

IEC 61850-90-5 Implementation at PG&E

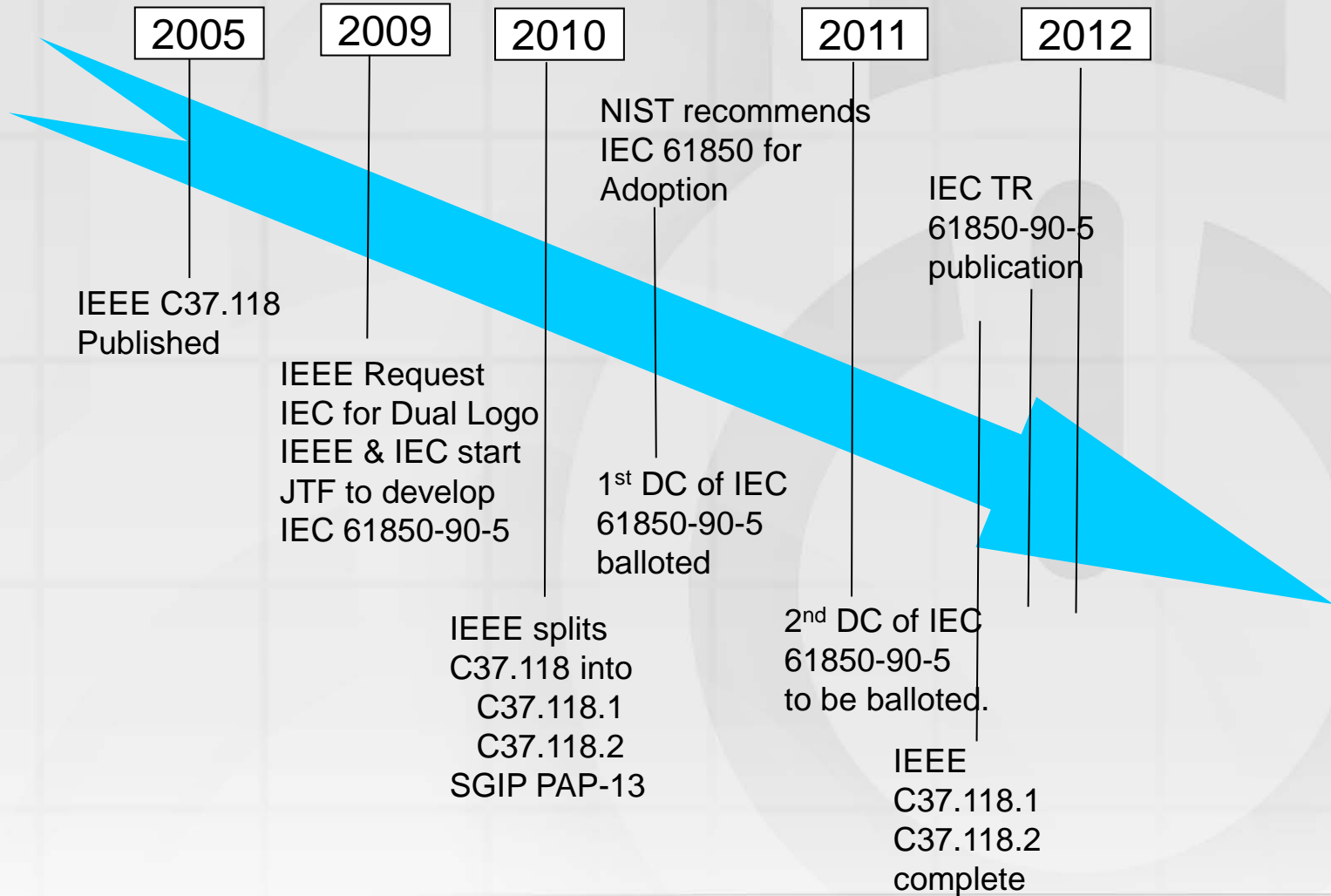
