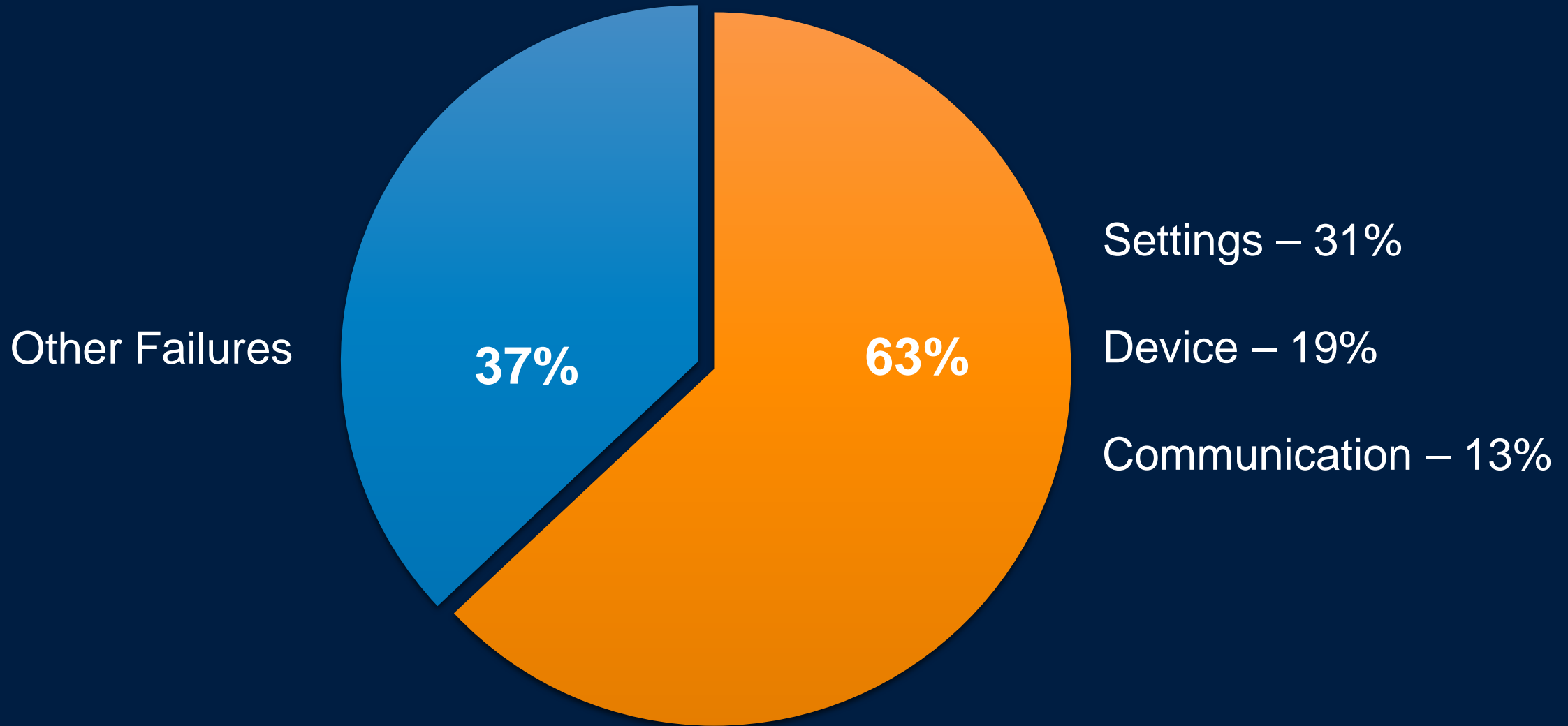


Choose Simplicity for a Better Digital Substation Design

Greg Rzepka, Scott Wenke, and Sarah Walling
Schweitzer Engineering Laboratories, Inc.

