WISP Testing of openPG

Western Interconnect Synchrophasor Program

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Background

- NASPInet was an emergent R&D concept at the time for solicitation of SGIG projects
- A demonstration of NASPInet was included in the WISP project
- The openPG was designed to fulfil the design principles of NASPInet

What is a phasor gateway?

- A Phasor Gateway
  - Creates a hardened security buffer between critical internal systems and external ones
  - Protects the confidentiality and integrity of reliability and market sensitive BES data
  - Facilitates and reduces the cost of phasor data exchange -- both the phasor data itself and the supporting metadata information for this data

openPG Core Functionality

- Reliably, and selectively, exchange high-sample rate signal values and timestamps (measurements) with other gateways so that this information moves between each owner's infrastructures with minimum time delay
- Enable gateway administrators to easily select the measurement points which are to be made available to owners of other gateways
- Enable gateway administrators to easily select the points that they choose to consume (i.e., the subset of the points made available to them) from other gateways

openPG Core Functionality
(continued)

- Detect, log and alarm on communications issues
- Be implementable as a high-availability solution that can meet NERC CIP compliance requirements
- Support encrypted communication among gateways as well as minimize bandwidth requirements for gateway-to-gateway data exchange
- Utilize standard communications, networking and server hardware
- Be easily extensible to support the development of custom interfaces to the gateway owner's internal infrastructure and/or new phasor data protocols

Why? Frame-based protocols don't scale

- In theory, C37.118-2005 can scale to the 64K UDP packet limit
- In practice, UDP has been found to frequently be throttled to 16K packet sizes – around 130 PMUs
- 61850-90-5 includes more overhead than C37.118
- Solution
  - Add configuration complexity through use of multiple output streams
  - **Implement a phasor gateway** that meets the NASPInet design principles – i.e., eliminate the problems of a frame-based protocol

NASPInet Design Principles

NASPInet Gateway Key Requirement	openPG
Serve as the sole access to the Data Bus	**Aligned.** The openPG is the sole access point for exchange of phasor information with other openPGs with establishing trusted gateway unions as a key design element.
Facilitate and administer registration of PG_REQUESTER's PMU, PDC, and signals	**Aligned.** The openPG configuration database contains metadata on the phasor measurements. An openPG downloads the metadata for points it is authorized to receive from other openPGs.
Facilitate and administer the subscription and publishing	**Aligned.** The openPG supports both publishing and subscription of phasor data.
Monitor data integrity	**Aligned.** Each block of points transferred by the openPG contains checks to assure data integrity.
Manage traffic priority through the PG gateway	**Not Aligned.** All data exchanged by the openPG is in the single service class of "critical real-time data".
Provide logging of data transmission, access controls, security for analysis of all anomalies	**Aligned.** The openPDC produces both configuration and operational logs
Provide application programming interfaces (APIs) for systems and applications.	**Aligned.** The openPG is extensible by the user through development of new input and output adapters.

