Project Status Briefing

NASPInet Specification Project

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NASPI Work Group Meeting, Feb. 4-5, 2009, Scottsdale, AZ

Table of Contents

How We Got Here

- Long-recognized need
  - NASPI's mission
  - DNMTT did extensive preliminaries
- DOE issued competitive solicitation in 2008
  - Administered by NETL
  - Quanta Technology was the successful bidder
- Finished product
  - Specification to be delivered to DOE/NETL for procurement of Phasor Gateways and Data Bus of NASPInet

Why Is It Important

- Synchrophasor data are vital for reliable operation of large interconnected power systems
  - Fast post-disturbance analysis
  - Situation awareness to prevent system collapse and blackout
  - Wide-area monitoring, protection and control
- Current infrastructures not sustainable or scalable
  - VPN networks over public internet – security? QoS?
  - ICCP data networks not suitable for carrying Synchrophasor data
- A secure, trusted and QoS guaranteed inter-utility Synchrophasor data exchange infrastructure (NASPInet) is needed

Project Status Update

- September 27, 2008
  - Contract awarded to Quanta Technology
- December 15, 2008
  - Conceptual Framework completed
- February 3, 2009
  - Draft specification review
- February 27, 2009
  - Delivery of draft specification
- April 27, 2009
  - Delivery of final specification – completion of project

Broad Participation Encouraged

- NETL Electronic Reading Room
  - http://www.netl.doe.gov/business/solicitations/NASPI/index.html
- DNMTT Regular Meetings
  - Monthly, by conference call
- Utility-hosted Meetings
  - New Orleans – Dec. 9-10
  - Los Angeles – Jan. 20
  - Valley Forge – Feb. 10

Table of Contents

Goal – Support Broad Range of Phasor Apps

- Apps that require STREAMING DATA
  - Example 1 – Visuals for Transmission Operators
    - Operator display of voltage angle btwn 2 critical points: alarm if angle reaches threshold value defined by planning studies
  - Example 2 – Inputs to EMS Tools
    - Voltage magnitude and angle help perfect boundary conditions for state estimator
  - Example 3 – Inputs to Wide Area Controllers
    - Receiving voltage measurements from someone else's substation helps me do a better job of controlling an SVC at my substation
- Apps that require ARCHIVAL DATA (data files)
  - Example 1 – Data for Post-disturbance Analysis
    - Faster understanding of what caused an event can help save $ by shortening the duration of sub-optimal generating patterns and can help prevent future events of similar nature
  - Example 2 – Data for R&D Purposes
    - Under the right circumstances, providing abundant data to research organizations can lead to breakthrough technology advancements

