PAP – 12

MAPPING IEEE 1815 (DNP3) TO IEC 61850 OBJECTS

December 6, 2011
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Grant Gilchrist, EnerNex
Ron Farquharson, EnerNex
Agenda

- Introductions
- NIST Remarks – Jerry FitzPatrick
- Framework 2.0 Draft status - Jerry FitzPatrick
- Overview and status of the PAP effort - Ron
- Catalog of Standards Status - Ron
- Review of last Meeting Notes – Ron
- CSWG and SGAC reviews - Ron
- IEEE WG C12 and DNP TechComm – IEEE Std 1815
  - Document update status – Lee Smith, Ron or Lorene
  - Current schedule – Lee Smith, Ron or Lorene
  - Update Secure Authentication section to SA Ver 5 - Grant
  - Comments and discussion - Open
- IEEE WG C14 – IEEE Std P1815.1
  - Document/chapter development status – Ron, Grant Gilchrist, Jim Coats, Christoph Brunner
  - Current schedule - Ron
  - Comments and discussion - Open
- TWiki updates
- New items, actions and next meeting
• NIST Remarks – Jerry FitzPatrick
• Framework 2.0 Draft status - Jerry FitzPatrick
PAP-12 Update

- Overview and status of the PAP effort - Ron
- Catalog of Standards Status - Ron
- Review of last Meeting Notes – Ron
- CSWG and SGAC reviews – Ron
- TWiki Updates
IEEE 1815 (DNP3) is the de facto communication protocol for T&D data (operations) communications. IEC 61850 offers many enhancements that will support important applications and provide significant life cycle savings in the future.

Focus of the PAP is defining mapping rules and functions for the gateway devices in substations that will connect DNP devices and systems to IEC 61850 devices and systems.

Primary initial applications will be within substations that are converting from DNP to IEC 61850 but still connecting a DNP based SCADA master or Energy Management System (use case A).

Growing list of IEC 61850 companion standards addressing: communications outside of substations, control centers, DER, phasor data, other
PAP12: Overview of Tasks and Status

- Develop Use Cases (done)
- Develop Requirements (done)
- Coordinate CSWG and SGAC reviews (close)
- Keep industry informed (doing it)
- Create IEEE working group (done, C12, C14)
- Help develop IEEE 1815.1 mapping specification
- Propose joint-logo to IEC as IEC 61850-80-2
- Propose any necessary standards changes
  - IEEE 1815: DNP Technical Committee
  - IEC 61850: IEC TC57 WG10
- If applicable, develop user guides and examples
PAP-12 SGIP Activities

- Review of last Meeting Notes
- Catalog of Standards Status – IEEE Std 1815-2010
  - Full document set completed and posted on CoS TWiki page
  - IEEE Std 1815-2010 – GB was successful – Nov 30
  - IEEE Std 1815-2010 – SGIP vote is pending (correction)
- Cyber Security Working Group (CSWG):
  - CSWG liaison to PAP-12 is Frances Cleveland
  - CSWG review of DNP3 SA Version 5 pending
  - Preliminary detailed review of P1815.1 is completed
- Smart Grid Architecture Committee (SGAC):
  - SGAC liaison to PAP-12 is Steve Behrens, KEMA
  - Preliminary detailed review of P1815.1 is pending
- TWiki Updates
IEEE WG C12 & DNP TechComm –
IEEE Std 1815 – 2010 & IEEE P1815 Update

• Document update status and summary of changes since 2010 – Lee Smith, Ron or Lorene
• Current schedule – Lee Smith, Ron or Lorene
• Update on DNP3 - Secure Authentication (SA) Version 5 - Grant
• Comments and discussion - Open
Schedule for update to IEEE Std 1815

The current schedule is as follows:

- Draft 6 ready for WG review – end of November 2011, Draft 7 to be posted Dec 5, 2011
- IEEE WG C12 review focused on “major” items to be completed by Dec 31, 2011 for voting at IEEE JTCM on January 9, 2012
- New PAR voted and agreed
- Ballot group formation is underway (42 to date) and closes on January 6, 2012.
- Balloting will open after JTCM in January
IEEE P1815 - PAR Update