Complexity Contributes to Misoperations

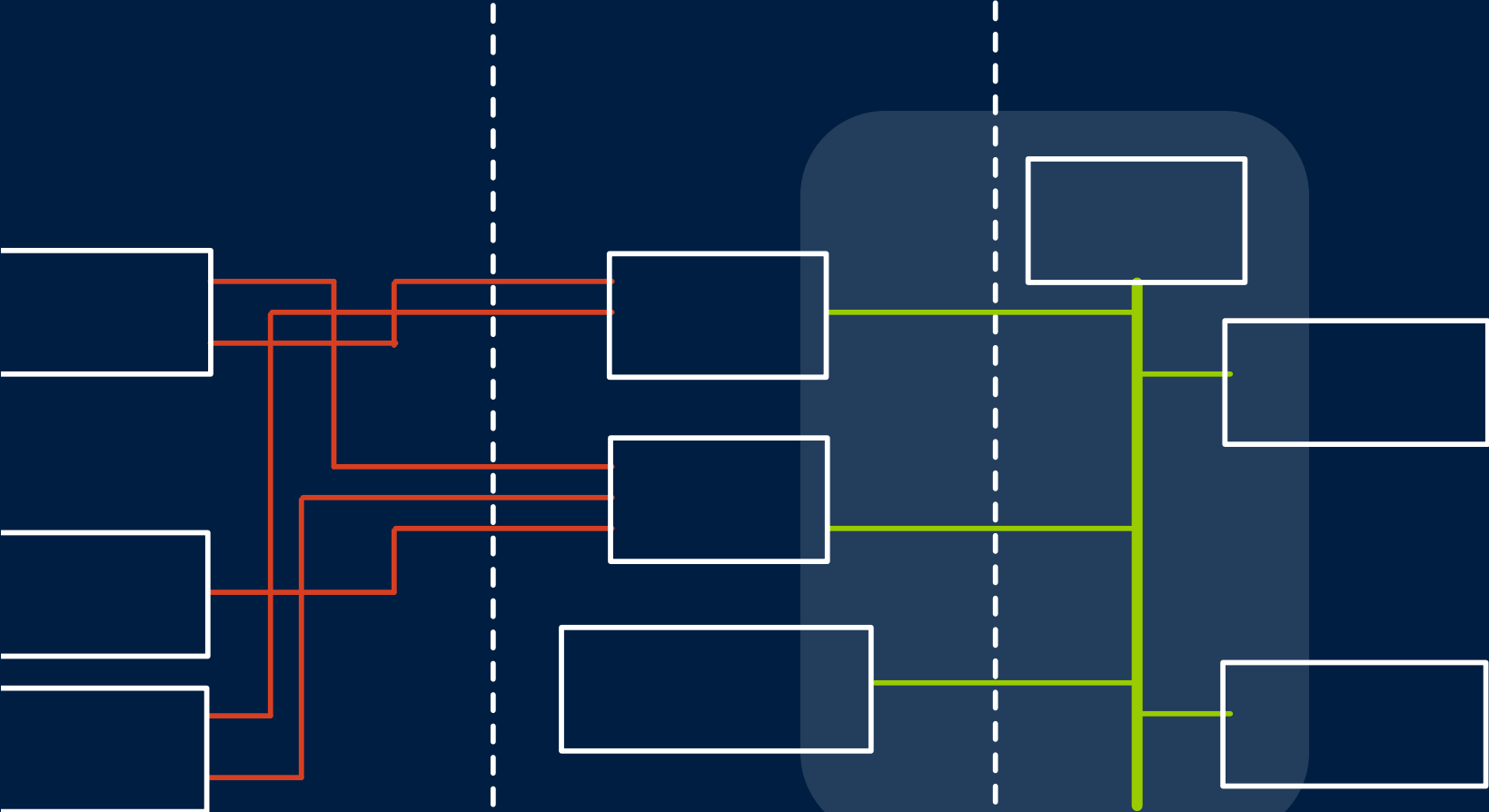




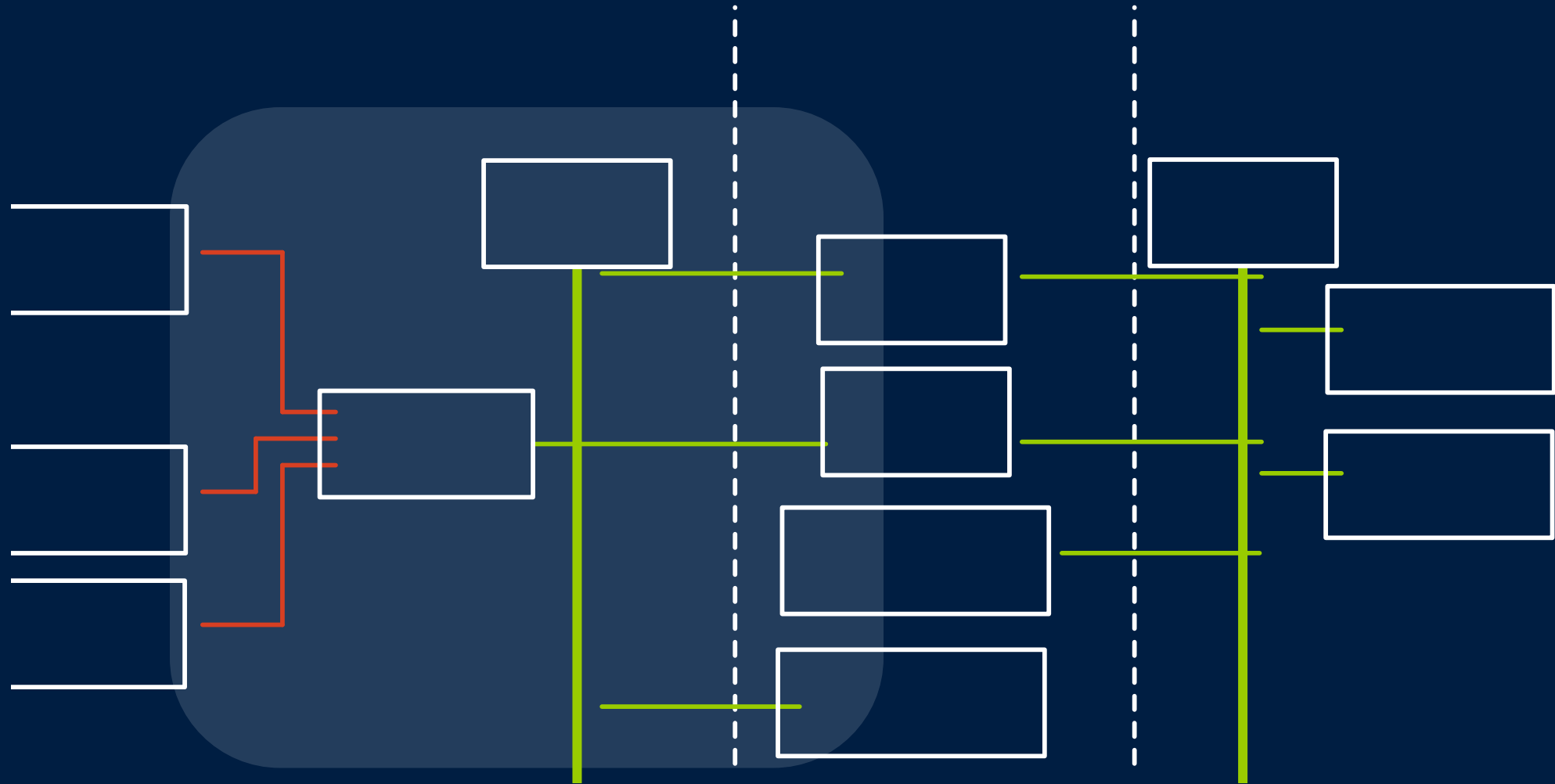
Fiber May Simplify Your Substation Design

- Digital station bus connects devices inside control house
- Digital process bus connects relays with primary equipment

