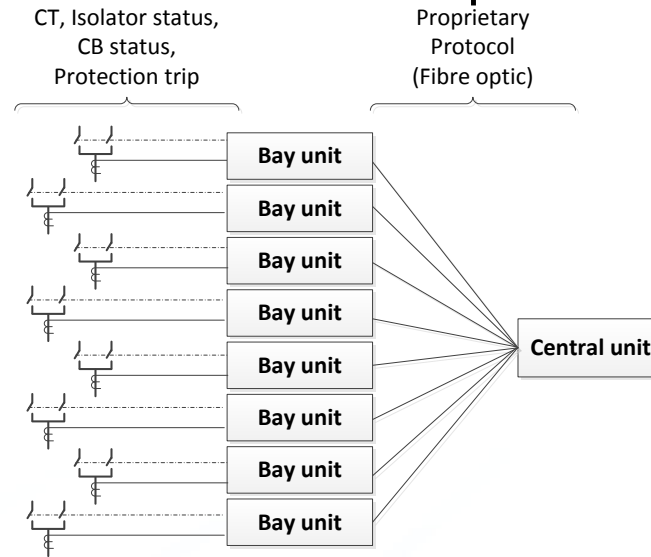


# Process bus busbar protection stepping stone towards digital substation

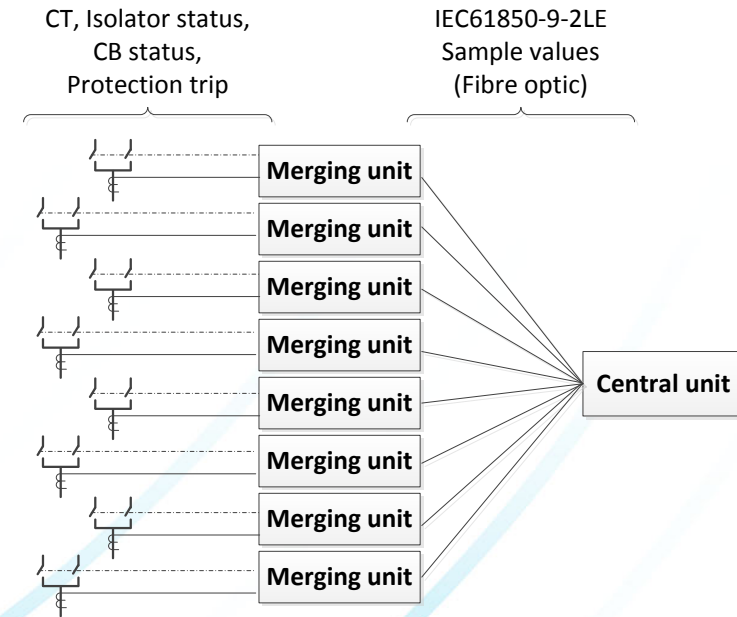
Terrence Smith – GE Grid Solutions

# Busbar protection

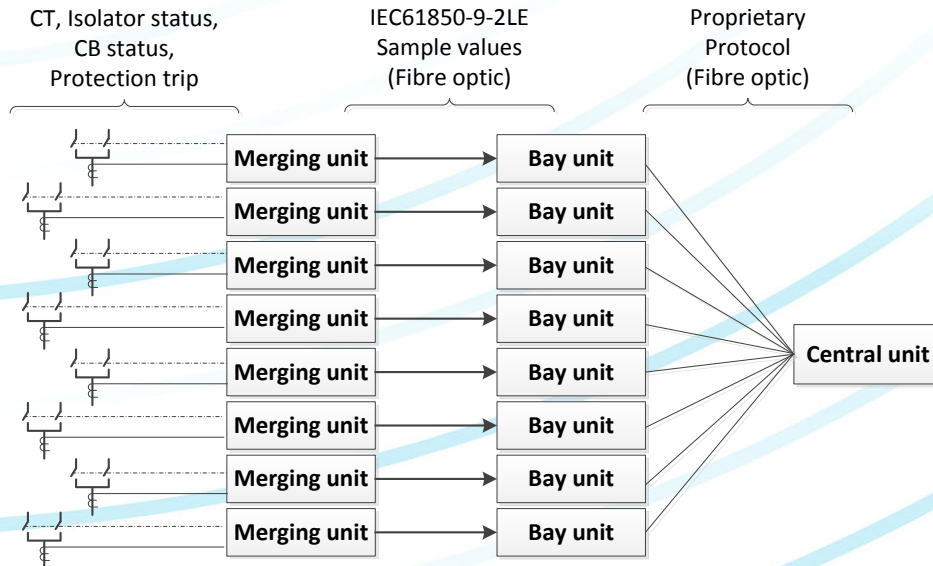
- Conventional busbar protection



- New process bus busbar protection

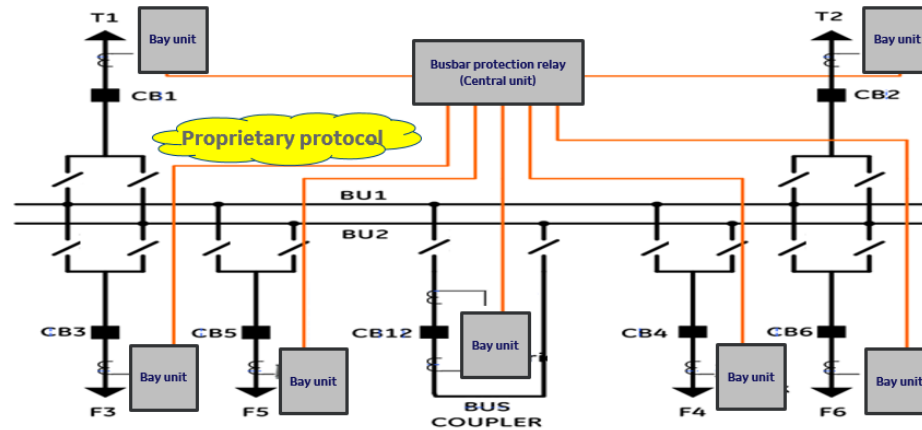


- Process bus busbar protection

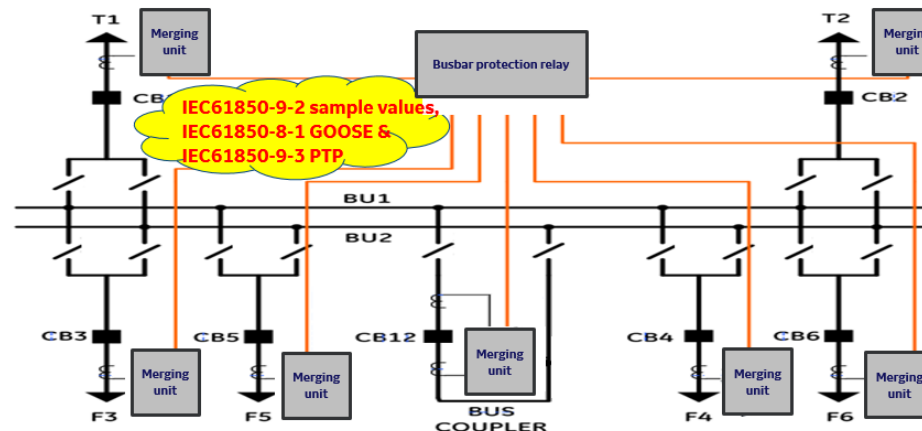