Provides all needed exchange services

Includes attribute or meta data

Pub/Sub environment

Monitor/Alarm on data quality

Includes QoS traffic mgmt. by data class

Provides logging

Provides APIs for integration

Why? A phasor gateway reduces cost

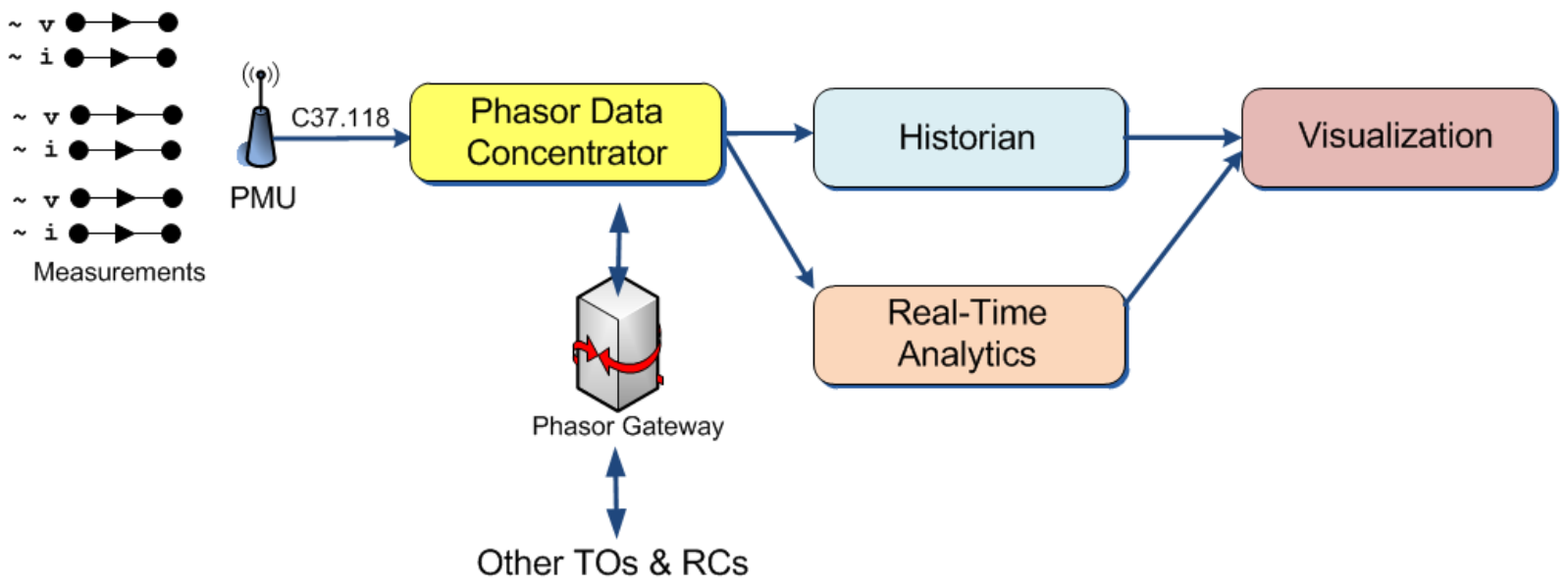
- Recognition that each entity needs the option to operate within its own name space
- The openPG allows easy exchange of phasor meta data among entities without the need for a common naming schema
- Redundant measurements can be published and subscribed
- The openPG can easily be integrated with enterprise or vendor modeling systems – or a regional naming service

How does the openPG exchange data?

- Today, there is no standard protocol for gateway-to-gateway data exchange
- GPA has created one for the openPG (and extended it for SIEGate) that nominally requires only 9 bytes per point

Data exchange efficiency is among the most important design considerations for a phasor gateway.

