OSCILLOQUARTZ
An Adtran company

Timing & Synch for Utilities

Are you ready?

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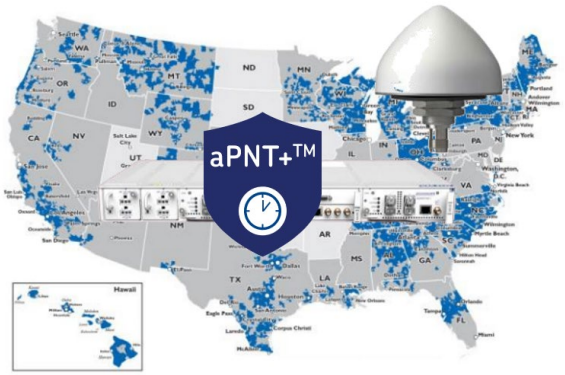
Business Development Manager
June 2, 2024

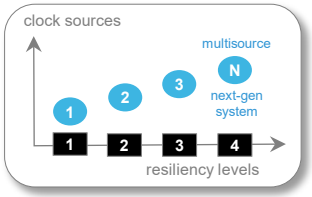
Oscilloquartz - 75 years of know-how in network sync



- ✓ **#1** - Industry's first supplier of sync solutions
- ✓ **#1** - The leader in resilient & assured PNT & packet-based timing
- ✓ **#1** - Leading-edge technologies in defense-in-depth PNT cyberthreat protection, including multilayer detection, zero-trust multisource backup & multilevel fault-tolerant mitigation, aligned with these industry standards:

DHS Resilient PNT Levels

IEEE SA P1952 PNT



- ✓ **#1** - The leader in field-proven, vendor-agnostic & intelligent sync network management
- ✓ **#1** - Industry's best complete portfolio of trusted sync services, from network design to installation to commissioning

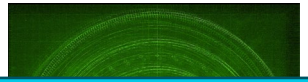
Longest continuously-serving synchronization vendor in the world

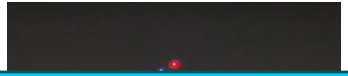
Distributed control requires tight synchronization

- Steadily increasing timing requirements
  - Upgrades to packet-based solutions
- Outages of synchronization networks can have a catastrophic impact
  - While not immediate, extended outages will impact
- Currently applied sync solutions do not meet actual demand of new digital sub-stations

Power utilities need to improve their synchronization architecture

It is Happening!





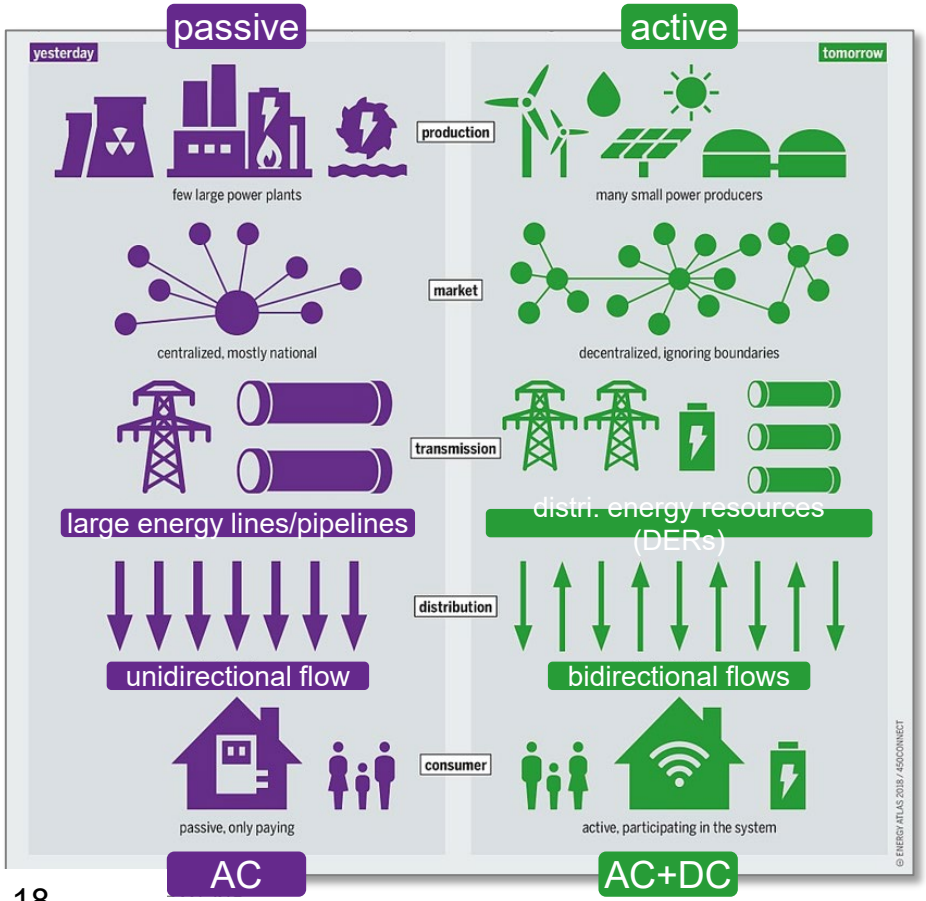
Anyone – ANYONE – who is relying on GPS today needs a resilient backup solution

airspace in Seoul (June 2024)