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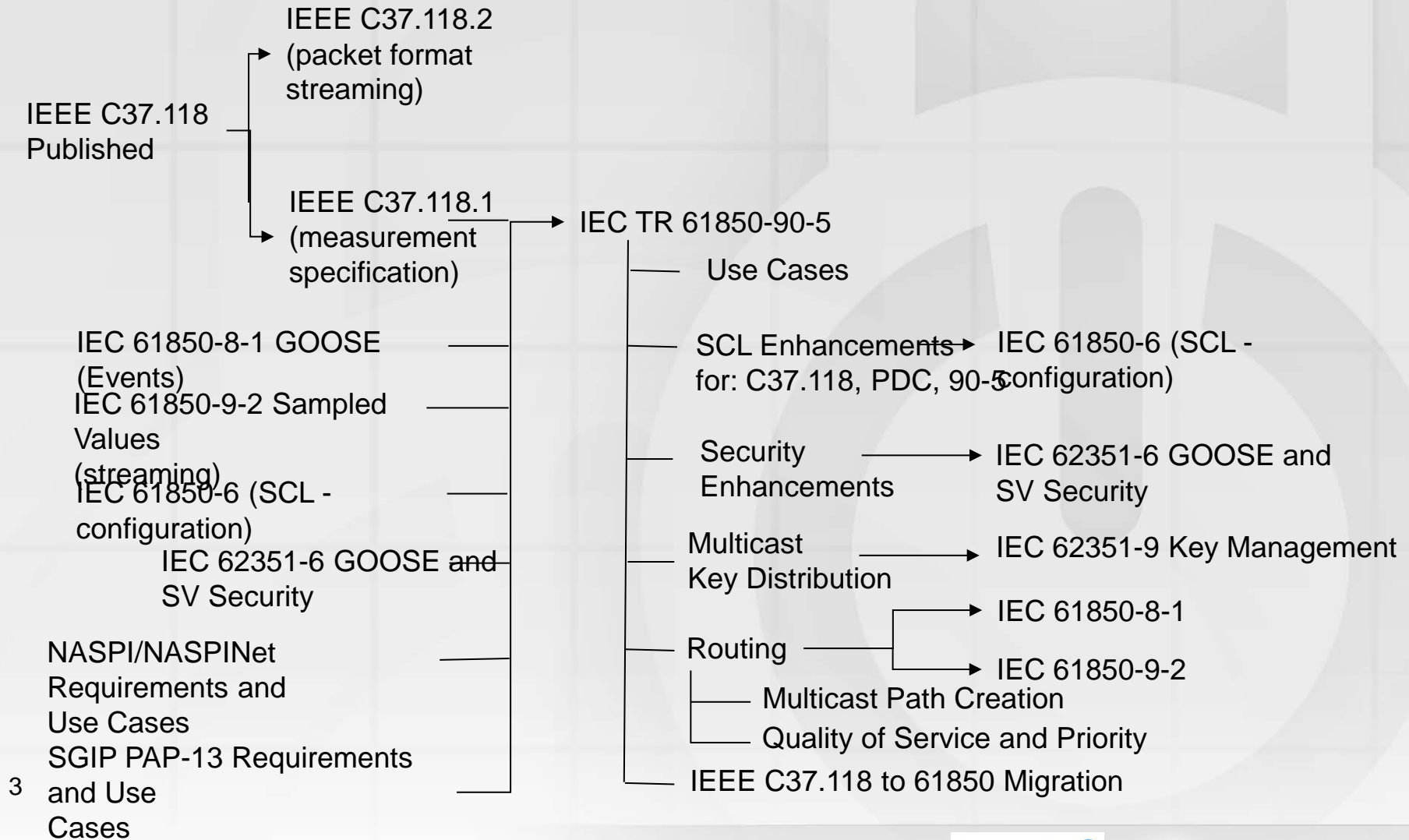
March 12, 2014