Typical Phasor Data Architecture



Gateways are used for external communications
vis-à-vis ICCP for SCADA Systems

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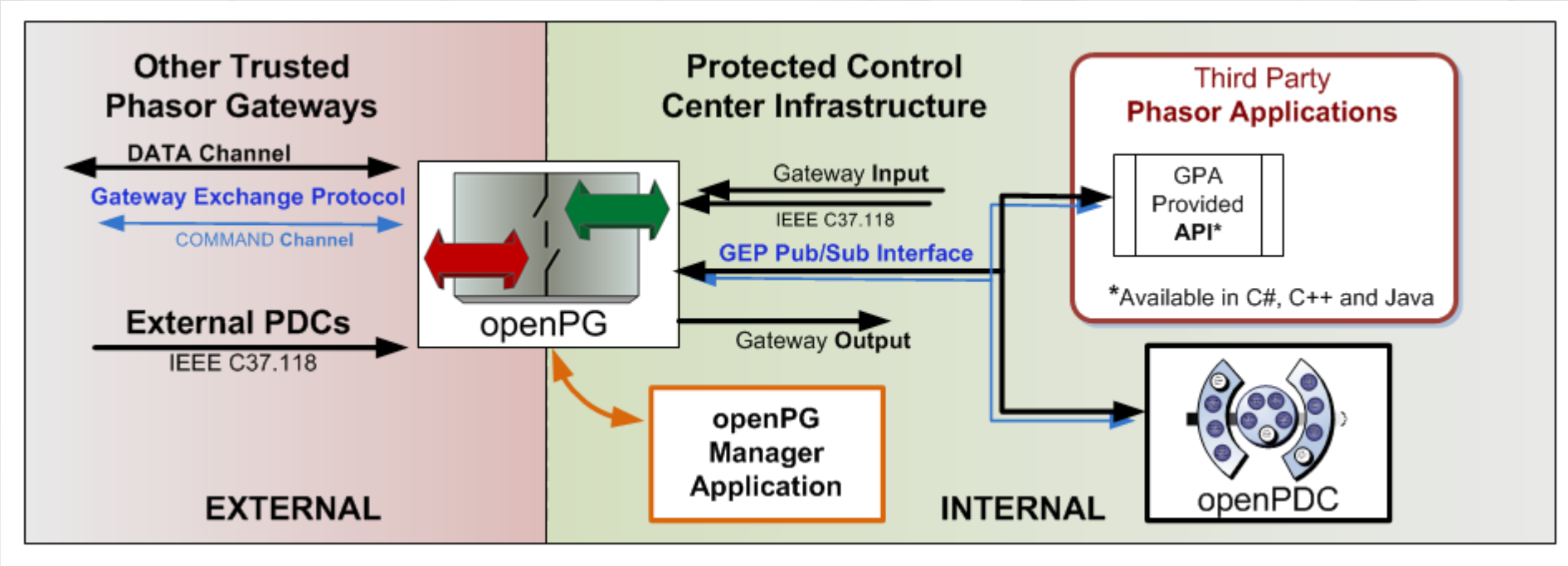
Typical Gateway Integration



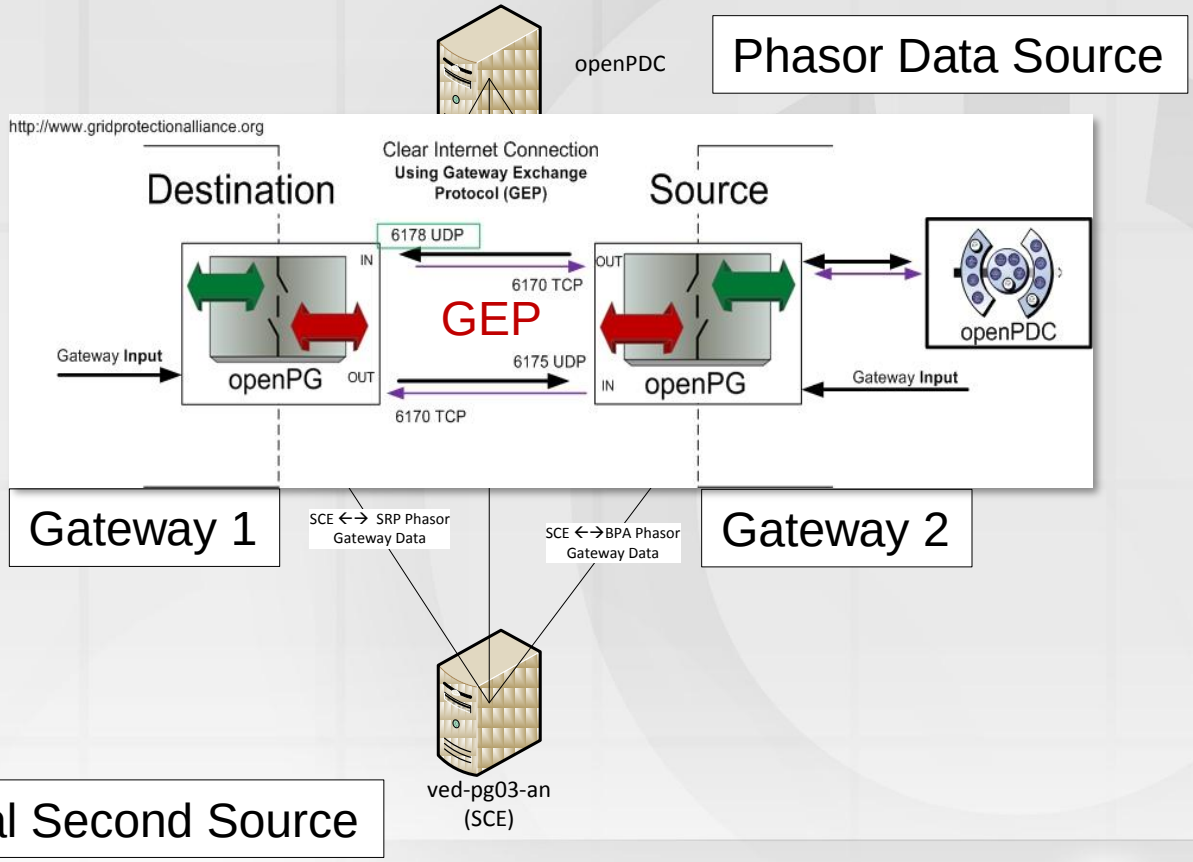
The openPG Manager allows all gateway inputs and outputs to be configured.

