



Addressing Challenging System Stability Issues while Retaining OEM Confidentiality

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ELECTRANIX

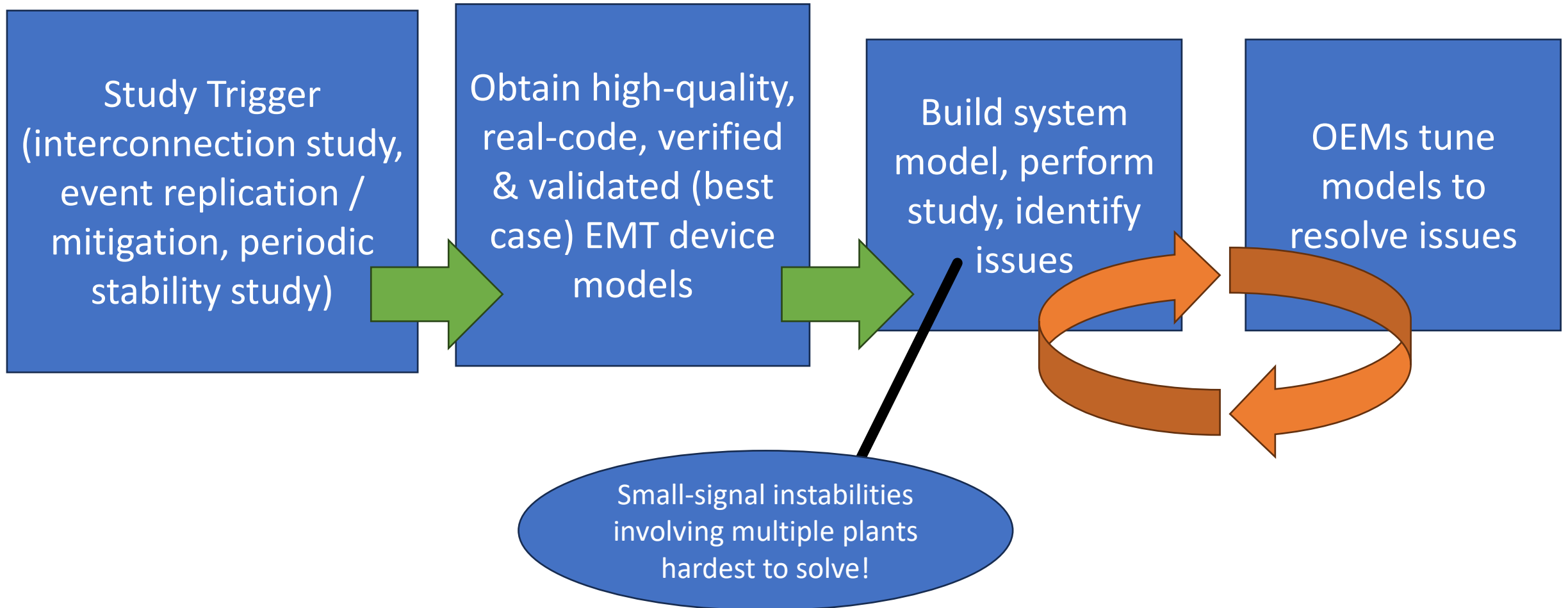
SPECIALISTS IN POWER SYSTEM STUDIES



Background

- EMT studies are now being performed regularly by many entities (typically by ISOs or TOs / consultants)
- Most modern EMT device models are real-code for accuracy and ease of modelling
 - Also means OEMs are very cautious about model distribution.
 - Models typically obtained under NDA which prohibit model distribution (especially to other OEMs!)
- This poses a major challenge when OEM involvement is needed in resolving stability challenges in systems with multiple device OEMs
- How to bring the OEMs “in the loop”?

Typical EMT Study Process



Resolving Issues by Control Tuning

- OEMs typically can't re-produce the issues on their side, and the full system model can't be shared.. *What now?*
- Before you start, *are you using the correct IBR model?*

