



# International Timing & Sync Forum 2022

#ITSF2022



# Precision Timing for Digital Substations

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**OMICRON**



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# and Precision Timing?

Test equipment for testing power system assets

Protection Testing

- End-to-End testing

- Distributed, time synchronized testing (since about 1993)

Power Utility Communication – IEC 61850

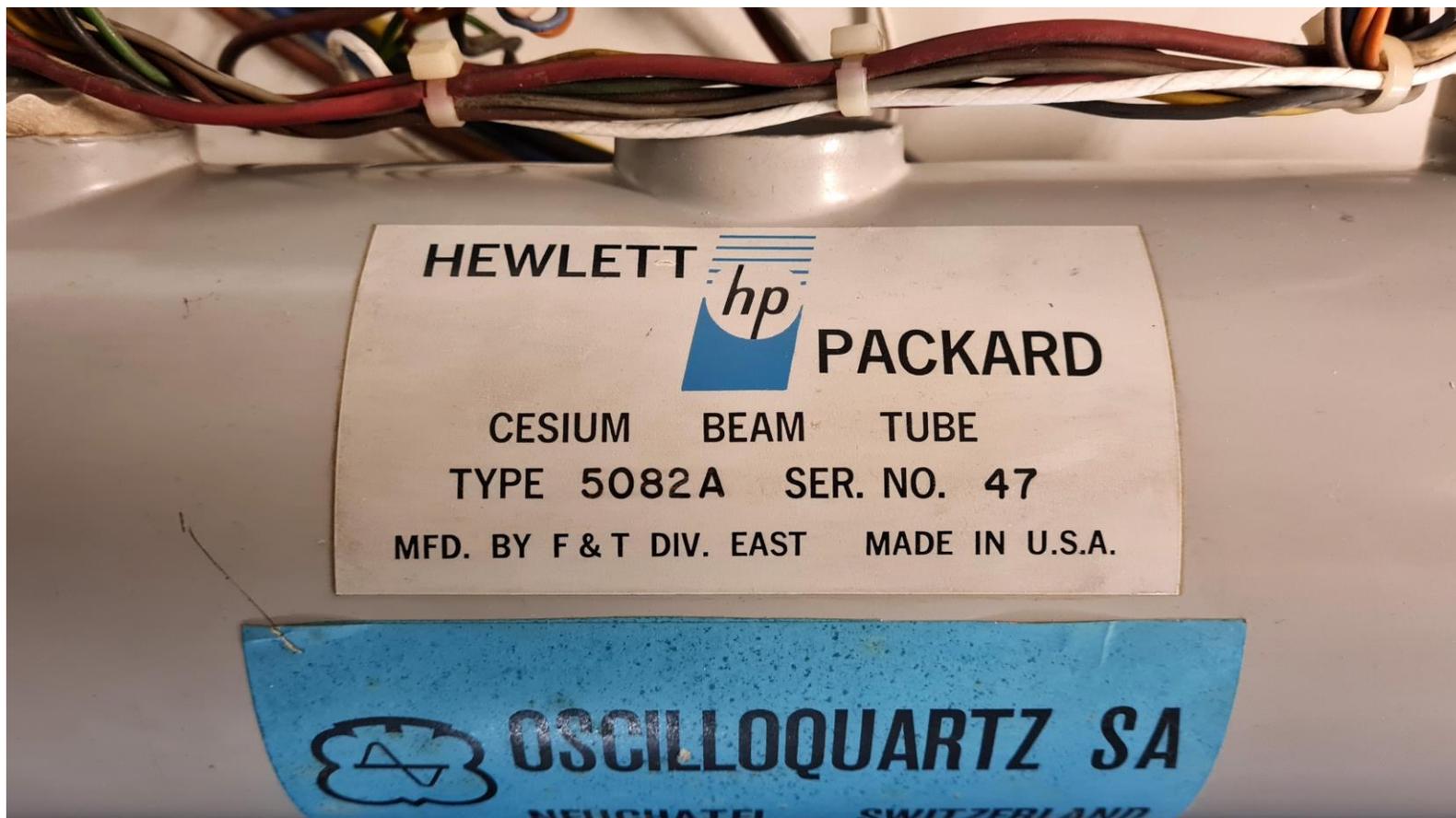
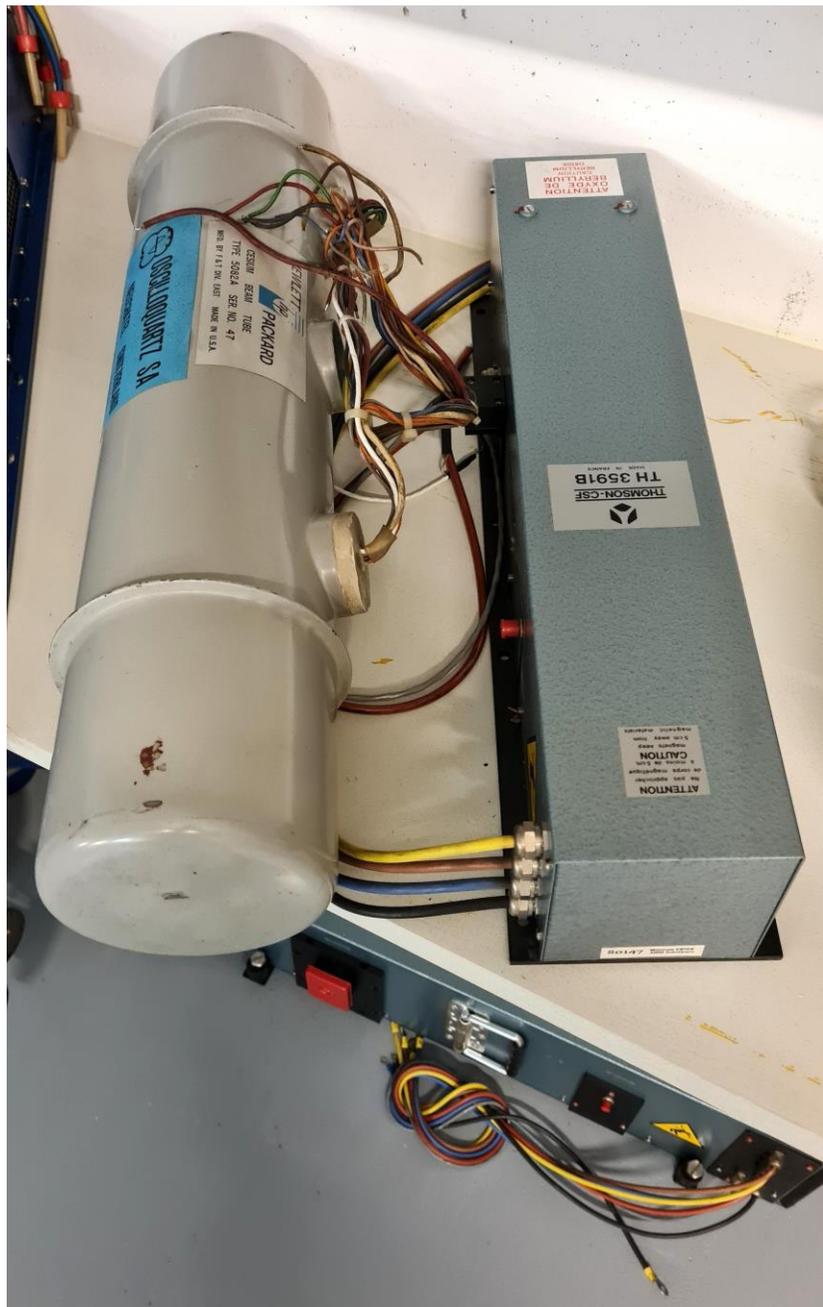
- Assessment of communication networks for Digital Substations

