Model Parts and Assembly

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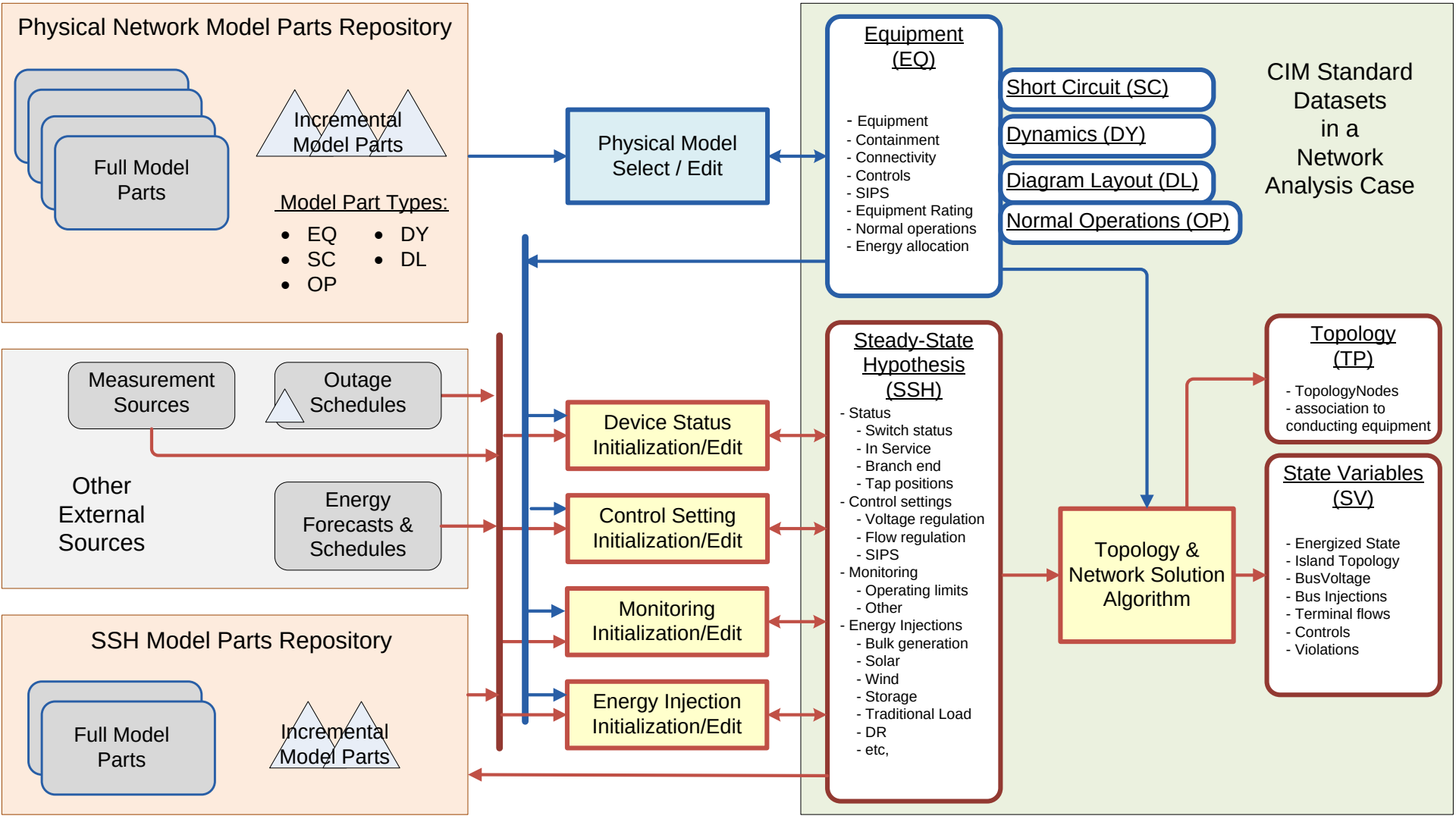
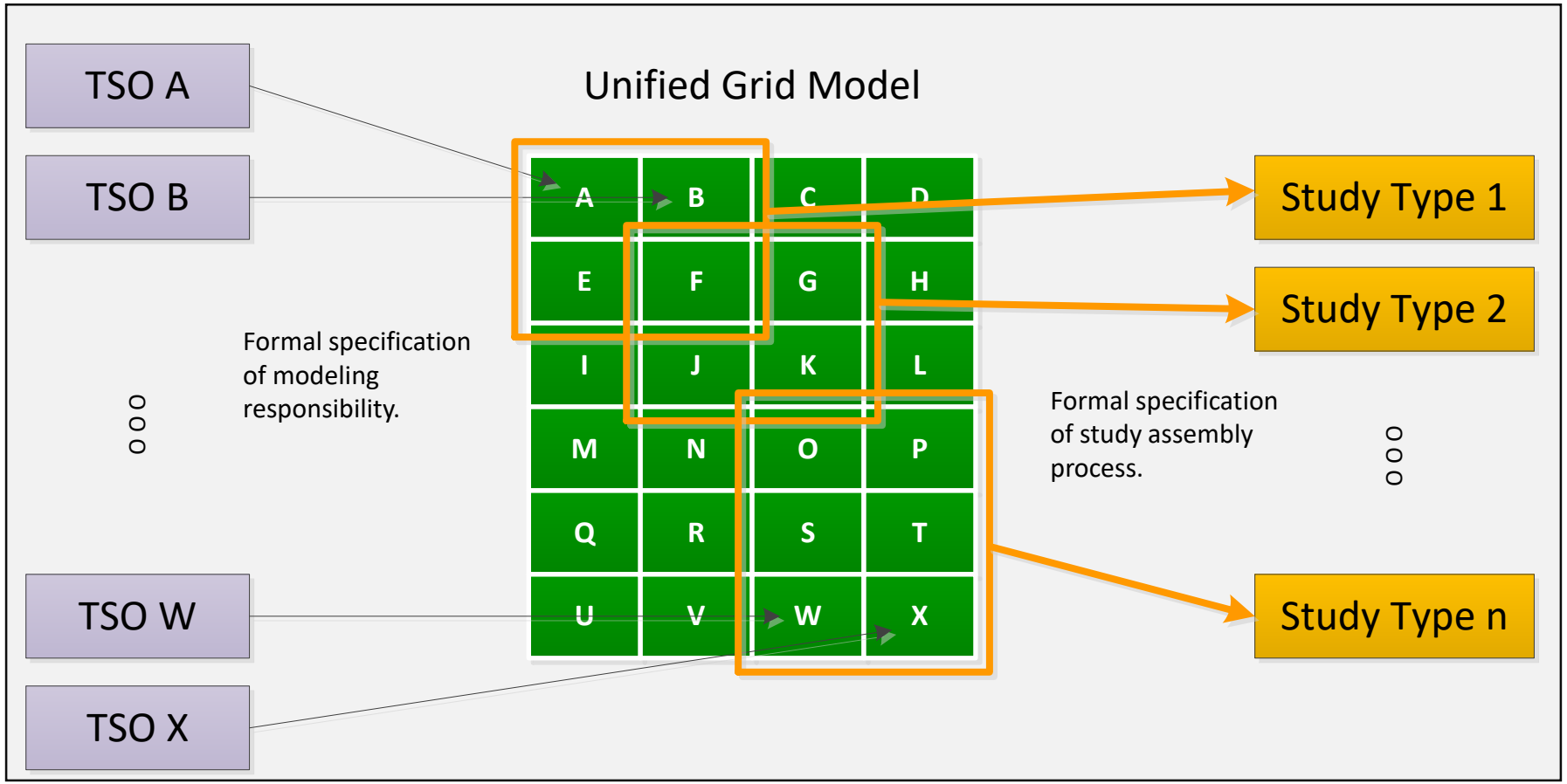
CIM users group

WG13 Ref Model for a Network Analysis Case



The Goal: Many Cases from Common Parts

Model parts are maintained once …



… and used in many different study case assemblies.

