# Real-Time Models for Real-Time Analysis


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# Motivation

- Power flow studies are done using a different model than is used in real-time modeling
- On-line power flow study tools do not match planning study tools
- EMS Systems can "spit-out" a planning-like model, but mapping data to this model is manual
  - Topology is constantly changing so keeping up with real-time is not reasonable
- Also, PowerWorld Simulator has features that on-line tools do not have
  - Conditional Contingency Actions (for RAS)
  - Much easier to use and interpret results (especially when you have a limited time to make decisions)

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## Problem with “Spit-out” of Planning Model from an EMS System

- Due to breaker status, a substation may end up with one 115 kV bus, or maybe 8 different 115 kV buses
  - Results in different bus numbers, names, etc… every time
  - Trying to match a planning contingency description to this ever-changing model is futile

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## Conceptual Problem

- You’re trying to “convert” the data to what is needed by another piece of software
- This inevitably leads to an ongoing maintenance task
- EMS data is already a heavy maintenance task that has to be done to operate the system – we can’t change this
- *Don’t change your data, change your software*

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## PowerWorld's Solution:
## Don't change your data, Change your software

- Build a model in PowerWorld that models *everything* that the EMS models.
  - Every breaker is modeled as a zero-impedance branch
- Model will be huge, but for modern computers this isn't a problem
- Also, PowerWorld's filtering, and graphical interface make dealing with a large model much more manageable.



## Advantages of PowerWorld's Solution

- Building an identical EMS model can be done programmatically
  - No human intervention of matching names, numbers, etc..
  - No decisions about what to keep – keep *EVERYTHING*
  - Write software that queries your EMS system and builds an exact replica of the model
  - Generate a PowerWorld Auxiliary file including
    - Interfaces
    - Injection Groups
    - Contingencies (including conditional RAS)
    - Model Conditions, Model Filters, etc…
    - More…

## Problem Encountered

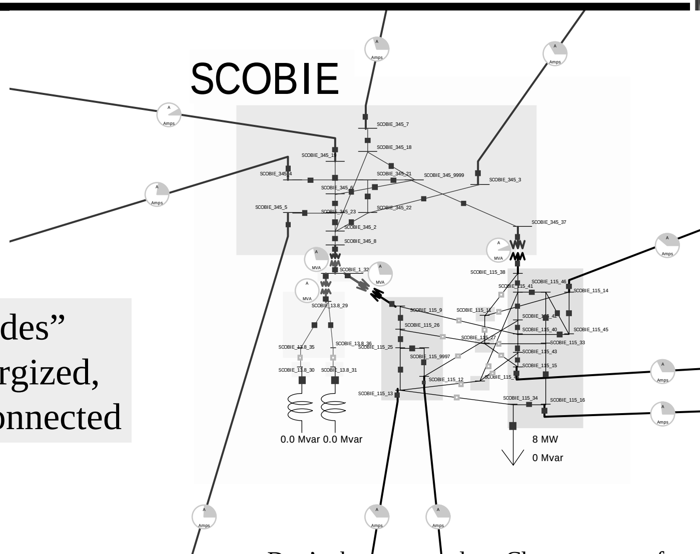
- Initial we experimented with solving the full topology model
  - About 75% of branches are zero-impedance branches
  - Makes for a very large case
- Problem encountered: Solution Speed
  - Solution was successful
  - However, the speed was not very good
- Solution: Topology Processing



## Solution to Problem: Topology Processing

- Bring the topology processing inside of PowerWorld (PowerWorld handles two power system models simultaneously)
  - Full Topology Model
  - Consolidated Model
- Presently the user must perform the Topology Process via a dialog
  - Eventually we will handle this automatically with little user-intervention

# Example Substation: Scobie Full Topology

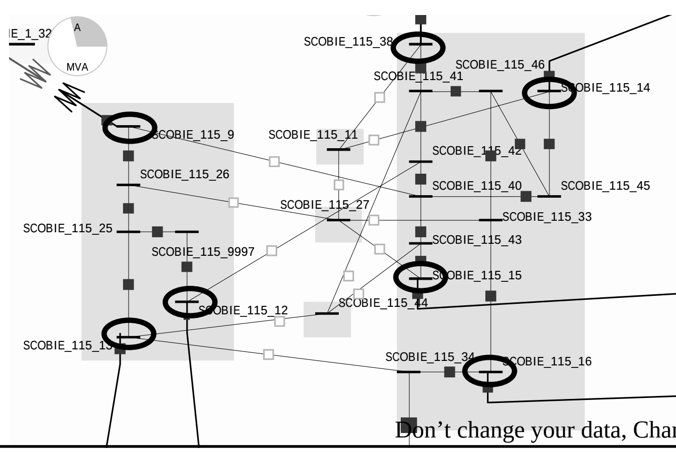



41 "nodes"
36 energized,
5 disconnected

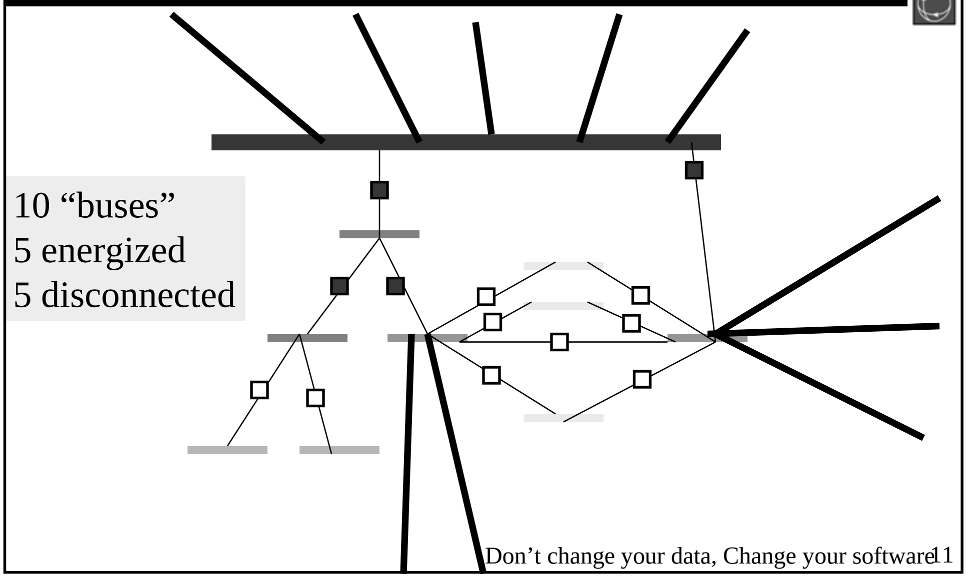


# Close-up of 115 kV nodes

- Could be up to 7 energized 115 kV buses
  - Only 2 in this example, but all depends on breaker status



# Example Substation: Scobie
# In *Consolidated* Case






# Example Case Statistics

- Full-Topology Model has 10,437 nodes
  – 9,653 energized (786 disconnected)
- After Consolidation, case has 2,366
  – 1,647 energized (719 disconnected)
- Total is 4.4 times fewer
- Energized Total is 5.8 times fewer

## Topology Processing Dialog

- Must specify which branches to maintain and which to throw out
  - Maintain interfaces branches
  - Maintain contingency branches
  - Throw out low impedance branches that represent ties



## Continuing Work

- Keeping all the breakers that are involved in a contingency can result in a large amount of extra nodes
- We are looking into performing *Incremental Topology Processing*
  - Throw out breakers involved in contingency
  - Then dynamically add them back in only for the contingency that needs them
    - Each contingency may add back in several nodes that are needed