IMPROVING GRID RELIABILITY WITH FIBER OPTICS

Enabling the High-Density Coordination of Automated Switching Devices

Highlights

Power Grid Management Requirements:

- **Scalable Point-to-Multipoint Communication**
- **Enablement of High-Density Coordination**
- **High Reliability and Fault Resilience**

Passive Optical Network (PON) Technology Attributes:

- **Proven Point-to-Multipoint Fiber Optic Technology**
- **High Capacity, Low Latency Access**
- **Efficient Use of Fiber Optic Cabling**

Growing Demands in Grid Management

Electric utility providers have a need to modernize their power distribution networks to increase the reliability, resiliency, and security of the power grid. Reducing the impact of a power fault is imperative. The power line fault must be quickly and accurately located to expedite repair and limit the affected area. To accomplish this, electric utilities have begun upgrading their communication networks by installing fiber alongside their distribution electric plants and leveraging passive optical network architectures. Due to the real-time, low-latency communication needed to support high-density coordination, traditional recloser coordination methods are not effective; however, enhanced PON communication enables increased density of automated electrical switches which allows for more granular and accurate fault sensing, fault segmenting, and power redistribution via more elegant auto-transfer schemes. The combination of point-to-multipoint fiber access and high-density coordination results in a more reliable, resilient, and secure power distribution network.

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Fiber Optics and PON Provide a Path Forward

With the complexity of the grid continually evolving, a robust communication backbone is essential to provide the reliability needed. Fiber access technologies continue to be the gold standard for point-to-multipoint access. By taking the highly proven, low latency fiber access network model and combining it with the speed and security of the Generic Object Oriented Substation Events (GOOSE) protocol and the reliability of a fully redundant communication architecture, electric utility providers have the opportunity to deliver high-density coordination of their power grid reclosers using GOOSE messaging.

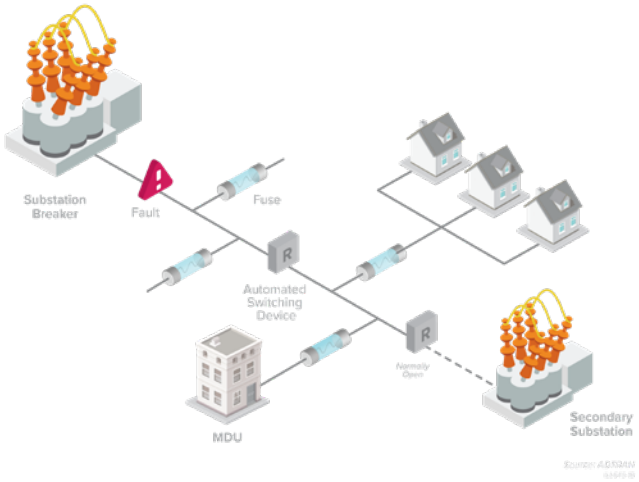
Total Access 5000 for Fiber Distribution

The Adtran Total Access 5000 (TA5000) is a fiber-access platform that has been deployed to improve the reliability and resiliency of power distribution networks. The TA5000 serves as the enhanced communication system for automated switching devices. It functions as a highly secure, high-speed, low-latency communication system that operates between power line reclosers without having to take the traffic through any equipment upstream of the OLT. It allows automated line switching devices to employ ultra-fast, effective peer-to-peer coordination between switching devices via GOOSE messaging utilizing the 61850 communication protocol and enhanced high-speed wired Supervisory Control and Data Acquisition (SCADA) communication, which enables a larger and more scalable self-healing network.

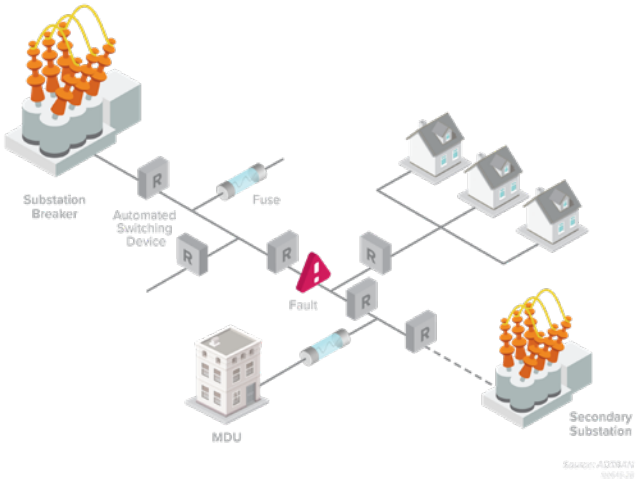
As a modern fiber access platform, the TA5000 supports network redundancy via multiple methods to maintain a secure and reliable connection. The redundancy scheme supports dual-parented Type B PON redundancy, which provides redundant connections from one or more PON OLT systems to each recloser and SCADA device deployed. Combining this redundancy with a dual-path optical distribution network (ODN) architecture feeding each distribution device, electric utilities can protect the high-density coordination communication system from both an OLT equipment and a fiber optic facility failures.