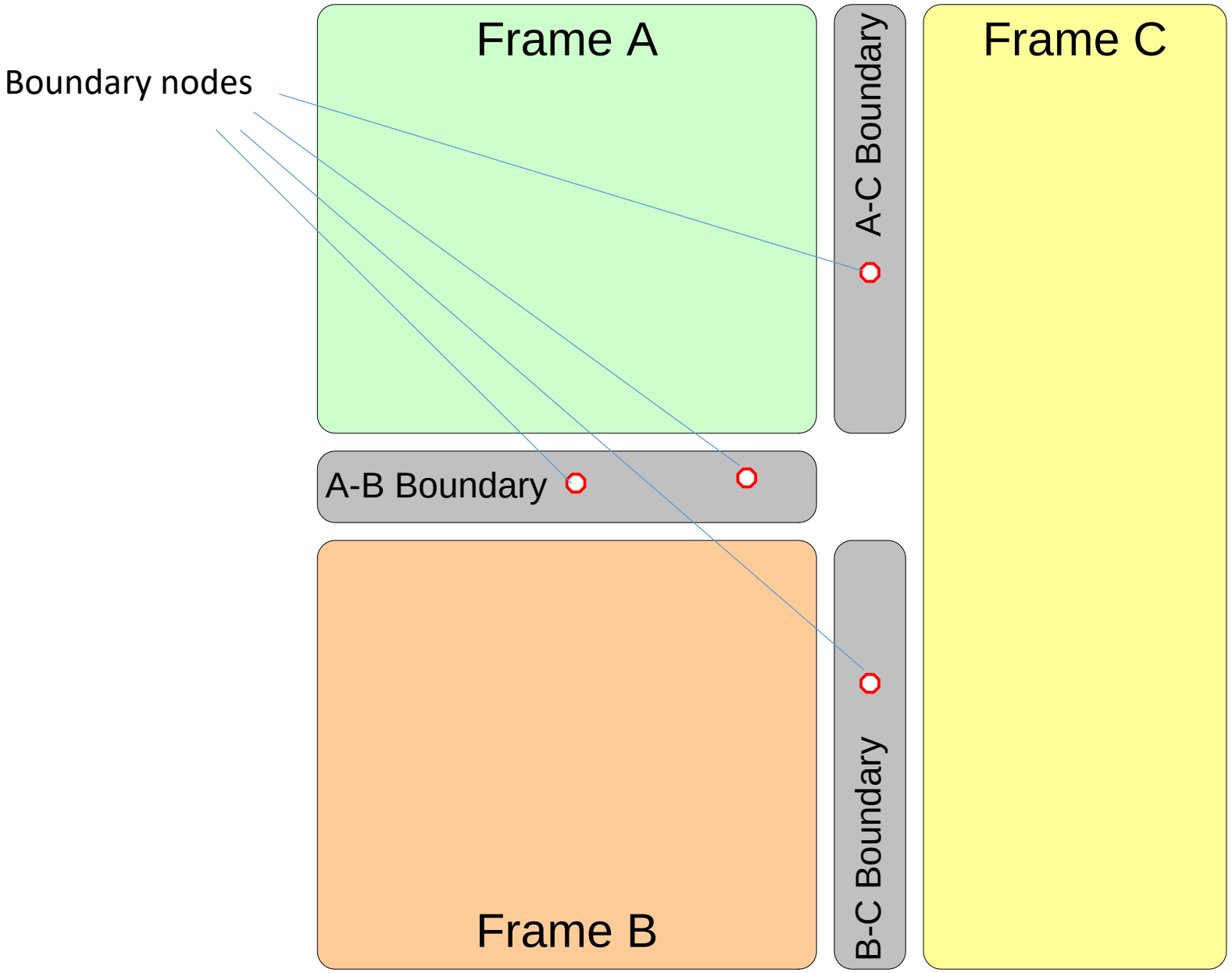
A ‘Model Part’ is a set of CIM data that can be composed with other model parts to create a complete model.

- There can be any number of instances (versions) of a given model part.
  - Versions are often used to track the ‘as-built’ state of the network as the network evolves over time.
- A model part has ‘business metadata’. This describes:
  - Model part name
  - Model part relationship to a framework part
  - Model part data type – i.e. information model
  - Model authority – who is responsible for the content?

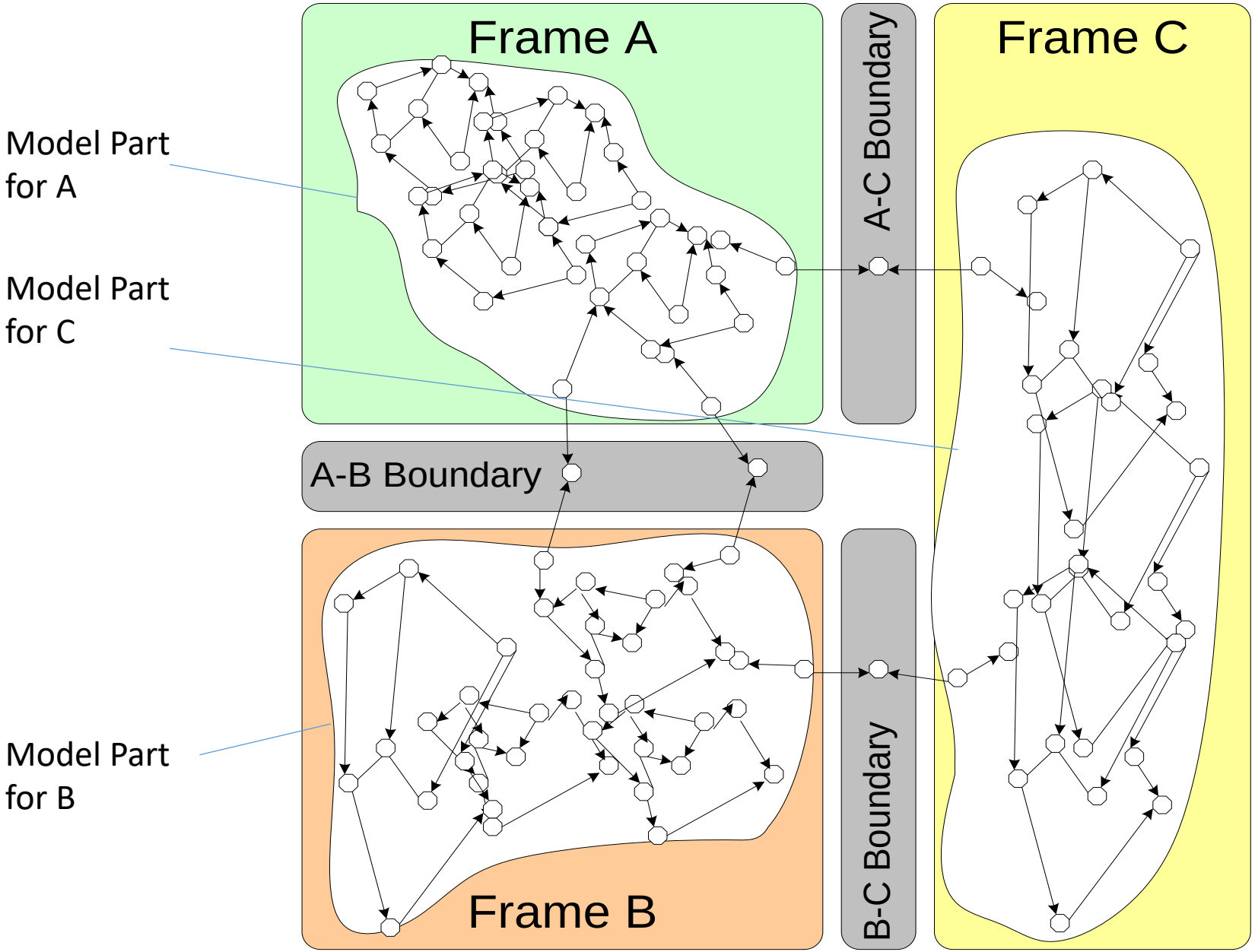
A ‘Framework’ is a set of Framework Parts that define how Model Parts fit together.

- Two main kinds of Framework Parts:
  - **Frames** define the regions (like TSOs) that are the responsibility of one model authority.
  - **Boundaries** define the set of objects that the model authorities of two adjacent frames agree to maintain in common.