So much GPS jamming in Norway that airlines are no longer reporting it (2024)

light show GPS jamming event (July 2024)

Tighter NTP-to-PTP data timestamping accuracy requirements

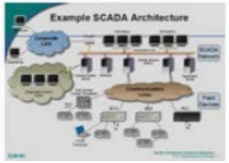


Grid applications	Timing requirements (min reporting resolution & accuracy relative to UTC)
Advanced time-of-use meters	15, 30, and 60 minute intervals are commonly specified (ANSI C12.1)
Non-TOU meters	Ongoing, with monthly reads or estimates
SCADA	Every 4-6 seconds reporting rate
Sequence of events recorder	50 µs to 2 ms
Digital fault recorder	50 µs to 1 ms
Protective relays	1 ms or better
Synchrophasor/phasor measurement unit (30 - 120 samples/second)	Better than 1 µs 30 to 120 Hz
Traveling wave fault location	100 ns
Micro-PMUs (sample at 512 samples/cycle)	Better than 1 µs
Substation communications protocols	
Substation local area network communication protocols (IEC 61850 GOOSE)	100 µs to 1 ms synchronization
Substation LANs (IEC 61850 Sample Values)	1 µs

source: NASPI Time Sync Task Force Report,

Power Grid Hardware

Equipment			
Transmission Line Fault Detection 	Equipment that determines the location on the transmission system of a fault, namely an event such as a short circuit, a broken wire, or an intermittent connectioni.	**Frequency Measurement** 	Equipment that measures the frequency, or rate of change of frequency, of the power grid. Also, equipment that computes the median of all the Frequency Response observations reported annually by Balancing Authorities or Frequency Response Sharing Groups for frequency events specified by the ERO. This will be calculated as MW/0.1Hz.[ii]
Synchrophasors/Phasor Measurement Units 	Measures the electrical parameters of an electricity grid with respect to universal time (UTC) such as phase angle, amplitude, and frequency to determine the state of the system[iii].	**Internet-based Market Transactions (OASIS, NTP, SNTP)** 	IP-based workstations, networks, and websites that use the network timing protocol (NTP) or simple network timing protocol (SNTP) to enable access to wide area energy market operation systems providing high-level market signals for transmission and distribution companies (ISO/RTO, Utility Operations).[iv]
Substation Control/ Re-Synchronization 	A type of control system at a transmission or distribution substation that transmits individual device status, manages energy consumption by controlling compliant devices, and allows operators to directly control power system equipment. Re-synchronization is the process of synchronizing an energized substation to the power grid.[v]	**Disturbance Monitoring Event Recorders** 	Devices capable of monitoring and recording system data pertaining to a Disturbance. Such devices include the following categories of recorders: Sequence of event recorders Fault recorders Dynamic Disturbance Recorders (DDRs)[vi]
Protective Relays 	A protective relay is an electromechanical or micro-processor controlled electronic system that senses an abnormal or fault condition and sends a trip to a circuit breaker in order to protect generators, transformers, and lines.[vii]	**Bulk Metering** 	Equipment that records the amount of power used in a particular area or sent down a particular line for power flow measurement and billing purposes.[viii]

Networks			
SCADA Networks 	A system of remote control and telemetry used to monitor and control the transmission [and distribution] system [including substations].[ix]	**Synchrophasor Networks** 	PMUs that are networked and synchronized to a single coordinated time source like GPS. Refers to a set of PMUs that all transmit data to a Phasor Data Concentrator. [x]

Synchronization accuracy requirements

PTP

1µs

NTP

1ms

- Fault localization
- Synchrophasor measurements

IRIG

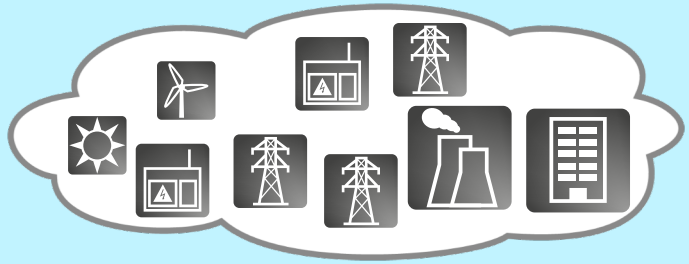
1s

- SCADA
- Frequency measurement
- Event recorder

- Bulk metering
- Customer premises metering

IEEE C37.238 2011 and 2017 “IEEE standard profile for use of IEEE 1588™ precision time protocol in power system applications”