As problem
complexity rises,
simulation
approach
complexity rises



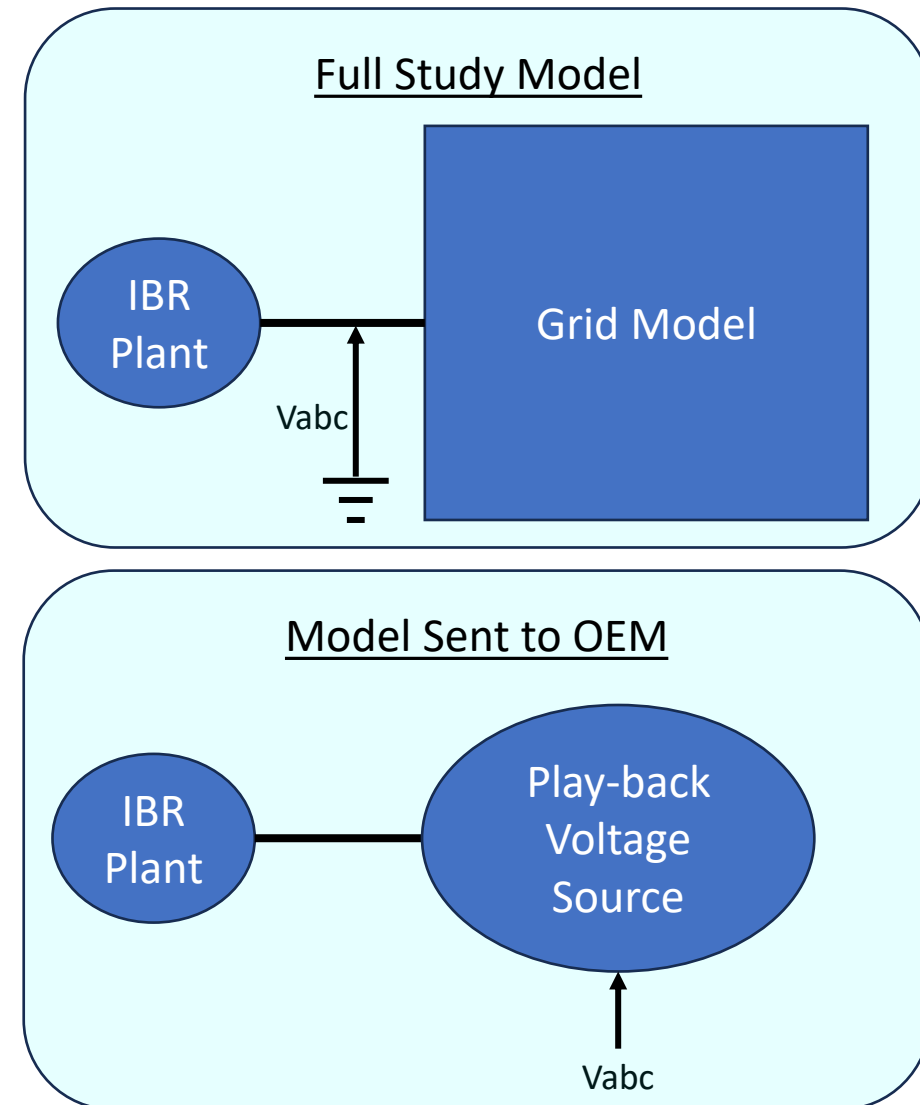
“Simulation Lab” ★
Simplified System
POI Playback
Simulation Outputs

Resolving Issues by Control Tuning – Simulation Outputs Only

- OEM suggests changes based on simulation outputs (no model sharing), study is re-run
- May require many iterations (inefficient), and may not be successful
- May be appropriate when:
 - Issue can be mitigated by straightforward control changes
 - OEM has experience correcting similar issues in other regions (i.e. issue is not particularly system-dependent)
- Additional challenges:
 - Time lag between OEM and study engineer (email, time-zone, etc.)
 - Language barriers

Resolving Issues by Control Tuning – POI Playback

- Measure instantaneous voltage at POI in problematic simulation, play these back into isolated plant model
- Allows for perfect replication of plant behaviour if voltage is sampled and played-back correctly
- All system details hidden from OEM
- Simulation may become “invalid” if behaviour of device changed substantially
- Appropriate when:
 - Issue can be fixed by OEM investigating internal model behaviour
 - Grid is relatively strong, minimal plant-grid or plant-plant interactions
- May not be appropriate for:
 - Instability modes that involve the plant and the grid together (eg. SSCI damping issue)
 - Weak or sensitive grid, many plants interacting



Resolving Issues by Control Tuning – Simplified System

- May be possible to demonstrate issue in reduced case with just one OEM included
 - No guarantee issue can be replicated, and may need substantial effort by study engineers
- OEM can tune model in simplified system
- OEM solution (if found) may not work in the full system, especially for interactions involving multiple plants
- System details (bus names / number, detailed T-line models, etc.) may need to be obfuscated