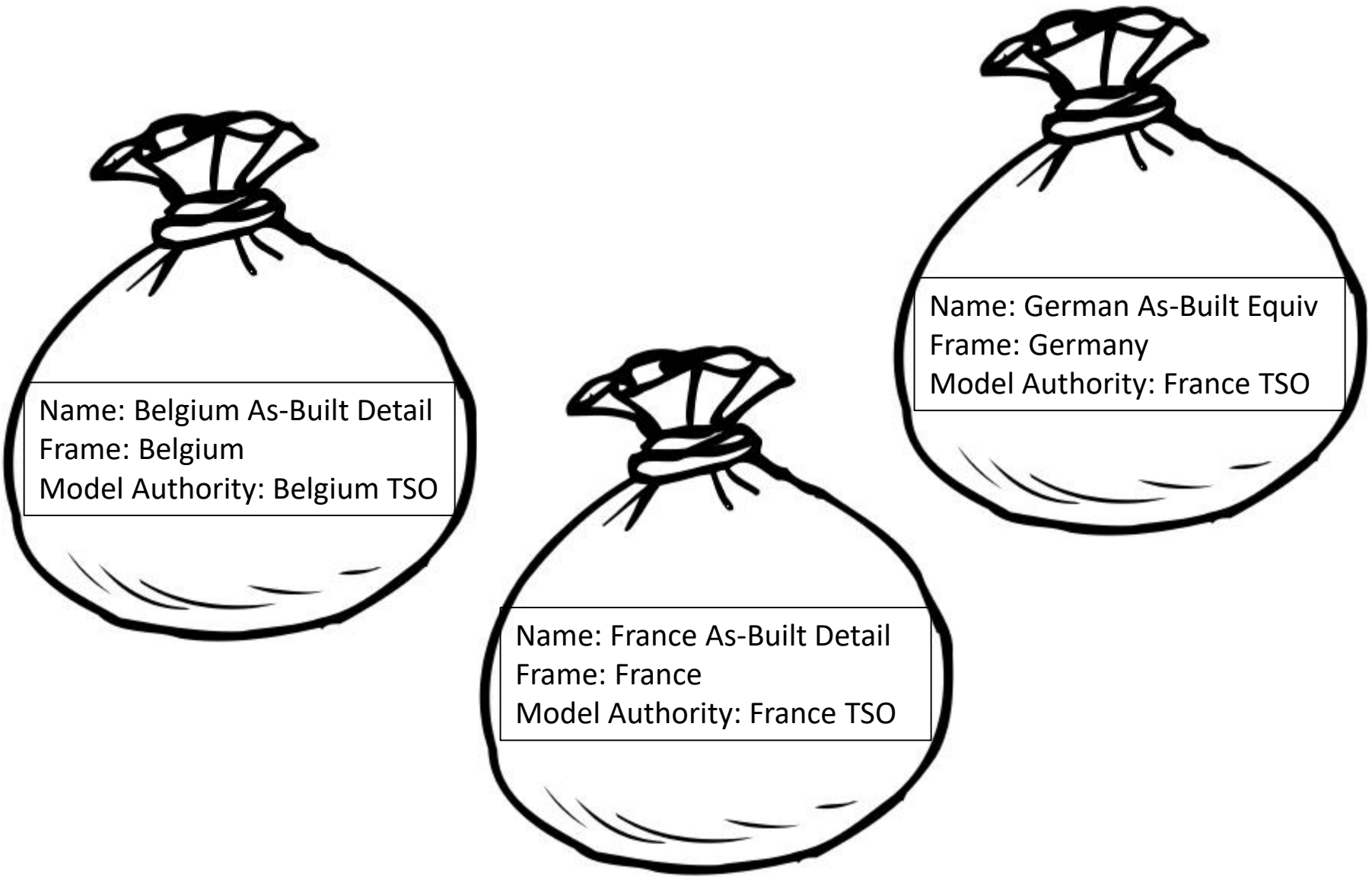
Framework


Boundary nodes
Frame A
A-C Boundary
Frame C
A-B Boundary
Frame B
B-C Boundary

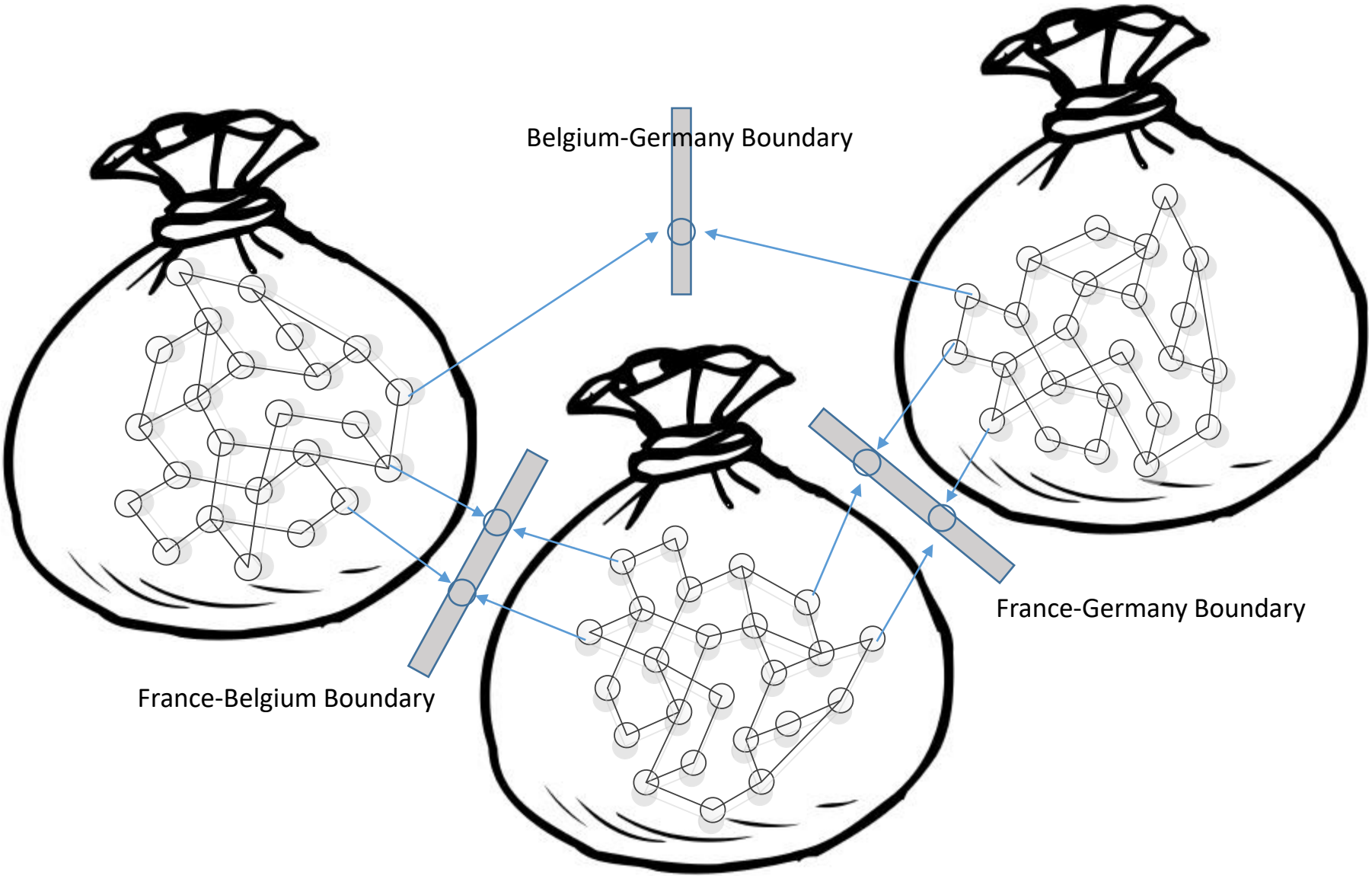
Framework


Frame A
A-C Boundary
Frame C
Model Part for A
Model Part for C
A-B Boundary
Model Part for B
B-C Boundary
Frame B

Model Part Business Metadata



Model Part Content



Assembling Model Parts

- Dump selected model part bags onto the magic table – i.e. a workspace.
  - The dangling references resolve.
- Dump in selected incremental model parts.
  - The dangling references resolve.
- When all dangling references resolve, you have a complete case.

Incremental Model Parts

- Similar to Model Parts
  - They have a type
  - They have both envelope and content data.
- Different from Model Parts
  - They express a change to a model part:
    - Creation of objects
    - Deletion of objects
    - Modification of objects
  - External references point to the modified objects.
- Used to represent planned new construction projects, for example.

An '**Assembly**' is a collection of model parts that are composed as part of some process.

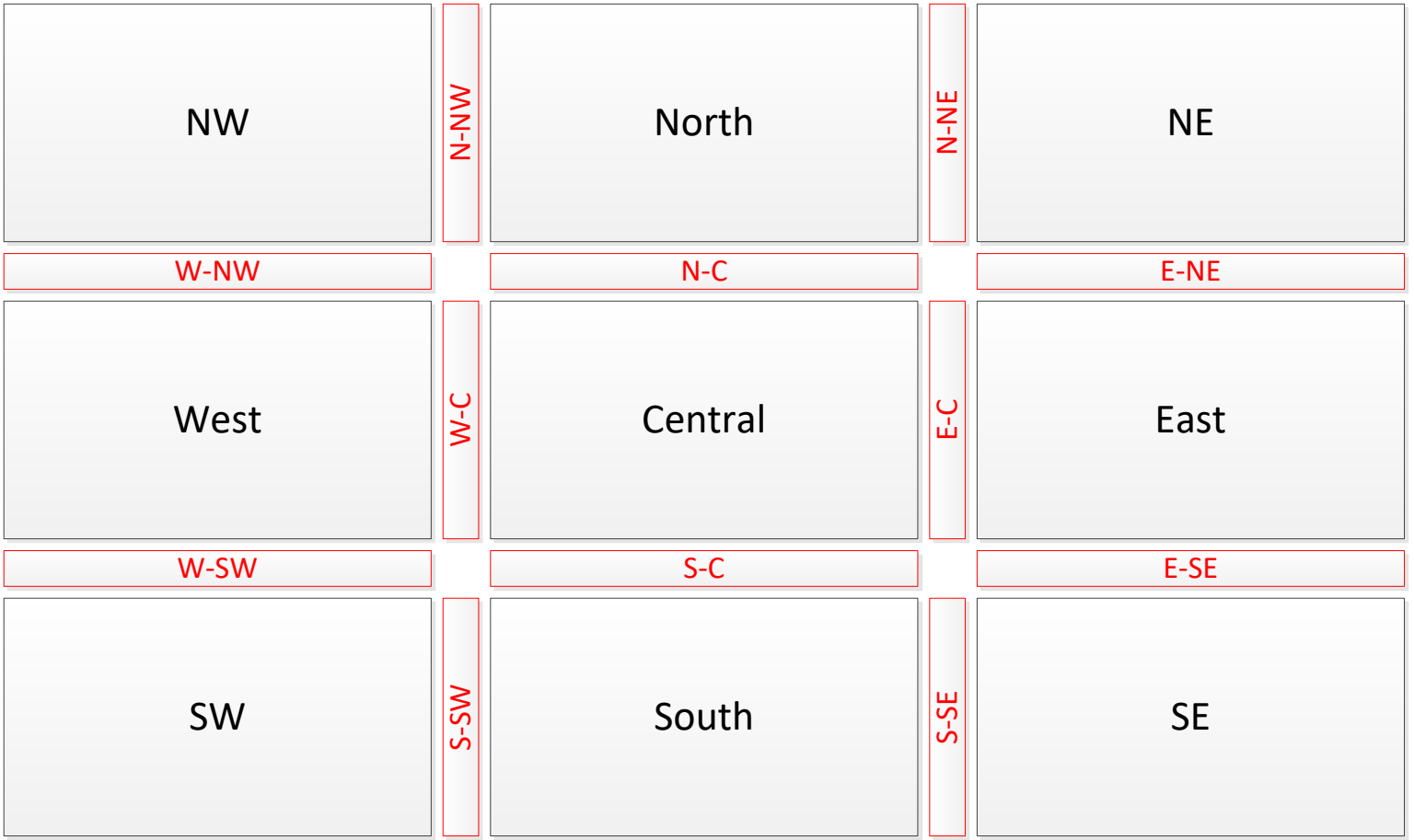
In discussion, but not yet formally standardized…

- A **Procedure** describes how to assemble a model.
  - The ability to capture common processes as repeatable, parameter-driven procedures is an essential feature for NMM products.
- An **Audit Trail** describes the how a model was assembled.
  - The ability to exchange a case with documentation of how it was produced will greatly reduce the engineering time that goes into checking validity of results.