Project Timeline: Simplified



Relationship of documents



PG&E Implementation

IEC 61850-90-5 is being used as the primary protocol for synchrophasor data exchange from substation to control center within PG&E.

- Multi-vendor interop:
 - Alstom openPDC
 - GE Multilin PDCs / PMUs
 - Sisco Protocol Stacks (includes open source 90-5) and Wireshark Dissector
 - GPA Connection Tester with 90-5 support

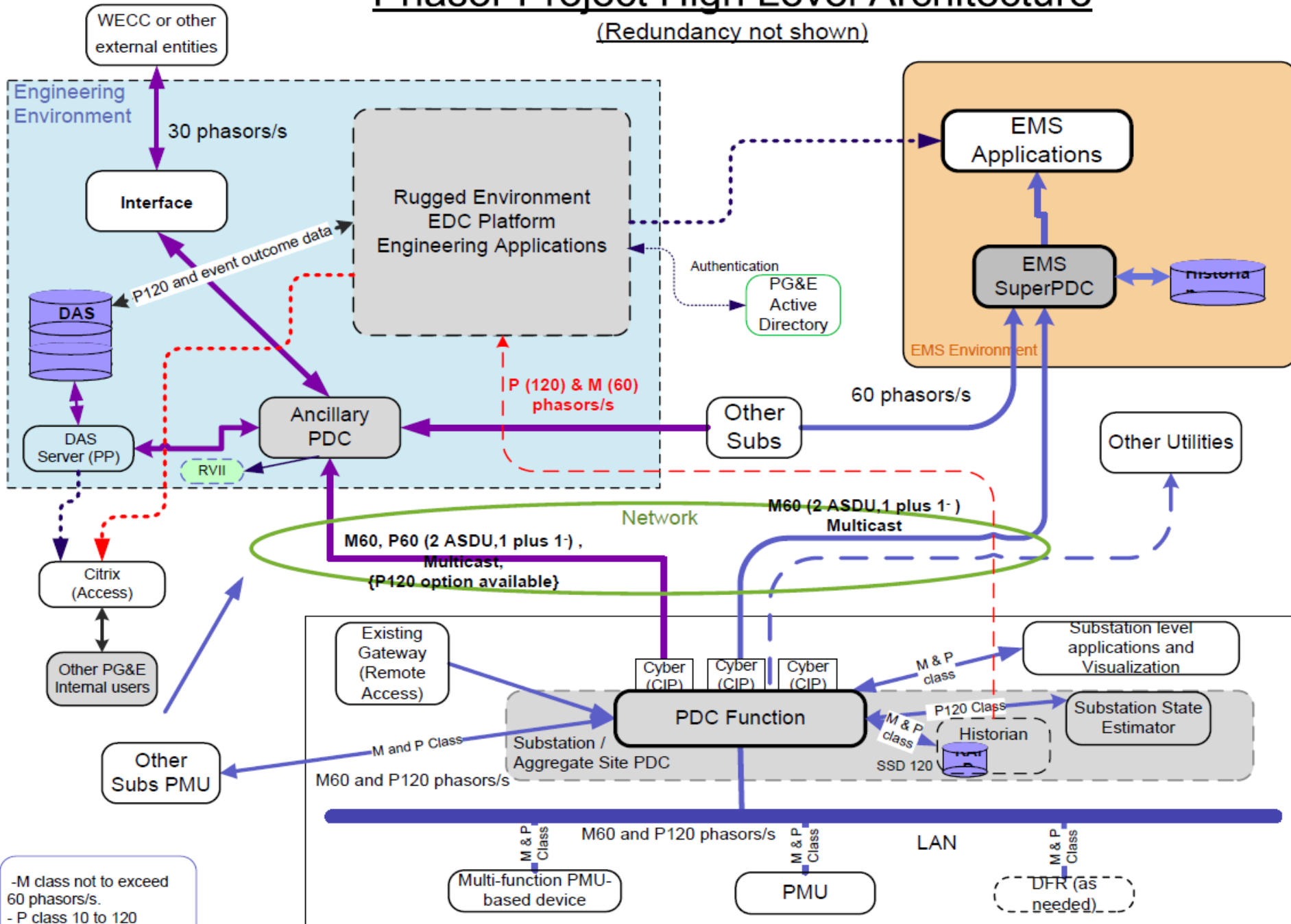


NASPI Contribution: PSTT held a half day tutorial at the October 2012 NASPI Meeting in Atlanta with more than 100 attendees.



