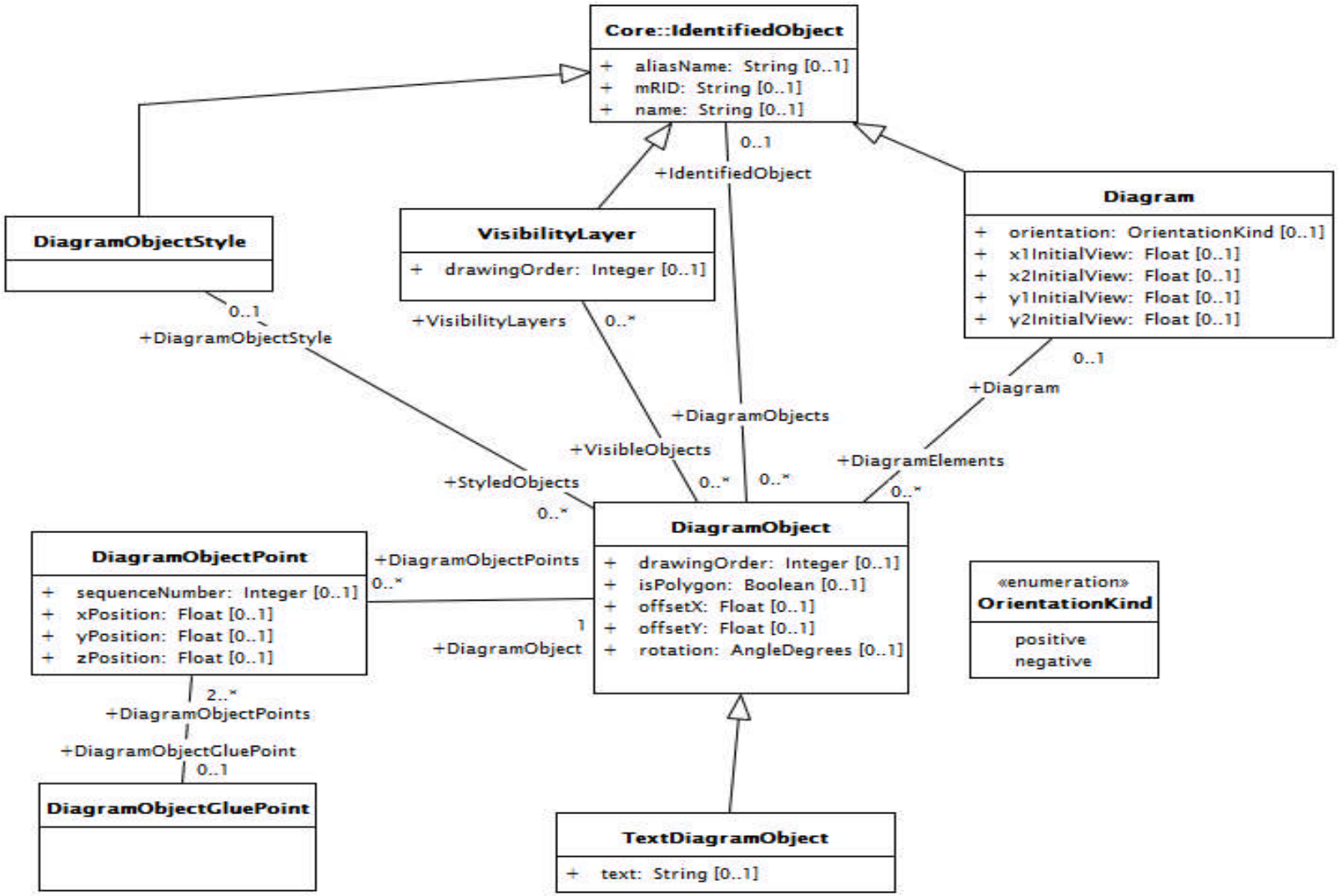
Diagram Layout



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