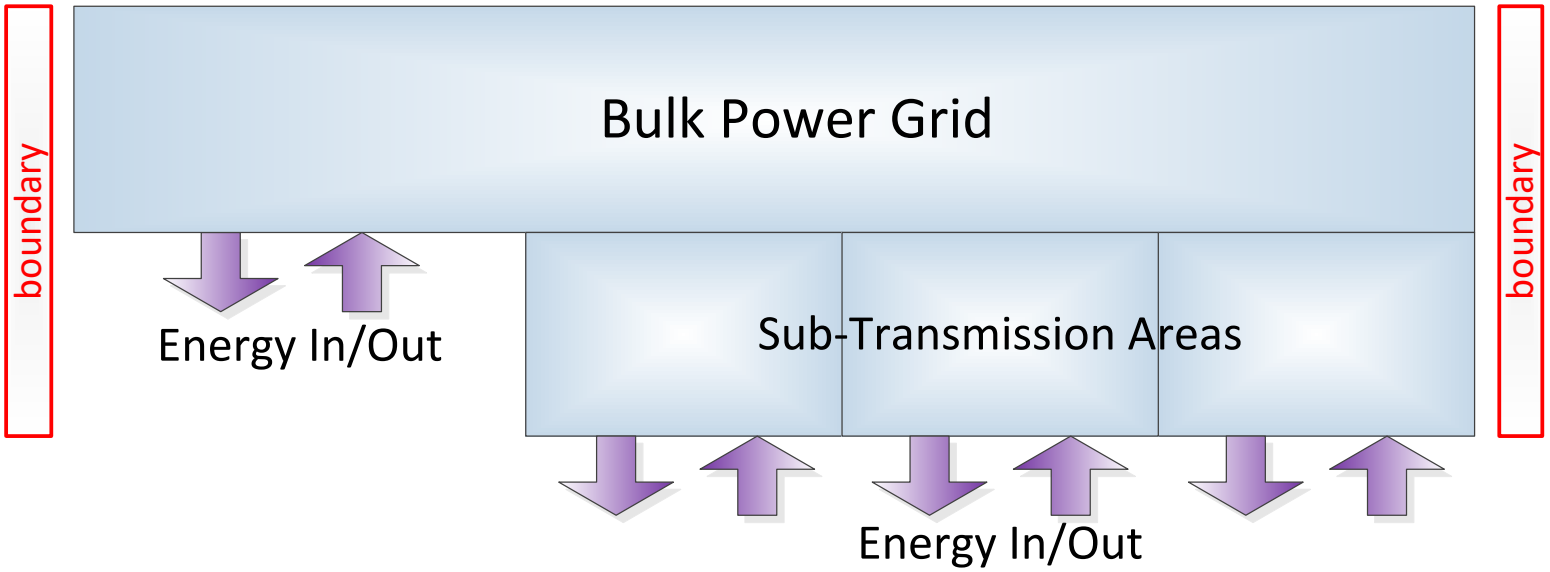
An interconnection framework example:

9 TSO frame parts

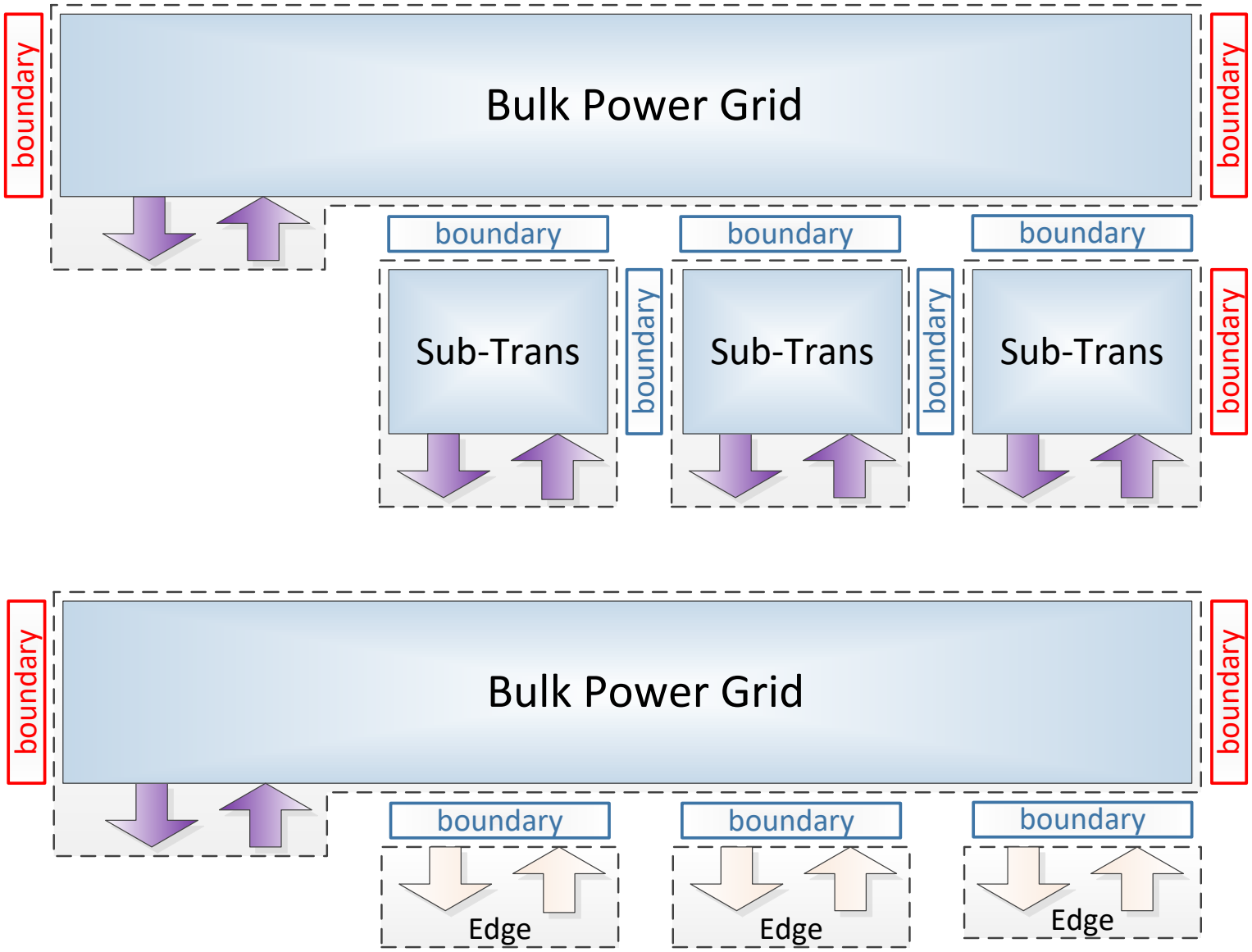
12 boundary parts



Monolithic TSO Model Part



Decomposed TSO Model Part Adds Flexibility



Decomposition can be continued down into the distribution system.

- Use as many levels as are appropriate, but three is a good starting idea:
  - Bulk power level (e.g. 345 and up)
  - Mid-level (e.g. 69 – 230 or any non-bulk that is networked)
  - Distribution level (primarily radial lower voltages)
- Strategy for decomposition can be left to the individual top level authority, as long as there are no ties (boundaries) that need to be agreed on.

Unifying T and D models

- Decomposition to lower voltages is the path to unifying transmission and distribution models.
- When T and D models fit together…
  - Better load modeling for T can be derived directly from D.
  - Better source modeling for D can be derived directly from T.
  - Specialized T and D studies are straightforward to create.

North Study 1: What TSO Frames to include?

