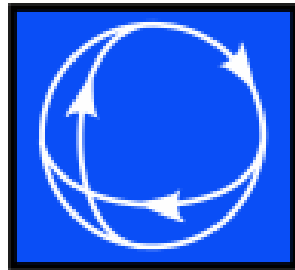


Real-Time Models for Real-Time Analysis



- Jamie Weber, Ph.D.
 - Director of Operations, PowerWorld Corp.
 - weber@ powerworld.com
 - (217) 384-6330, ext 13



PowerWorld
Corporation

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 some 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)

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

It's a 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*

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

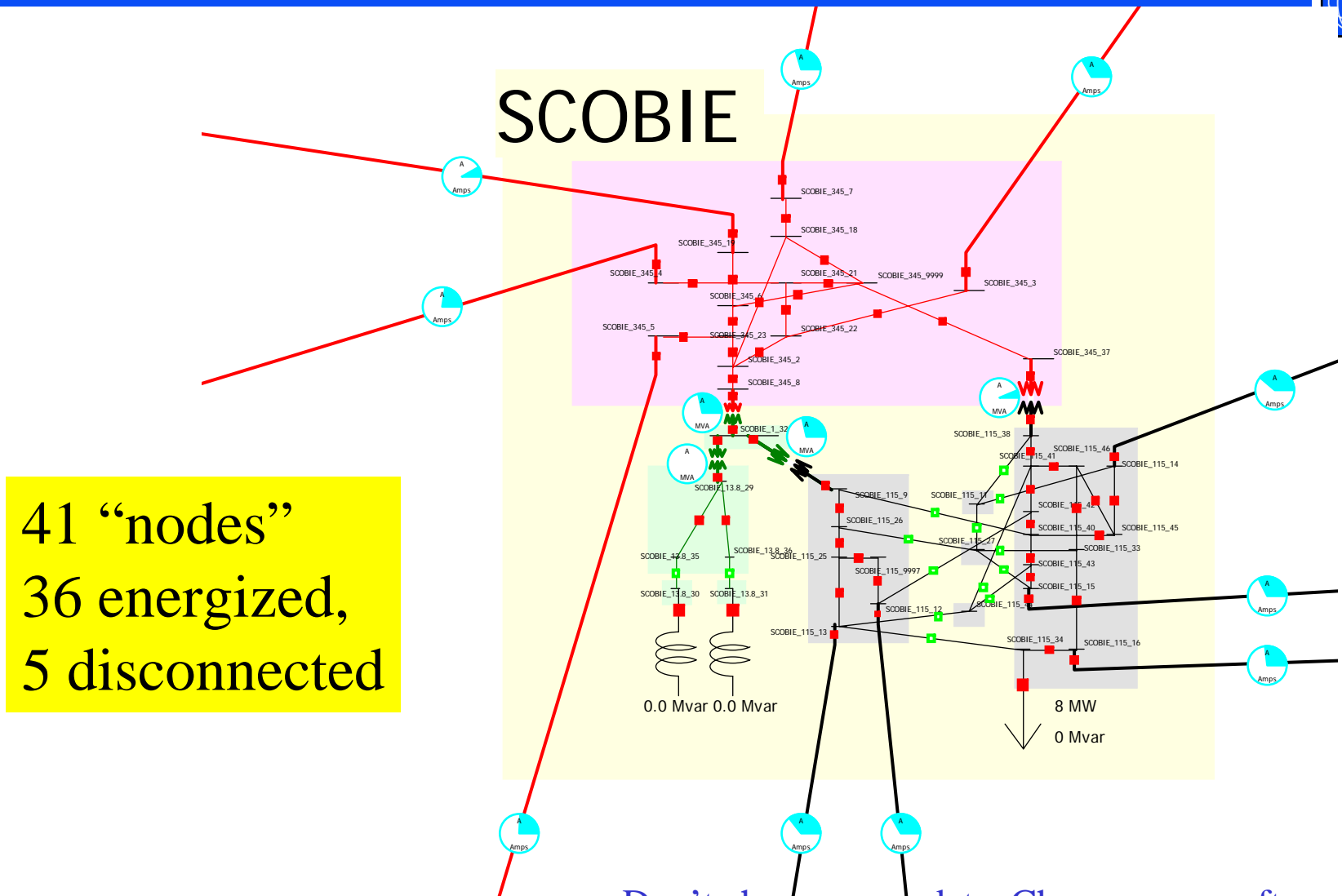
Solution to Problem: Topology Processing



