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Best Practices in Solving PNT Threats in Critical Defense Communications Infrastructure

WSTS, March 13-16, Vancouver, BC

3/14/23 | 11:55-11:10a (15 min) | Nino De Falcis, Director, Sync Business Development Americas, Oscilloquartz

DRIVEN BY US FEDERAL EXECUTIVE ORDER 13905

The new resilient PNT mandate & standard

- **PNT** stands for **P**ositioning, **N**avigation & **T**iming. Timing enables **P** & **N**
- **Protect** defense/industry critical infrastructure (CI) against PNT services disruption from frequent GPS & network timing attacks – GPS, commercial or M-Code, is a single point of failure & can no longer be considered as a sole source for reliable PNT services in CI
- **Deploy** resilient, multisource and assured PNT systems PNT assurance
- **Target** critical infrastructure sectors under national security threats
  - Power grids
  - Finance
  - Transportation
  - DoD Communications
  - DoD Data centers
- **Use** published resilient PNT guidelines & standard in progress
  - DHS Resilient PNT Conformance Framework
  - NIST Cybersecurity Framework for PNT Profile NIST NISTIR 8323
  - IEEE P1952 Resilient PNT for User Equipment Standard working group IEEE SA P1952 PNT

Why GPS alternatives are a high priority?

Senator Video

LI post by Dana A. Goward, March 10, 2023

Sen. King Urges Top General to Make GPS Alternatives a "High Priority"

King says:

- *"I believe GPS will be one of the first targets in a conflict"*
- *"Are we developing alternatives to space-based resources?"*

General James H. Dickenson, Commander of US Space Command, confirmed:

- *"…I know there's efforts underway… looking to alternative PNT and how we can develop those types of capabilities."*

Can the current C5ISR infrastructure survive massive GPS/PNT attacks?

C5ISR - Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance & Reconnaissance

The current **C5ISR infrastructure** supports the Army's combat capabilities with reliable & real-time information for tactical battlefield decisions. Secure, resilient & synchronized datacomms support critical land, sea, air & space missions

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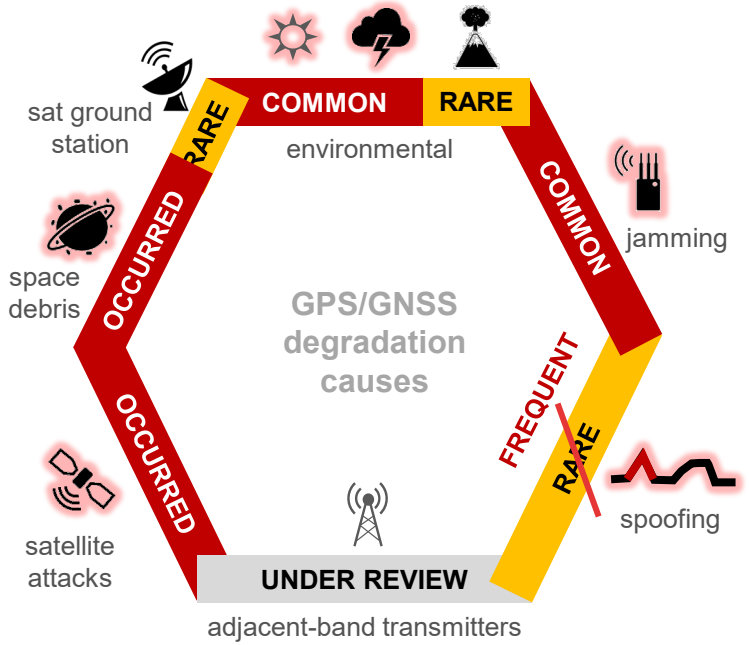
JADC2 - Joint All-Domain Command & Control

The next-gen **JADC2 is an AI-powered unified network**, connecting sensors & weapons from all branches of the armed forces. Tactical networks will utilize 5G ORAN capabilities for ubiquitous high-speed connectivity, to move massive data to connect distant sensors into a dense & resilient battlefield network. Low-latency & synchronized datacomms will enable next-gen connected unmanned/autonomous weapons systems across all domains

What are the PNT threats & GPS vulnerabilities?