- Propagation delays, ...

- Distributed, time synchronized testing

Tools made for electrical power engineers

- Different usability than for telecom engineers



# Applications

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# Applications Depending on Precision Timing

Much fostered by the advent of GNSS

Differential protection

Fault location

Synchrophasors

End-to-End testing

Fault analysis

# Fault Analysis

## 2003 Blackout



U.S.-Canada Power System Outage Task Force

## Final Report on the August 14, 2003 Blackout in the United States and Canada:

### Causes and Recommendations



Canada

April 2004



# 2003 Blackout

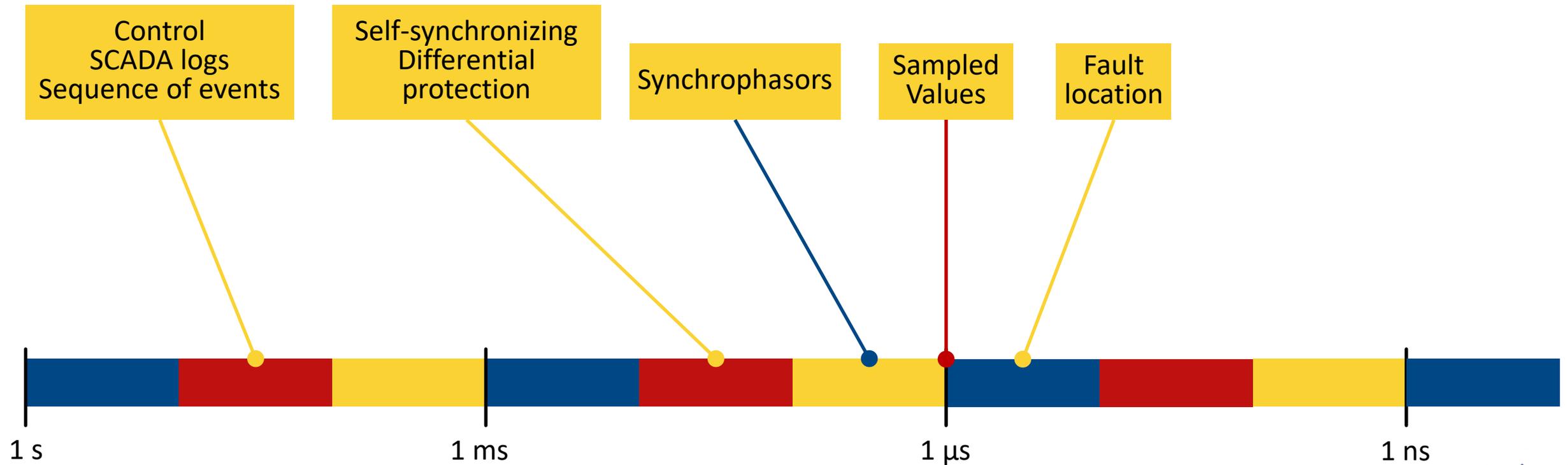
## Proposed measures

26. Tighten communications protocols, especially for communications during alerts and emergencies. Upgrade communication system hardware where appropriate.
27. Develop enforceable standards for transmission line ratings.
28. Require use of time-synchronized data recorders.
29. Evaluate and disseminate lessons learned during system restoration.
30. Clarify criteria for identification of operationally critical facilities, and improve dissemination of updated information on unplanned outages.
31. Clarify that the transmission loading relief (TLR) process should not be used in situations involving an actual violation of an Operating Security Limit. Streamline the TLR process.

*(continued on page 142)*

# Applications on the Uncertainty Scale

Well covered with PTP (and related profiles)



# Application Uncertainty Reference

Power system frequencies – 50 Hz / 60 Hz

Time Error	Phase Error @ 50 Hz	Phase Error @ 60 Hz
1 ms	18°	21.6°
100 $\mu$ s	1.8°	2.2°
55.5 $\mu$ s	1.0°	1.2°
46,3 $\mu$ s	0.8°	1.0°

## Ballpark figures

50  $\mu$ s  $\approx$  1°

5  $\mu$ s  $\approx$  0.1°

1  $\mu$ s  $\approx$  1.2 minutes

(360° corresponds to one cycle of the power system)

# The Power Utility Mindset

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# Power Systems started without Precision Timing

Much was achieved without precision timing

Established methods are seen as the reference

Precision timing-based methods are seen as "nice to have" extensions

Reliance on precision timing is not desired

The power industry has not yet fully embraced precision timing



# Power Utility Value Perception

HV Circuit Breaker



≈ 100 k€  
accepted ✓

HV Protection Relay



≈ 10 k€  
accepted ✓

Ethernet Switch



≈ 10 k€  
expensive !

GNSS/PTP  
Master Clock



≈ 5 k€  
expensive !

# Apprehensions

Emphasizing on threats

What if ...?

But there may be GNSS spamming!

But there may be GNSS spoofing!

...

# Components vs. Solutions

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# What makes a Precision Timing Solution?

Components are readily available

GNSS receivers

Master clocks, boundary clocks

PTP and its parameters

PTP transparent Ethernet switches

Oscillators with long holdover time (atomic clocks)

....



