



# 2018 System Operator Training: Synchrophasors and Oscillation Detection

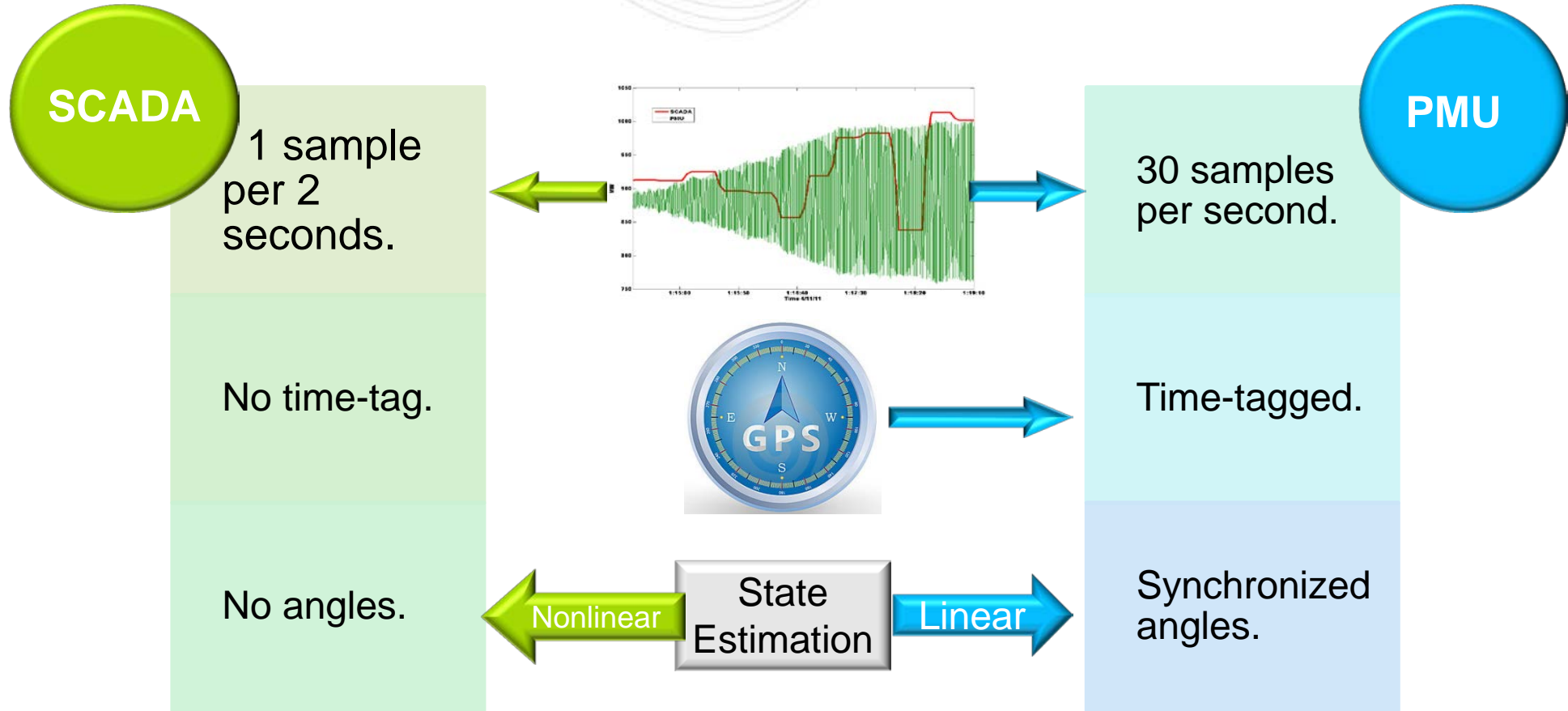
September 19, 2018

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- 1. Introduction
    - a. What are synchrophasors
    - b. PMU usage in operations
    - c. PMU vs SCADA
    - d. What is an oscillation
      - i. Oscillation Types
  - 2. How to find PMUs in DIMA and RTDMS
    - a. Locate PMU in DIMA
    - b. Locate signal in RTDMS
  - 3. Break
  - 4. Simulation
    - a. Introduction to Oscillation event (~10 min slide presentation)
    - b. Run base case (steady state)
    - c. Operators select mitigating action (Interactive)
    - d. Review outcome
  - 5. Stream Oscillation Event
    - a. Find PMU in DIMA (Interactive)
    - b. Add signal to display in RTDMS (Interactive)
  - 6. Quiz
    - a. 10 questions
  - 7. Summary of course content and action items
- Diagrammatic groupings:
- PMU Refresher (connected to items 1a, 1b, 1c, 1d.i)
  - Oscillation Detection Applications (connected to items 2a, 2b)
  - Simulation (connected to items 4a, 4b, 4c, 4d, 5a, 5b)

Upon the completion of this training, the learner will be able to:

- Access and analyze real-time Synchrophasor data to determine: the size, frequency, and affected area of a system oscillation.
- Identify appropriate operator actions to monitor and mitigate undampened oscillations by utilizing the Oscillation Mitigation Procedure in Manual – 03.
- Interpret a Synchrophasor phase angle clock to identify a system island condition.



## What is an Oscillation?

- A disturbance or weak system causes one generator or a set of generators to swing with respect to the rest of the generators in an interconnected system.
- The fluctuations or “swing” noticed in MWs or MVARs is called an oscillation.
- The frequency of this “swing” is the oscillation frequency!

