The Effect of Cyber-Physical Characteristics on Large-Signal Stability of Microgrids

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What is a Microgrid?

- Distributed Energy Resources (DERs)
- Energy storage devices
- Control and communication systems
- Island or grid connected operation

Courtesy: PITT
Stability Studies

- Stability
  - Small Perturbations
    - Small Signal
  - Large Transients
    - Large Signal
Large Signal Stability

- Estimate region of attraction
- System is stable within region of attraction
- System is unstable outside that region
From Centralized Systems to Microgrids

Centralized Systems
- Operator-based
- Central command and control
- Stability studies do not account for cyber features

Microgrids
- Distributed Resources
- Full automation requiring Cyber-Physical attributes
Effect on Large Signal Stability

- Account for cyber attributes
- Effect on large signal stability?
Effect on Region of attraction

- Difference between physical-only and cyber-physical stability studies
- Manipulate the region using those cyber attributes?
Cyber Attacks In Stability Studies

• What is the effect of cyber attacks on large signal stability?