EPMS-HD
Power Management in High Definition

System Presentation
Know what happened and when—*to 1 msec*!

1. **Understand**—Forensics tool
   - Perform root-cause analysis based on reliable data.
   - View current and voltage waveforms captured with each event.
   - Determine if the initial source was internal or external.

2. **Respond**—Act quickly
   - Evaluate control sequences, timing, and operator actions.
   - Confirm protective device time-current coordination.
   - Restore service quickly if an outage does occur.

3. **Prevent**—Take corrective actions
   - Resolve or mitigate persistent problems.
   - Provide documentation for the electric utility, legal, insurance, etc.
   - Identify slow breakers before they can cause an arc flash hazard.
EPMS-HD is needed where reliable power is important:

- Data centers
- Hospitals
- Industrial facilities
- Universities
- Airports
- Microgrids & alternative energy
High Definition Power Management

- Energy metering: just the start!
- Monitor everything: more data = better decisions
- Time sync: the foundation for meaningful analysis
Modern power systems = 1000s of points to be monitored
Thousands of potential blind spots!
High Definition Power Management: Monitor Everything

CyTime SER-3200: 32-input Sequence of Events Recorder

[Diagram showing utility sources and onsite sources with monitored points indicated by check marks.]
For data to be meaningful, devices must share a common (precise) time reference.

- Meter data
- Alarms
- Events
- Waveforms
- Data logs
Precision Time Protocol (PTP) per IEEE 1588

- IEEE Std 1588-2008 (v2)
  - Special Ethernet hardware does time-stamping
  - Mechanism to correct for network latency
  - Multicast messaging
  - High accuracy over Ethernet possible

- Many optional features
  - Several clock types (grandmaster, slave-only, transparent, etc.)
  - Domain number, 0 to 127 (default = 0)
  - Delay mechanisms: End-to-end (E2E) or Peer-to-peer (P2P)
  - UDP vs. Layer 2, 2-step vs. 1-step, etc.

- Flexible—but interoperability requires a “profile”
Power Profile (per C37.238) defines PTP characteristics in “Power System Applications”

- Power Profile: Standard set of PTP characteristics defined by IEEE Std C37.238-2011
- Primarily for utility substation automation
- Profile characteristics:
  - Target accuracy: 1 μs (up to 16 switches)
  - 802.3 Ethernet (Layer 2) mapping
  - Multicast only
  - Peer to peer (P2P) delay measurement
  - Switches must be transparent clocks (PTP-aware)
"Simple PTP“ (SPTP) is based on the PTP default profile (<100 μs: Goldilocks solution—just right.)

<table>
<thead>
<tr>
<th>PTP (IEEE 1588)</th>
<th>“Simple PTP” Profile</th>
<th>Power Profile (C37.238)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy: nanoseconds</td>
<td>Accuracy: &lt; 100 μs</td>
<td>Accuracy: &lt; 1 μs</td>
</tr>
<tr>
<td>All clock types</td>
<td>Master and Slave-only</td>
<td>Most clock types</td>
</tr>
<tr>
<td>Multicast or Unicast</td>
<td>Multicast</td>
<td>Multicast</td>
</tr>
<tr>
<td>802.3 or UDP/IPv4, v6</td>
<td>UDP/IPv4</td>
<td>802.3 only (layer 2)</td>
</tr>
<tr>
<td>PTP-aware switches</td>
<td>No special switches req’d.</td>
<td>PTP switches required</td>
</tr>
<tr>
<td>P2P or E2E delay mech.</td>
<td>E2E only</td>
<td>P2P only</td>
</tr>
<tr>
<td>1-step or 2-step</td>
<td>2-step</td>
<td>1-step or 2-step</td>
</tr>
<tr>
<td>Variable delay requests</td>
<td>32s</td>
<td>1s</td>
</tr>
<tr>
<td>Timescale: TAI, UTC or arbitrary</td>
<td>Timescale: UTC (or TAI)</td>
<td>Timescale: TAI only</td>
</tr>
<tr>
<td>TLV, MIB, VLAN tags</td>
<td>None</td>
<td>TLV, MIB, VLAN tags req’d.</td>
</tr>
<tr>
<td>General</td>
<td>Simple</td>
<td>Strict</td>
</tr>
</tbody>
</table>

CSI “Simple PTP” Profile is based on IEEE 1588 default profile (E2E).
Time sync—easy as 1-2-3

1. Choose time source
2. Time sync via PTP
3. Sync non-PTP devices
PTP (IEEE 1588): Precision time sync over Ethernet

1. **TIME SOURCE**
   - IRIG-B
   - DCF77
   - NTP
   - Modbus TCP

   set the first SER's time...

2. **PTP MASTER**
   - SER-3200-PTP (or SER-2408-PTP)

   Ethernet

3. **PTP SLAVES**
   - all other SERs sync automatically via PTP
   - SER-3200-PTP (or SER-2408-PTP)
   - SER-3200-PTP (or SER-2408-PTP)
   - SER-3200-PTP (or SER-2408-PTP)

   EPMS server
PTP-enabling other EPMS devices (via legacy protocols)
EPMS time-sync system examples
Example: sync first SER from **NTP** server (GPS optional)

— first SER is located in MV switchgear
Example: sync first SER from GPS clock (via **IRIG-B**) — **IRIG-B** to first SER and to relays and meters that support it
Example: **SER #1 as PTP Master, SER #2 as standby**

—**IRIG-B to both SERs (and others if desired)**

- **IRIG-B (5V DCLS)**
- **DCF77 (24V DCLS)**
- **1per10 (24V DCLS)**
- **ASCII/RS-485**
Example: sync first SER from GPS clock (IRIG-B)

—first SER in same panel as clock, relays sync via IRIG-B
Events Happen... (in milliseconds)

I ♥ 1588SM

Power monitoring at the speed of NOW!

Precision Time Protocol (PTP), per IEEE 1588, enables 1-ms time-sync over Ethernet. Diagnose root cause, verify control schemes operate as designed, identify slow breakers before they increase arc flash hazard.

Download our 20-page white paper on PTP and you’ll ♥ 1588 too:

www.cyber-sciences.com