- 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



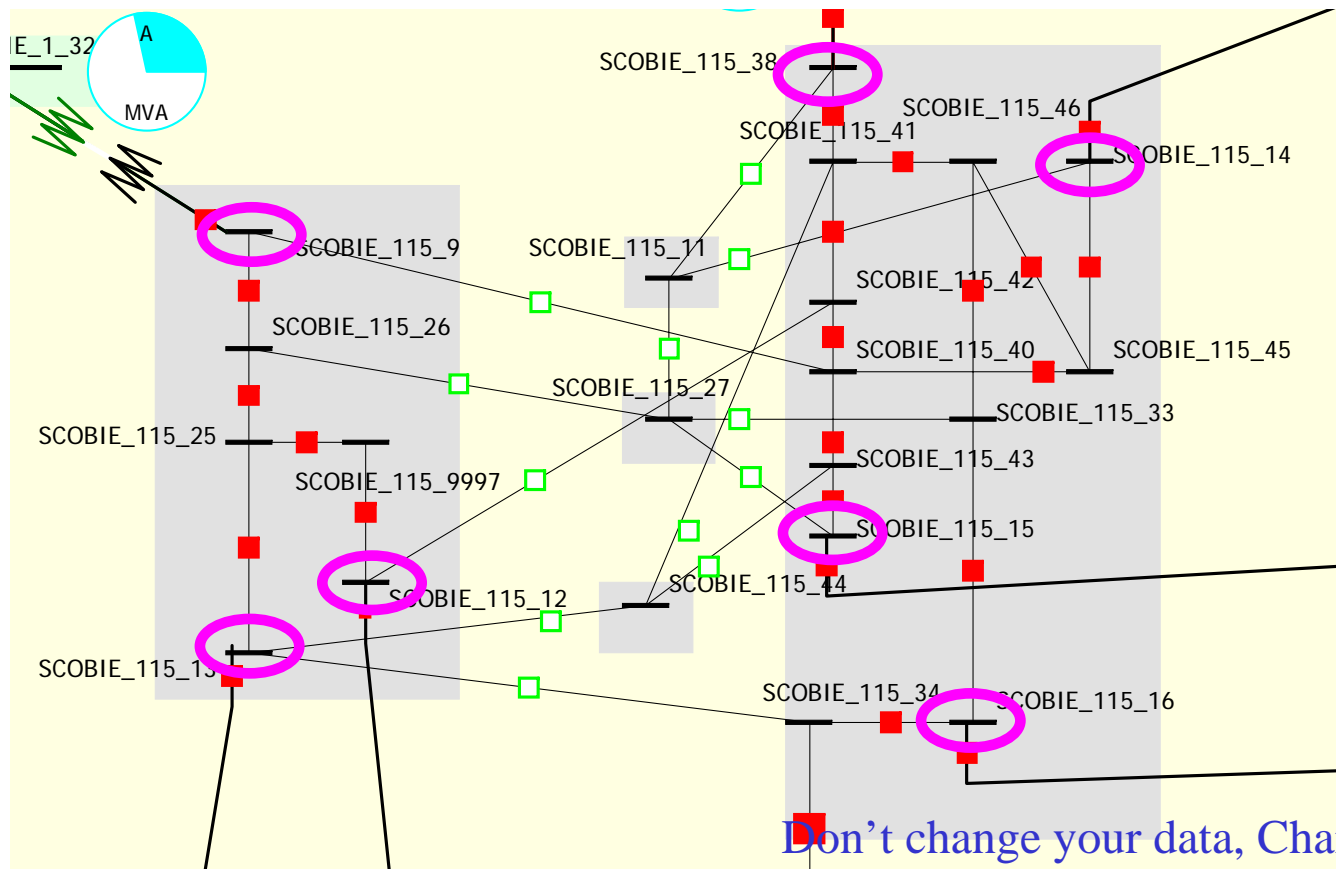
41 “nodes”
36 energized,
5 disconnected

Don't change your data, Change your software 9

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