This is NOT the system frequency of 60 Hz!

**Forced:** Occurs when a single generator has a failure in one of its control systems

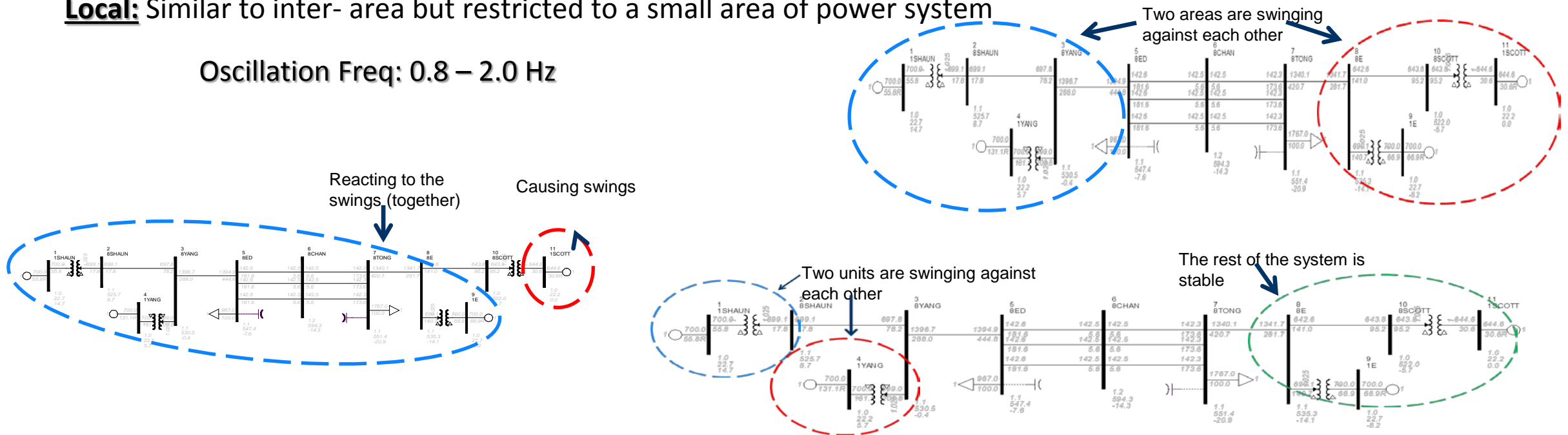
Oscillation Freq: Less than 15 Hz

**Inter - area:** Occurs when a power system is weakened with equipment outages, light load, and large amounts of power are imported across the system

Oscillation Freq: below 0.8 Hz

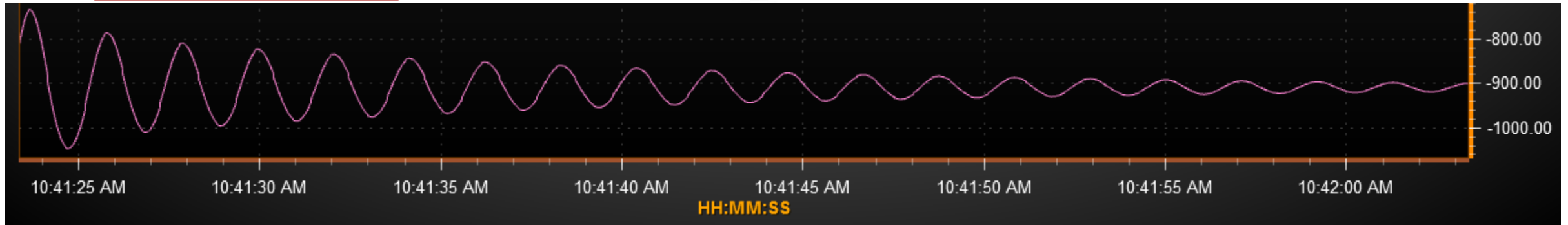
**Local:** Similar to inter- area but restricted to a small area of power system

Oscillation Freq: 0.8 – 2.0 Hz

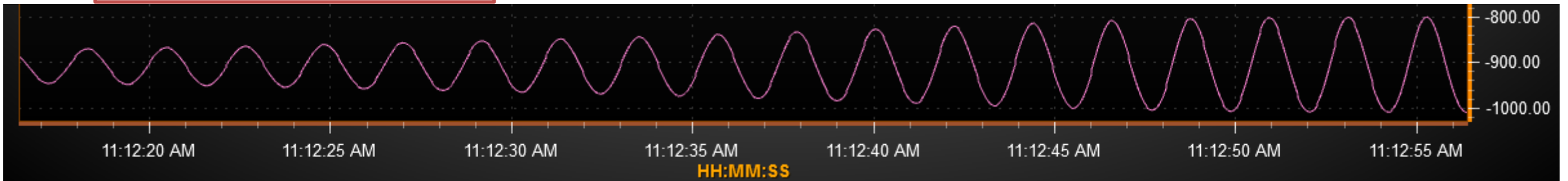


Damping: PJM considers anything more than 3% as well damped

Well Damped



Negative Damping





- Adjust north-south transfers
  - A. Increase north-to-south transfers
  - B. Decrease north-to-south transfers
- Adjust voltage schedule
  - C. Raise voltage
  - D. Lower voltage
- Change system topology
  - E. Return transmission lines to service
  - F. Remove transmission lines from service
- Other
  - G. Increase load (pumps)
  - H. Return PSS
  - I. Switch on reactor
  - J. Trip units

