IEEE PES-TR74 Report Overview

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April 15, 2021 NASPI Meeting
Presentation Agenda

Background
- IEEE Std C37.118.2™-2011
- IEC 61850-90-5

Report Overview
- Use cases, conceptual architecture, and data, configuration, and control message exchange
- Detailed mapping overview

Takeaways & Outlook
- Key takeaways
- Current synchrophasor data transfer protocol related standardization activities

Source: https://resourcecenter.ieee-pes.org/publications/technical-reports/PES_TP_TR74_PSCC_012020.html
Phasor Measurement System

**Communication standards**
- IEEE C37.118.2
- IEC 61850
- DNP3, ICCP, etc.

**Measurement standards**
- IEEE C37.118.1
- IEC/IEEE 60255-118-1

**Future real-time controls:**
- PMUs
- Data storage standards “COMTRADE”

**Real Time Monitoring & Alarming**

**Off-line Dynamics Analysis**

**Other utility PDC**

**Phasor Data Concentrator**

**3rd Party EMS**
IEEE Synchrophasor Standards

- IEEE1344-1995, first standard
  - Focus on sampling & timing

- IEEE C37.118 – 2005, second standard
  - Measurement requirements--
    - Test method & error limits specified
    - Steady-state phasor only
  - Data transmission format--
    - Comprehensive status and error indications
    - Allows transmitting data aggregated from multiple PMUs
    - Adaptable for network communication
Synchrophasor System Growth

- Large growth in phasor measurements after 2003 blackout in N. America & others around world
  - IEEE & IEC interested in harmonization of standards for synchrophasor applications

- IEC considered adoption of C37.118
  - C37.118 includes measurements and communications
  - IEC separates communication and measurement into separate technical committees and thereby has separate standards
  - Therefore adoption or direct harmonization were not possible

- In 2008 IEEE split C37.118-2005 split into two standards to facilitate joint development or adoption
IEEE Synchrophasor Standard Changes

- IEEE C37.118-2005 split into 2 standards:
  - C37.118.1 – 2011 (& 2014 amendment)
    - Measurements only
    - Dynamic operation qualifications added
    - Frequency & ROCOF included in qualification tests
  - C37.118.2 – 2011
    - Preserved existing data exchange
    - Added needed improvements (flags & configuration)

- Note: C37.118.1 is now superseded by IEC/IEEE 60255-118-1
WG10 (IEC TC57) developed TR 61850-90-5

- Based on use cases of established synchrophasor uses and applications
- Changes included --
  - Routable mapping of SV
  - New models for logical node & PDC function
  - New A & T profiles
  - New data classes & object types
  - Advanced security features

Completed October 2011, published May 2012
When one protocol is used, data exchange is a simple send-receive process.

When exchanged data between systems/devices using different protocols:
- Some "Translation" (or "Mapping") will be needed.
Work started in 2013 to develop a report with an intention to potentially develop it into a standard
  - IEEE C37.118.2 ↔ IEC 61850-90-5

During the development, some changes to the two standards occurred
  - IEC integrated key components of TR 61850-90-5 into main parts of 61850 Ed.2.1
  - IEEE C37.118.2-2011 update has started

Decision was made to keep it as a report but make some adjustment to take changes in IEC 61850 into account

Source: IEEE PES-TR74 Report
Use Cases for Mapping

**Use Case A**

61850 ➔ C37.118.2

**Use Case B**

C37.118.2 ➔ 61850

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**Use case A**: An IEEE C37.118.2 system receiving PMU data from an IEC 61850/90-5 system, i.e. IEC 61850/90-5 ➔ IEEE C37.118.2

**Use case B**: An IEC 61850/90-5 system receiving PMU data from an IEEE C37.118.2 system, i.e. IEEE C37.118.2 ➔ IEC 61850/90-5

Note: Required cyber security measures such as firewalls are not illustrated for simplicity.

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Source: IEEE PES-TR74 Report

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Recommend to address both use cases using gateway functions
Use Case Conceptual Architecture

**Use Case A**
61850 → C37.118.2

**Use Case B**
C37.118.2 → 61850

Source: IEEE PES-TR74 Report
Data, Configuration, and Command Exchange for Each Use Case

Use Case A

61850 ➔ C37.118.2

Use Case B

C37.118.2 ➔ 61850

Source: IEEE PES-TR74 Report
Recommended Detailed Mapping

### Dataset mapping
- (Stream or Source or PDC) ID code
- Number of PMUs in the data stream
- A Time Stamp that includes
  - Second of Century
  - Fraction of Second
  - Time quality indicator
- A 16-bit Status WORD
- Synchrophasors
- Frequency
- ROCOF
- Analog values
- Digitals

### Configuration mapping between CFG-2 (and CFG-3) and the IEC 61850 SCL:
- Stream ID Code (single PMU or PDC)
- Number of PMUs in the stream
- Time base
- **Station name of a PMU dataset**
- Source ID code of a PMU dataset
- Global PMU ID of a PMU dataset (a CFG3 data item – Needs to be added to 61850)
- Data format of a PMU dataset (Note: all data in a 61850 SV frame is to be in Float format)
- Number of phasors in a PMU dataset
- Number of analog values in a PMU dataset
- Number of digital status words in a PMU dataset
- **Signal channel names (Note: 61850 has standard names for the Synchrophasor Data Objects; names from C37.118.2 should be mapped into the Description fields of these standard Data Objects)**
- Phasor conversion factors with flags (only used when mapping Integer data from C37.118.2)
- Analog signal conversion factors (Note: CFG2 ANunit is ambiguous)
- Mask words for digital status words
- PMU location – Latitude (CFG3 only)
- PMU location – Longitude (CFG3 only)
- PMU location – Elevation (CFG3 only)
- PMU service class – Note: this data is not available in a CFG2 message. It is proposed that Service Class be incorporated in the STN.
- Phasor measurement **window length**
- Phasor measurement **group delay**
- Nominal frequency (Should be part of LLN0)
- Configuration count
- Data rate

“Global PMU ID”, “Window Length (in µsec)”, and “Group Delay (in µsec)” are not mapped!

**Control messaging** and **security requirements** are not mapped!
Key Takeaways

When systems and communication capabilities expand

- Protocol update and extension
- Discontinue obsolete methods
- Develop new protocols

Increased need for standardized protocol
“Translation” or “Mapping”
Development of systems and methods continues to meet user needs

C37.118.2 revision
- Clear up ambiguities such as status indications
- Add new features including discrete event frame, more status indications, measurement quality, remote configuration, & missing data retrieval

P2664 standard (STTP)
- Publisher-Subscriber operation
  - Easier to manage data exchanges
- Measurement value oriented rather than PMU
  - Reduced data loss & simplifies data set management
- Easier to integrate multiple data rates & types
- Uses standard IT managed network systems and methods (TCP & UDP/IP protocols)
Thank You!

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