WISP Test Purpose

- Demonstrate Gateway Functionality
- Document
  - Suitability for production implementation
  - Technical challenges / issues

Test Setup

Phasor Gateway Setup in DEMS



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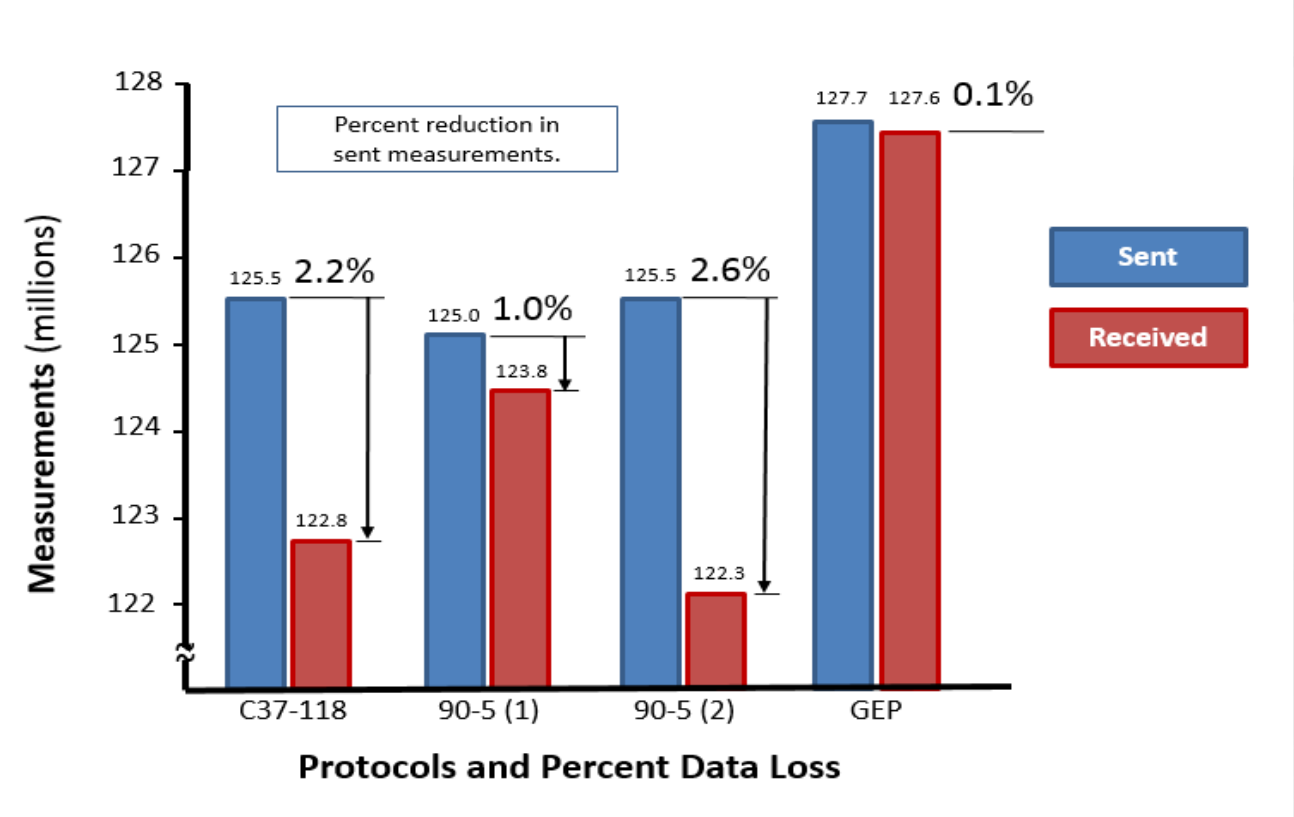
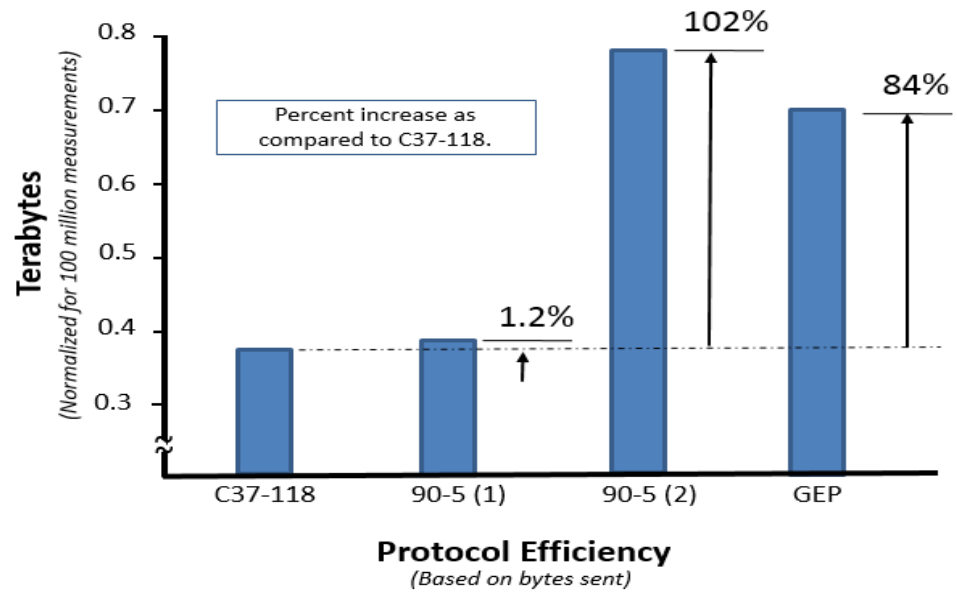
Data Loss Test Results



Note: *Testing conducted over LAN-to-LAN VPN over the internet between GPA and WECC offices. Results over a dedicated network will be less lossy in all cases.*

Bandwidth Test Results

	C37-118	90-5 (1)	90-5 (2)	GEP
Bytes Per Measurement	**3.88**	**3.94**	**7.84**	**7.13**



Note: *Test is being rerun with improved data compression for the GEP protocol which could result in some limited reduction in GEP bandwidth utilization.*

High Level Conclusions

- By design, the openPG overcomes the limitations of frame-based phasor data exchange (both C37.118 and IEC 61850-90.5) as envisioned by NASPInet
- Use of an openPG assures low data loss without a dependency on highest quality network communications and this benefit will scale well to higher volume phasor data flows
- The GEP protocol used by openPG requires from 1.5 to 2.0 times the bandwidth of C37.118 and requires about the same to slightly less bandwidth than the recommended implementation of 61850-90.5.
- The openPG is ready for pilot implementation to further evaluate its suitability for support of Western Area phasor data exchange