Choose Simplicity for a Better Digital Substation Design

Greg Rzepka, Scott Wenke, and Sarah Walling
Schweitzer Engineering Laboratories, Inc.
Complexity Contributes to Misoperations

- Settings: 31%
- Device: 19%
- Communication: 13%
- Other Failures: 37%

Source: Analysis of System Protection Misoperations, NERC, December 2015
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
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

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Switched</th>
<th>Point to Point</th>
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</thead>
<tbody>
<tr>
<td>Equipment connections</td>
<td>More</td>
<td>Less</td>
</tr>
<tr>
<td>Time</td>
<td>Needed</td>
<td>Not needed</td>
</tr>
<tr>
<td>Network engineering</td>
<td>Complex</td>
<td>Simple</td>
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## Comparison of Process Bus Architectures

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<tr>
<td>Cybersecurity</td>
<td>More points of access; complexity causes risks</td>
<td>Fewer access points; inherently secure</td>
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<tr>
<td>Data redundancy</td>
<td>Available, offsetting reliability concerns of more devices</td>
<td>Limited, with focus on functional protection system redundancy</td>
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<tr>
<td>Maintenance issues</td>
<td>Testing; changes require evaluation and rework</td>
<td>Testing</td>
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</tbody>
</table>
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
• 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?