# Busbar protection with redundant comm

- Conventional distributed busbar



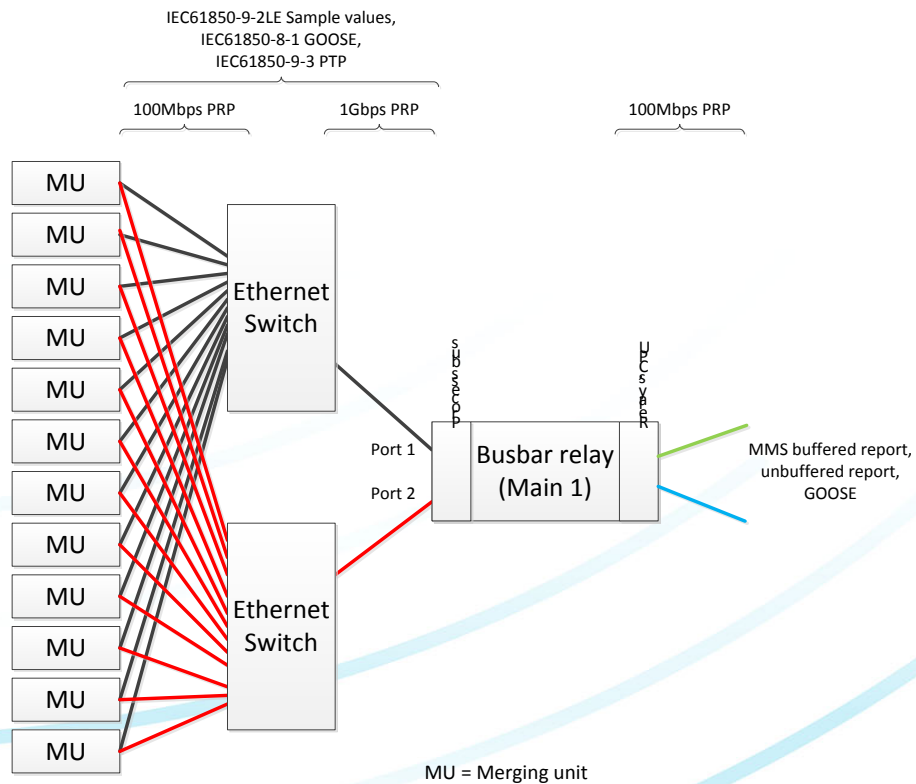
- New process bus busbar protection



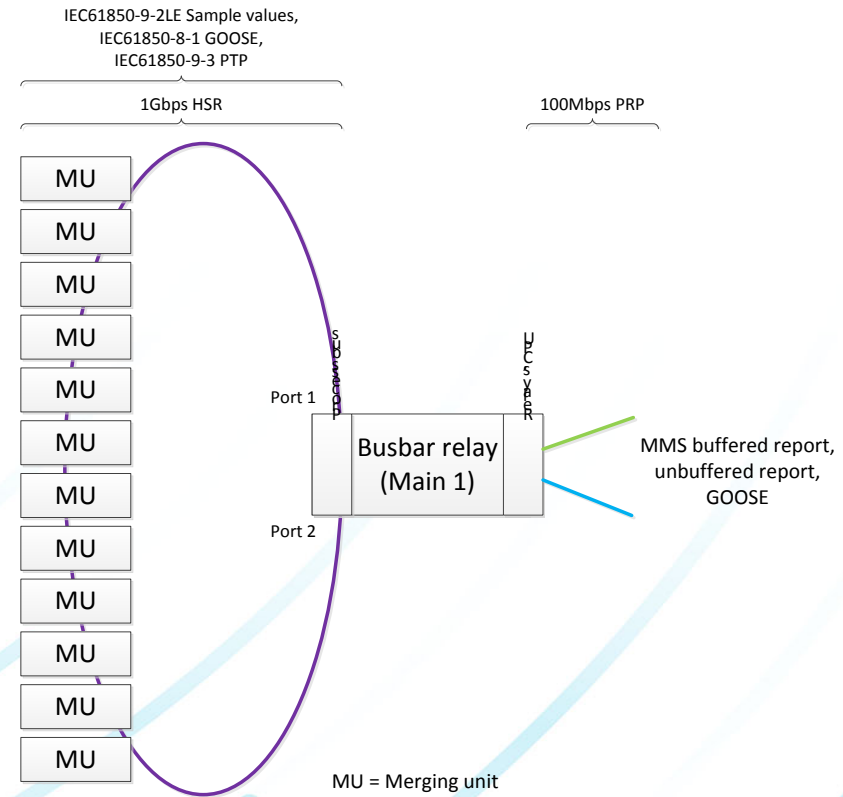
- The process bus busbar protection is not a new nor special application. It is simply the field proven concept of a distributed busbar protection system, using merging units, sampled values, GOOSE and IEEE 1588 as opposed to dedicated bay units and proprietary communications.

