GPA Proposal Discussion – Part 2

- Solution Architecture
- Solution Delivery

SDGE

VISUALIZATION SOFTWARE SYSTEM *for*
WIDE AREA SITUATIONAL AWARENESS

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GPA Solution – Typical Architecture

(with Metadata management in Pi-AF)

* Connection can only be established from the higher security zone

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SDG&E High-Level Data Flows

(Adaptation of Figure 1, page 8 in RFP Attachment 4)

*Streams replicated from each substation

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GPA Solution – Architecture

- Security
- Logging
- Integration Approach
- Scalability

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Solution Architecture -- Security Requirement Gaps

- CIP Compliant Design
- Autonomously Secure
- Consistency
- Active Directory Integration
- Role Based Security
- Audit Logging
- Authorization Controls
- Secure baseline configuration
- Cryptographic Key Management
- Information input validation
- Supports Periodic Backup
- Can be monitored
- Least functionality
- Malicious Code Protection
- Password strength enforcement
- Encrypts stored data

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GPA Patch and Code Review Assurance

- Enables compliance with CIP standards. FIPS support.
- Products quickly migrated to latest .NET libraries
- Numerous utility code checks
- Third Party (largely Microsoft) security patches applied within 30 days.
- Visual Studio's built-in code analysis applied during build process
- SolarQube used to perform static code analysis monthly
  - All products
  - All code libraries

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Solution Architecture – Logging

For the Visualization Layer

Grafana utilizes log15, a “best practice” logger

- Late data
- In Part — Event logging
- Configuration change logging
- In Part — Log viewing/filtering
- User cannot modify
- Error logging

SSAM

- Programmatic wrapper for APIs
- Annunciation panel key 24x7 cyber SA tool
- “Bubbles” below are systems – each containing many data flows
- Successful data flows are logged
- Each data flow:
  - Has an expected periodicity, or execution time
  - Is linked to dependencies on hardware e.g., server names, subnets

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Solution Architecture – Integration Approach

- GPA products are open source and built with multiple points of integration including APIs and Web Services.
- GPA is proficient in the many of the major programming languages *(C, C++ Java, Python, C#, among others)* and data base systems *(Oracle, MS SQL Server, MySQL, SQLite, among others)* as deployed on both Linux and Windows platforms and has developed multiple interfaces with third party systems.
- There are only a few integration gaps between SDG&E architecture and the GPA solution – the largest being using PI as the master metadata source.

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Solution Architecture – Scalability

GPA prides itself on delivering high-performant solutions that dynamically scales to the number of cores and memory presented to it.

- All GPA products are scalable to many millions of points per second on pedestrian hardware – and are typically horizontally scalable beyond that.

- GPA has not yet extensively stress tested Grafana; however, indications are that it will scale well with the infrastructure.

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Solution Architecture – Additional Questions ?

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GPA Solution – Delivery

- Approach & Schedule
- Graphical Requirements Gaps
- Data Migration
- Development Approach
- Testing & Acceptance

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The Proposal Timeline (Revised)

Design	Pre-Production	Production	
▪ Develop the VSS Design Document ▪ Define the precise scope of each phase ▪ Turn-up test and acceptance systems ▪ Begin prototyping key displays	▪ Develop VSS functionality for Beta Release ▪ Install in acceptance ▪ Conduct SAT ▪ Conduct training ▪ Deploy pre-production	▪ Integrate with additional systems ▪ Develop balance of VSS functionality ▪ Conduct SAT ▪ Conduct training ▪ Deploy in Production	▪ Provide on-going product maintenance
	Phase 1	**Phase 2**	
2 to 4 Months	**12 Months**	**12 Months**	**Future**

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Three Major Development Groups

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① Advanced Tools

- Metadata Integration with Pi-AF
- Batch configuration tools
  - Alarm settings import & export
  - PMU locations
  - Assignment of name aliases
- Fully implement bad data and data range flagging in GSF
- Crisp integration with Alarm Management System

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② Alarm Management System

a.k.a. Notification Engine

- SCADA-like alarm management capability
- Can launch with limited functionality
- Includes advanced alarming service

[See Part 1, Slide 42 for a list of openAMS features.]

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3 Grafana Displays

Extended

- Major focus of the Design Document
- Prototype displays and test with operators / engineers using existing Grafana panels in acceptance - e.g., frequency disturbance, real power, voltage
- Build displays that require development of new panels – e.g., system/substation schematics

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With greater understanding, less estimated effort and cost.

Development costs can be estimated with greater precision following creation of the Design Document.

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Solution Delivery – Data Migration

- No data migration will be required from SDG&E existing solution.

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Solution Delivery – Development Approach

There is high-value on the right; however, GPA values the left more.

- Responding to change > Following a plan
- Client collaboration > Structured development process
- Robust, highly-performant software > Comprehensive documentation

[*adapted from Microsoft*]

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Solution Delivery – Display Development

- Be consistent
- Put data in context to enhance understanding
  - Show trends
- Match the user's mental/work model
- Make important information stand out
- Minimize cognitive load
  - Keep it simple
  - Use color and motion sparingly
  - Dials and other analog representations preferred over digitals
- Provide information (not data) and group information that belongs together
- Where possible, provide operating boundaries on displays
- Create an information hierarchy– from overview information down to the details

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Solution Delivery – Testing & Acceptance

Phase 1

- Bench testing in GPA's Offices
- Early installation in SDG&E acceptance
- Frequent SDG&E acceptance updates
- Formal SAT

No FAT Necessary

Phase 2

- Bench testing in GPA's Offices
- Frequent SDG&E acceptance updates
- Formal SAT
- Production Installation

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The GPA Proposal - Approach

1. Leverage existing open source software
2. Develop new open source software to close function and feature gaps
3. Test and document

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Approach Summary

The Grid Protection Alliance (GPA) is pleased to provide this response to the July 14, 2017, SDG&E Request for Proposal (RFP) that is a part of Phase 2 of WASA system development.

The proposal is focused on meeting SDG&E's current technical requirements while minimizing first and on-going costs. In doing so, GPA is also providing a highly-performant and flexible architectural foundation to allow SDG&E to easily incorporate new technology and components as well as to adapt the visualization system to meet changing business requirements without lock-in to GPA or any other vendor.

The central theme of this proposal is to meet the RFP's requirements largely through use of three existing open-source architectural components – (1) an analytics integration platform called openECA, (2) a web-based open-source visualization platform called Grafana, and (3) a display tool for event data called the open PQ Dashboard.

Following completion of the Functional Specification and Design Document, GPA proposes that the visualization system be delivered in a minimum of two phases. This phased delivery reduces technical and business risk and allows value to be returned to SDG&E earlier than with a grand "all at once" delivery approach.

The proposed team of GPA and T&D Consulting Engineers has extensive expertise in the development and integration of phasor data within production grid operating environments, and we are confident that we can deliver a system to fully meet SDG&E requirements.

- Minimizes first and on-going costs
- Performant and flexible architecture
- Adaptable to meet changing business requirements without vendor lock in
- Delivery is in phases to return value early
- The proposal team has the skills and experience to be successful

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Business Basis for Selecting GPA

Tactical

- Value at the pace of investment
- Precisely meets business requirements
- Low total cost
- High quality
- Start-of-the-art
- Assured security
- Fast delivery

Strategic

- Future Proof
  - Low cost of modification
  - Can incorporate best-of-breed technology
- No vendor lock-in
- Enables innovation
- Lowers Risk
  - Scalability
  - Technology
  - Business

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Solution Delivery – Additional Questions ?

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