Phasor Project High Level Architecture

(Redundancy not shown)

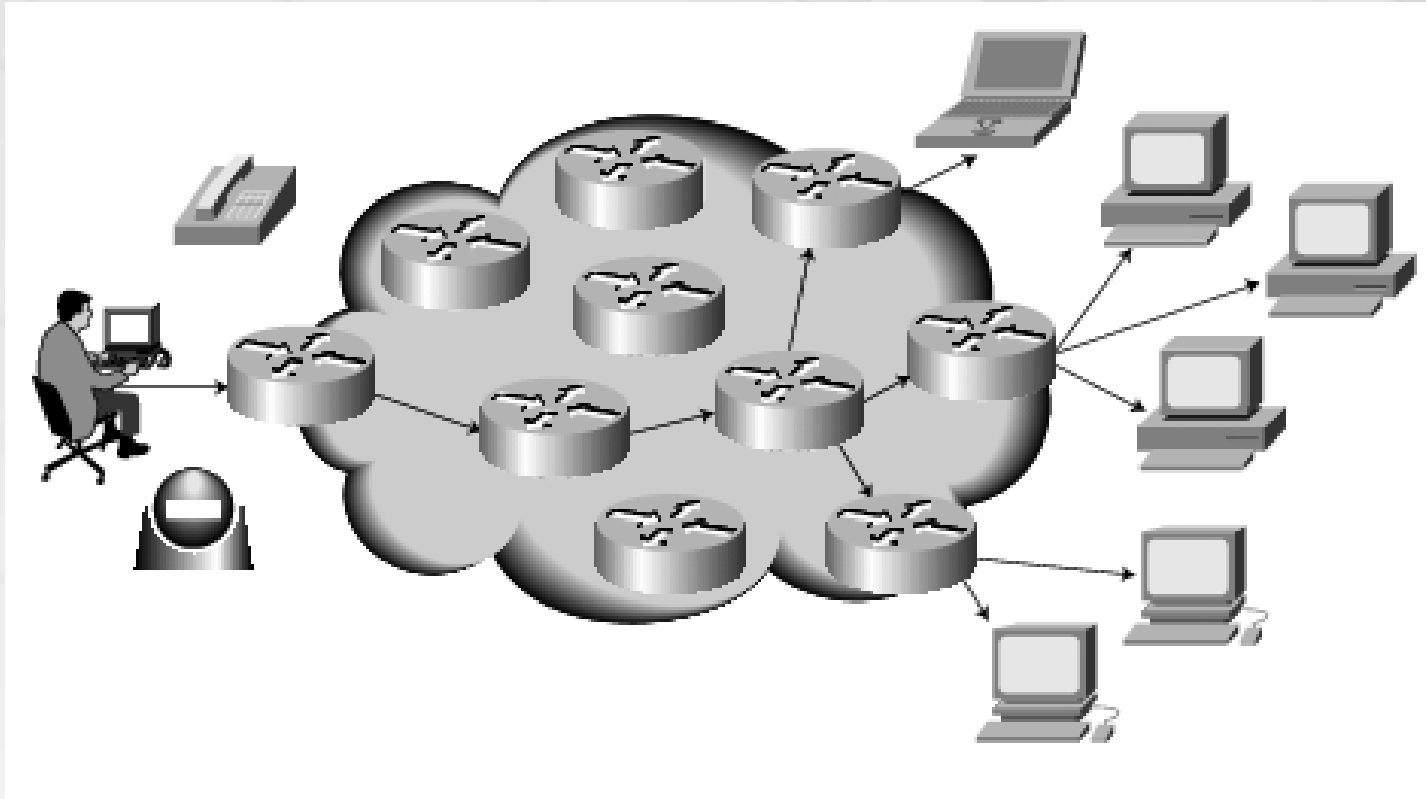


Why IEC 61850 and 61850-90-5?

- International and National Standard
 - Meets Overall Enterprise Level Solution
 - Lower capital costs (high value-to-cost ratio)
 - Improved engineering and design efficiency
 - lower cost and higher reliability
- Cyber Security
 - Comprehensive Cyber Security Solution (IEC 62351)
 - Includes authentication and encryption as a “standard”
 - Secure Hashing Algorithm and Key Management; in-line w/ NERC Compliance
- Life-time Support and Cost
 - Consistent with other 61850 substation LAN support and devices
 - Standard naming convention and processes
 - Leverages available 61850 tools and processes

