Time Sync for Power

Tutorial

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The Synchronization Experts.

WORKSHOP ON SYNCHRONIZATION AND TIMING SYSTEMS

Challenges of todays power grids

Fluctuation (production AND demand)

Renewables

- Energy production varies over time
- Generation amount does not follow the energy demand





Disruption in Mobility

- Electric cars will change the demand side drastically
- □ New demand will kick in eventually instead of continuously







Measures to master the challenges

PMU – the NASPI

- □ Measure the frequency in the electrical grid
- □ Basis for counteract generation/demand imbalance
- □ The faster the fluctuations occur, the more precise the measurements need to be
- □ Time synchronization enables measurement correlation
- → Synchronization accuracy: < 1 usec

Modern flexible digital Substations

- □ The higher demand on flexibility and communication asks for digitalization
- Losing synchronicity going from analogue to digital
- → Synchronization accuracy: 1 msec on station level 1 usec on process level







Fault and Event recording

- Sequence of event recording
- Timestamp and track events
- Provide system or area-wide Snapshot of Event / Faults and what happened before
- Used for post-mortem data analysis
- ➔ Goal: System improvement

Special use case: Traveling fault detection

- locating faults on transmission lines
- □ a traveling wave is generated at the point of the fault
- Fault takes different time to travel
- Coordination of 2 Fault recorders
- → Repair crews can spend less time finding the damaged equipment





The digital substation



- The logic moves from the bay level to the process level to the IEDs
- Events must now be timestamped by IEDs for event recording
- To get rid of discrete wiring, data AND sync must be on the same bus system

→ IEC61850-9-3 (specifies usage of PTP IEEE1588-2008 & defines the utility profile)



Synchronization accuracy requirements

Function	Purpose of timing	Accuracy required
Control Room	Log file coordination	1 second
SCADA system	Grid wide monitoring and control	1 ms
Synchrophasors	Measurements more precise than SCADA system. Monitor grid stability. Predict faults	1μs
Travelling wave fault detection	Location of faults to within 100s of meters Improves maintenance efficiency	300 -1000 ns



Thank you!

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