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Grid Protection Alliance



Advanced Synchrophasor Protocol

Transmission Reliability Program Peer Review Meeting

Washington, DC
June 13, 2017

DOE FOA 1492
DE-OE0000859



ASP Project Summary

Objective

- To develop a new phasor data publish/subscribe protocol that is performant at scale -- and a collection of tools to support it.

Milestone Schedule

- May 2017 – April 2019
 - Initial Specification Draft – Dec 2017
 - Release ASP Specification – Apr 2018
 - Release α Protocol Toolkit – Apr 2018
 - Begin Demonstrations – Oct 2018
 - Publish Demo Results – Apr 2019



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Prime: Grid Protection Alliance

Financial Partners:

Bonneville Power Administration
Washington State University
Electric Power Group
Tennessee Valley Authority
Southwest Power Pool
Oklahoma Gas & Electric
San Diego Gas & Electric
Dominion Energy
Schweitzer Engineering Laboratories
Utilicast

Federal Cost: \$1.083 M

Cost Share: \$1.206 M

Total Value of Award: \$2.289 M

Funds Expended to Date: 4% (thru May 2017)

Project Partners

Advanced Synchrophasor Protocol Project

sttp

Streaming Telemetry Transport Protocol



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ASP



Electric Power Group



Project Collaborators	Project Financial Partner	Vendor	Utility	Demonstration Host
Bonneville Power Administration	♦		♦	
Bridge Energy Group				
Dominion Energy	♦		♦	EPG
Electric Power Group	♦	♦		
Electric Power Research Institute				
ERCOT			♦	
Grid Protection Alliance (Prime)	♦	♦		
ISO New England			♦	
MehtaTech		♦		
Oklahoma Gas & Electric	♦		♦	WSU
OSIsoft		♦		
Peak Reliability			♦	
PingThings		♦		
PJM Interconnection			♦	EPG
Southern California Edison			♦	
San Diego Gas & Electric	♦		♦	WSU
Schweitzer Engineering Laboratories	♦	♦		
Southern Company Services			♦	
Southwest Power Pool	♦		♦	WSU
Space-Time Insight		♦		
Trudnowski & Donnelly Consulting Engineers		♦		
Utilicast	♦	♦		
Tennessee Valley Authority	♦		♦	WSU
University of Southern California				
V&R Energy		♦		
Washington State University	♦	♦		