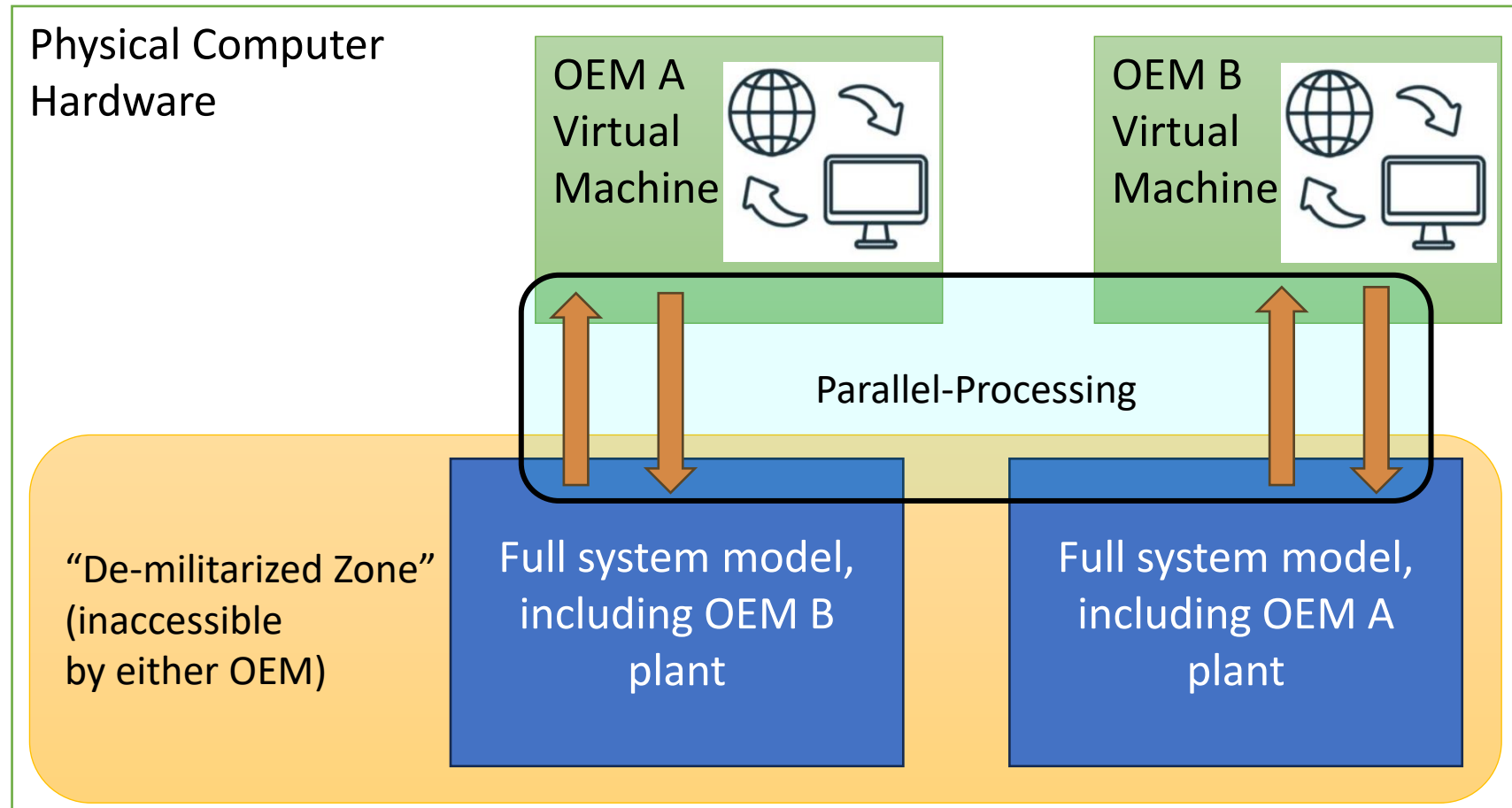
Resolving Issues by Control Tuning – “Simulation Lab”

- Trusted 3rd party configures Virtual Machine (VM) with all required simulation software
- OEM A remotely logs-in to VM with encrypted VPN. They only have access to a parallel processing connection point in the EMT program (eg. a POI bus...)
- The rest of the system model (containing OEM B, C, etc. device models) is on the same machine but not accessible to OEM A
- The OEM model is seen by the system as a parallel processing connection point (details of the OEM model are hidden)
- Faults and events are pre-programmed into the system model.
- OEM A can launch system model, run faults, and check status via custom client/server messaging program
- Allows OEM to iterate control tuning as needed

