Testing and commissioning advantages of GOOSE and SV messaging

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Questions

> What are we doing?
> Why are we doing it?
> How are we doing it?
What are we doing?

> Improving the efficiency of testing
Why are we doing it?

> To improve the reliability of the electric power system
> To reduce the duration of outages
> To improve the efficiency of the use of the time of testing crews
> To improve safety
Conventional interface
Conventional Substations
CT Explosion
Optical sensor interface
Optical CT in France
Protection panel in France
Optical CT in Scotland
Protection panel in Scotland
Conventional Isolation
Digital substation
Process Bus interface
Conventional Test Setup

- Ethernet Switch
- Test Computer
- GOOSE and SV
- IEC 61850 Based IED
- IEC 61850 Based Test Device

IEC 61850 Based IED
Testing an IED

Control service

Test=FALSE
Test=TRUE

GOOSE (data interpreted as control)

q.test=FALSE
q.test=TRUE

Mod=ON ✓
Mod=ON ✗
Mod=TEST ✓
Mod=TEST-BLOCKED ✓

Wired output

✓
✗
✓
✗
Simulation Bit

Simulation Device injects signal with the simulation bit set to TRUE

Simulation Bit = true

Actual Devices inject signal without the simulation bit set to TRUE

Goose 1

Goose 2

Goose 3

Incoming data processed

IED1

LPHD1

Sim sfVal=true

Goose 1

Goose 2

Goose 3

Reception Buffer

XXYZ1

Beh sfVal=true
The CDC of data
InRef1 is "ORG" -
Object Reference Setting

InRef1
- srcRef = PTRC1.Tr.general
- dstRef = GGI01.ind1.stVal
- IsIEna = true

Incoming test signal
E.g. GGI01.ind1.stVal

Incoming actual signal
E.g. PTRC1.Tr.general

Incoming data processed
Ed. 2 Mirroring Control Info

A. Command is sent to Data Object

B. Response is to set the Data Attribute “opRcvd”

C. “opOk” is set with same timing as wired output

D. “tOpOk” has same time stamp as wired output and “opOk”.

E. The attributes are produced independent of the wired output

F. Wired Output is Not produced if MOD=TEST-BLOCKED
Ed. 2 Mirroring Control Info

IED

Control service

opRcvd

opOk

tOpOk

ctlVal

Wired output
Complete Test Isolation

> Simulation Flag and Test Mode

- Simulation Flag and Test Mode
- Complete Test Isolation

MOD = ON
LPHD.Sim = False

MOD = Test

SV (Sim = False)

SV (Sim = True)

MOD = ON

SV Test Set
Trip GOOSE
q.test = true

Substation Network

SV (Sim = True)

Merging Unit

SV (Sim = False)

MOD = ON

Breaker IED

Electrical Power System

Circuit Breaker

Protection IED

Protection IED

Test Set
Complete Test Isolation

> Simulation Flag and Test Mode

- **LPHD.Sim = False**
- **MOD = ON**
- **LPHD.Sim = True**
- **SV (Sim = False)**
- **SV (Sim = True)**
- **SV MU**
- **SV Test Set**
- **OpOk, tOpOk**
- **MOD = TEST-BLOCKED**
Optical sensor test

- Test Computer
- Ethernet Switch
- IEC 61850 Based MU
- NCIT
- Current Booster
- Primary Test Device
9-2 based interface test
Commissioning of protection IEDs

- GPS Clock
- Test Computer
- Ethernet Switch
- IEC 61850 Based Test Device 1
- IEC 61850 Based IED

Links:
- GPS Clock to Test Computer
- Test Computer to Ethernet Switch
- Ethernet Switch to IEC 61850 Based Test Device 1
- IEC 61850 Based Test Device 1 to IEC 61850 Based IED
Why do we need remote testing?
The benefits

- No travel time
- Minimum setup time
- Independent of weather conditions
- Improved PACS availability
- Reduced outage time
The challenges

> Changes in test philosophy
> Changes in test procedures
> Test object and test system isolation
> Test equipment availability in the substation
> Remote access capability
> Cyber security
Conclusions

> Testing of digital substations with GOOSE and SV messages offers significant advantages

> It improves the efficiency of the testing process during commissioning

> Remote testing can be implemented in IEC 61850 based digital substations

> It allows a significant improvement in the efficiency of maintenance testing