PNT threats

External GPS/GNSS level



Internal network level

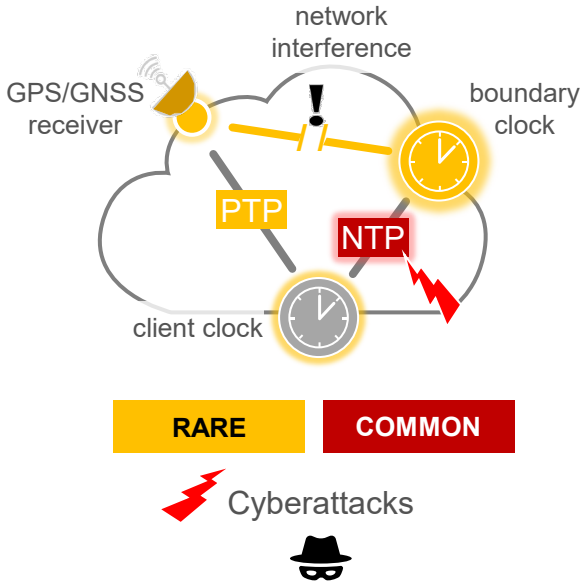


Figure 4.1 – Known GPS vulnerabilities to telecom (updated)

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Are GPS/PNT threats real?

NEWS UKRAINE WAR

Russia threatens to shoot down Western satellites for helping Ukraine

Oct 27, 2022

GPS WORLD — GNSS POSITIONING NAVIGATION TIMING

Disruption *"lasted for 33.5 hours. Wireline and cellular providers had timing backup systems and were unaffected. A radio system with no backups suffered, as did a simulcast radio system that used rubidium backup clocks"*

What happened to GPS in Denver? Jan 21, 2022

ETSatcom.com From ETTelecom

Ukraine war disrupts GPS in Finland, Mediterranean March 19, 2022

DAILY HONKER

Mysterious GPS Disruptions Spread Across Texas; FAA Issues Warning to Pilots Oct 19, 2022

Newsweek

March 1, 2023

Massive Solar Flare Causes Radio Blackout Over U.S.

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MIL network timing requirements, applications & solution

New PNT requirements

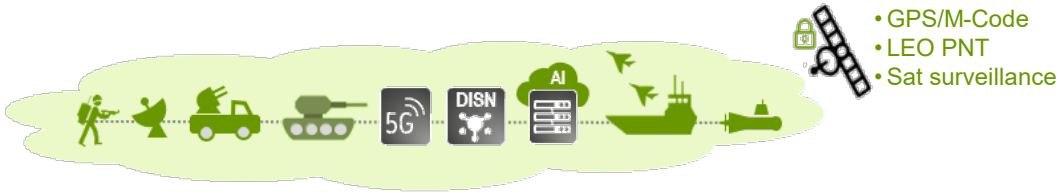
- DoD zero-trust strategy *"never trust, always verify"*
- **GPS cannot be a single point of failure** in critical PNT services
- Secure, resilient & assured PNT with **six 9's reliability**
- DHS Resilient PNT guideline specifies the use of **multiple sources vs. user's risk profile**
- PNT capability with **end-to-end defense-in-depth resiliency**

Next-gen PNT applications

- Resilient & assured PNT for all combat domains (land, sea, air, space)
- Secure & synchronized multidomain tactical datacomms network
- Accurate timing for real-time DISN/C5ISR information network
- Synchronized JADC2 network powered with AI, 5G & neural DCs
- Precise timing for connected weapons/radars (event trigger/timestamp)

Resilient & assured PNT solution

- **GPS TaaS+GBaaS** (Time-as-a-Service + GPS-Backup-as-a-Service)



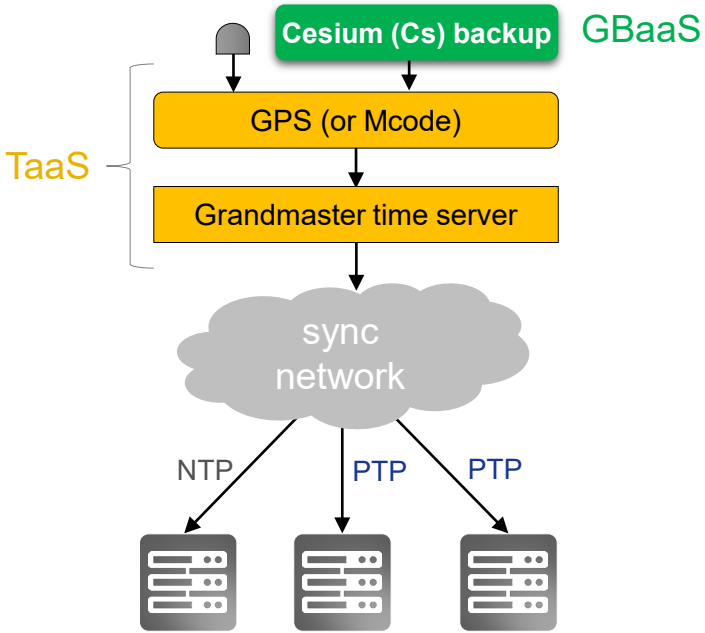
Next-gen JADC2 unified battlefield network