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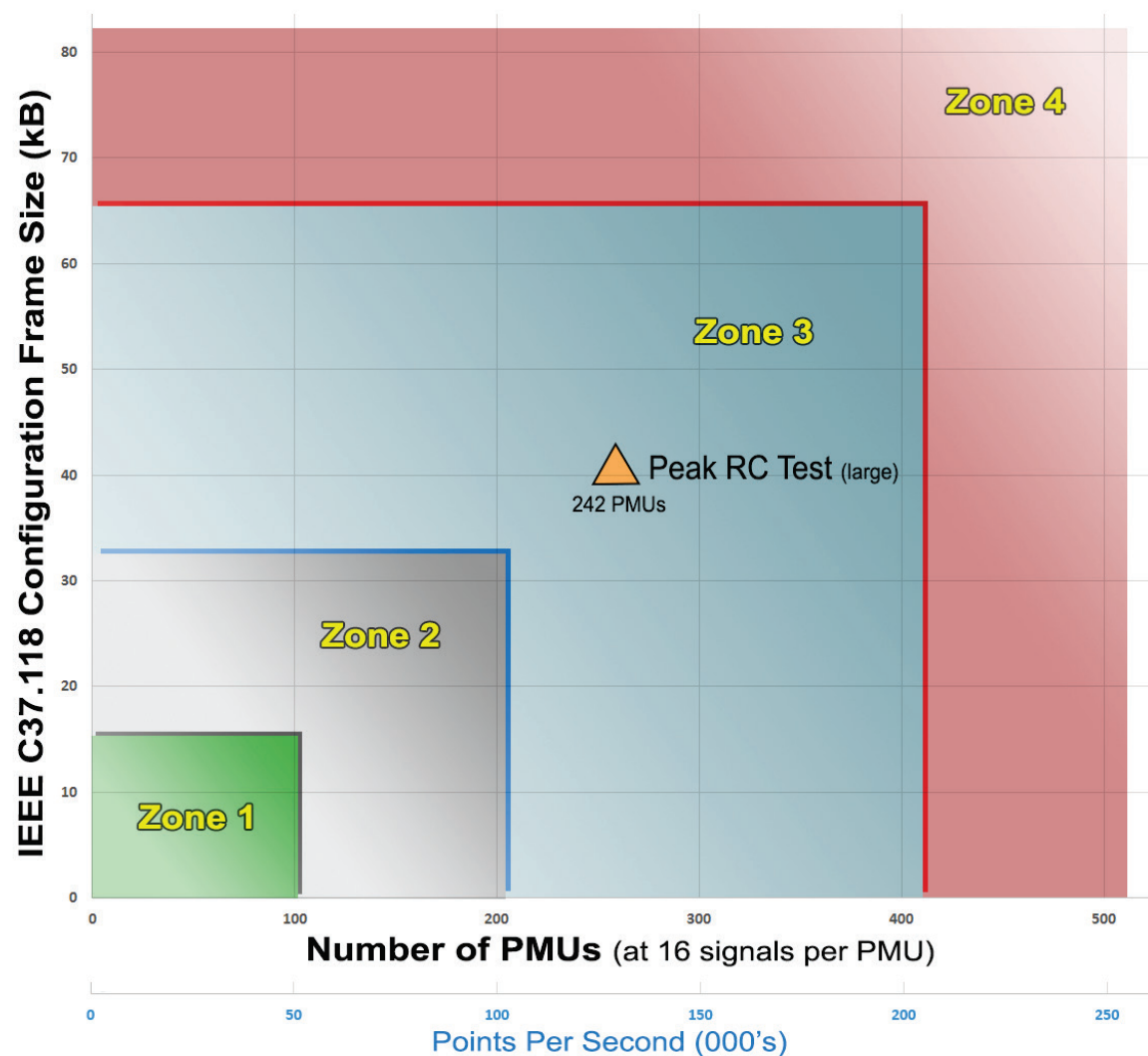
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ASP
OE-859

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Problem Statement – Existing Protocols Do Not Scale



- 4** IEEE C37.118 V1 & V2 configuration frame size max out. A second stream must be created.
- 3** Increased data loss and latency. Purpose-built / allocated networks typically required.
- 2** Data loss and latency issues begin to appear. Network tuning may be required.
- 1** Issues, if any, are easy to resolve.

Advancing the State-of-the-Art – STTP Design Objectives

- Perform at high volume / large scale
 - Minimize losses
 - Lower bandwidth requirements
- Optimized for the performant delivery of individual data types via TCP and UDP
- Automated exchange of metadata (no centralized registry required)
- Detect and expose communication issues
- Security and availability features that enable use on critical systems to support critical operations
- Pub/Sub – Measurement Based
- API implemented in multiple languages on multiple platforms

STTP will be based on GPA's Gateway Exchange Protocol

- Signal-centric
- Open and non-proprietary
- True pub/sub
- Multilayered security – encryption and data access control with expression based permissions
- Automated exchange of authorized metadata
- Tightly-compressed, binary serialization of time-series values
- Adapters provided in .NET, C/C++ and Java for convenient native integration in other systems
- Efficient -- includes lossless compression
- Available transports include TLS, TCP, TCP with UDP, TLS with AES key-rotated UDP, and ZeroMQ