NW

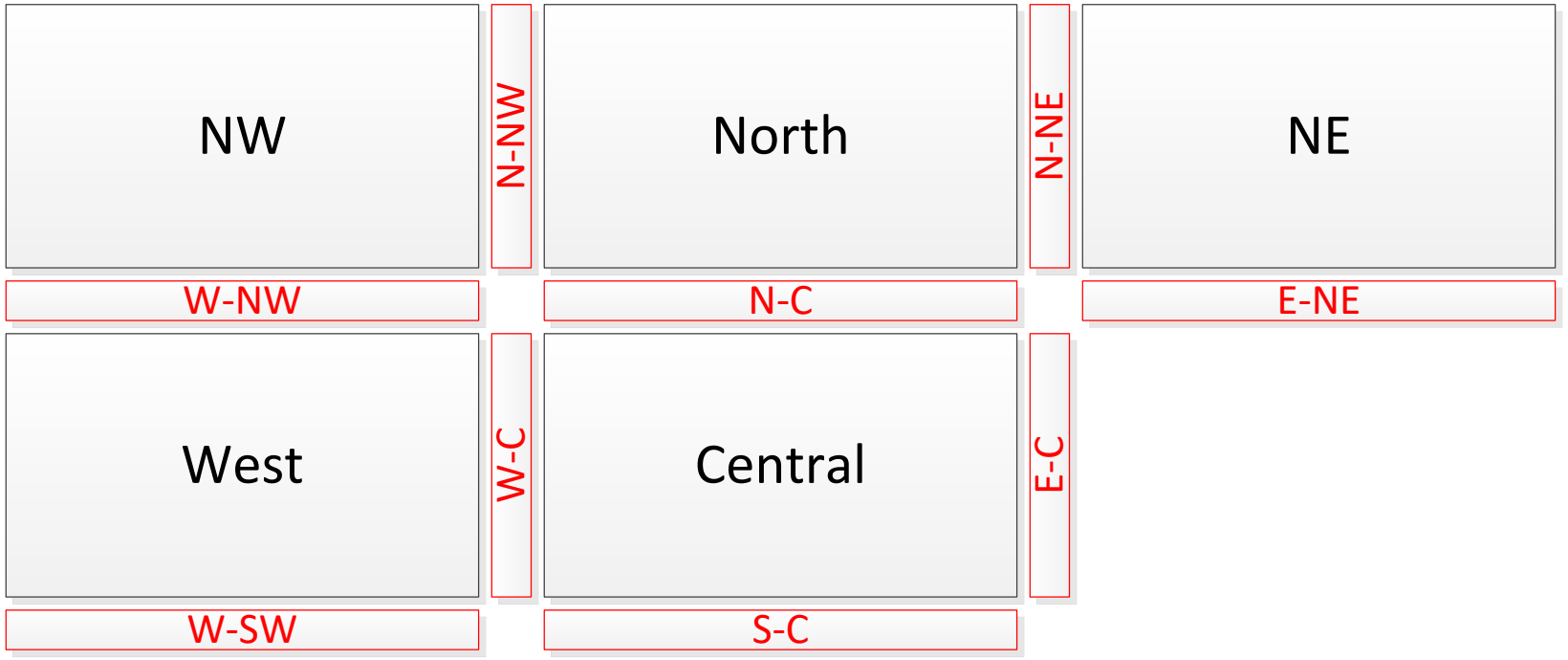
North

NE

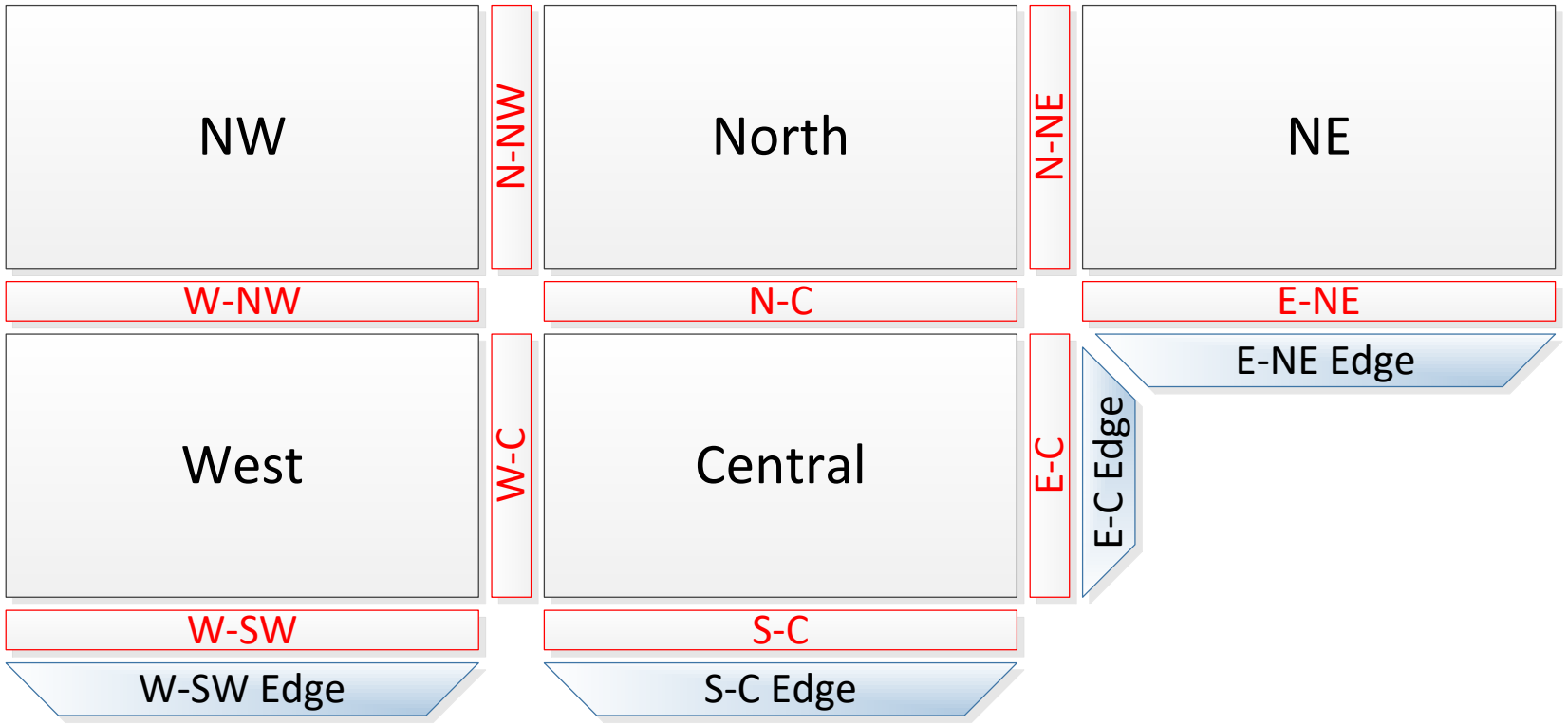
West

Central

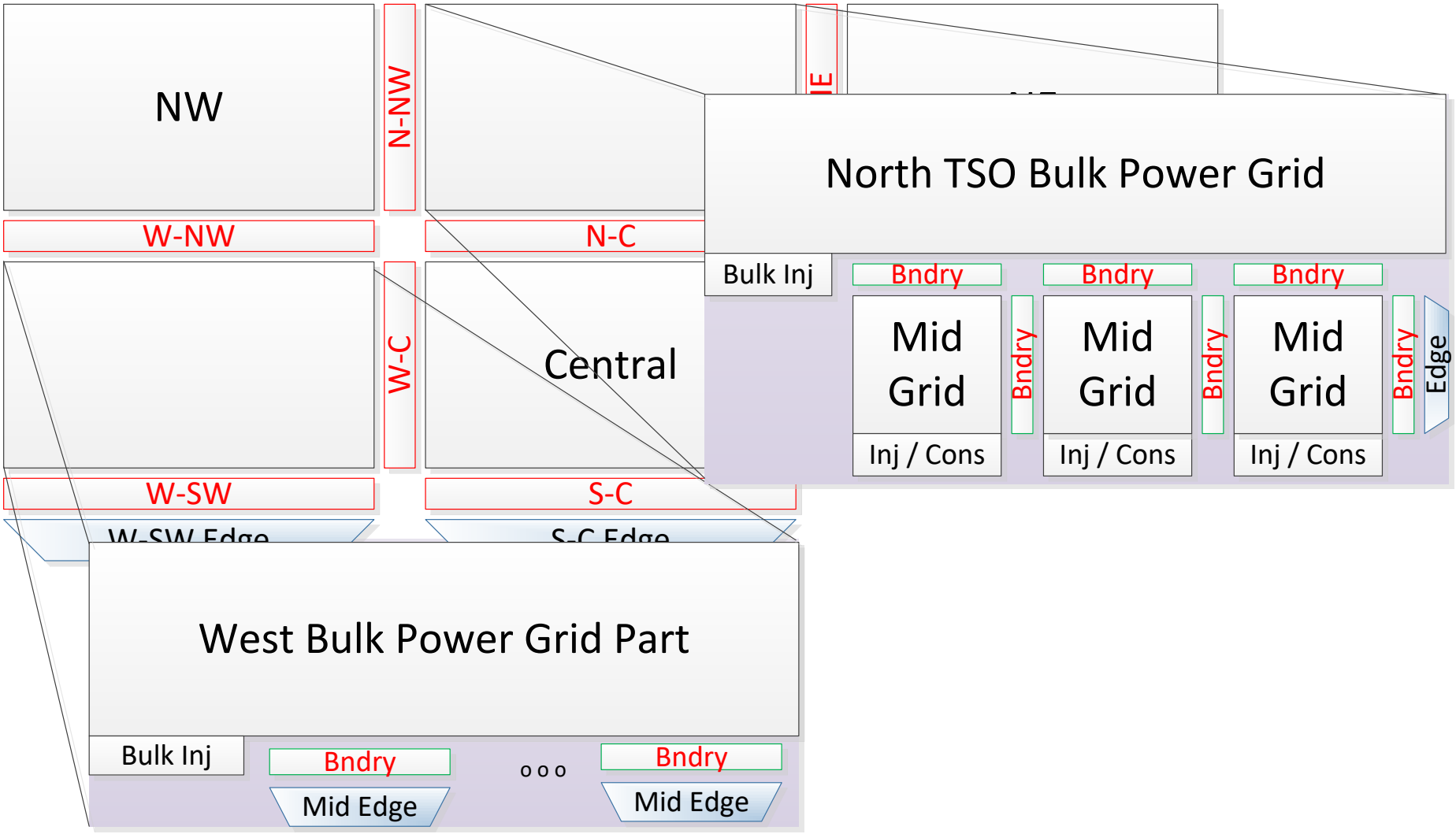
North Study 2: Add Boundaries for the required Frames.



