Substation Engineering
Substation Automation Basics (Part 3 of 3)

Milav Dabgar

Substation Automation Basics (Part 3 of 3)

- Course: Substation Engineering (DI04009011)
- Unit 5: Substation Automation System (SAS)
- Focus: Communication Protocols (IEC 61850) & SCADA

Agenda

- The Need for Communication Protocols
- Legacy Protocols vs. Modern Standards
- Introduction to IEC 61850
- Key Concepts: GOOSE and MMS
- Network Topology in Substations
- What is SCADA?
- SCADA Integration in SAS
- Course Wrap-up for Unit 5

Why Standard Protocols?

- In the past, each manufacturer (Siemens, ABB, GE) had proprietary protocols.
- Proprietary protocols made it difficult to mix devices from different vendors.
- Utilities needed Interoperability to avoid vendor lock-in.
- Standards ensure long-term stability and easier system integration.

Legacy Protocols in Substations

- Modbus: Simple, widely used, but slow and lacks standardized data models.
- DNP3 (Distributed Network Protocol): Very common in North America, robust, but not optimized for high-speed local bay communication.
- IEC 60870-5-103/104: European standards, reliable but increasingly replaced by newer standards.

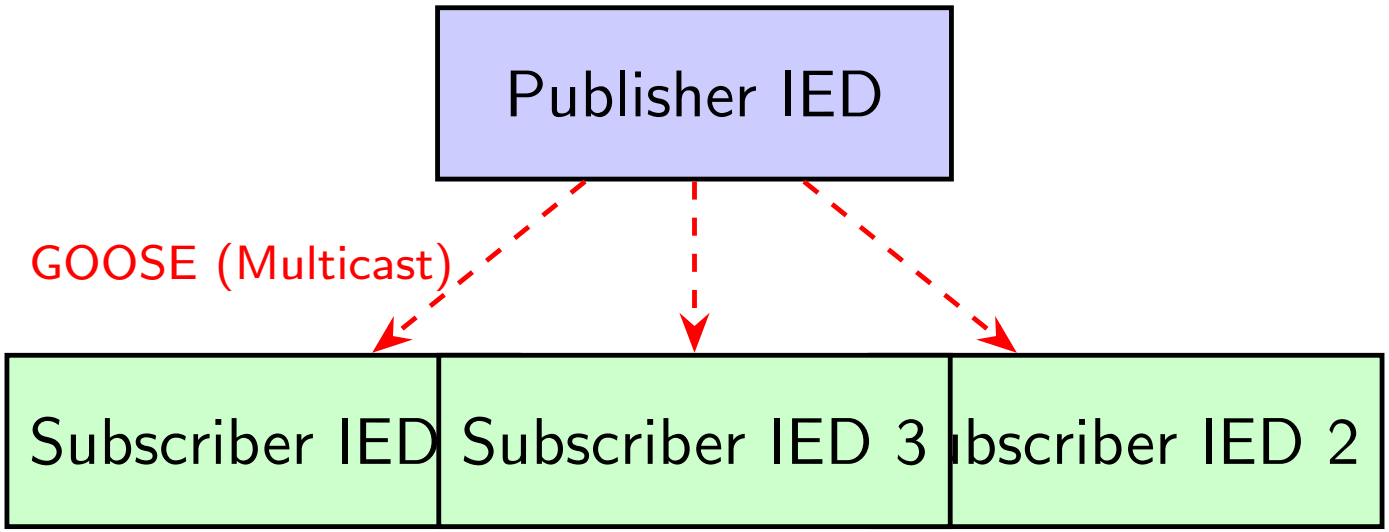
Introduction to IEC 61850

- The global standard for communication networks and systems in substations.
- Standardizes not just the protocol, but the data models and engineering process.
- Uses Ethernet as the underlying physical network.
- Achieves true interoperability between different vendors' IEDs.

Key Features of IEC 61850

Feature	Description
Data Modeling	Standardized names for data (e.g., XCBR for Circuit Breaker).
SCL Language	Substation Configuration Language (XML-based) for system design.
Ethernet Based	High speed, scalable, using standard IT network hardware.
Future-Proof	Separates data models from the specific communication technology.