# Busbar protection with redundant comm

- Busbar protection with PRP

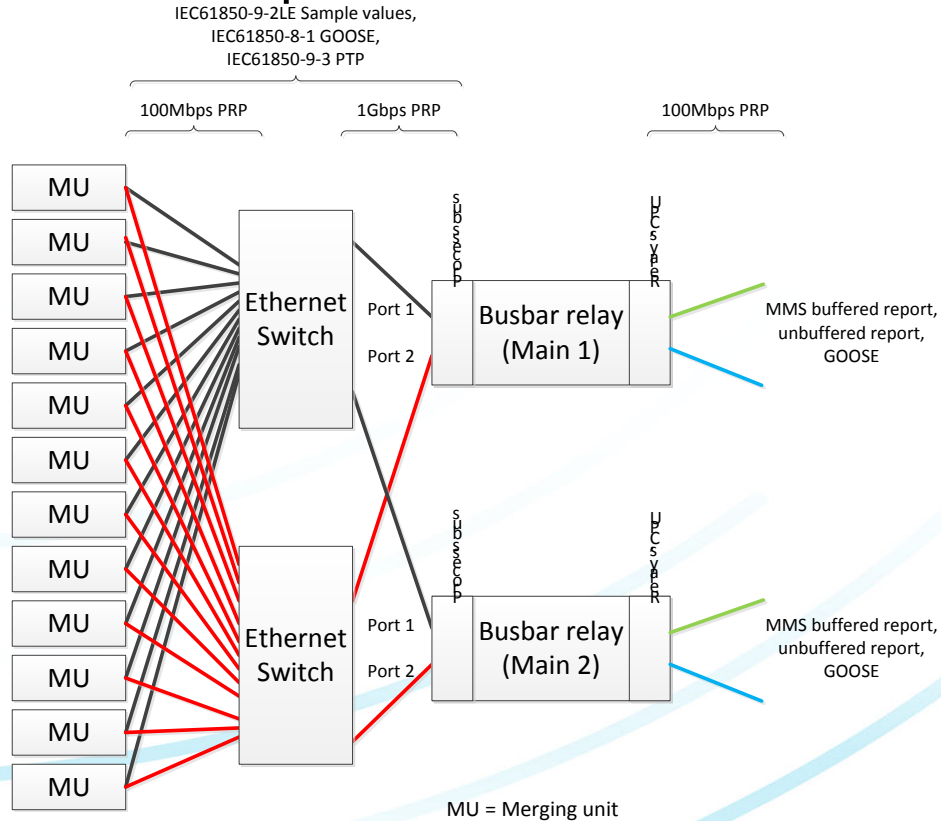


- Busbar protection with HSR

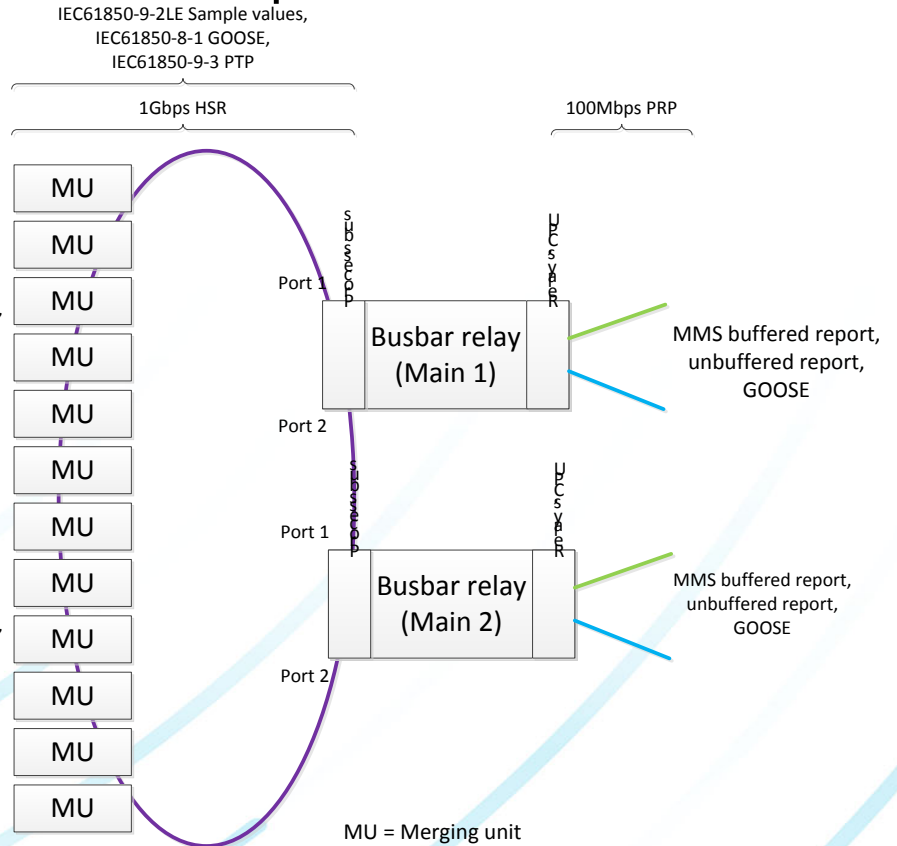