North Study 3: Add Edge Parts to represent interchange with un-modeled parts.



North Study 4: Select detail for TSO Frames.



IGM – CGM Use Case

Best Practice Approach

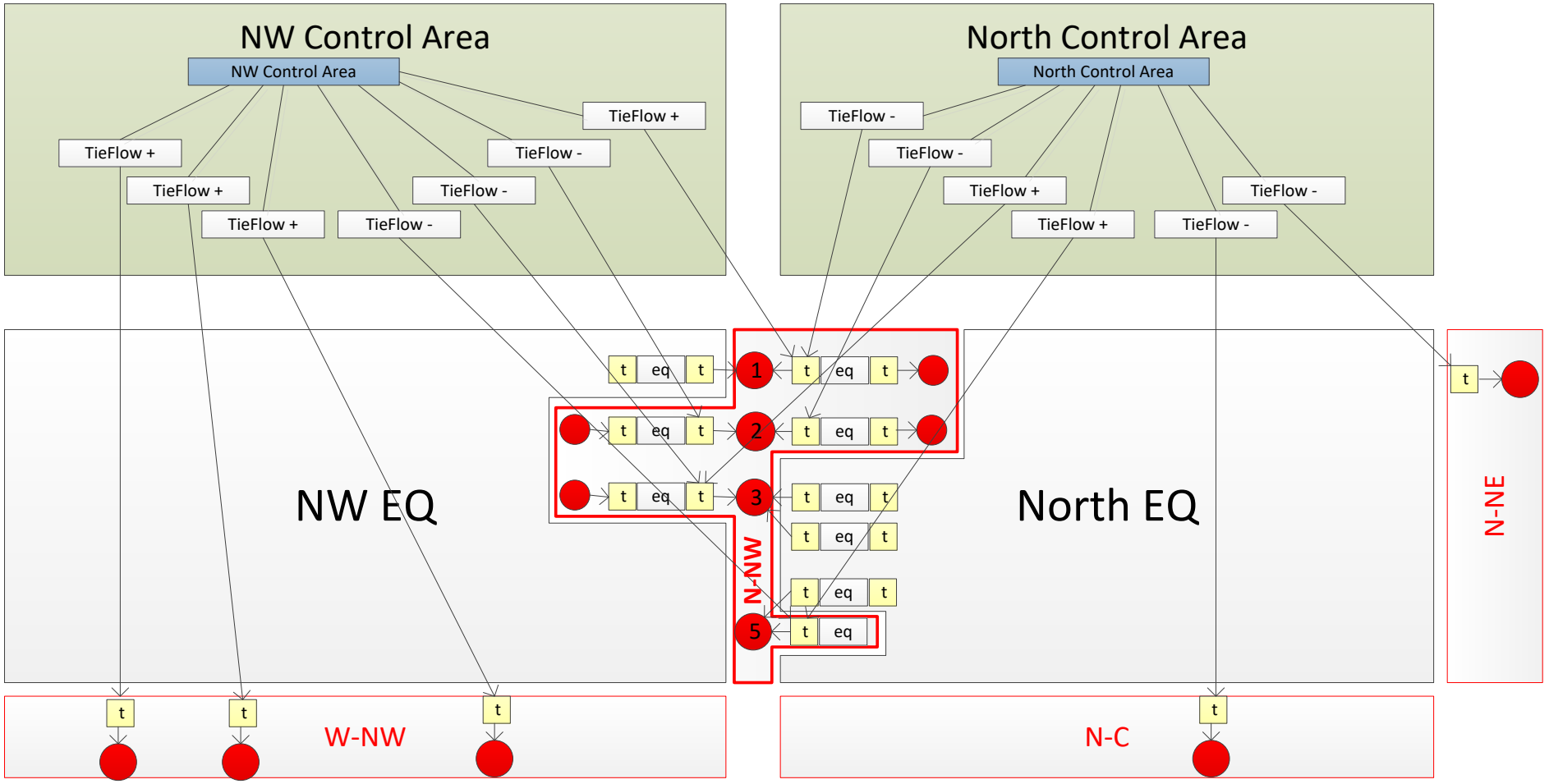
Broad Outline

1. An orchestrator defines the situation that is to be represented.
2. The control area participants build IGMs of the situation for their territory.
3. IGMs are sent to the orchestrator.
4. The orchestrator assembles the CGM from the IGMs.
5. The CGM is made available to all parties that will use it to conduct analysis.

Using control area specifications

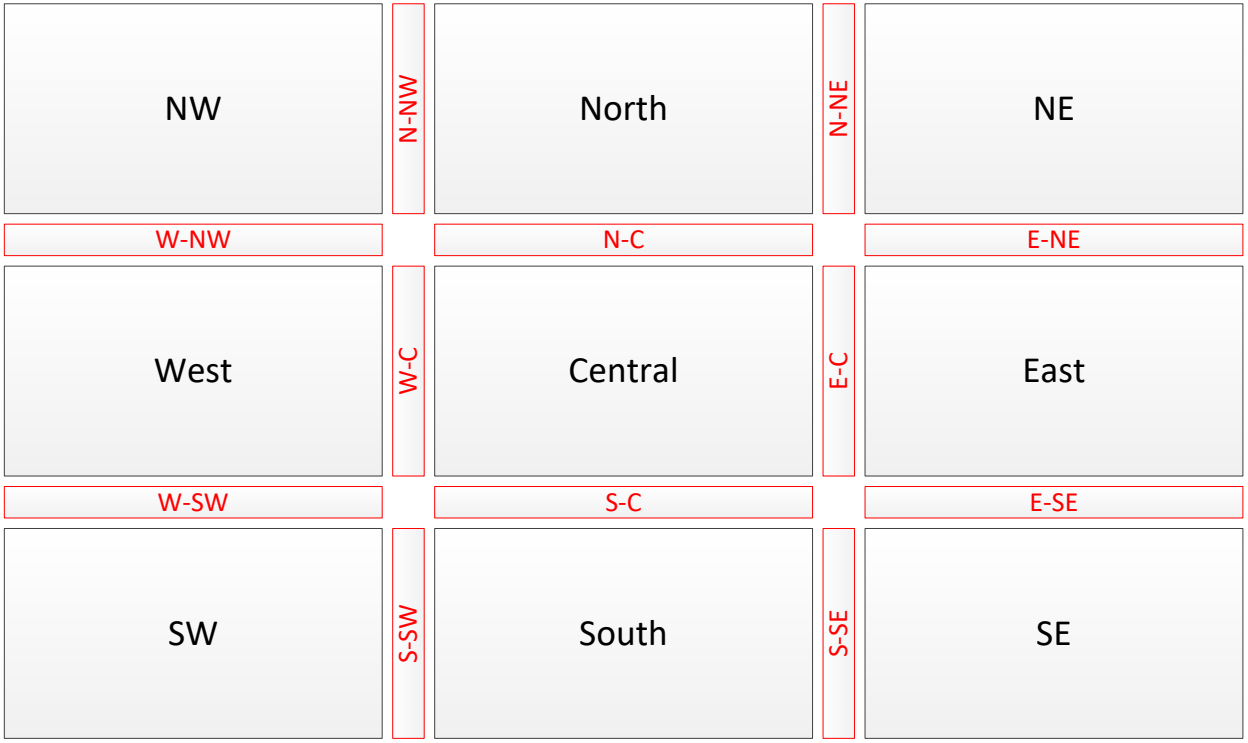
- Operationally, control areas are very important
  - Load forecasts and energy schedules are based on control areas.
  - In power flow, study situations normally begin with assumptions about load forecasts and net interchange by control area.
- Using interchange control equations in the power flow is the best way to get a solution that matches the desired situation.
- CIM provides ControlArea and TieFlow classes for defining control areas.
  - TieFlow objects reference Terminals.
  - TieFlow objects reference the ControlArea that they define.
- Control areas are like boundaries in that each TieFlow location must be mutually agreed between the pair of control areas connected by the tie.
- No correspondence is required between frames and control areas, but in transmission, the entities that operate control areas are usually the same entities that are model authorities for the territory within the control area.

