

First Experiences With IEC 61850 Edition 2 Testing

Richard Schimmel

DNV GL - Energy (previously KEMA), the Netherlands

richard.schimmel@dnvgl.com

PAC World Conference Zagreb, 23-26 June 2014

KEYWORDS

IEC 61850, Edition 2, conformance testing, certificate

ABSTRACT

This paper describes what has changed from Edition 1 to Edition 2, the basis for the edition 2 server conformance testing, which parts have been implemented in the Edition 2 tested devices from Siemens, ABB and Alstom at the time of writing (May 2014) and what test procedures need to be developed.

1 INTRODUCTION

In 2008-2012 the IEC 61850 Edition 2 part 6, 7-1, 7-2, 7-3, 7-4, 8-1 and part 10 are published. As can be expected the first manufacturers have implemented Edition 2 in their devices now. Also the UCA international user group published the Edition 2 server conformance testing procedures. The protocol competence & test centre from DNV GL (previously known as KEMA) has executed several Edition 2 conformance tests on devices from Siemens, ABB and Alstom.

This paper describes what has changed from Edition 1 to Edition 2, the basis for the edition 2 conformance testing and which changes have been implemented in the Edition 2 tested devices from Siemens, ABB and Alstom and what test procedures need to be developed.

2 WHAT HAS CHANGED IN EDITION 2

The changes from First Edition to Edition 2 are grouped as: Data model, Communication and SCL.

Data model changes:

- Scope changed from substation to “power utility”
- Many Logical Nodes from outside the substation and power quality have been added
- Hierarchy of logical devices using the GrRef data object. This enables to turn on/off certain protection functions using LLN0.Mod
- Private extensions are now limited to private Logical Nodes and Data Objects
- Added protection settings to all Pxxx logical nodes

Communication changes:

- Extended name length to 64/64 (mandatory)
- Switch the subscription of Simulated GOOSE <> Real GOOSE using the LPHD.SimSt
- GOOSE fixed length encoding to improve performance
- Service tracking; one client can monitor what other client(s) are doing
- Supervision Logical Nodes:
 - GOOSE subscription supervision = LGOS
 - Sampled Values subscription supervision = LSVS
 - Time management and supervision = LTMS, LTIM
- Well defined situations for each error code
- More precise control and reporting specifications
- Clarified the use of Mod = test and Operate with Test=True
- Improved Local / Remote on local, station and remote level

SCL changes:

- Many new SCL attributes to improve the exchange between SCL tools
- Indexing of report control blocks is specified in SCL
- SCL schema = 2007B.Jan 2014
- New SCL file extension
 - “.iid” = Instantiated IED description
 - “.sed” = System Exchange Description to support system tools from different projects
- Setting group editing: FC=SE (was FC=SG)

3 TESTING EXPERIENCES

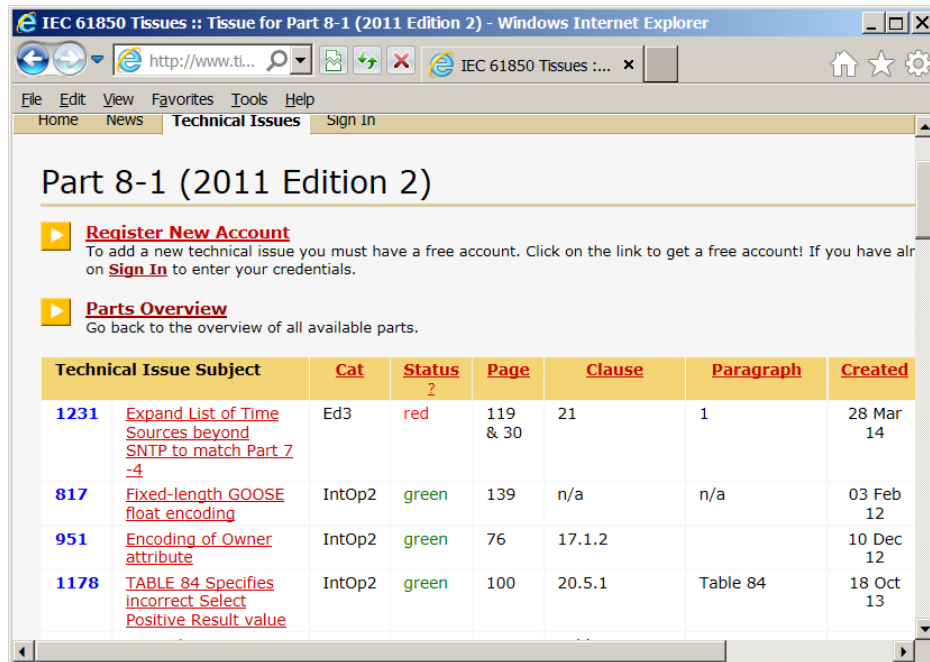
3.1 Reference for conformance testing

To execute a conformance test and issue certificates the test labs need a stable reference for the testing. These references are:

- IEC 61850 Edition 2 parts 6, 7-x, 8-1
- “IntOp2” technical issues (TISSUES)
- UCAIUG Server Ed2 Conformance Testing Procedures, version 1.0
- UCAIUG Test Procedures Change List (TPCL)
- SCL schema, version 2007B

During the editing of the test procedures and also during the testing several technical issues have been raised to clarify the certain parts of the standard. It’s important to know which technical issues are mandatory for the conformance testing. This is a task for the WG10 editors to indicate the technical issue “category”. The category “IntOp2” is mandatory to implement.