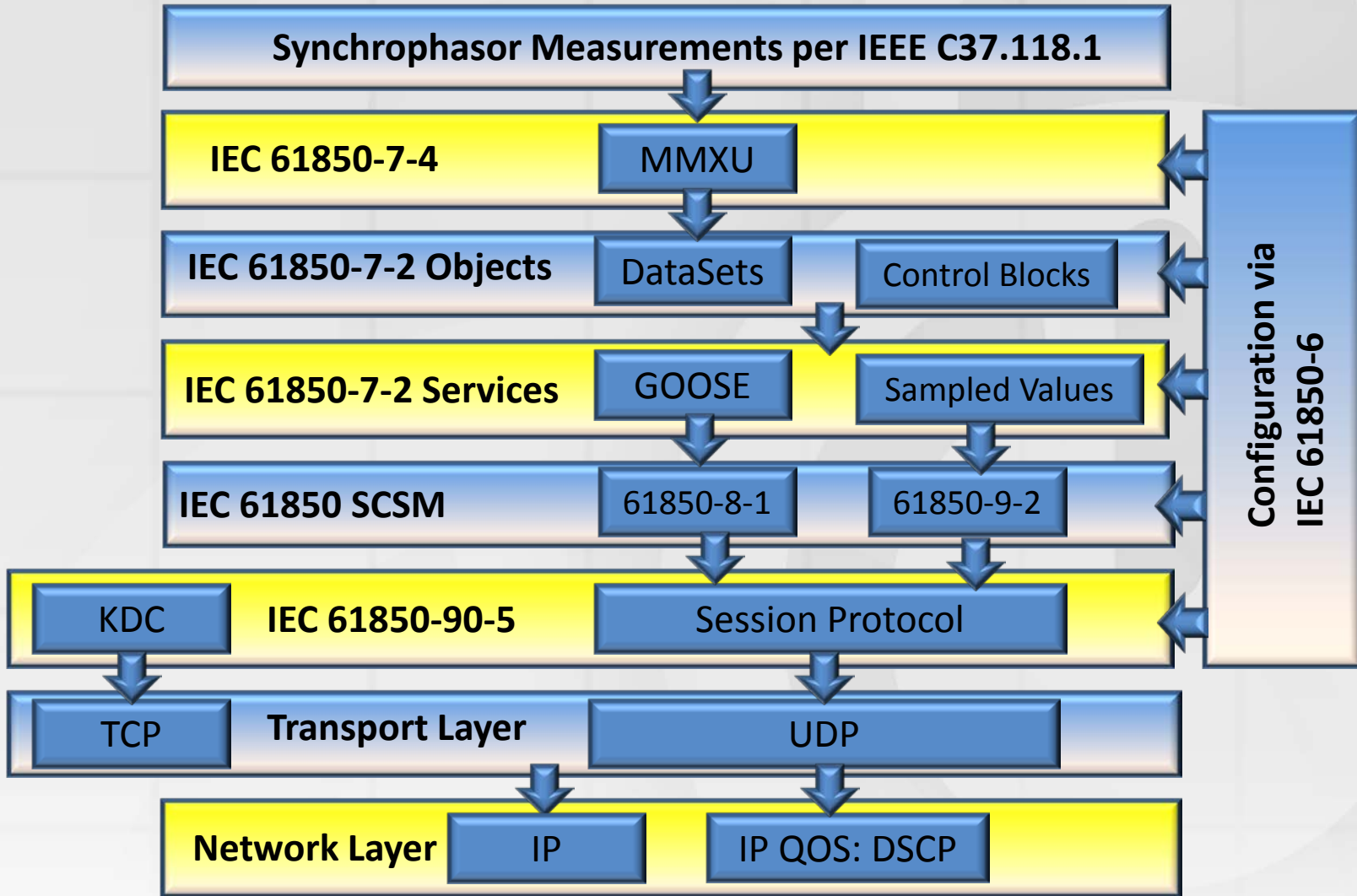


IEC 61850-90-5 is Deployable as a UDP Multicast Solution:



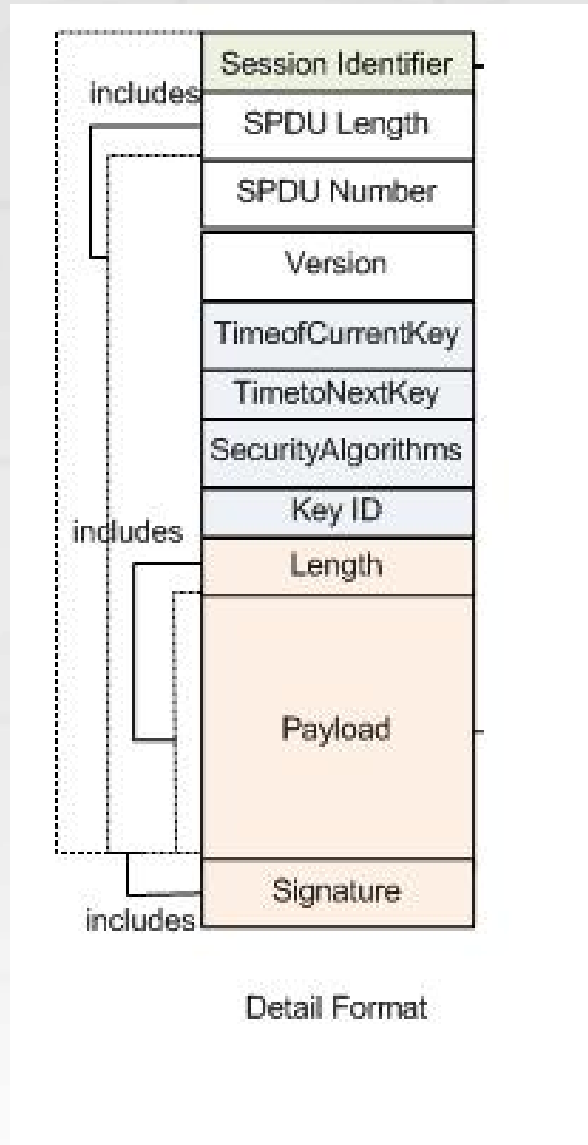
One Message Only Sent to Intended Recipients (i.e., Subscribers)