TaaS+GBaaS solution for DoD's zero-trust PNT strategy for all-domain branches

ITU-T standard-based GPS TaaS+GBaaS solutions

❶ PRTC (G.8272 A/B)

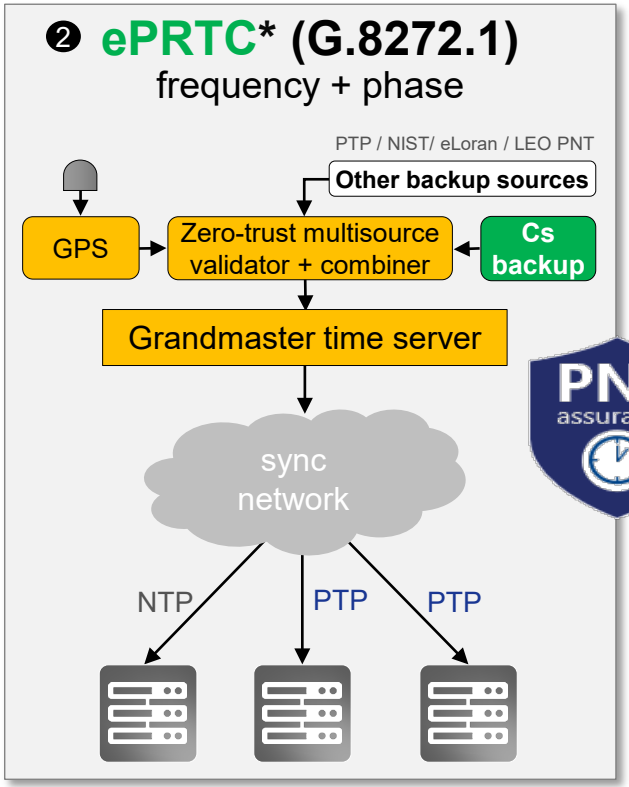
frequency + phase



PRTC A accuracy: 100ns | **PRTC B:** 40ns

❷ ePRTC* (G.8272.1)