- **Title:** No change, other than to the year (will be 2012)
- **Purpose:** No change
- **Minor change to the Scope and Abstract requested, as follows:**

This document specifies the DNP3 protocol structure, functions, and interoperable application options (subset levels). The specified subset level defines the functionality implemented in each device. The simplest level is intended for basic devices. More advanced levels support increasing functionality. The protocol is suitable for operation on a variety of communication media consistent with the makeup of most electric power communication systems.
Major Changes from IEEE Std 1815-2010 to P1815-2012

- Secure Authentication:
  - Replacement of Clause 7 Secure authentication,
  - addition of Subclause 11.9.10 Security statistics point type,
  - addition of object group 120 variations 9-15,
  - addition of object group 121 variation 1,
  - addition of object group 122 variations 1-2.

- Subclause 3.1 Definitions: Changes/additions
- Subclause 8.2.1.4 [Transport Function] Rules, Table 8-1: Changes
- Counter processing rules: Addition of Subclause 11.9.5.7
- Changes to IED and Master startup sequences: Subclauses 5.1.1.1.2 & 5.1.1.2
- Addition of “Parsing Codes” links to all Objects
- Clause 9 Data Link Layer: General updating/improvements
- Updates to Object group 60 variations 1 to 4
Next Steps – Page 1 –
Update to IEEE Std 1815-2010

- IEEE editorial work is nearly complete – final pending
- WG review C12 members have the document (Ver. 6) and the comment form (earlier e-mail from Ron)
- Matt will post Doc Ver. 7 will be available on IEEE SA website by Dec 5
- Goal is to complete review before the JTCM (January 6, 2012)
- WG C12 will vote on the standard at the JTCM (January 9, 2012)
- Major comments will be incorporated with a new version prior to January 6th if necessary. Major comments must be received by December 31st.
- Request that WG members defer minor comments until sponsor balloting process commences.
- Use the comment form for all comments and send to Lorene, Matt, and Ron
The WG review should look at the most critical areas impacting users.

The most critical update is Secure Authentication V5.

**Action:** Lorene will contact Sherman and request a list of the areas that were changed and send to Matt and Ron for forwarding to the WG with notice of V7.

New PAR Scope wording was developed during this meeting – see slide.

WG voted and approved the revised for the PAR scope.

Ballot group is currently in formation.


42 people have joined ballot group as of Dec 2.

Plan to commence balloting after JTCM.
IEEE WG C14 – IEEE Std P1815.1

- Document/chapter development status – Grant, Ron, Jim Coats, Christoph Brunner
- Current schedule - Ron
- Comments and discussion - Open
Updated Topology Diagram – Use Case A
Updated Topology Diagram – Use Case B

DNP Mapping to IEC 61850 Objects
Use Case B

EMS
Operational historical database

EMS
Remote access
to/from field

Corporate firewall
Non-Operational historical database

Remote access
to/from field

EMS firewall

Alarm and analysis data from EMS

Other Enterprise applications

61850 Client

61850 Server
DNP Outstation
Substation Data Manager

Substation Access Control Device

Utility private or leased network

61850 to/from EMS
Remote access
Non-Operational data

Substation Network

DNP Outstation
DNP Outstation
Substation HMI

DNP Outstation

DNP3

Wireless network

Data transfer legend:
Remote Access
EMS to/from remote
EMS data to Enterprise Applications
EMS historical data
Non-Operational historical data

Each user is responsible for implementing his network design in compliance with applicable security policies and standards.