# Main 1 & 2 Busbar protection

- Busbar protection with PRP

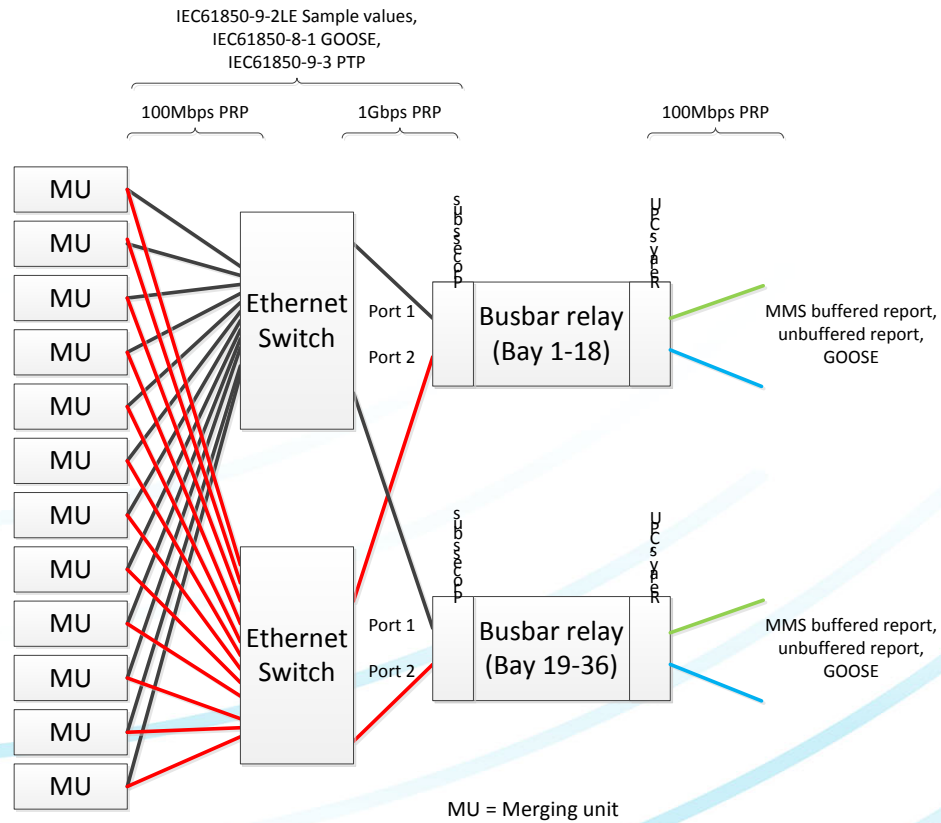


- Busbar protection with HSR

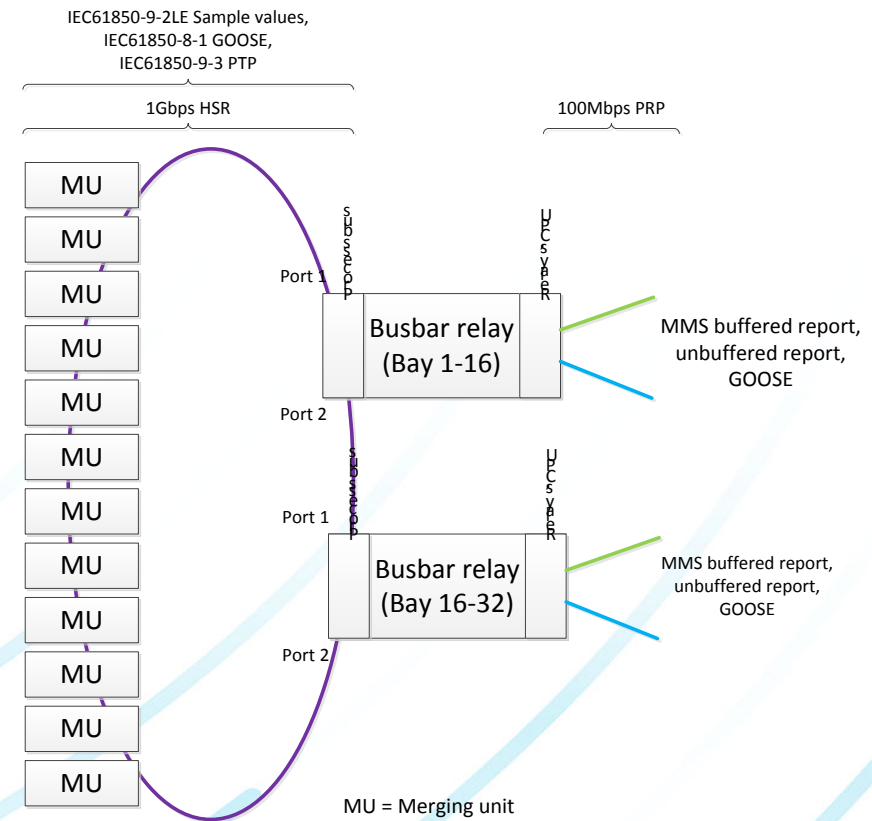


