Using IED Data To Implement Substation Automation Functions

Reducing Costs by Reusing Available Data

Gerrit Dogger
Product and Application Specialist
Cybectec Inc.
Objectives

- Where are we and what is needed
- The benefits of using IED data
- Discussion of challenges and their solutions
- Discussion of future developments
- Real-world case study:
  Emergency power management and load restoration
Substation Evolution
1/2

Existing situation
Substation Evolution 2/2

New situation:

- IEDs for protection, measurement and control
- Substation gateway/data concentrator for communication
Automation Requirements

Substation automation functions need –

- Access to all substation data
- Control capability of substation switchgear
- A device with programming capability
Introducing the Intelligent Gateway

A communications gateway provides data access and control capabilities.

An **intelligent** gateway also provides automation capabilities.
Direct Benefits of the Intelligent Gateway

- No PLC or other additional devices needed
- Fewer devices reduce administrative costs
- No additional cabling – IEDs are already connected
- Opportunity for optimized price/performance relay configuration
  - Reinforced by the additional intelligence
- Simplified substation architecture – vendor independent
Indirect Benefits of the Intelligent Gateway

These might be more important in the long run –

- Simpler diagrams because of reduced cabling
- Less maintenance on diagrams
- Fewer devices means
  - Fewer spare parts
  - Less training
Challenges and Their Solutions

Using intelligent gateways introduces new challenges –

- Response times
- Exception handling
- Supporting redundancy
Response Times – Issues

- Data acquisition delays due to communication between gateway and IED
- Delay in command execution

**Note:** Immediate faults are handled by the IED.
Response Times – Solutions

Modern protocols reduce data acquisition delays –

- DNP3, IEC 60870-5-101, IEC 60870-5-104 use unsolicited reporting
Response Times – Solutions

Processor/task priority reduce the command delay –

- High priority for
  - Automation tasks
  - Command handling
  - IED command handling
Exception Handling – Issues

Special care needs to be taken for –

- Invalid incoming data
- Command execution error handling
Exception Handling – Solutions

Data invalidity can be handled by –

- Checking individual data point quality
- Checking the communication link status
Exception Handling – Solutions

For command execution –

- Check the protocol command acknowledgement
- Check the corresponding indications
Supporting Redundancy – Issues

Redundancy introduces additional challenges –

- Correct handling of failover situations
- Synchronization of data between the programs
- No or limited concurrent execution
Supporting Redundancy – Solutions

To ensure correct execution –
- Plan redundancy from the start
- Use internal program indications
- Use external indications – binary inputs
Supporting Redundancy – Solutions

- Fast failover needs data synchronization
- Gateway must address this issue
Supporting Redundancy – Solutions

- Both synchronized gateways might execute the program.
  - Highly undesirable
  - Should be solved in the design
Future Developments

Some trends we see developing:

- IEC 61850 – GOOSE messages can optimize interaction
- Communication availability
  - Substations can share more data
  - This enables region-wide automation
Real-World Case Study: Emergency Power Management and Load Restoration
REDUNDANT CONTROL CENTERS

REDUNDANT GATEWAYS

INCOMER UNDervoltage PLCs

EDG MCP

GENERATOR breaker IEDs

FEEDER IEDs
Initialization and IDLE state

Blackout: open feeders

Feeders open: Start generators

Retry feeders that didn’t close

Power: Close feeders (priority based)
Emergency Power Management and Load Restoration

Basic facts

- Put into service in November 2005
- Normal conditions: restore power within 1 minute
  - Mainly waiting for generators to come online
- Failover condition: restore power within 1.5 minutes
Concluding Remarks

Benefits

- No additional hardware
- Uses existing data and wiring
- Fewer spare parts
- Lower administration costs –
  - Minimal training needed
- Everything is available to implement it now
- Proven concept
Concluding Remarks

Development

- Better interaction using IEC 61850 GOOSE messages
- Upcoming opportunities for region-wide automation
Contact Information

Gerrit Dogger
Product and Application Specialist
Cybectec Inc.
Gerrit.Dogger@Cybectec.com
Questions?