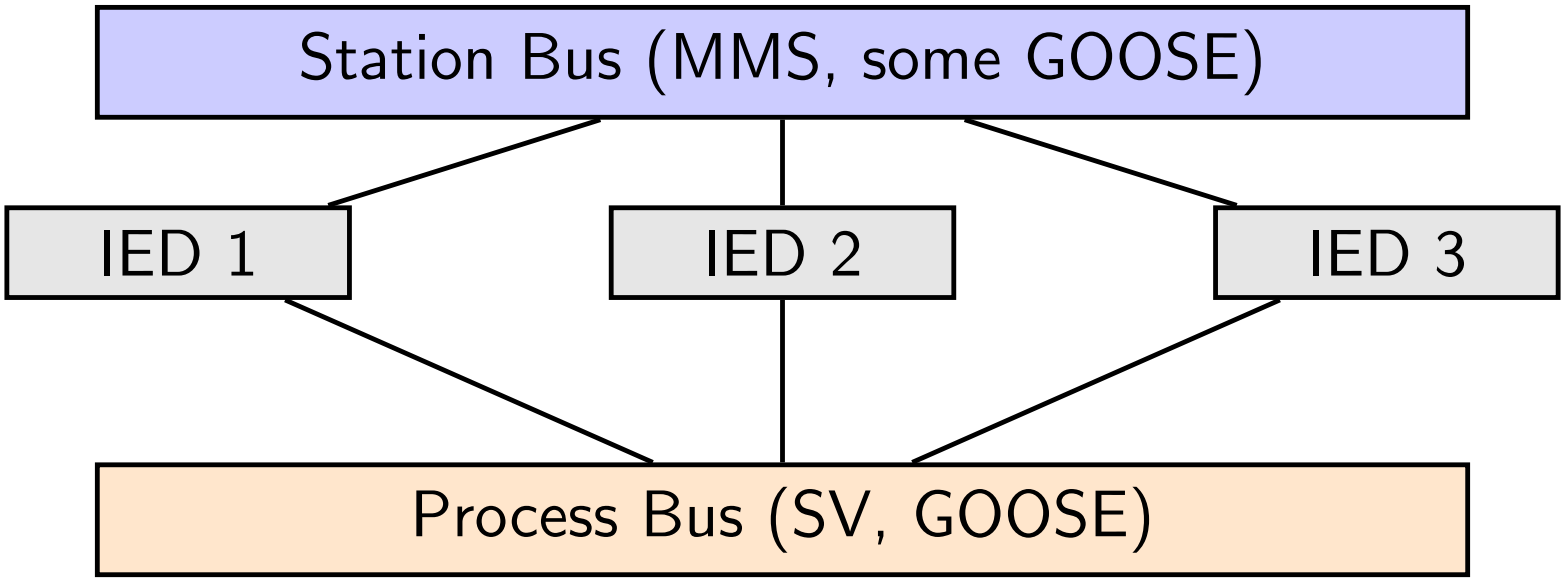
GOOSE Messaging



MMS and Sampled Values (SV)

- MMS (Manufacturing Message Specification): Used for reporting data, monitoring, and control commands from Station HMI to IEDs. Slower than GOOSE.
- Sampled Values (SV): Digitized instantaneous values of voltage and current from CTs/PTs.
- SV allows the complete digitization of the Process Level.

Substation Network Topology



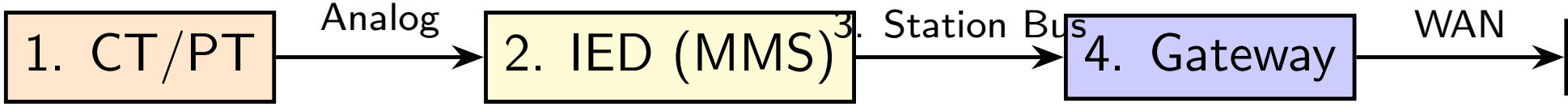
What is SCADA?

- Supervisory Control and Data Acquisition.
- A system operating at the utility's National or Regional Control Center.
- Provides operators a wide-area view of the entire power grid, not just one substation.
- Collects data from substations and allows remote control of breakers.

SAS Integration with SCADA

- The Substation Gateway acts as the bridge between SAS and SCADA.
- Gateway translates IEC 61850 data from IEDs into protocols understood by SCADA (like DNP3 or IEC 104).
- Transmits alarms, measurements, and status updates.
- Receives remote switching commands from SCADA operators.

Data Acquisition Flow



Benefits of SCADA Integration

- Faster fault location and isolation across the grid.
- Reduced need for personnel to travel to remote substations.
- Better load management and prevention of cascading blackouts.
- Historical data archiving for post-fault analysis.

Summary

- Standard protocols like IEC 61850 ensure vendor interoperability.
- GOOSE messaging allows high-speed communication for protective tripping over Ethernet.
- SCADA systems provide wide-area monitoring and control.
- Substation Gateways link the local SAS to the remote SCADA control centers.

Next Lecture Preview

- Future Trends in Substation Engineering.
- What is a fully Digital Substation?
- The impact of the Process Bus.
- Moving beyond traditional switchyards.