# Busbar protection for larger substation

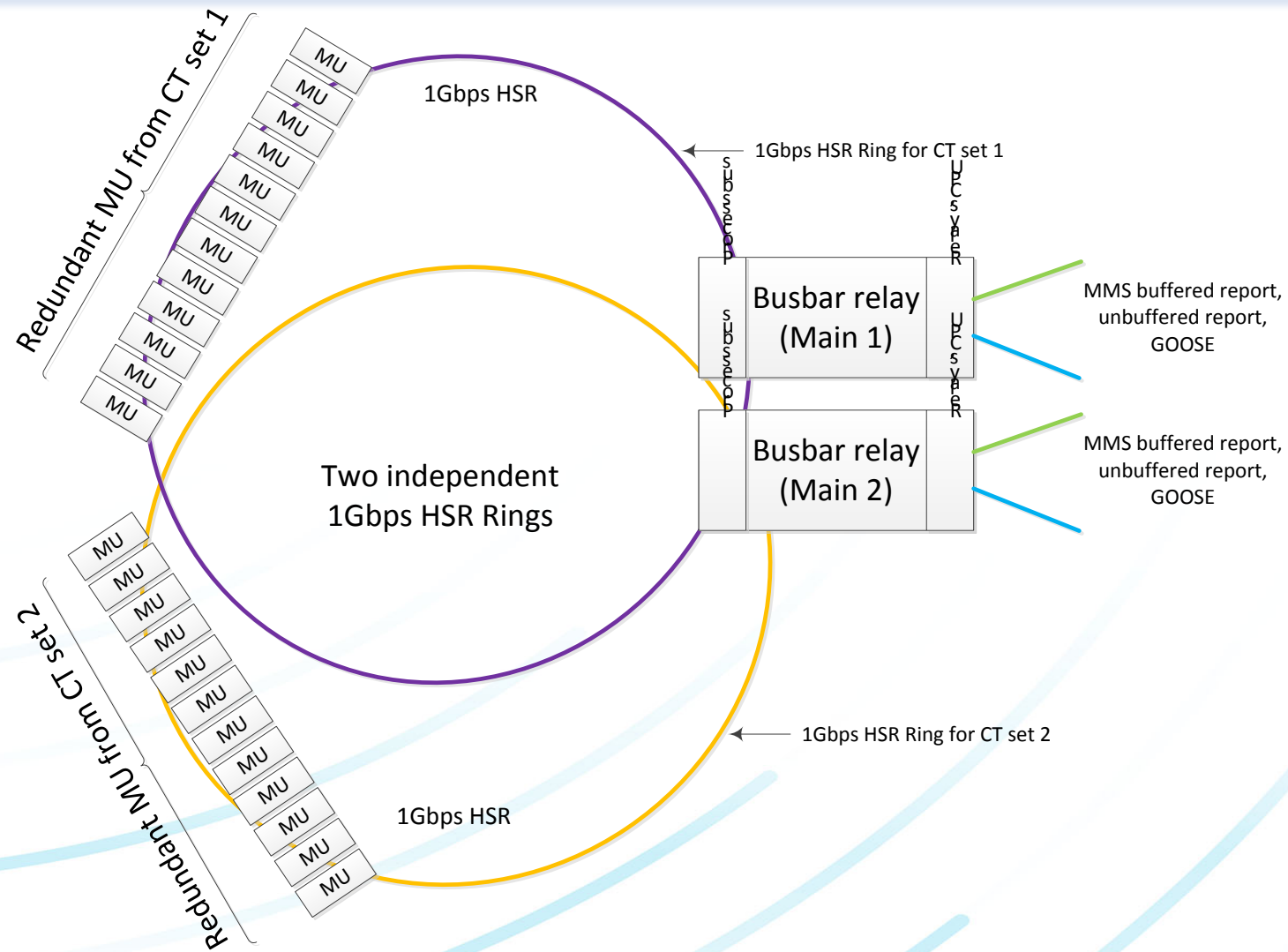
- Busbar protection with PRP



- Busbar protection with HSR (High Speed Ring)