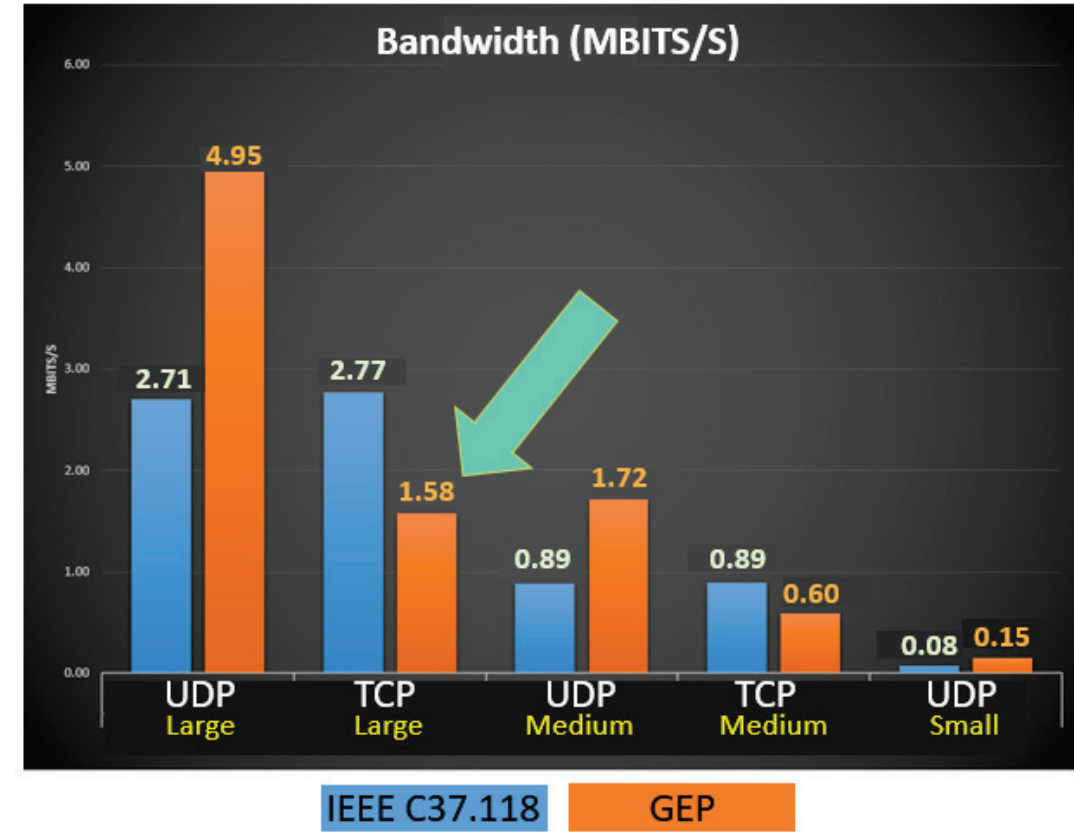
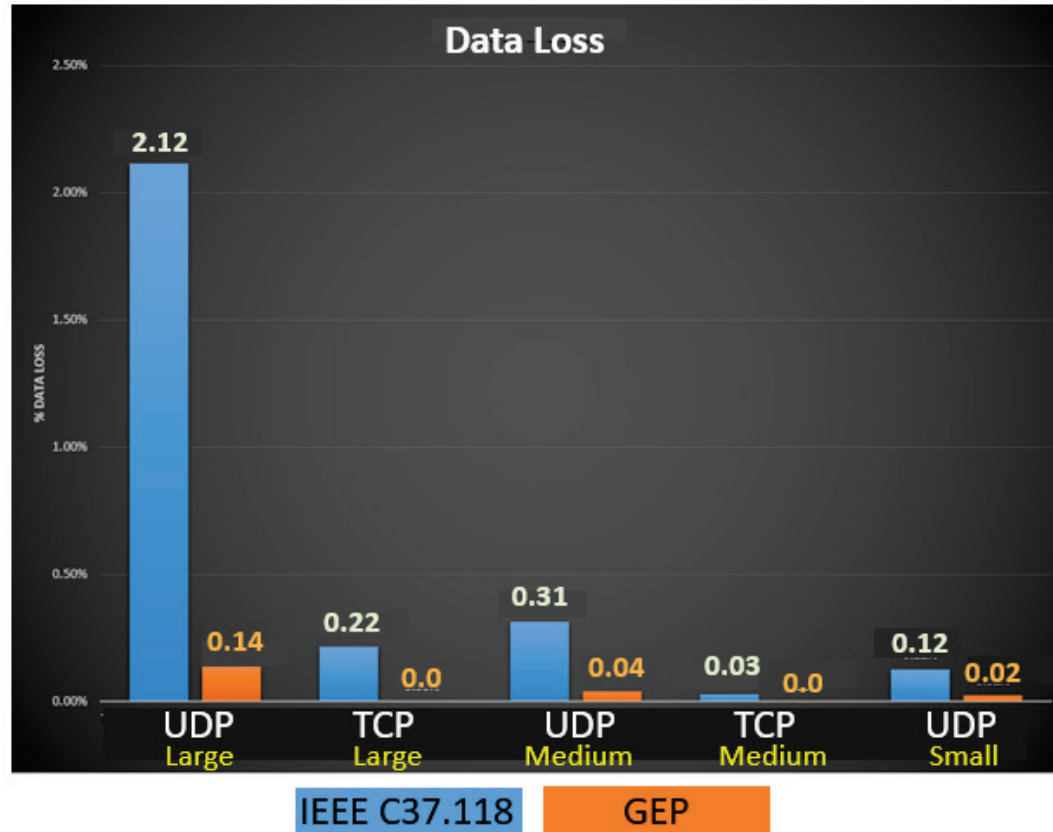
Serialized Measurement Structure – 9 Bytes:

Unique ID	2 Bytes	128-bit Guid ID mapped to 16-bit runtime ID
Timestamp	2 Bytes	64-bit full resolution timestamp mapped to 16-bit offset
Value	4 Bytes	32-bit floating point value
Quality	1 Byte	8-bit quality flags

Several serialized measurements are grouped together to create a message payload. Total size is adjusted to reduce fragmentation.



Value to Industry – Less data loss at lower bandwidth



Data from testing at PeakRC

Work on the specification is now underway

STTP will improve on GEP

- Simplify and remove unused GEP functionality
- Stand alone (not integrated into other GPA solutions)
- Required minimum set of meta-data fields
- Cross-platform architecture

STTP Core Requirements

Minimize	external libraries and dependencies for reference implementations
Keep	portability in mind with all protocol design work
Target	Smallest possible API functionality – specialized use cases will be handled by example
Set	design mantra to be “keep it simple” <i>as possible</i>

Candidate STTP Features

- Enhanced per-channel delivery characteristics:
 - Priority
 - Reliability
 - Verification
 - Exception
 - Resolution
- Improved meta-data exchange
 - Versioning information, i.e., all meta-data is $f(\text{time})$
 - Ability to exchange differences in meta-data vs. a known version
- Accommodate crossing security zones in the desired direction
(typically higher-to-lower -- regardless of the defined role of a publisher or subscriber)

Deliverables

- Update PMP
- Release ASP Spec
- Develop α Toolkit
- Develop Demo Plan
- Publish Demo Results
- Publish API

- 1.1 Update PMP (D1)
- 1.2 Update Data Management Plan
- 1.3 Establish Contracts
- 1.4 Manage Project and Submit Reports

2.1 Define Requirements
2.2 Create Initial Design (M1)
2.3 Release ASP Specification (D2 - M2)

- 3.1 Develop Alpha APIs
- 3.2 Develop Alpha Tool Kit (D3)
- 3.3 Release Alpha Versions (M3)

- 4.1 Incorporate Alpha ASP into EPG Tools
- 4.2 Incorporate Alpha ASP in WSU Tools
- 4.3 Bench Test EPG and WSU Tools

- 5.1 Develop EPG Tool Demo Plan (D4)
- 5.2 Develop WSU Too Demo Plan
- 5.3 Conduct Demo & Publish Results (D5-M4)
- 5.4 Publish Ver 1.0 API with Documentation (D6 - M5)



Next Steps

Business Perspective

- Execute project agreements
- Hold project kick-off meetings

Technical Perspective

- Setup independent STTP web site
 - Collaboration
 - Documentation
 - Language specific reference implementations
 - Example use cases
- Continue work on the protocol specification document
 - Define a set of measurement data types for transport
 - Define minimal required meta-data

Questions ?