# Precision Timing System Integration

## Putting the components together

Set of complex tasks

Designing the precision timing system

Building the system

Configuring the system

Testing the system

Who can do that?



# What I wish to see

"All bases covered" solution

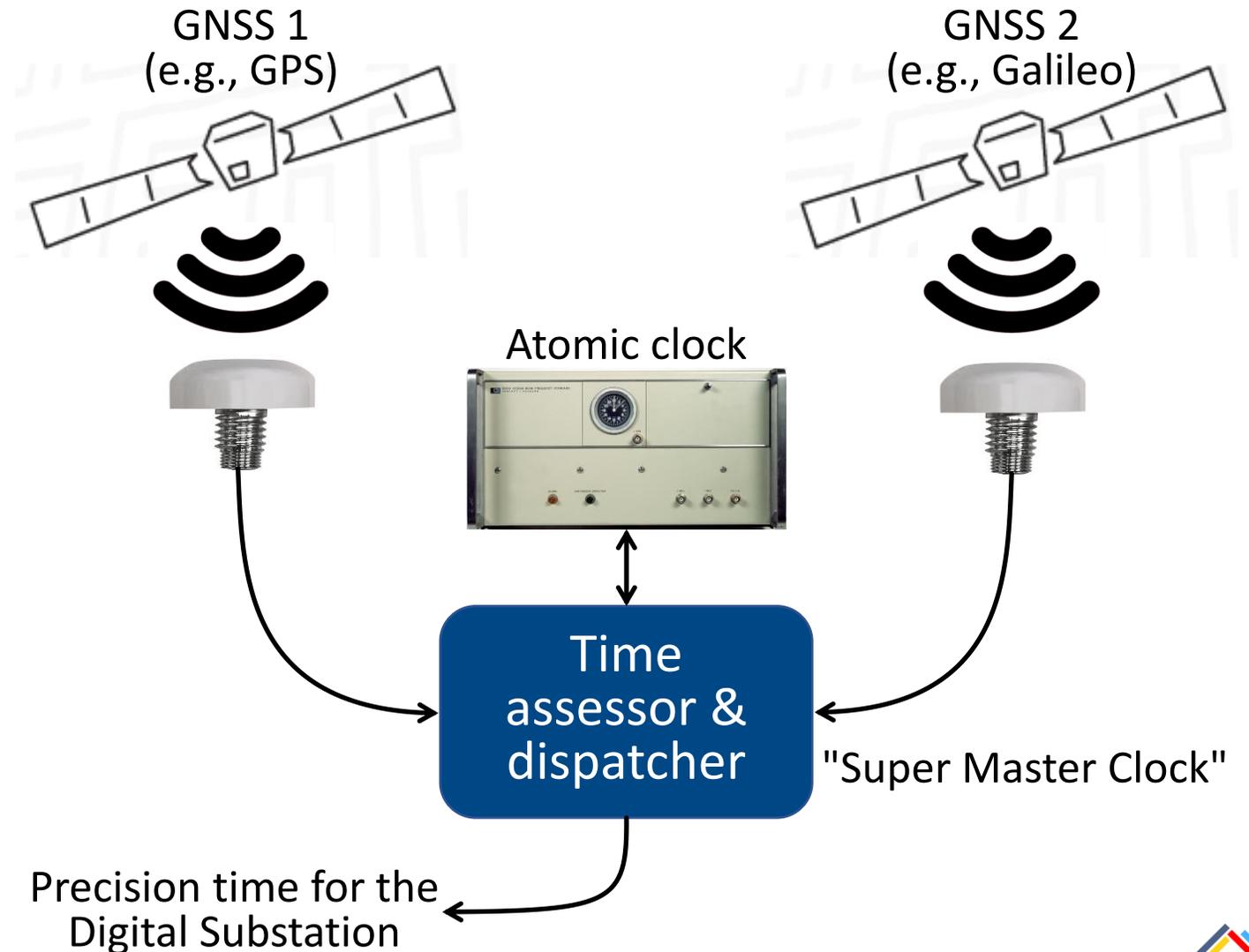
Perceived problems addressed

Solutions explained

Holdover specified

Implementation described

Offer for the integrated solution



# Redundant Time Synchronization

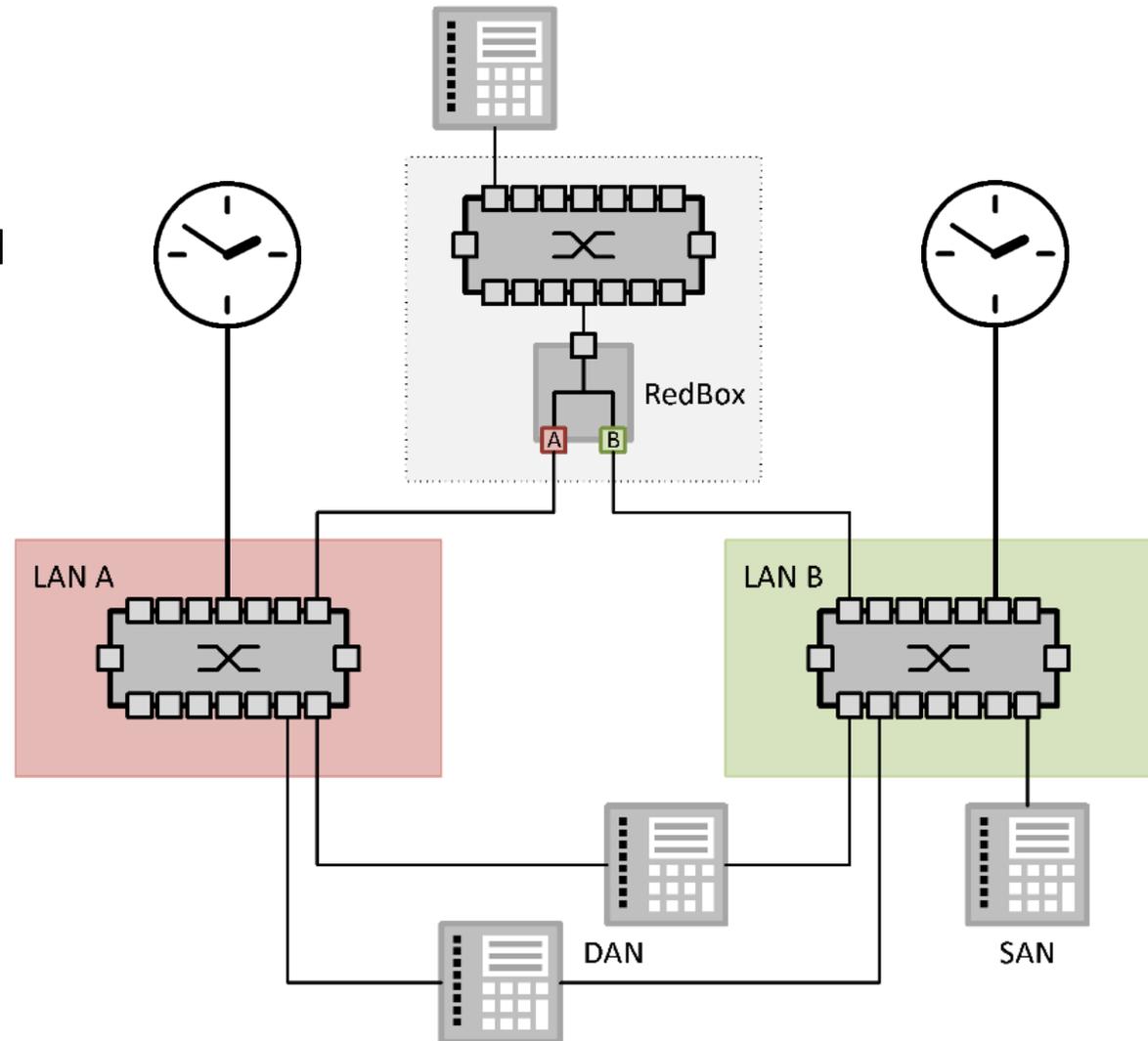
## Reliable clock failover scenarios

Straps and belts can make things complicated

Best practice still evolving

Guidance welcome

To be thoroughly tested



# Summary

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# Let's summarize ...

Applications in power systems that benefit from or even require precision timing exist

The value of precisely time synchronized systems is not yet fully recognized

Suspected problems are often brought up

Possible solutions exist but are not well known

Solutions must be well communicated and promoted





# THANK YOU

... FOR YOUR ATTENTION



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