Recommended practice for control areas and boundaries…

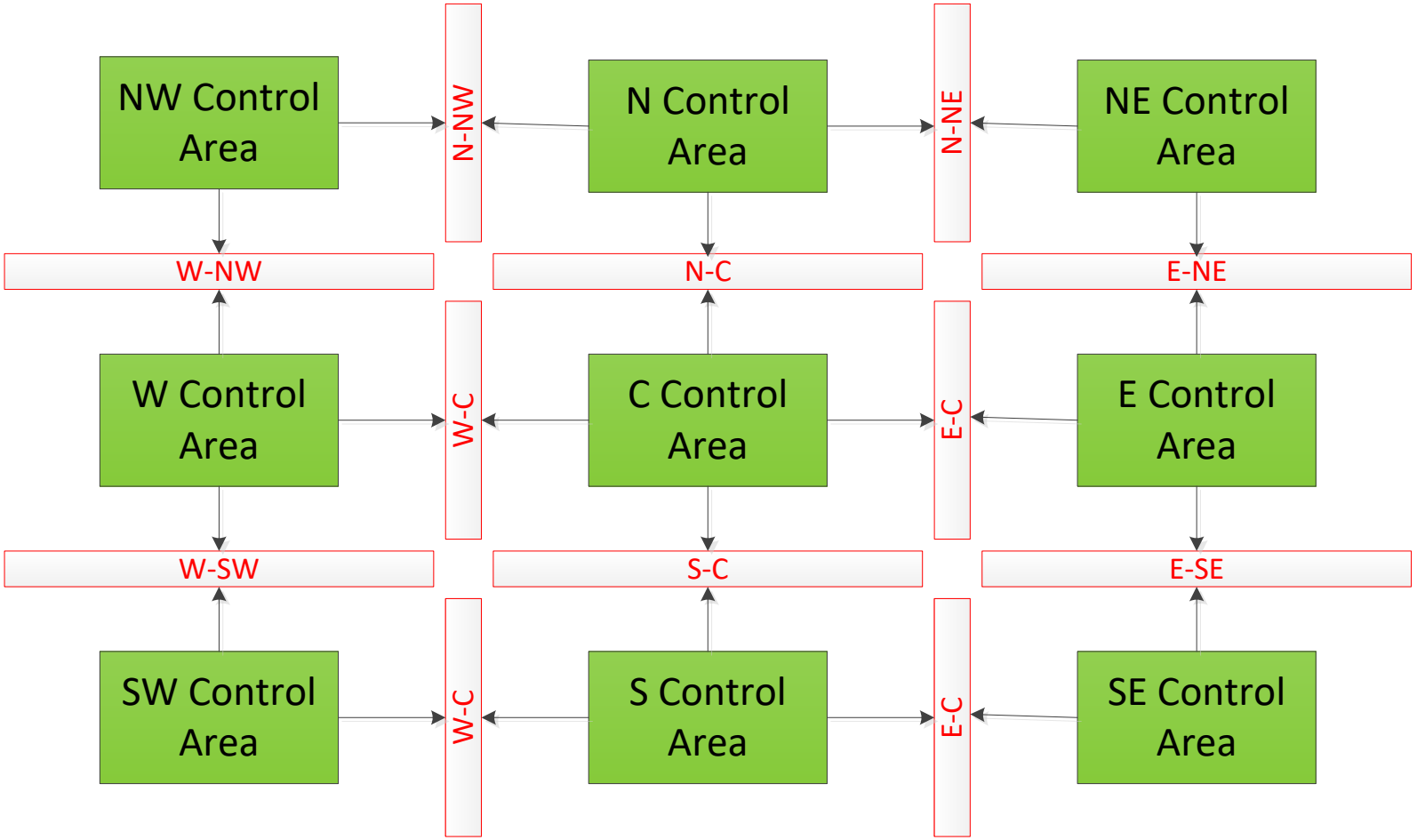


- The boundary is expanded to include all terminals referenced by TieFlow objects.
- Control area objects are better in separate model parts.
  - If an area is not completely included in a case (so that its interchange control spec would be invalid), this avoids having unsatisfied references from a global control area model part.

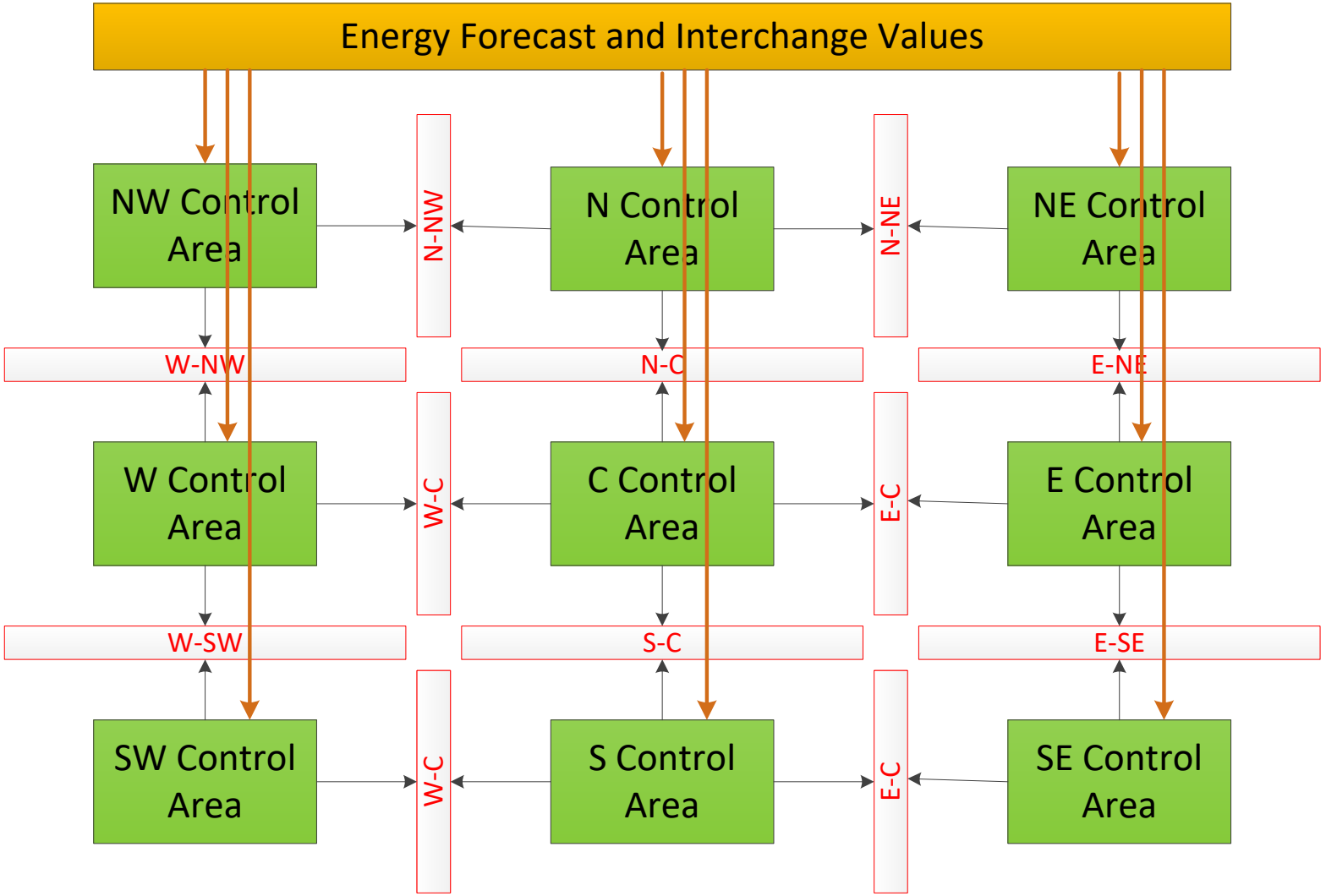
Suppose we have an interconnection of 9 regions



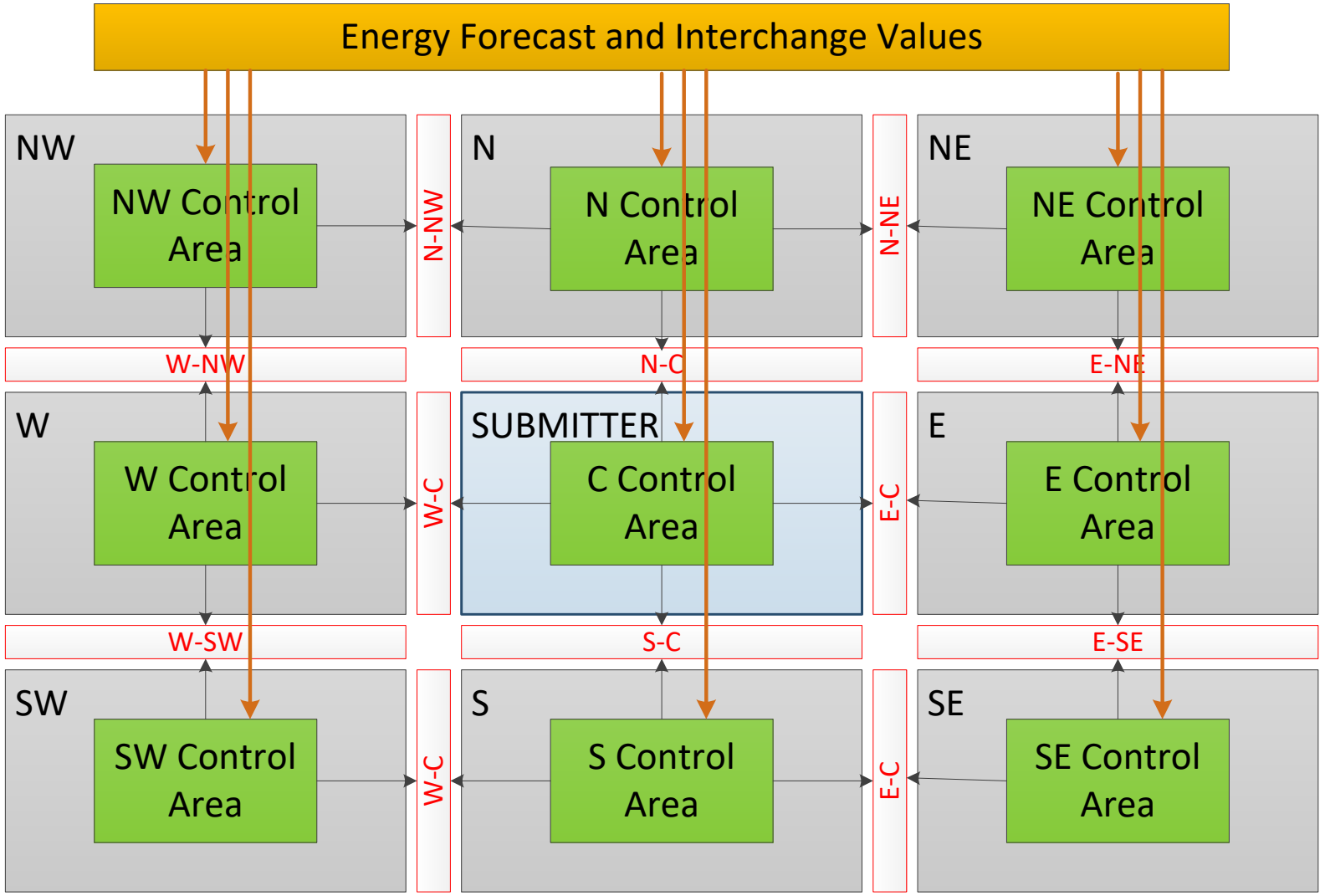
Mutual agreement is made for both boundaries and control areas. This definition is re-usable across many scenarios.



