MISSION-CRITICAL COMMUNICATIONS FOR UTILITIES

Ready for the challenges of tomorrow.
FOX615 teleprotection solutions.
ABB has been protecting critical infrastructure for more than a century, but our history is one of constant innovation – taking the best new technologies and developing them for challenges unique to the industry, and unique to you.

Communication networks have always been important to the operation of electrical grids, but in recent years it has become the enabler that makes the truly intelligent grids possible. That intelligence requires a network which can deliver outstanding performance, with the resilience expected from a system critical to the uninterrupted delivery of power. The communication system you use is essential in maintaining that delivery, while ensuring the safety of your staff, and the protection of your assets.

Critical to grid operations is the protection of power lines, through teleprotection. Teleprotection systems were developed alongside the electrical grids themselves, and the communication networks used were created with those applications in mind. In 1940, the average telephone user was just getting to grips with the rotary-dial telephone, while ABB was deploying power line carrier communications utilizing the electrical transmission infrastructure to carry teleprotection data and avoiding the need for a separate Pilot Line.

Back then it was obvious that consumer communications and teleprotection systems had little in common. The users had different priorities, used different applications, and were thus best served with different technologies and techniques. Commonality might be found in some components, but the resilience required of electrical systems, compared to the cost-sensitive consumer market, reduced that overlap.

With the introduction of the use of fiber within the operational communication networks of electrical utilities, similarities between the technologies being used in consumer communications and operational communication networks of electrical utilities have appeared. The application requirements have been somehow comparable: private, highly available communication links with low jitter, wander and high level of symmetry as well as frequency synchronization. This is why Synchronous Digital Hierarchy (SDH) and Synchronous Optical Network (SONET) transport technologies have been successfully deployed in both network types.

Consumer systems have evolved with alarming speed due to the changing needs of consumers. This has seen a move away from voice communication requiring high quality networks towards data networks (Internet) with non real time but massive bandwidth requirements. This has lead to rapid deployment of the latest technologies and cost-saving ideas. This was often to their detriment, as quality of service reduced for real time applications (e.g. voice calls) but bandwidth for data networks increased tremendously.

Teleprotection systems, in contrast, have always operated under the pressure of protecting critical infrastructure and hence been heavily optimized to the performance characteristics of the used WAN technology. Reliability is paramount, resilience required, while new technologies and techniques must prove themselves robust enough to match, or exceed, the existing equipment before they can safely be used in the electrical network. That’s why migration to new technologies for such systems is more complex and takes significantly longer compared to consumer networks.

Protection applications have very specific requirements; if the same are not met maloperation or even worse no operation of the protection system can result with the potential for large blackouts, destroyed primary equipment and dissatisfied customers. Differential protection is very sensitive to latency, jitter, wander and asymmetries. If those performance parameters are not met the application is severely compromised. Distance protection on the other side is sensitive to latency, maloperation due to false or missing commands due to communication problems or simple different communication channel characteristics. The same has been standardized in IEC 60834-1 and compliance to the same usually needs to be proven by the vendor of the Teleprotection system.
Rip-and-replace is not an option for a utility supplying power to homes and industries. Protection relay’s and RTU’s are often designed to run for decades, and many still-functional units were deployed before the latest standards had been defined, let alone tested, so interoperability with existing equipment is a vital requirement for any next-generation solution.

Today operators of communication networks in electrical utility environment are quite often confronted with the fact that established suppliers of TDM technology do not support the device anymore and replacement of the communication infrastructure has to be considered. Considering the fact that often a significant amount of applications still communicate on TDM, especially also protection applications, the migration needs to be planned carefully. Changing the network with a new device and at the same time changing the technology of the network bears significant risks for ending up in situations where not all applications can be migrated to the new network infrastructure in a reasonable time frame or extensive refurbishment projects need to be done additionally.

To smooth that process, FOX615 supports the widely-deployed synchronous Digital Hierarchy (SDH) standard as well as MPLS-TP at the same time and can bridge between the two to create a hybrid infrastructure. The hybrid option permits a managed and risk minimized migration towards a packet based infrastructure. Devices can be moved between the two networks as they are replaced during the normal lifecycle management. That, in turn, reduces the complexity of updating components, and provides access to an increasing range of applications which are being made available to packet-based networks.

Communications, even over a hybrid network, must be low-latency, but most importantly it must be deterministic. New technologies, as well as equipment not designed for teleprotection, can lead to non-deterministic behavior (jitter, wander and asymmetrical delay times) which causes virtual fault currents in differential protection relays, misinterpreted as an infrastructure fault leading to false tripping. ABB’s FOX615 is designed to provide that stability, preventing variations and turning latency into a known quantity which can be mitigated against.

MPLS-TP provides missing features being available in SDH networks to packet networking and solves many of the features needed by critical utilities, but the teleprotection quality of service requirements cannot be met easily.

Today's and tomorrow's challenges.
Comparing SDH and MPLS-TP applications.

MPLS-TP provides missing features being available in SDH networks to packet networking and solves many of the features needed by critical utilities, but the teleprotection quality of service requirements cannot be met easily.
ABB’s solution.
FOX615 Teleprotection

ABB has a long lasting experience in providing optimized teleprotection solutions leading to superior performance, higher availability and reduced operational costs. With the latest generation of protection interfaces, ABB also enables the technology migration of those services.

FOX615 provides integrated protection solutions for distance as well as differential protection. OPIC2 and OPIC2, which provide integrated distance protection and differential protection respectively. OPIC2 provides IEC 60834-1 compliant teleprotection, over packet-switched networks, while OPIC2 guarantees symmetrical real time communication channels using wide area communication networks, based on packet-switched technology, for differential protection.

TEPGI Integrated packet based line protection
Recent development of IEC 61850 standard as well as activities in the Teleprotection industry lead towards generic packet based protection schemes. For line distance protection the IEC 61850 standard allows the use of GOOSE messages. FOX615 with the integrated TEGO1 interface provides a IEC 61850 Gateway functionality where the TEGO1 Interface card acts as an IED, connects to up to 8 different remote ends and provides selective filtering of GOOSE messages, translation capabilities in case of miss-matching configurations and controlled access to the station bus from remote ends through the WAN. With TEGO1 ABB closes the gap between substation automation and protection and wide area communication. Networking concepts are brought to the protection application which allows optimized solutions with better performance at lower costs.

Supervision and Data security / authenticity
All teleprotection cards provide continuous channel supervision and collection of performance statistics, hitless traffic protection in case of link failure, and authentication of trip signals to guarantee data integrity. Additionally the high performance encryption unit SENCl of FOX615 allows encryption of teleprotection signals. All interface cards are integrated into ABBs FOXMAN-UN control software. Integrated management is a vital component in managing protection hardware and securing it from the next-generation threats of cyber-attack. Packet-based networks use publicly-documented protocols, and utilities are potential targets, so a comprehensive (and coordinated) security policy is essential across the entire network.