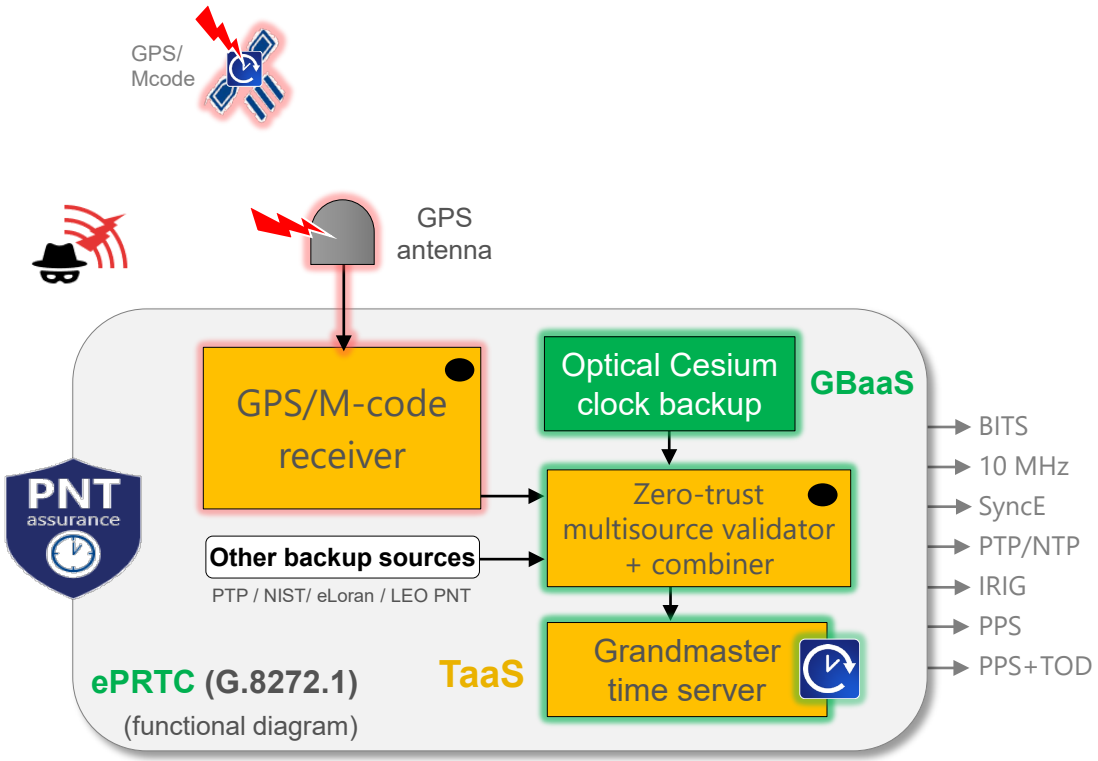
frequency + phase



*enhanced Primary Reference Time Clock

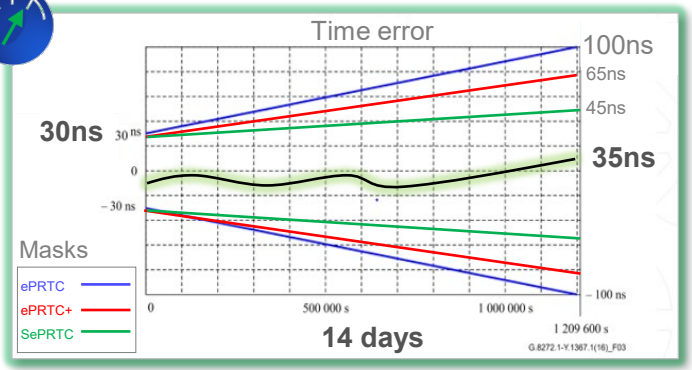
ePRTC accuracy: **30ns**

ePRTC solution configuration & performance



GPS receiver and Zero-trust multisource validator + combiner are integrated into the Grandmaster

Short-term GPS backup holdover performance



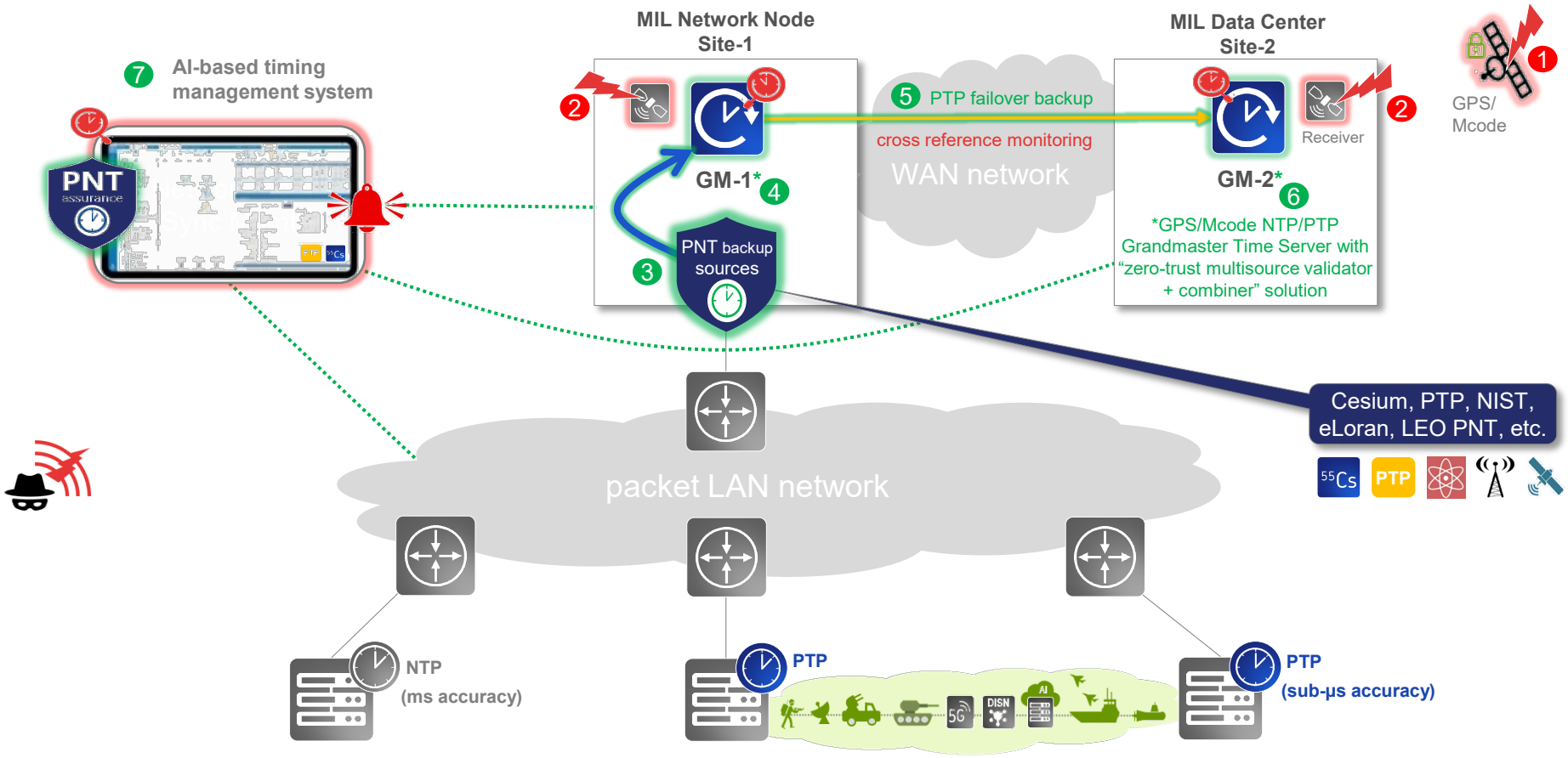
Long-term GPS backup holdover performance