Fiber for Digital Station Bus



Next, Digital Process Bus



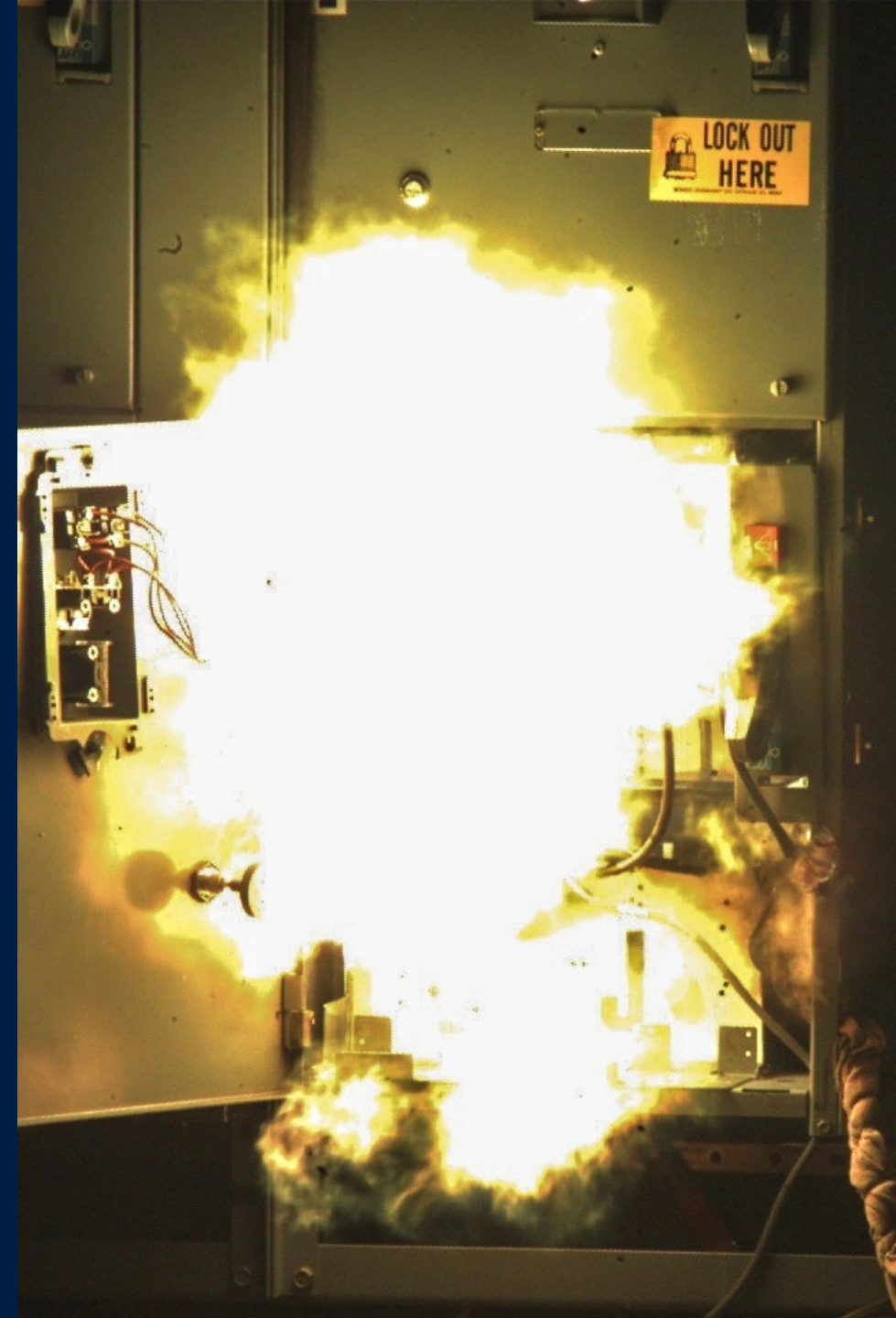


Fiber Simplifies Substation Design

- Consolidate copper wires
- Lower number of termination points
- Simplify drawings
- Reduce trenching size
- Optimize panel space
- Speed up installation