"With the complexity of the grid continually evolving, a robust communication backbone is essential to provide the reliability needed."

The Adtran Total Access 5000 fiber access platform installed within an environmentally hardened cabinet.



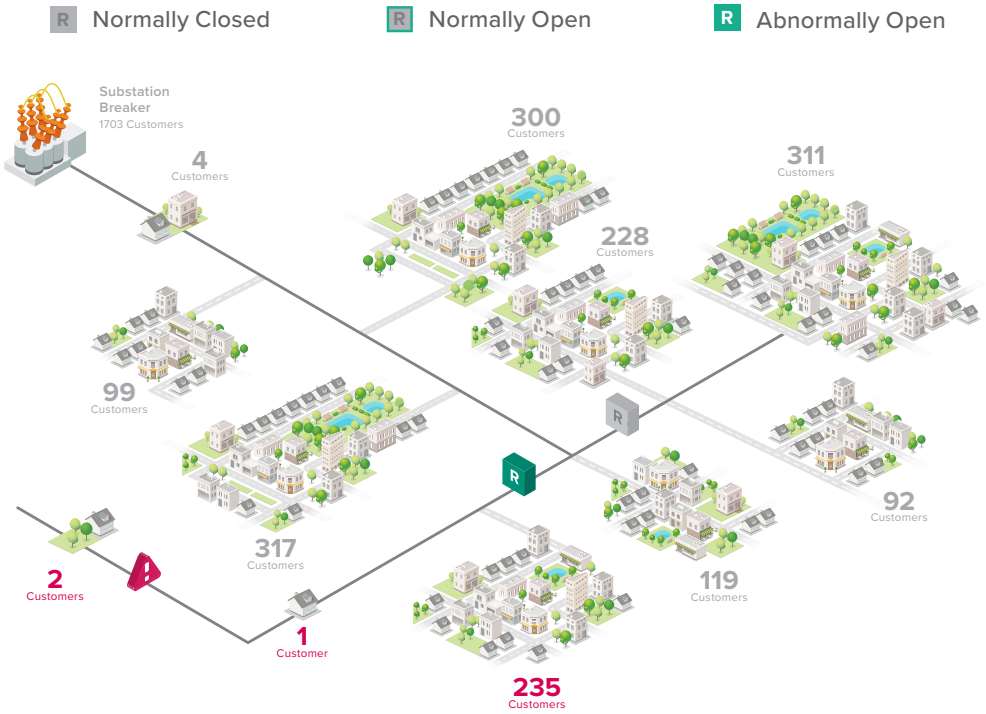
Traditional recloser networks often leave many customers without power in the event of a power grid fault.



Modern recloser network using high-density coordination.

99% Reduction in Customer Minutes Interrupted (CMI)

To illustrate the case for PON management of a power grid fault event, consider a regional utility's pilot program of high-density coordination of automated switching devices networked with point-to-multipoint fiber access. An outage lasting 402 minutes (6.7 hours) could have affected 237 customers under a traditional automated recloser network, resulting in a CMI of 95,274. However, due to the utility's use of an advanced automation strategy underpinned by PON technology, the actual power line fault duration of 402 minutes affected only two customers resulting in a CMI of only 804 -- a reduction of greater than 99%.



