PS2 - Applications of emerging technology for protection, automation and control

Question 2.05 What are the experiences to improve the practical application and verification of the protection in a real substation project?

Real-time monitoring of the Protection, Automation and Control system - PAC of an IEC 61850 substation

When we exchange electrical cables for an Ethernet network and electronic devices we can impact the reliability of the system. What improves availability is the possibility of alternative paths for signals (redundancy) and the ability to monitor infrastructure and functionality.

Real-time monitoring basically includes:

- Diagnostics of each device: hardware failure, communication failure, power failure ;
- Signal Diagnostics: loss or degradation of Sampled Values – SV signals, loss or degradation of Generic Object Oriented Substation Event - GOOSE signals, loss of Manufacturing Message Specification - MMS signals ;
- Ethernet Network Diagnostics: Traffic volume on each network segment, jitter and latency of data packets ;
- Configuration diagnosis: Verification of the correct application of the configurations comparing the System Configuration Description - SCD project with the real time in the Intelligent Eletronic Devices - IEDs and in the signal traffic;
- Cybersecurity Diagnosis: Observing the services and accesses on the network, the integrity of the signals, the presence of unforeseen signals;
- Monitoring of time synchronization, on devices (IEDs), on the time server (Global Navigation Satellite System - GNSS) and on the Precision Time Protocol - PTP applied network. Due to the importance of time synchronization for systems appliyng Sampled Values, the application of more than one time server is recommended. This situation creates the need to additional monitoring on GNSS' statuses.

Strategies for applying monitoring involve defining the implementation strategy in the project. It will involve the local SCADA system, an asset management system and a cyber security system. These systems need to work in an integrated way and report the information properly to the Power System Operation Center, the Cyber Security Operation Center and the Maintenance Center.

Monitoring can be done actively, establishing communication connections or requests, using MMS or Simple Network Management Protocol - SNMP protocols. It can also be passively, monitoring traffic and interpreting messages. Some signals are reported in the communication connections used by the Protection, Automation and Control system.

Some information can be collected in requests that also identify firmware versions, protection settings, last change date, hardware performance. In this case, it depends on the resources of the IED itself or communication equipment (Switch, Router, etc).

An important issue that projects have been pointing out is the need to include more features and requirements in the Switch. They are the functional core of the Ethernet network and need to have the features not only of availability, IEC 61850 compatibility, network functionalities (Virtual Local Area Network - VLAN, Rapid Spanning Tree Protocol - RSTP, High-availability Seamless Redundancy - HSR, Parallel Redundancy Protocol - PRP) but also intelligent monitoring and communication capability (SNMP and MMS).

For system monitoring purposes, MMS applications are more suited for PACS, as they provide timestamping just like other IED devices. Some ethernet switch vendors already offer such functionality on their devices, and the same resource on GNSS' could provide a complete MMS-based supervision of process bus relevant devices.