Use Case Step 1. Forecasted Energy and Interchange values are added by the Orchestrator



Step 2. Submitter adds regional network modeling and prepares IGM using best guess of external



Step 3. Submitting an IGM

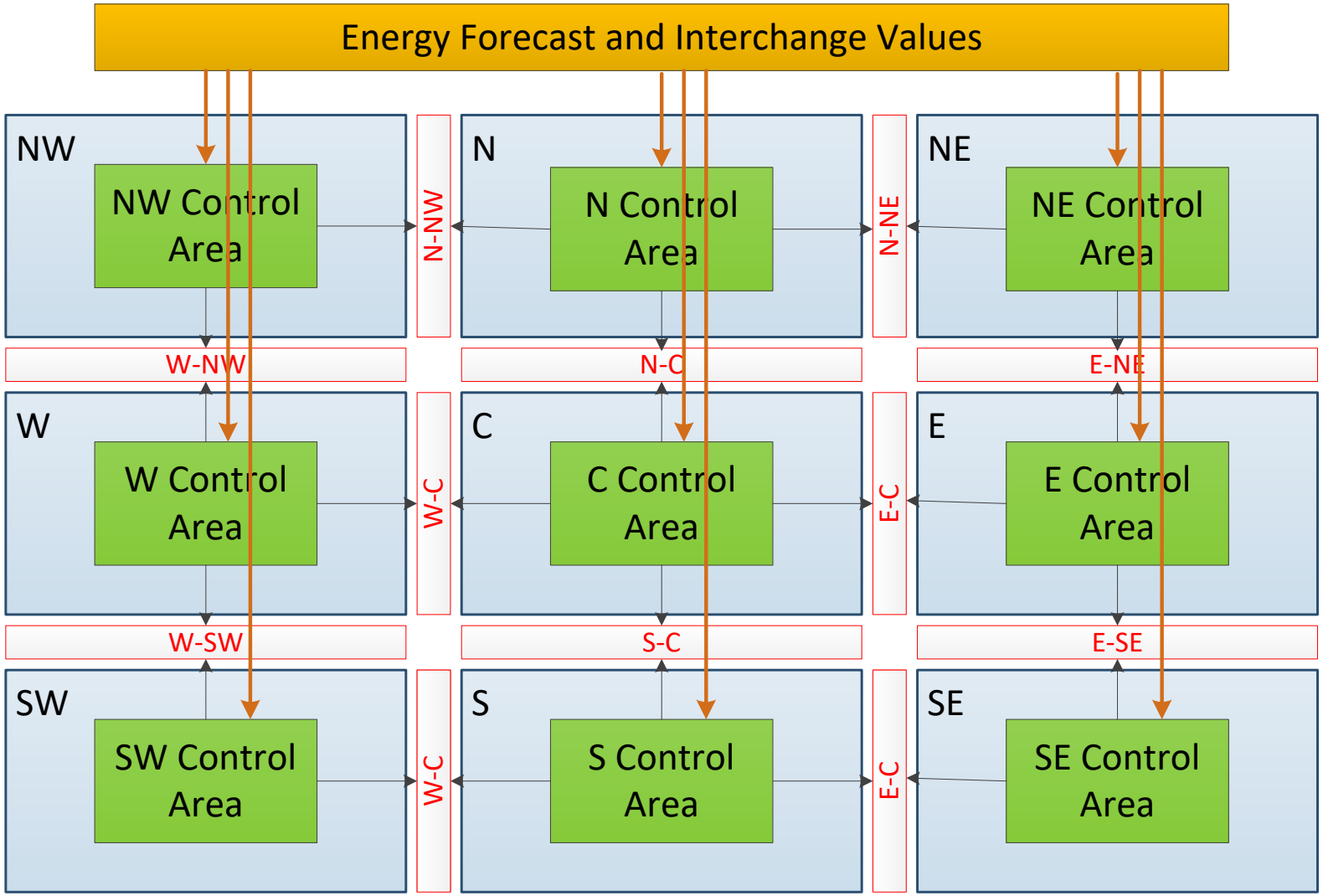
Minimum requirements for submission:

- The submission shall include the control area's EQ and SSH model parts.
- The submission shall include TP and SV model parts covering the control area and its boundary. (This is sufficient to check whether the IGM conforms to the specified criteria and is solved.)

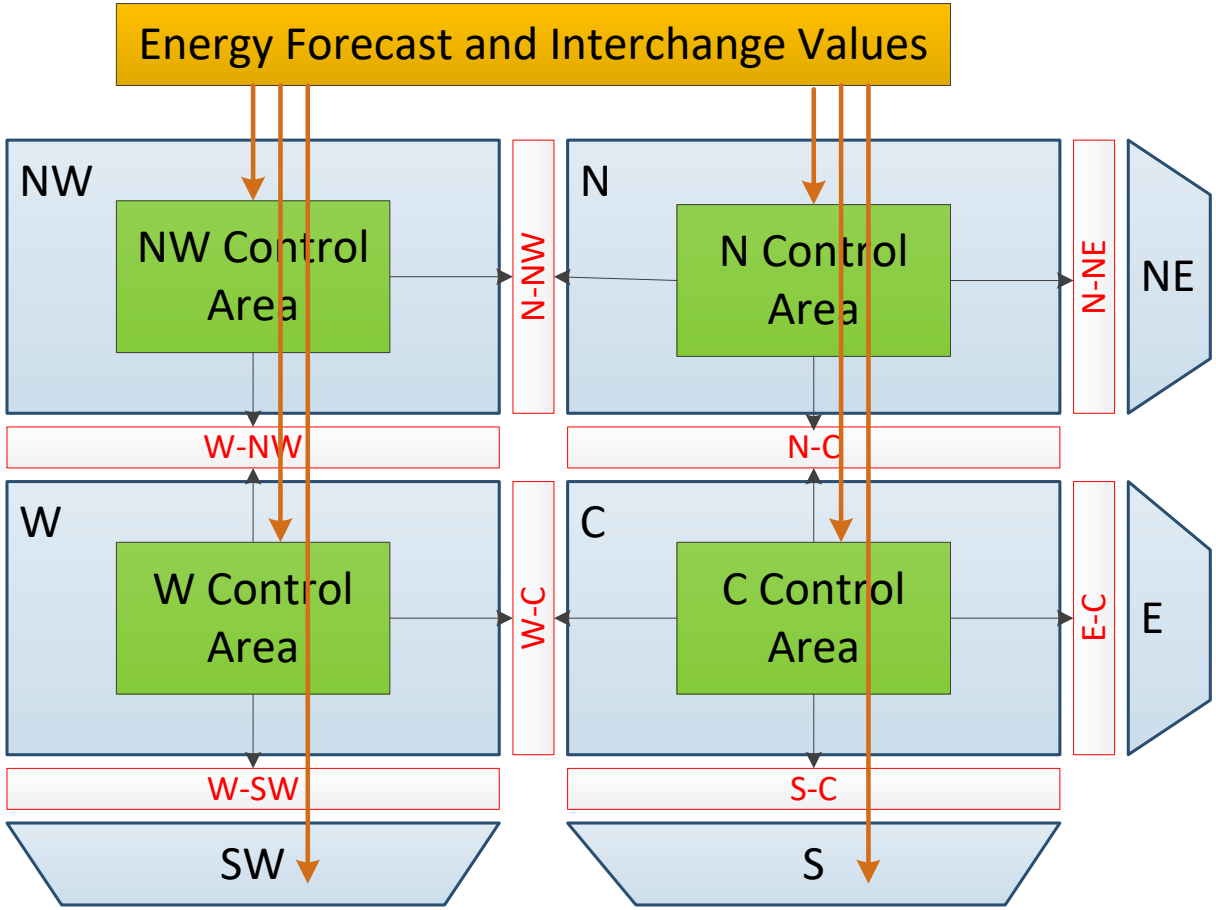
Optional submission requirements:

- The IGM shall submit their complete solved power flow case, including all EQ, SSH, TP and SV, retaining all original model part identity.
  - Submitting the complete case gives the orchestrator maximum insight as to how the result was built.

Step 4. Building the CGM



Step 5. Using the CGM (reduced with edge models)



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