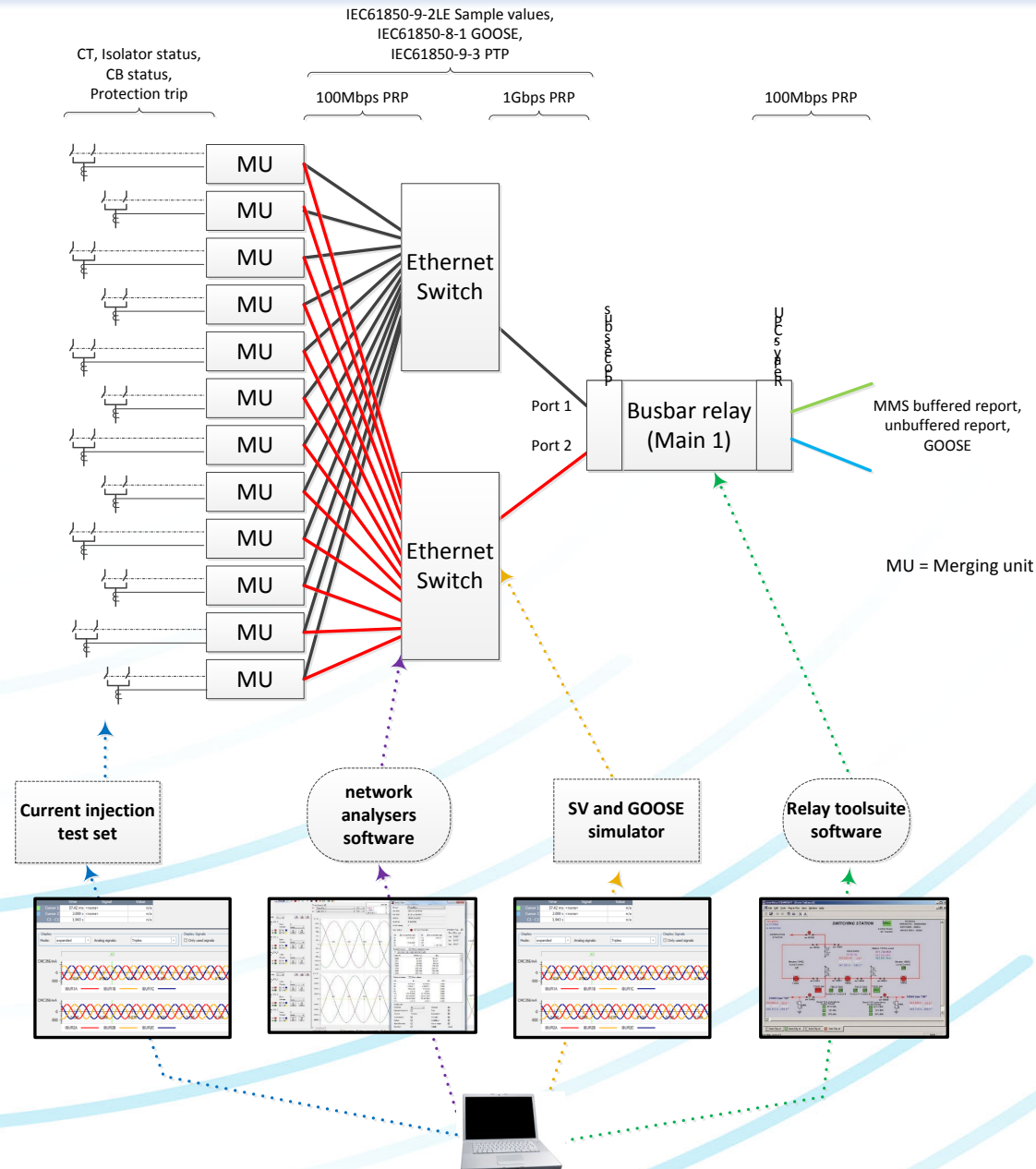


# Total redundant



- 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

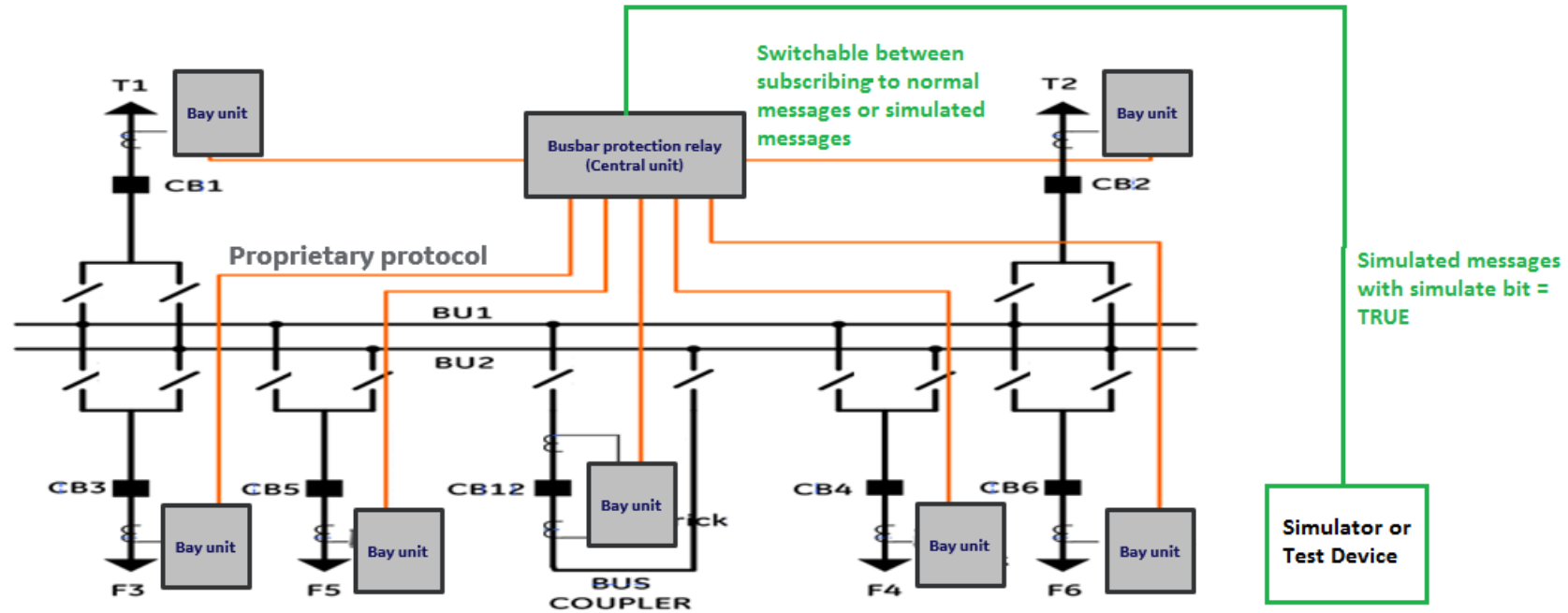
# Testing & Monitoring



- Busbar communication is no longer a blackbox.
- Busbar testing can be simplified to test the merging units and busbar protection relay separately