What 90-5 Looks like



IEC 90-5 Data Model

SPDU:
Session
Protocol
Data
Unit

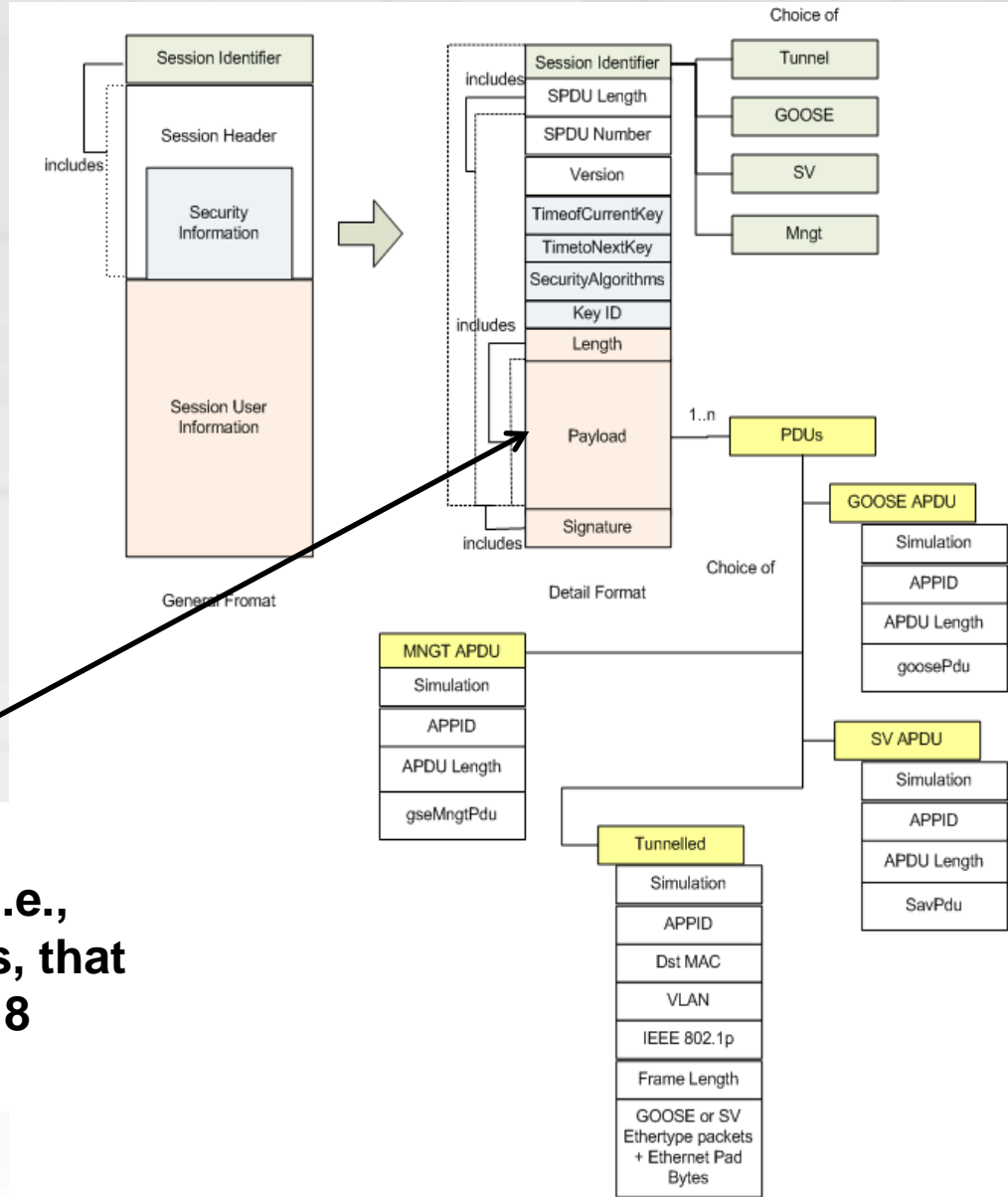


Total Max Size:
65,535 bytes

Supports Multiple non-
time-aligned PMU
datasets



IEC 61850-90-5 Session Protocol



Payload contains synchrophasor data, i.e., floating point samples, that are in the IEEE C37.118 binary sequence

Streaming: Sampled Values

Format
Number of ASDUs
ASDU1
ASDU2
⋮
ASDUx

ASDU Contents
ID
DatSet Reference
Sample Count
Configuration Rev
Refresh Time
Samples Synched
Sample Rate
Samples
Sample Mode
UTC Timestamp

Requirements:

- Sharing of CT/VTs to IEDs (original)
- Support of DSP processing instead of use of analog distribution (original)

Resulted in use of multicast and ability to send multiple sample periods in a single PDU.

Synchrophasors and NASPI have much lower sampling and report rates.

Multiple ASDUs:

- Allows multiple sample periods to be reported.
- Allows an older sample period to be reported (useful for synchrophasor) to prevent information loss.

Can deliver different DataSet contents in a single PDU.

SV Message Fields



Interoperability Considerations

- Standards
 - Having standard(s) is required but not sufficient for interoperability.
 - Standard compliance doesn't guarantee interoperability
- Implementation Agreements
 - Clear Implementation Agreement(s) among various device developers and manufacturers are usually required to achieve interoperability
- Testing
 - Both standards and implementation agreements are subject to interpretation and may include options, choices, or configurations.
 - Only actual testing can verify interoperability between various devices/systems.
 - Testing often identifies the need (or desire) for improvements and enhancements, as well as feedback for improving standards and implementation agreements.
- Life-cycle management
 - Life-cycle management, asset utilization, and revision control are all considerations affected by interoperability
 - Device interoperability needs to support system life-cycle management and asset utilization (long-term system deployment roadmap to be supported)



90-5 Implementation Notes

Alstom delivered with openPDC (open source) contracting with GPA for code development. SISCO provided Wireshark dissectors for 61850-90-5.