Fiber Improves Safety

- Reduce exposure to hazards
- Lower electromagnetic stress
- Replace devices quickly



Standard Digital Substation Design Affects Reliability

- ✓ Decreased wiring and connection errors
- ✓ Detection of communications issues via self-tests
- ✗ Increased number of electronic devices
- ✗ Higher number of settings
- ✗ Complicated network engineering
- ✗ Requirement of accurate time for protection

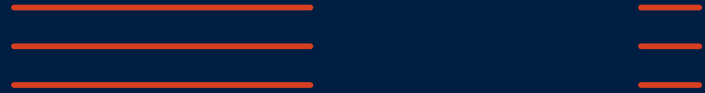
Process Bus Architectures

Switched Network



Process Bus Architectures

Point-to-Point Network



Comparison of Process Bus Architectures

Aspect	Switched	Point to Point
Equipment connections	More	Less
Time	Needed	Not needed
Network engineering	Complex	Simple

Comparison of Process Bus Architectures

Aspect	Switched	Point to Point
Cybersecurity	More points of access; complexity causes risks	Fewer access points; inherently secure
Data redundancy	Available, offsetting reliability concerns of more devices	Limited, with focus on functional protection system redundancy
Maintenance issues	Testing; changes require evaluation and rework	Testing

Point-to-Point Architecture Shows 17% Savings

\$43.4K

Traditional System

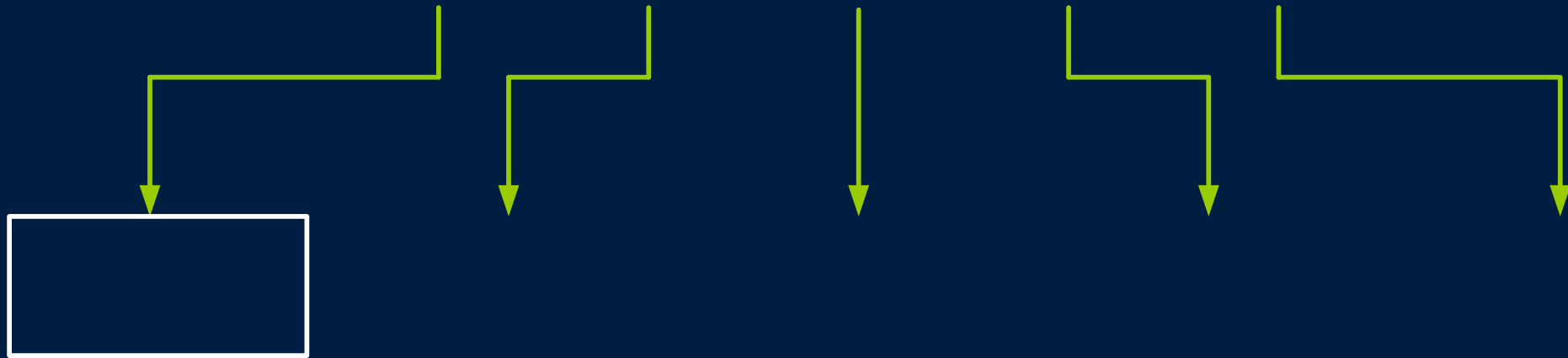
\$43.3K

Switched Network

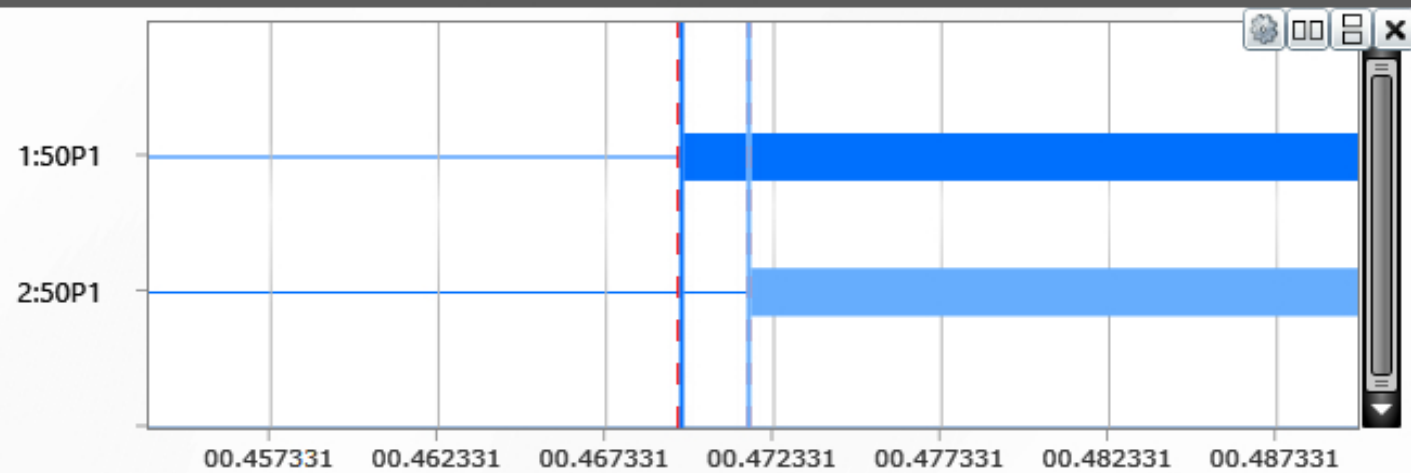
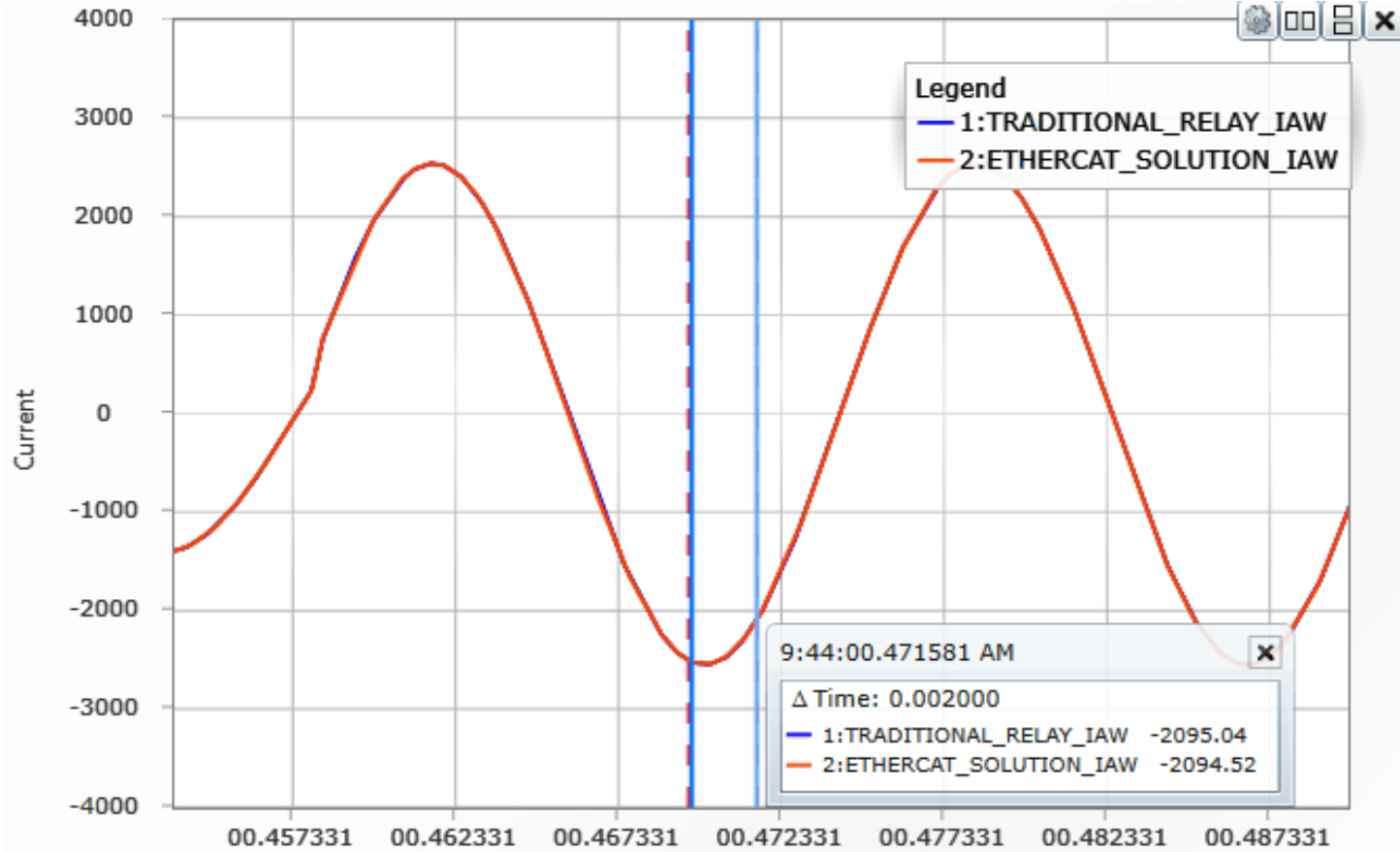
\$36.2K