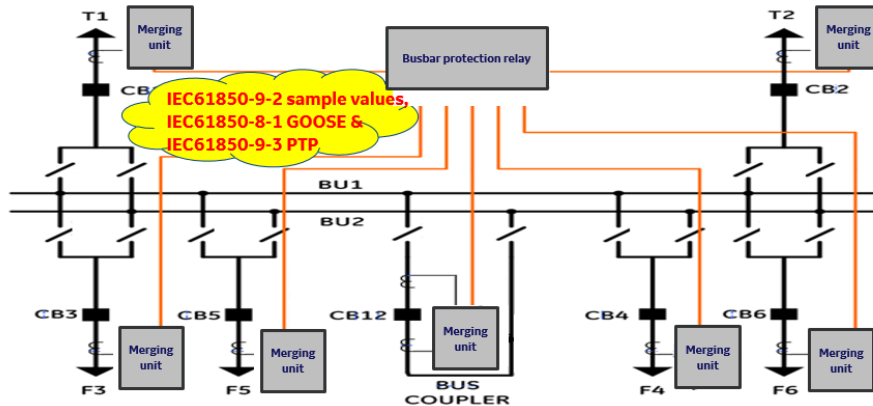
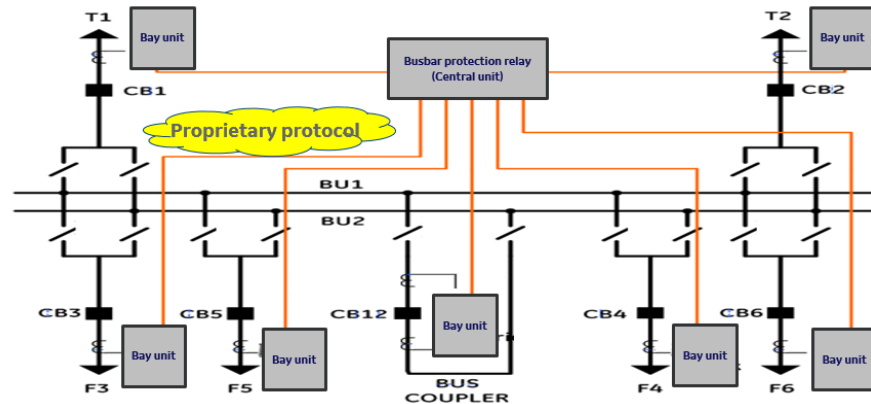


# Testing Process bus busbar



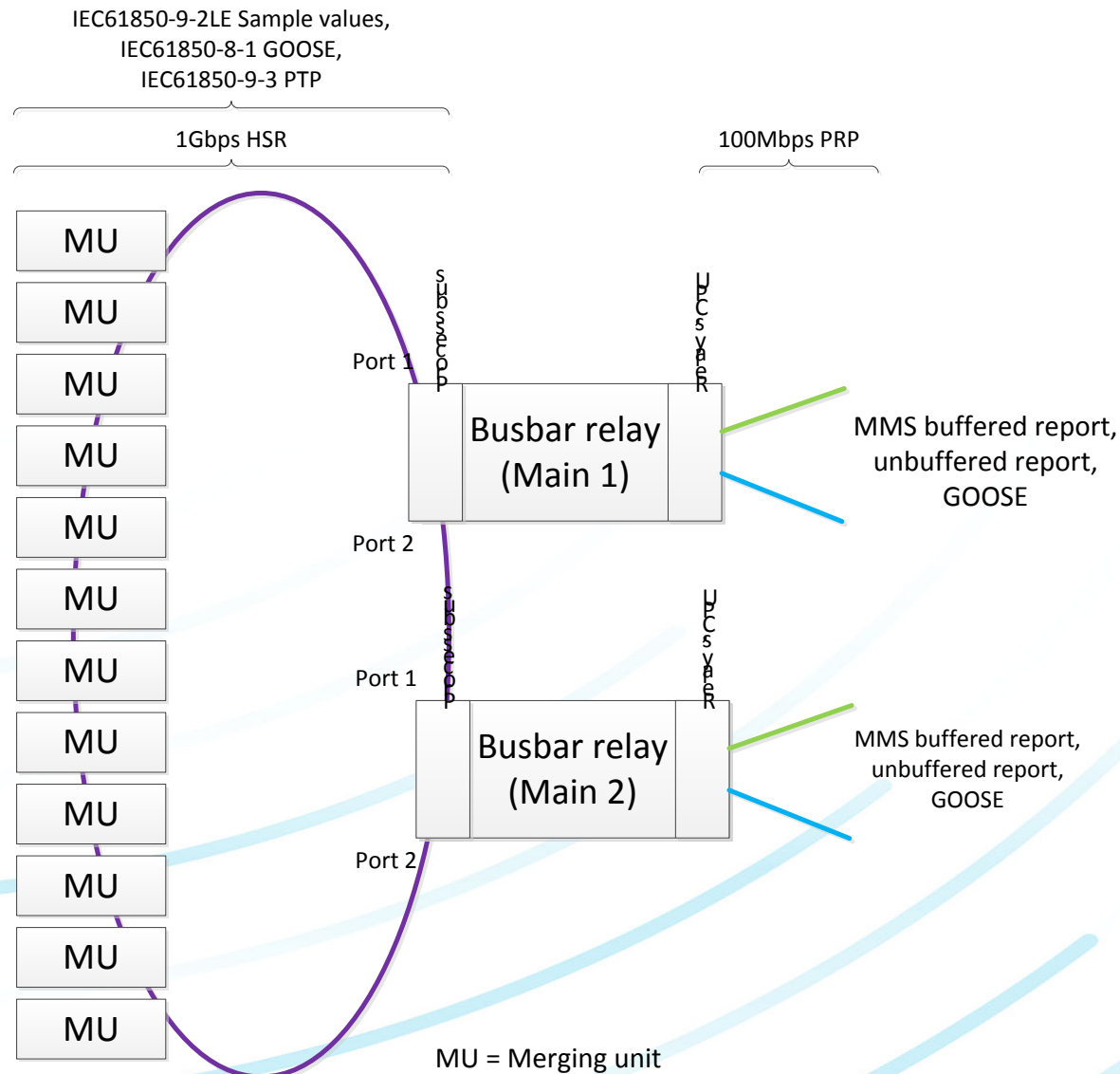
- IEC61850 simulation mode allows simulating SV and GOOSE messages to the network and only devices operating in simulation mode will subscribe to and use these simulated messages for testing purpose.
- IEC 61850 test mode allows the relay application to operate normally but all the relay outputs are blocked