Figure 2 – Use Case (b) Topology
# IEEE 1815.1 – Document Status

<table>
<thead>
<tr>
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<tr>
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<td>3</td>
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<td>7</td>
<td>Mapping of data structure</td>
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NIST and the Smart Grid Interoperability Panel (SGIP) are asking that we work as quickly as possible to put this standard in place. The current schedule is as follows:

- WG C14 is close to complete (meeting) note reviews
- Plan is for full draft ready for WG review and voting – by December 19, 2011
- Objective - CSWG and SGAC preliminary detailed reviews complete – by January 31, 2012
- Complete WG review and IEEE editorial update by January 31, 2012
- Ready for first ballot – February 2012
Use Case (a)

INPUT
Capabilities
Files
- DNP Master
  - DNP Master
- DNP Outstation
  - DNP Outstation
- Gateway
  - Gateway
- IEC 61580 Client
  - IEC 61580 Client
  - IEC 61850 Device
  - IEC 61850 Device
  - IEC 61850 Device
  - IEC 61850 Device

OUTPUT
System Files
- DNP XML
  - DNP XML with IEC 61850 names
- IEC 61850 SCD
  - IEC 61850 SCD with private DNP info

DNP-XML
- DNP-XML
- DNP-XML
- IEC 61850 ICDs
- IEC 61850 Device
- IEC 61850 Device
- IEC 61850 Device
- IEC 61850 Device

DNP-XML
- DNP-XML
- DNP-XML
- DNP-XML
- DNP-XML
DNP Mapping Use Case (a1)

1. Configure IEC 61850 Substation
   - Device ICD Files
   - User Input

2. Find DNP Link Capabilities of Gateway
   - DNP-XML Capabilities of Master
   - User Input

3. Choose IEC 61850 Data
   - SCD of IEC 61850 Substation
   - Chosen Mapping Rules

4. Gateway Mapping Process
   - SCD with Mapping in Private Sections
   - Chosen Data

5. Configure Master

6. Finish Configuring Gateway
   - DNP-XML file(s) For Gateway
   - SCD Interop 2011 TM

- DNP-XML with Only Proprietary
**DNP Mapping Use Case (a2)**

1. Configure IEC 61850 Substation

2. Identify Required Data

3. Choose IEC 61850 Data

4. Gateway Mapping Process

5. Configure Master

6. Finish Configuring Gateway

**Device ICD Files**

**User Input**

**List of Required Data**

**Mapping Rules**

**SCD of IEC 61850 Substation**

**SCD with Mapping in Private Sections**

**DNP-XML file(s) For Gateway**

**DNP-XML Requirements of Master, including required points list**

**User Input**
Use Case (b)

INPUT
Capabilities
- Files
  - Desired IEC 61850 ICD
- DNP-XML

OUTPUT
System Files
- IEC 61850 SCD with mapping
- IEC 61850 IID with mapping
- DNP-XML File(s) with mapping

Gateways

IEC 61580 Client

IEC 61580 Server

DNP Master

DNP Device
DNP Device
DNP Device
DNP Device
DNP Mapping Use Case (b)

1. Configure Gateway DNP Master

2. Create IEC 61850 Model

3. Gateway Mapping Process

4. Configure Client

5. Finish Configuring Gateway

Choose database points

Mapping Rules

ICD of Gateway IEC61850 Server

Gateway Database Point Map

SCD with mapping

IID with mapping in private sections

DNP-XML for each DNP device

DNP-XML files with mapping

Grid-Interop 2011

User Input

User Input
## Data Structure Mapping (SPS)

### Preferred DNP3 Implementation

<table>
<thead>
<tr>
<th>Data Attribute Name</th>
<th>First Choice</th>
<th>Second Choice</th>
<th>Use Case (a) Mapping IEC 61850 Substation to DNP3 Master</th>
<th>Use Case (b) Mapping DNP3 Substation to IEC 61850 Client</th>
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### Data Structure Mapping: “Leaf” Mapping Rules

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Service Mapping - SBO Enhanced

Select (0x03)
CROB (g12) or Analog Output (g41)

Response (0x81)
CROB (g12) or Analog Output (g41)
Status Code=SUCCESS

Operate (0x04)
CROB (g12) or Analog Output (g41)

Response (0x81) or Unsolicited (0x82)
Binary/Analog Cmd Output Event (g13, g43)

Response (0x81)
CROB (g12) or Analog Output (g41)
Status Code=SUCCESS

Response (0x81) or Unsolicited (0x82)
Binary/Analog Cmd Output Event (g2, g4, g32)

Response (0x81) or Unsolicited (0x82)
Binary/Analog Output Event (g11, g42)

Optional in DNP3 Level 1-3