Two phase implementation:

Phase 1: support for 61850-90-5 input streams

Phase 2: Support for 61850-90-5 output streams

Acceptance testing done at PGE POC facility

Input from GE P60 and P30 devices

Output to P30 device and to other openPDC

Data exchange using UDP (unicast or multicast).



openPDC 90-5 Implementation

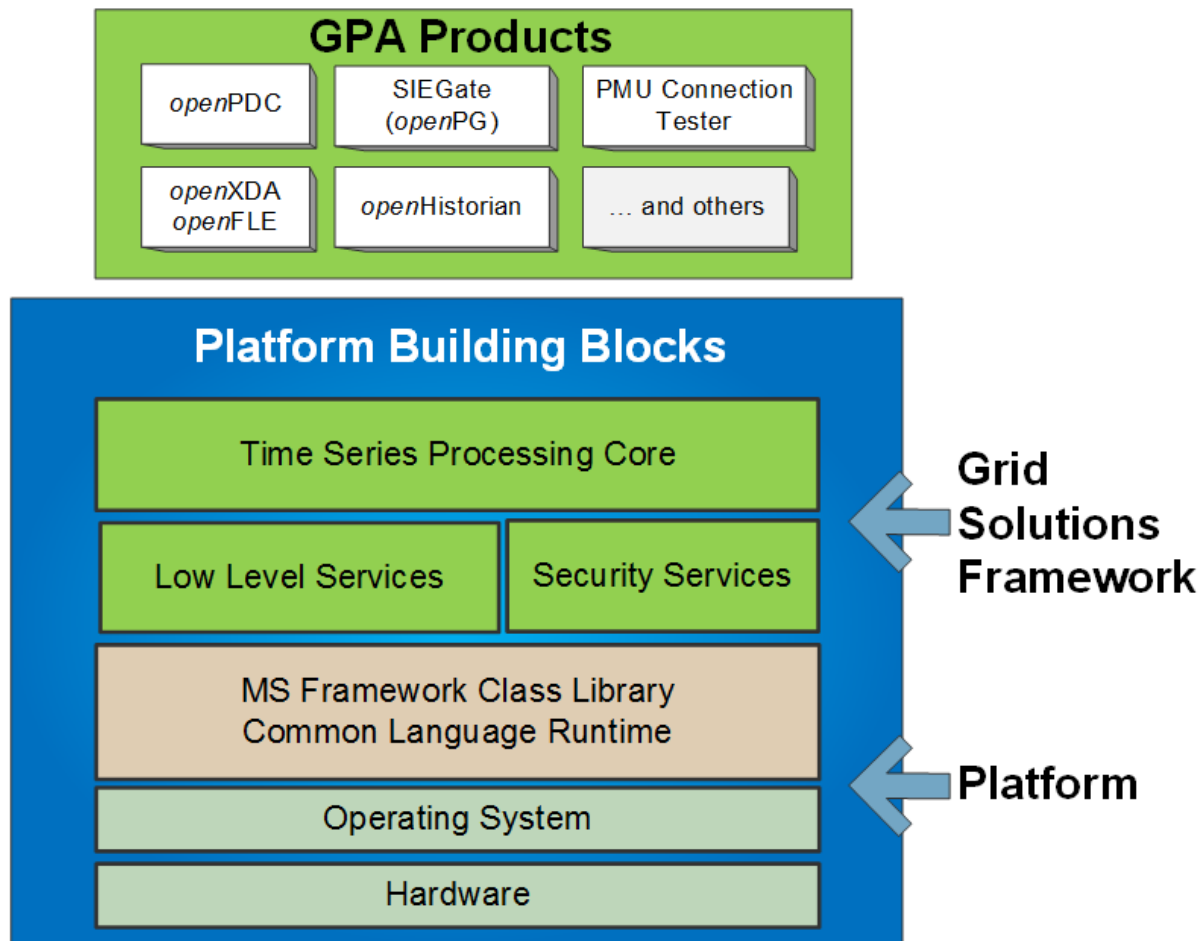
- The open source phasor protocol library of the openPDC, found in the [Grid Solutions Framework](#), was updated to include an implementation of the IEC 61850-90-5 protocol.
- This protocol implementation was created as a fully managed .NET library using C#
- The code was derived by examining the Cisco open source C implementation of 90-5



IEC 61850-90-5 open source in GSF



- All GPA products implement 90-5 through GSF
- All internal utility projects that use GSF also have access to 90-5



Test Tools and Further Reading

- http://www.pacw.org/issue/december_2012_issue/iec_61850905_an_overview/iec_61850905_an_overview.html
- PMU Connection Tester:
 - <http://pmuconnectiontester.codeplex.com/releases/view/109471>
 - Allows selection of a specific network interface when using a TCP or UDP socket
 - Allows for specifying a multicast source IP for multicast subscriptions for devices or systems that require this

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