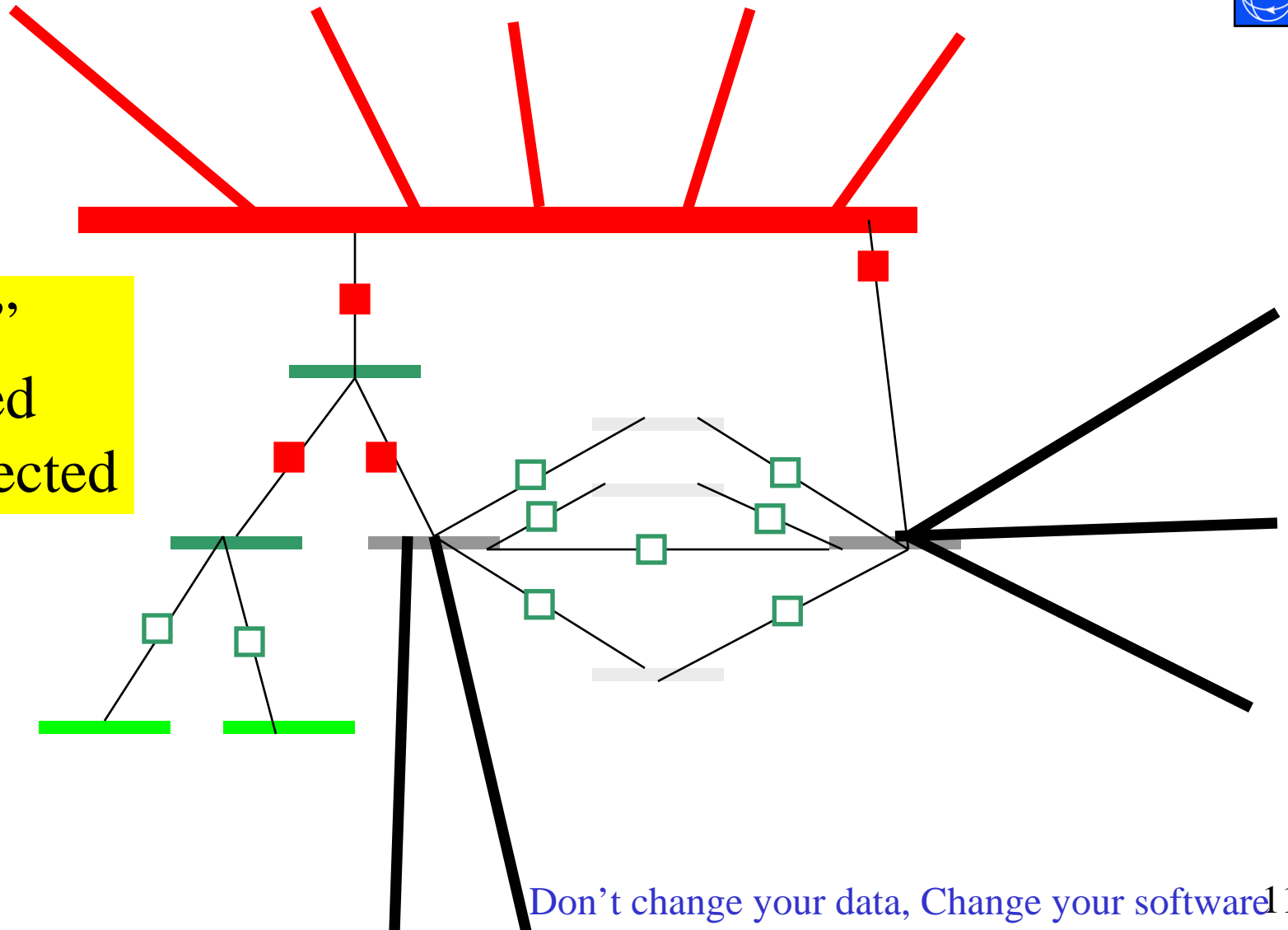


Don't change your data, Change your software 10

Example Substation: Scobie In *Consolidated* Case



10 “buses”
5 energized
5 disconnected



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