<https://www.electranix.com/publication/electranix-advanced-simulation-lab/>

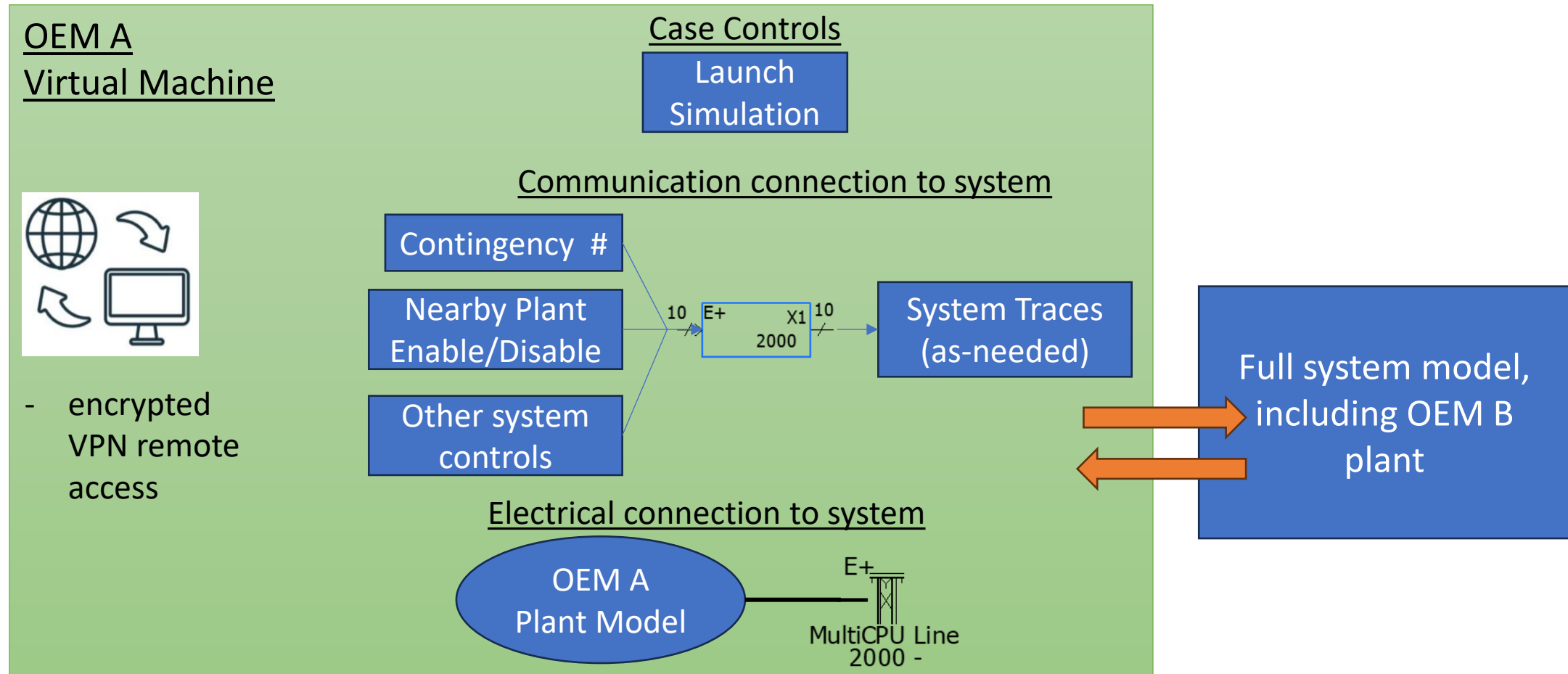
“Simulation Lab” – Application Example

- System instability issue involving two OEMs



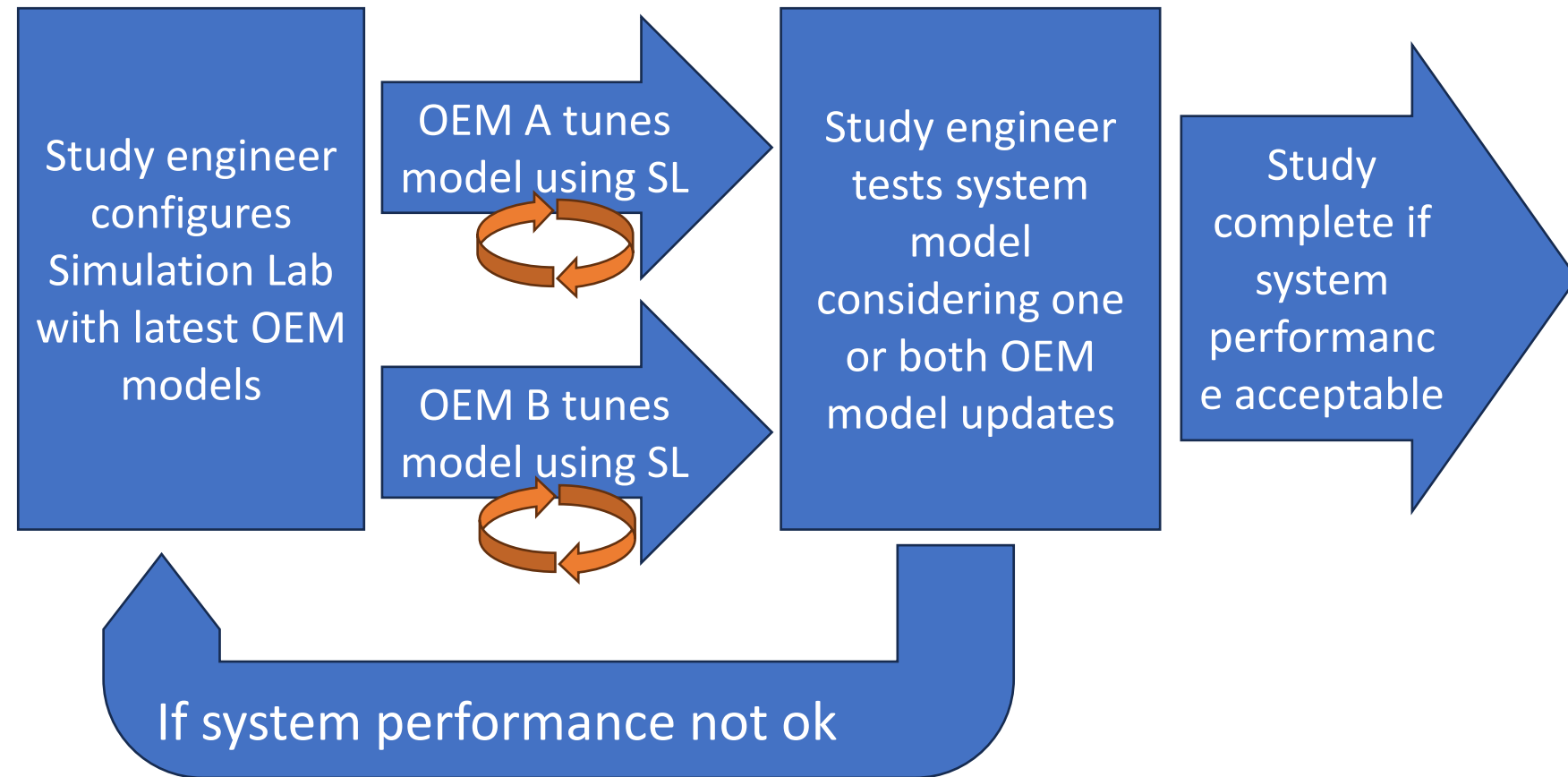
“Simulation Lab” – Application Example

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“Simulation Lab” – Application Example

- SSCI involving two OEMs.. practical solution to hard problem!
 - Stability hyper sensitive to IBR controls, heavily shaped by nearby devices
- Parallel OEM tuning
- Many iterations may still be needed



“Simulation Lab” – More Applications

- HVDC/FACTS Dynamic Performance Study by OEM in multi-OEM systems
- Pre-interconnection study (think AEMO interconnection tool)
 - Feasible for every plant?
- Event Replication in multi-OEM systems (model validation)
- Simulation Lab environment “As a Service”
 - Configuring computer and environment for large EMT simulation non-trivial
 - Software licensing, security, firewalls/Anti-virus, compilers, compute hardware may all be hurdles for newcomers / infrequent users
 - Engineering Expertise!

What's next?

- “Simulation Lab” available tool for resolving unresolvable complex issues!
- Future studies will continue to become more complex as we add more IBRs, LLs, and series capacitors to the system.
 - Can status quo be scaled?
 - Loosening NDA restrictions?
 - Open source models?
 - Strong model-sharing requirements?
- Many stability concerns are downstream of policy decisions that result in nearly inoperable systems... we're doing our best to get things working!

Thank you!

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