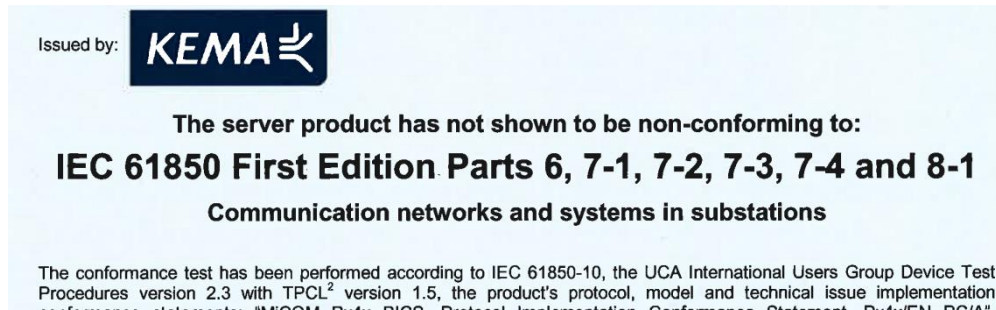
The tissue database with IntOp2 issues:



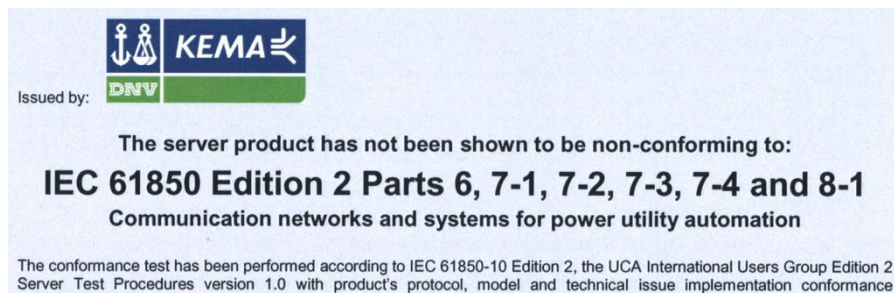
| Technical Issue | Subject | Cat | Status | Page | Clause | Paragraph | Created |
|-----------------|---|--------|--------|----------|--------|-----------|-----------|
| 1231 | Expand List of Time Sources beyond SNTP to match Part 7-4 | Ed3 | red | 119 & 30 | 21 | 1 | 28 Mar 14 |
| 817 | Fixed-length GOOSE float encoding | IntOp2 | green | 139 | n/a | n/a | 03 Feb 12 |
| 951 | Encoding of Owner attribute | IntOp2 | green | 76 | 17.1.2 | | 10 Dec 12 |
| 1178 | TABLE 84 Specifies incorrect Select Positive Result value | IntOp2 | green | 100 | 20.5.1 | Table 84 | 18 Oct 13 |

A similar effort is required to clarify and enhance the server test procedures. This is a task of the UCA international users group – IEC 61850 testing subcommittee. This group maintains a list of test procedures changes, the so-called “TPCL”. The TPCL version is specified on the certificate.

First edition certificate with TPCL reference:



Edition 2 certificate without TPCL reference:



Note that the certificate for First Edition and Edition 2 look very similar.

The SCL schema used for the test (version 2007B) can be downloaded from WG10 sharepoint. It's an IEC 61850-6 copyright issue that prevents publishing it on the ucauig sharepoint.

3.2 What has been implemented

Most Edition 2 features are optional to implement. Below table indicates which device has implemented the feature.

| Edition 2 feature | Device X | Device Y | Device Z |
|-----------------------------|-----------------|-----------------|-----------------|
| Time management: LTMS/LTIM | Y | Y | Y |
| GOOSE supervision: LGOS | - | Y | - |
| Service tracking | Y | - | Y |
| Simulated <> real GOOSE | Y | Y | - |
| Grouping of logical devices | Y | Y | Y |
| Protection settings | - | - | Y |

The table shows that at least each feature has been implemented in at least one device, however not in all devices. As such it's up to the utilities to add a requirement into their specification to encourage vendors to implement certain Edition 2 features.

4 **NEXT STEPS**

The conformance testing of Edition 2 server is the first step. The next steps are to develop Ed2 test procedures:

- GOOSE performance test procedures
- Finalize the conformance test procedures for Client
- Improve the conformance test procedures for Server (test procedure change list TPCL)
- Sampled value publisher test procedures

Of course we expect more and more devices will support Edition 2 and therefore test labs will perform more Ed2 conformance tests in the future. As such manufacturers, IEC, UCAIUG and test labs are gaining more experiences that will further improve the quality of the standard and implementations.