Point-to-Point Network

New Point-to-Point EtherCAT[®] Method Is Simple

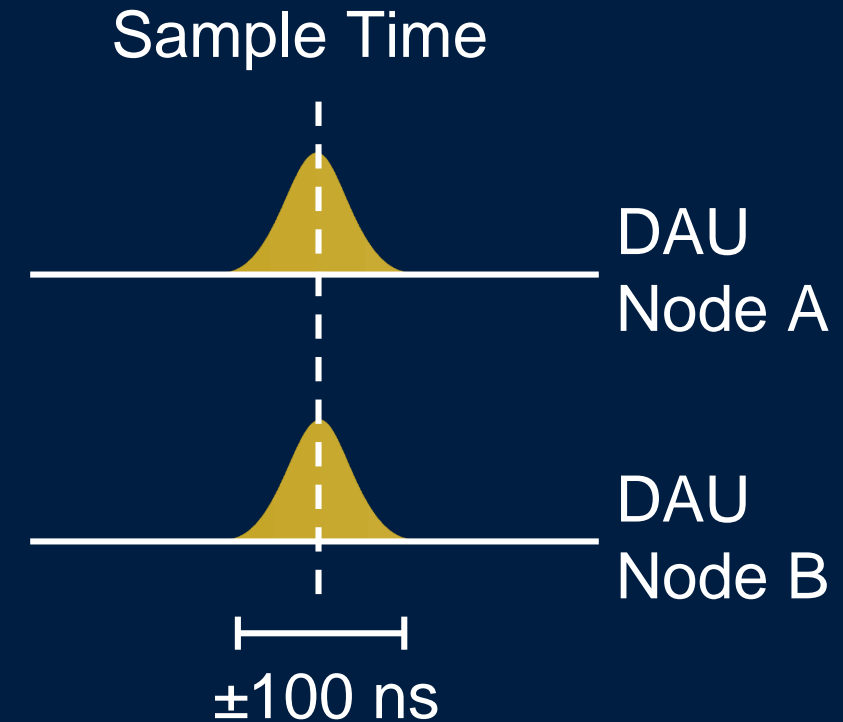


Relay Performance Traditional vs. EtherCAT-Based



Gain Additional Benefits With EtherCAT

- Relative time is maintained across system without external clock
- Bandwidth is used more efficiently
- Latency is reduced
- Less than 100 ns jitter guarantees protection-grade determinism



Conclusion

- Process bus solutions simplify substation design
- Point-to-point system is simpler to engineer, deploy, and maintain
- New EtherCAT-based point-to-point system is economical, robust, easy to use, and secure

Questions?