IEC PAS 61850-9-3 “Precision time protocol profile for power utility automation”



Power grids need a combination of all timing technologies

Substation synchronization - today

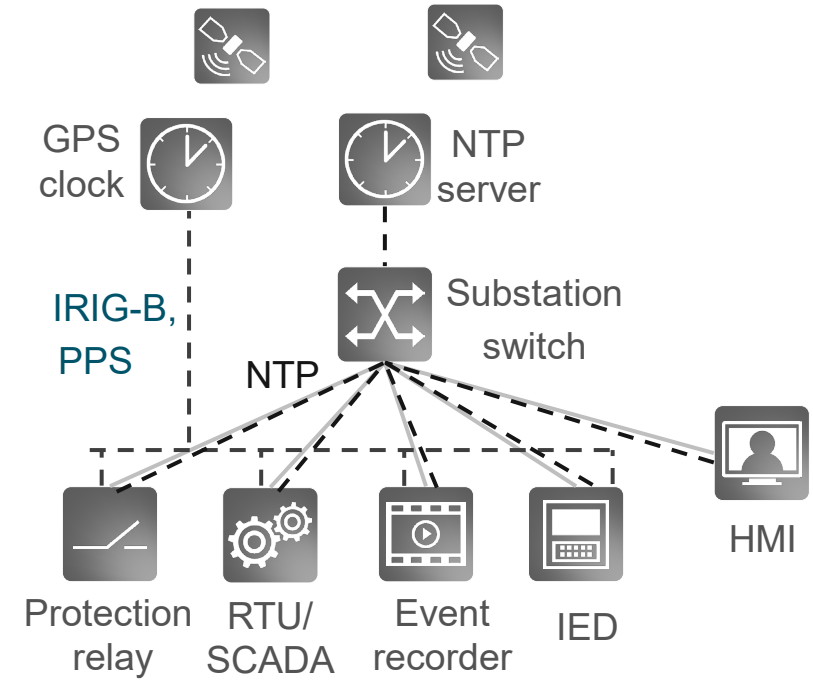
IRIG and PPS provide time information

GNSS as “highly accurate” local time reference

Migration to Ethernet

Network Time Protocol (NTP) provides msec precision to appliances

GNSS time reference



Presently applied solutions neither meet accuracy nor availability requirements

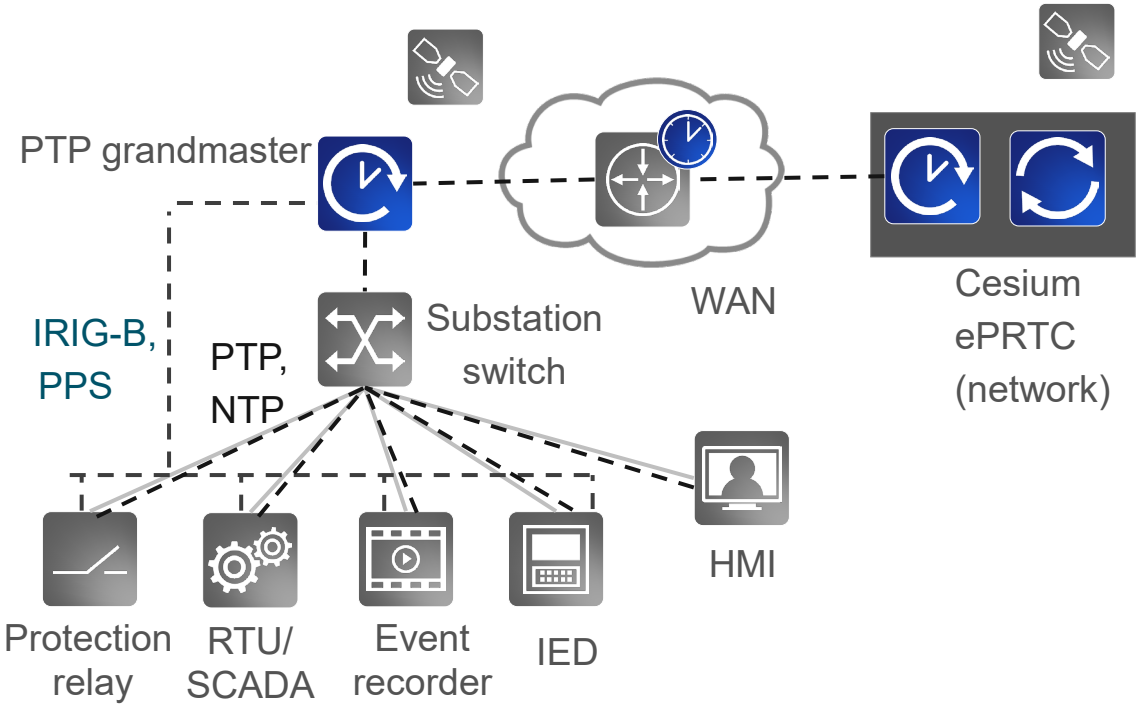