Time/Phase holdover if GPS goes down

SePRTC*: 100ns over typ. 55 days
1µs over typ. 4 months

*Super ePRTC solution

GPS TaaS+GBaaS architecture in Hi-Rel MIL networks



Servers/VMs running critical JADC2 battlefield applications supported by zero-trust PNT services

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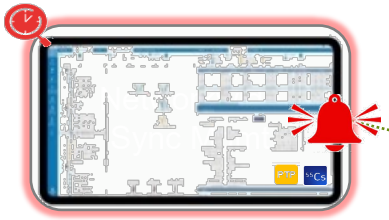
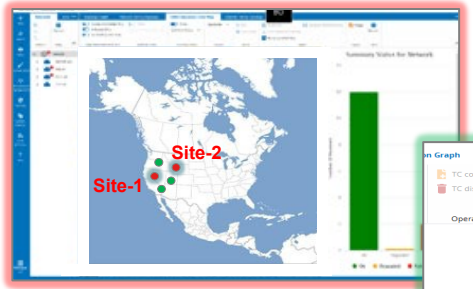
Managing GPS TaaS+GBaaS architecture in Hi-Rel MIL networks

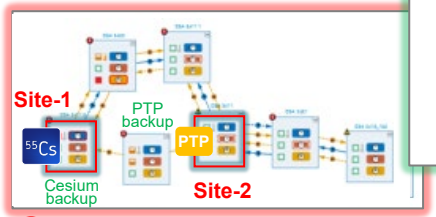
AI-based timing management system with multilevel fault-tolerance for end-to-end control, visibility and six 9's reliability



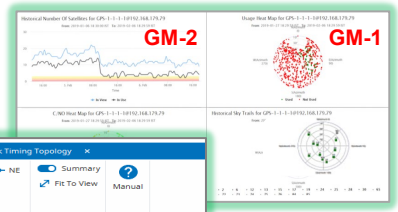
PNT assurance



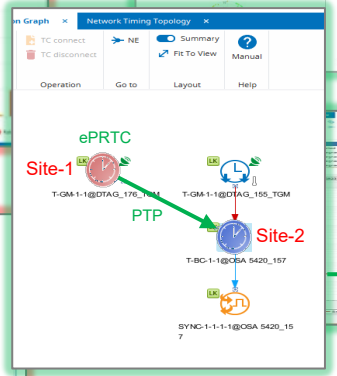
1 geolocation **Site-1** & **Site-2**



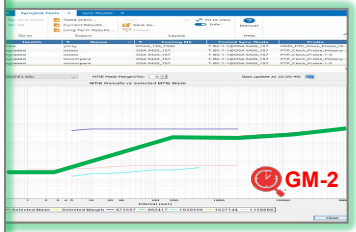
2 timing chain alert with Cesium/ PTP backup rearrangements



7 vendor-agnostic analytics for GPS assurance



5 timing topology with Cesium/PTP backup



6 PTP backup monitoring from **GM-2** to **GM-1**

GPS attack

3 **GM-1** alert with Cesium backup

4 **GM-2** alert with PTP backup from **GM-1**

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Thank you!