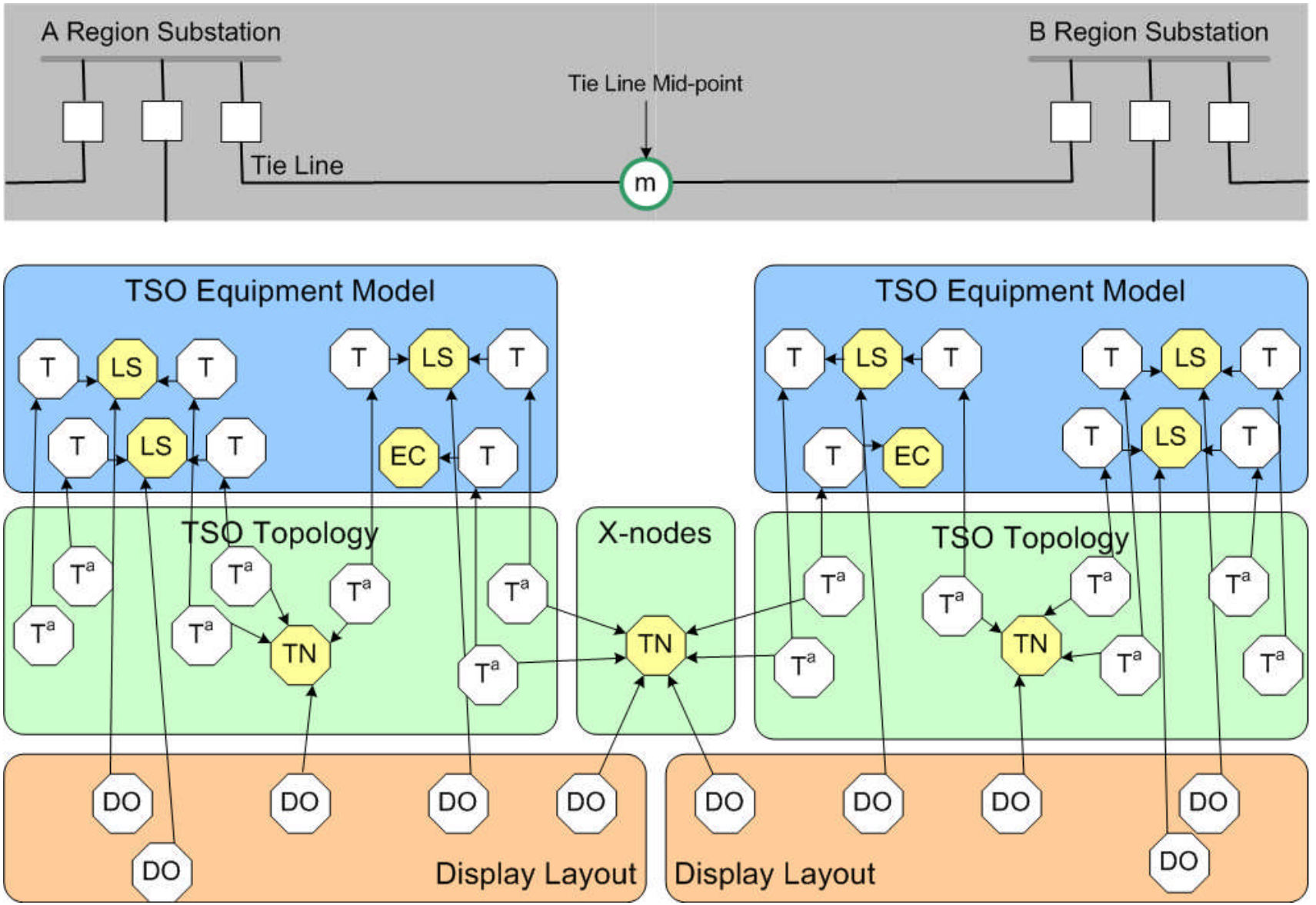
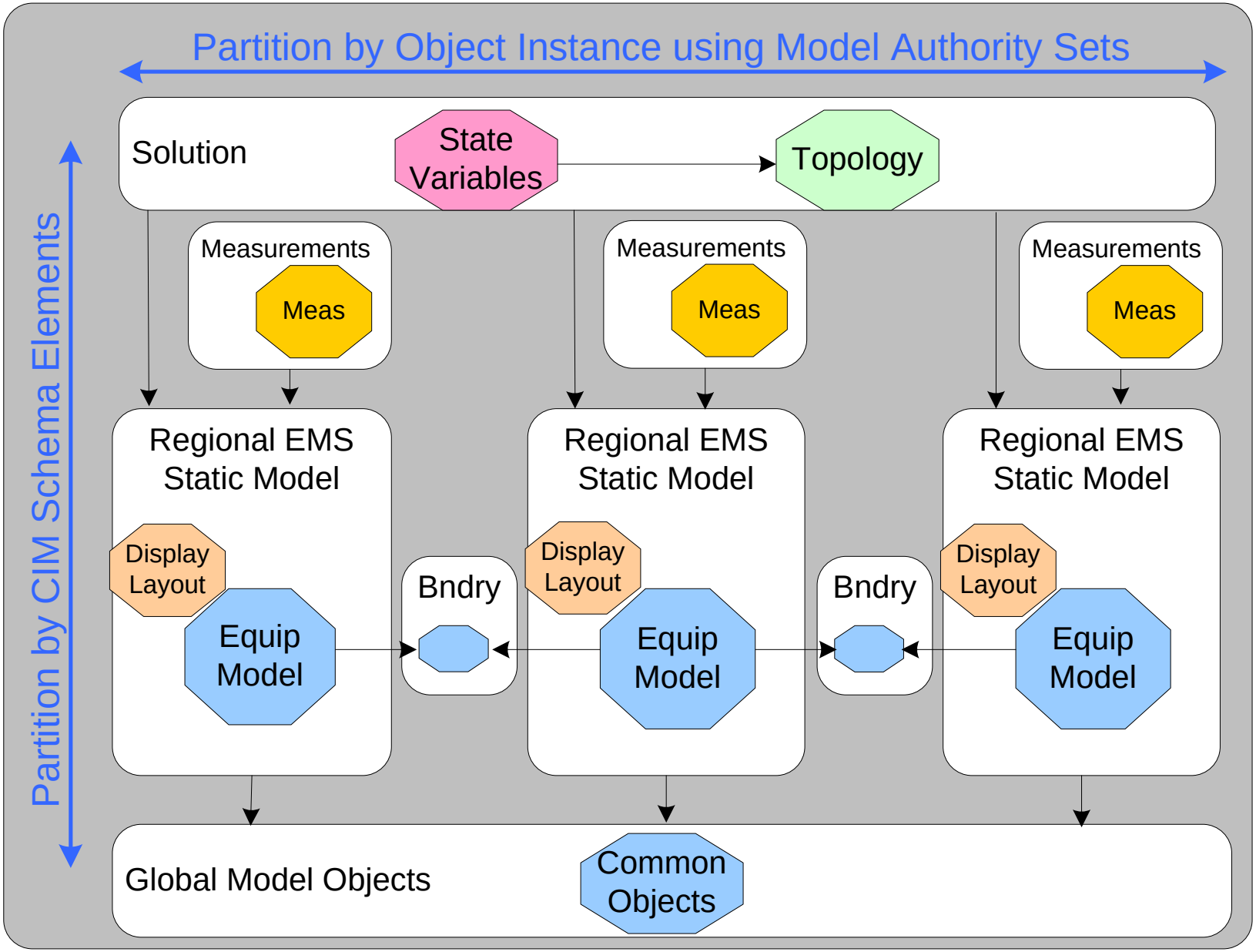
ENTSO-E Case – Display Layout Exchange



Partitioning of EMS Solved Cases



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