Modern Substation Synchronization

Precision time protocol for **sub-µs timing accuracy**

Converging PTP, NTP and IRIG-B into **single solution**

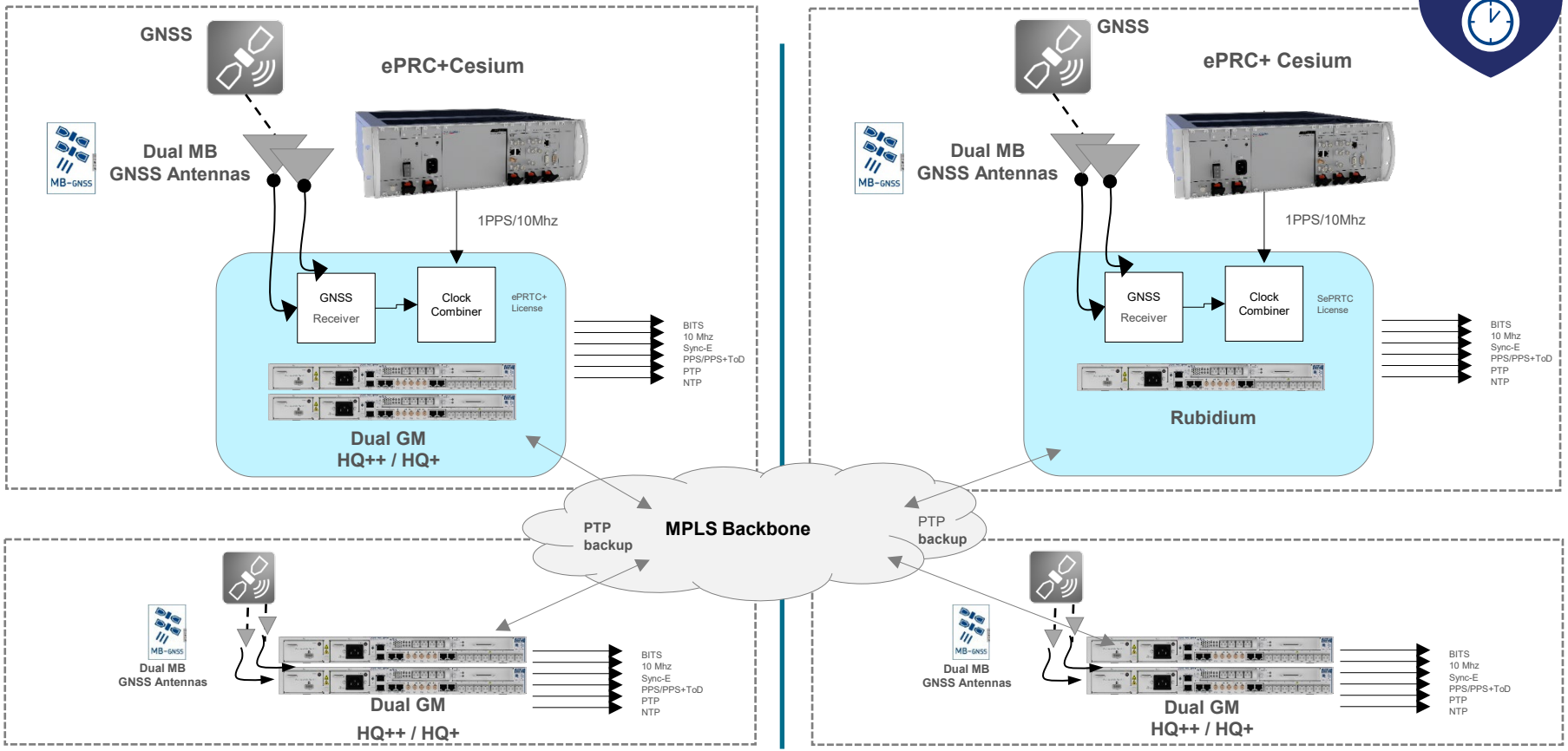
Mitigating GNSS outages with network-based backup for **highest availability**

Assuring business continuity by **monitoring sync quality**



Highest accuracy and best availability with satellite and network-based timing

IOU Case Study



Thank you!!

“Does anybody really know what time it is?”

Yes…OSA does!

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