Process bus bar protection – a stepping stone towards digital substation

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Busbar protection

- Conventional busbar protection
  - CT, Isolator status, CB status, Protection trip
  - Proprietary Protocol (Fibre optic)
  - Bay unit
  - Central unit

- Process bus busbar protection
  - CT, Isolator status, CB status, Protection trip
  - IEC61850-9-2LE Sample values (Fibre optic)
  - Proprietary Protocol (Fibre optic)
  - Merging unit
  - Central unit

- New process bus busbar protection
  - CT, Isolator status, CB status, Protection trip
  - IEC61850-9-2LE Sample values (Fibre optic)
  - Merging unit
  - Central unit
Busbar protection with redundant comm

• Conventional distributed busbar

• New process bus busbar protection

• The process bus busbar protection is not a new nor special application. It is simply the field proven concept of a distributed busbar protection system, using merging units, sampled values, GOOSE and IEEE 1588 as opposed to dedicated bay units and proprietary communications.
Busbar protection with redundant comm

- **Busbar protection with PRP**
  - Ethernet Switch
  - 100Mbps PRP
  - 1Gbps PRP
  - IEC61850-9-2LE Sample values, IEC61850-8-1 GOOSE, IEC61850-9-3 PTP
  - Port 1
  - Port 2
  - MU = Merging unit

- **Busbar protection with HSR**
  - Ethernet Switch
  - 1Gbps HSR
  - IEC61850-9-2LE Sample values, IEC61850-8-1 GOOSE, IEC61850-9-3 PTP
  - Port 1
  - Port 2
  - MU = Merging unit
Main 1 & 2 Busbar protection

**Busbar protection with PRP**
- IEC61850-9-2LE Sample values,
- IEC61850-8-1 GOOSE,
- IEC61850-9-3 PTP

**Busbar protection with HSR**
- IEC61850-9-2LE Sample values,
- IEC61850-8-1 GOOSE,
- IEC61850-9-3 PTP

MU = Merging unit

Ethernet Switch

- 100Mbps PRP
- 1Gbps PRP

- Port 1
- Port 2

Busbar relay (Main 1)

- MMS buffered report, unbuffered report, GOOSE

Busbar relay (Main 2)

- MMS buffered report, unbuffered report, GOOSE

Port 1

Port 2

Port 1

Port 2
Busbar protection for larger substation

- Busbar protection with PRP
  - IEC61850-9-2LE Sample values, IEC61850-8-1 GOOSE, IEC61850-9-3 PTP
  - 100Mbps PRP
  - 1Gbps PRP
  - MMS buffered report, unbuffered report, GOOSE

- Busbar protection with HSR
  - IEC61850-9-2LE Sample values, IEC61850-8-1 GOOSE, IEC61850-9-3 PTP
  - 1Gbps HSR
  - 100Mbps PRP
  - MMS buffered report, unbuffered report, GOOSE

MU = Merging unit
• Two HSR is NOT QuadBox, but two independent HSR
• The relay has ability to detect the discrepancy between the CT set 1 and CT set 2
Testing & Monitoring

- Busbar communication is no longer a blackbox.
- Busbar testing can be simplified to test the merging units and busbar protection relay separately.
• IEC61850 simulation mode allows simulating SV and GOOSE messages to the network and only devices operating in simulation mode will subscribe to and use these simulated messages for testing purpose.

• IEC 61850 test mode allows the relay application to operate normally but all the relay outputs are blocked
• GPS or Absolute time synchronization for protection is not normally required in the conventional substation. Process bus busbar relay can have IEEE 1588 boundary clock capability.

• All merging units are synchronized to the same source, the busbar protection relay, the sampled values streams can be aligned and used for the low impedance busbar differential protection.

• This therefore allows the application of the same process bus busbar protection in a conventional substation without the need of a satellite clock or absolute time synchronization.
Stepping stone to digital substation

- Installing process bus busbar system in a conventional substation becomes the first step towards a fully digital substation.
- Merging units are installed in all bays, along with a process bus network encompassing all bays.
- Future relay refurbishments for bays and zones will involve simply connecting relays to the existing network and merging units.
Thank You

Questions?