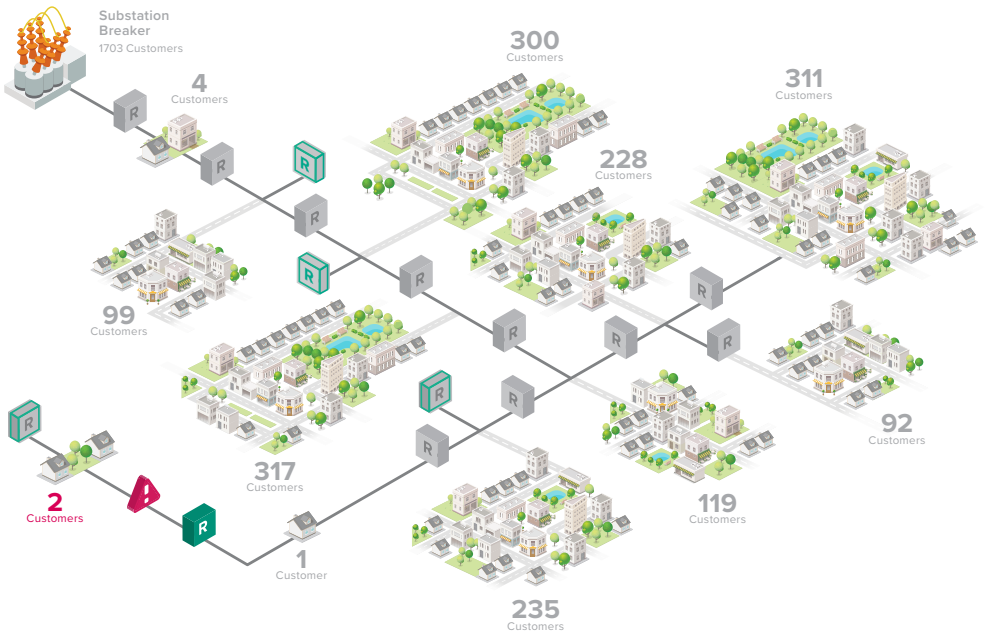
Pilot network PRIOR to high-density coordination

Assumed Duration:
402 Minutes

Customers Out:
238

Total CMIs:
95,274

Source: ADTRAN | ILL646-1C



Pilot network AFTER passive optical network deployment

Actual Duration:
402 Minutes

Customers Out:
2

Total CMIs:
804

Source: ADTRAN | ILL646-2C

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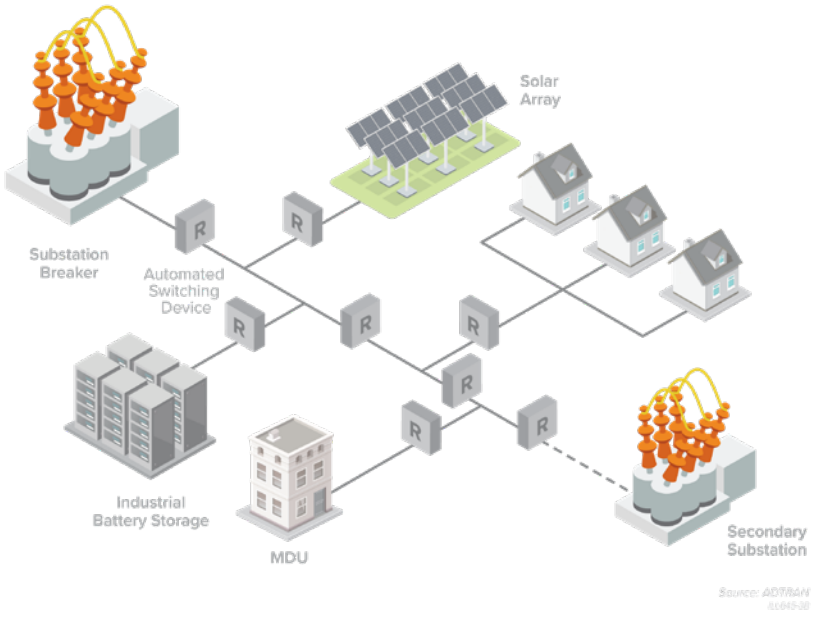
"Electric utilities can protect the high-density coordination communication system from both OLT equipment and fiber optic facility failures."

Extending Intelligent Data Collection Even Rurther

Scalable, cost-effective fiber access technology carries a host of other advantages. It can be leveraged to modernize automatic meter reading using next-generation advanced metering infrastructure, affording the network operator real-time, on-demand interrogation and data collection of metering endpoints. This will become increasingly important as the power grid is asked to support emerging solar arrays, battery storage, electric vehicle applications, and power- and current-sensitive customer equipment.



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