# Application in Conventional substation



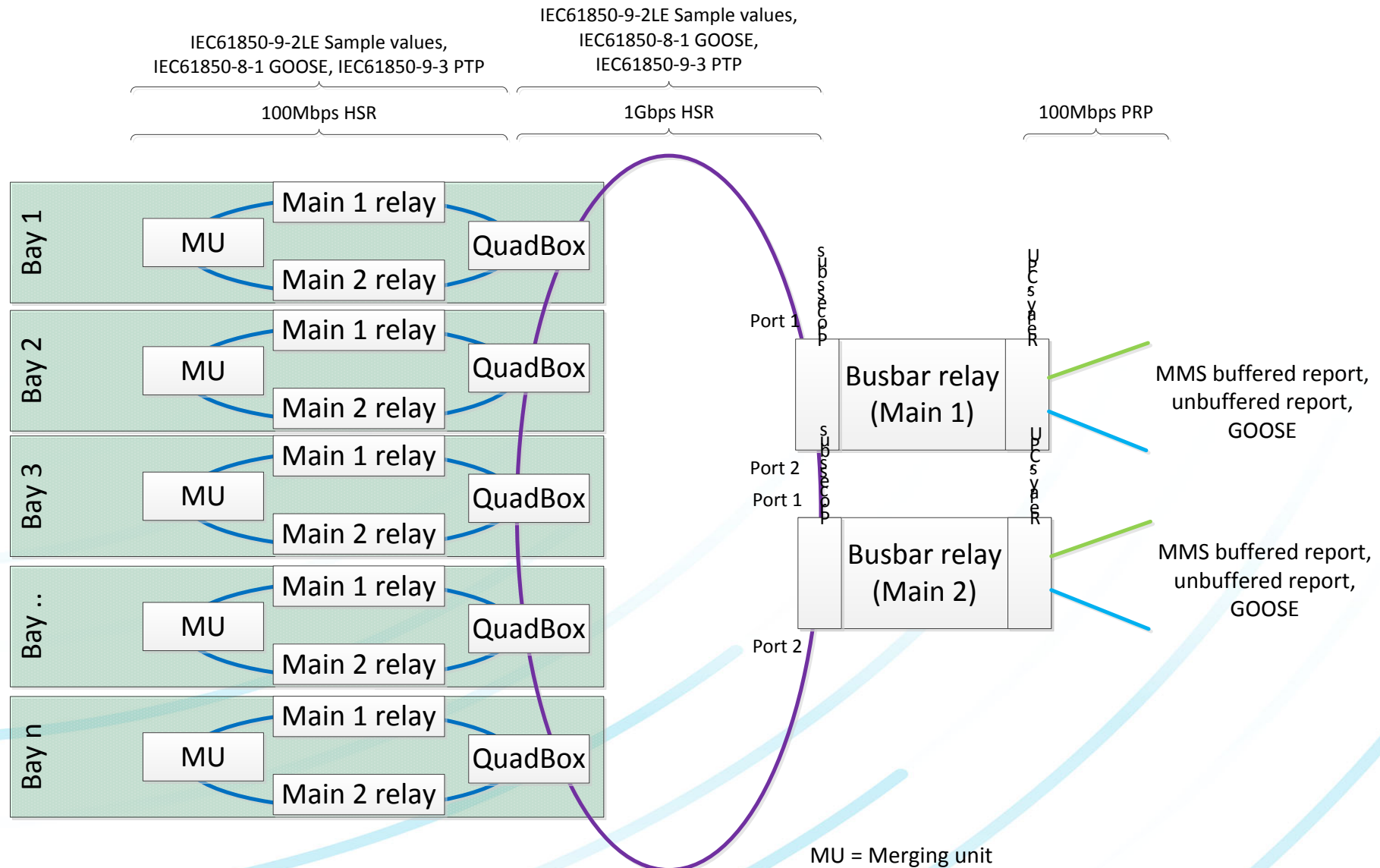
- GPS or Absolute time synchronization for protection is not normally required in the conventional substation. Process bus busbar relay can have IEEE 1588 boundary clock capability.
- All merging units are synchronized to the same source, the busbar protection relay, the sampled values streams can be 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.

# Stepping stone to digital substation



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**Thank You**

**Questions?**