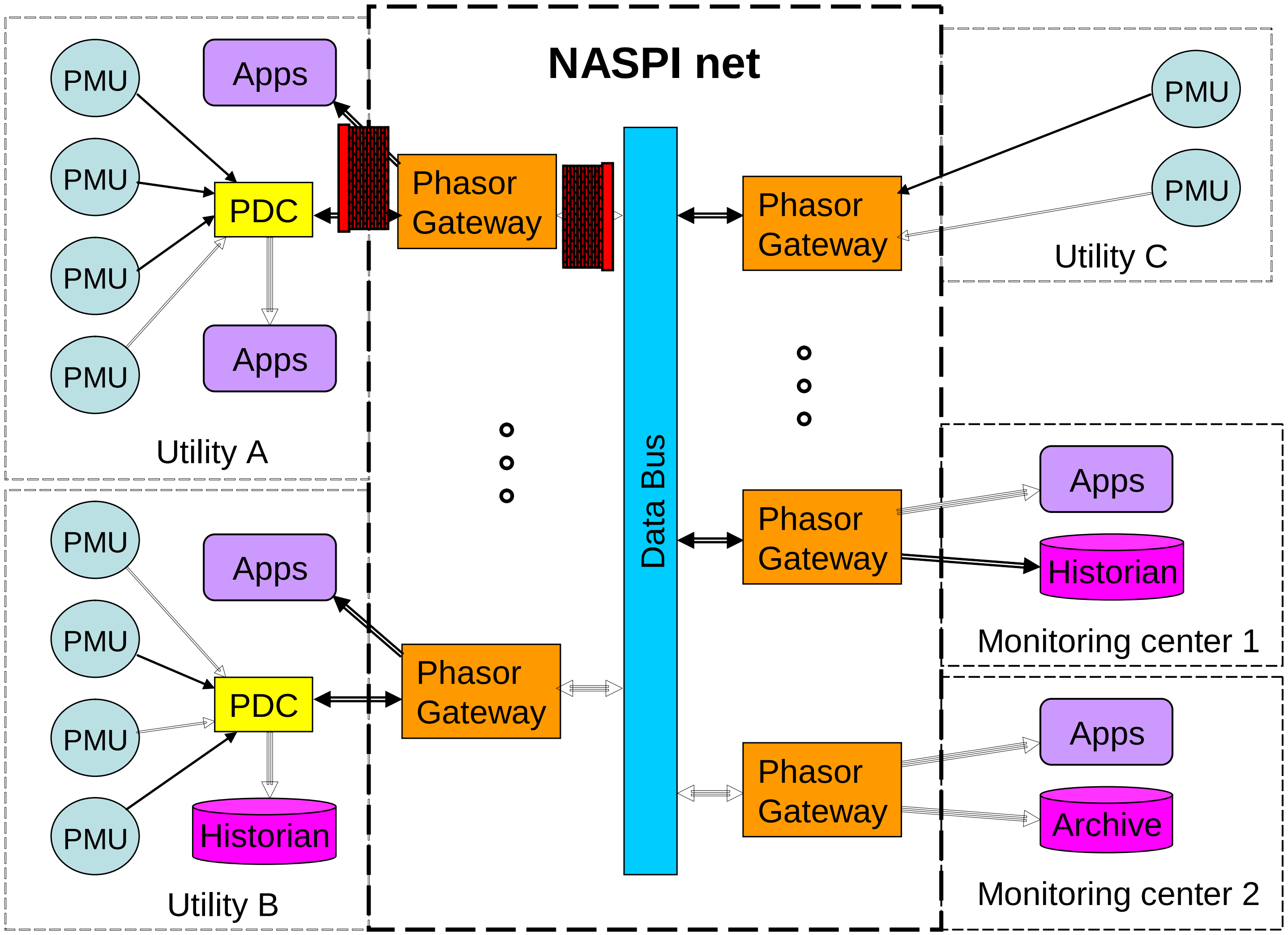
Classes of Data

NASPInet Traffic Attribute	Real-time streaming data			Historical data	
	CLASS A <u>Feedback Control</u>	CLASS B <u>Feed-forward Control</u>	CLASS C <u>Visualization</u>	CLASS D <u>Post Event</u>	CLASS E <u>Research</u>
Low Latency	4	3	2	1	1
Availability	4	2	1	3	1
Accuracy	4	2	1	4	1
Time Alignment	4	4	2	1	1
High message rate	4	2	2	4	1
Path Redundancy	4	4	2	1	1

Table key:

4 – Critically important, 3 – Important, 2 – Somewhat important, 1 – Not very important

NASPInet Conceptual Overview



Additional Goals

- Security
  - CIP compliance on trusted network with robust access control
- Respect for Intellectual Property (ownership of data)
  - PMU owners control who gets what data – not a free-for-all
- Broad Industry Acceptance
  - Users *want* to use NASPInet because it delivers value
- Ease of Use
  - Low maintenance

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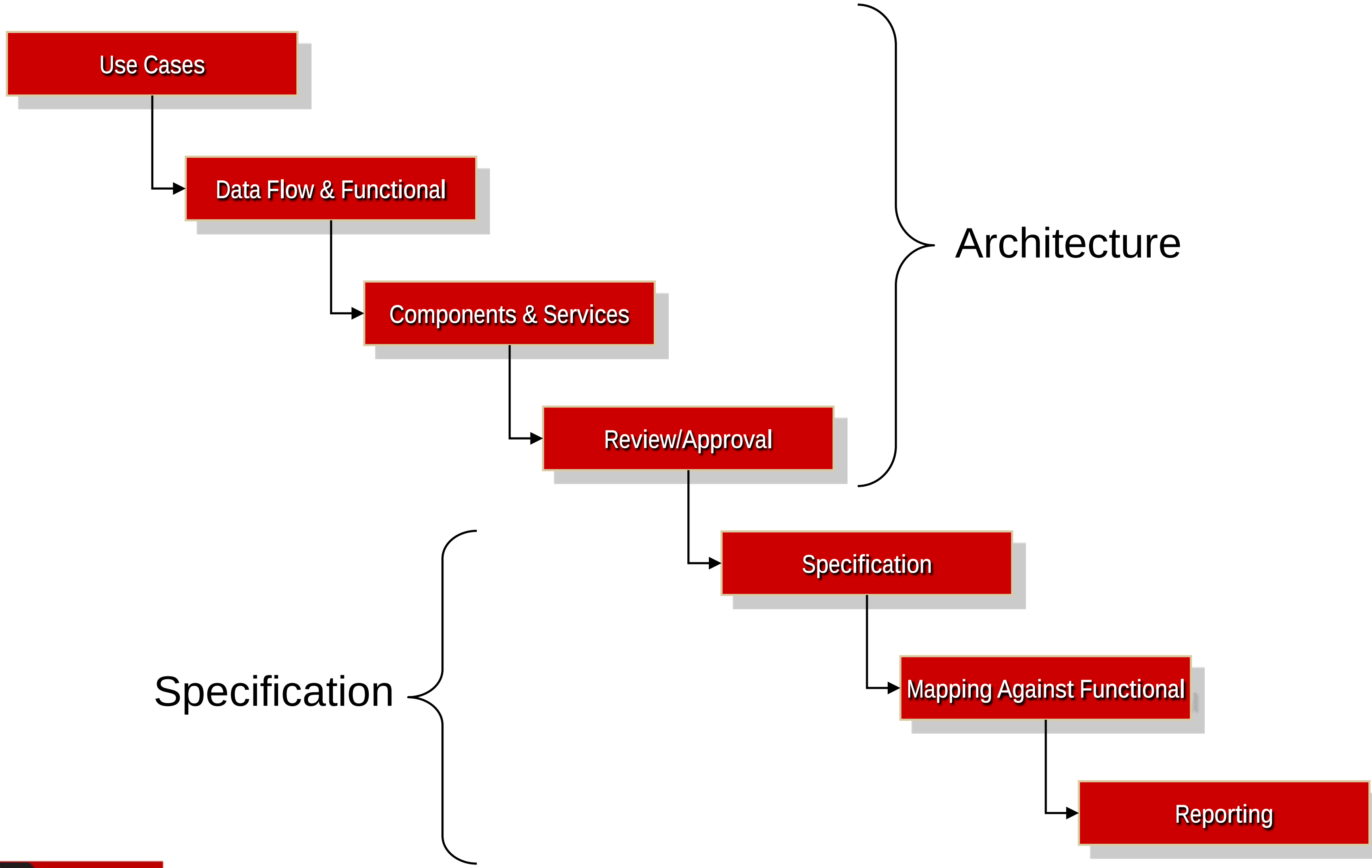
Table of Contents

- History and Administrative
- Design Goals – Application Classes
- Proposed Architecture
- Specification Outline
- Summary and Next Steps

Architecture Design Methodology



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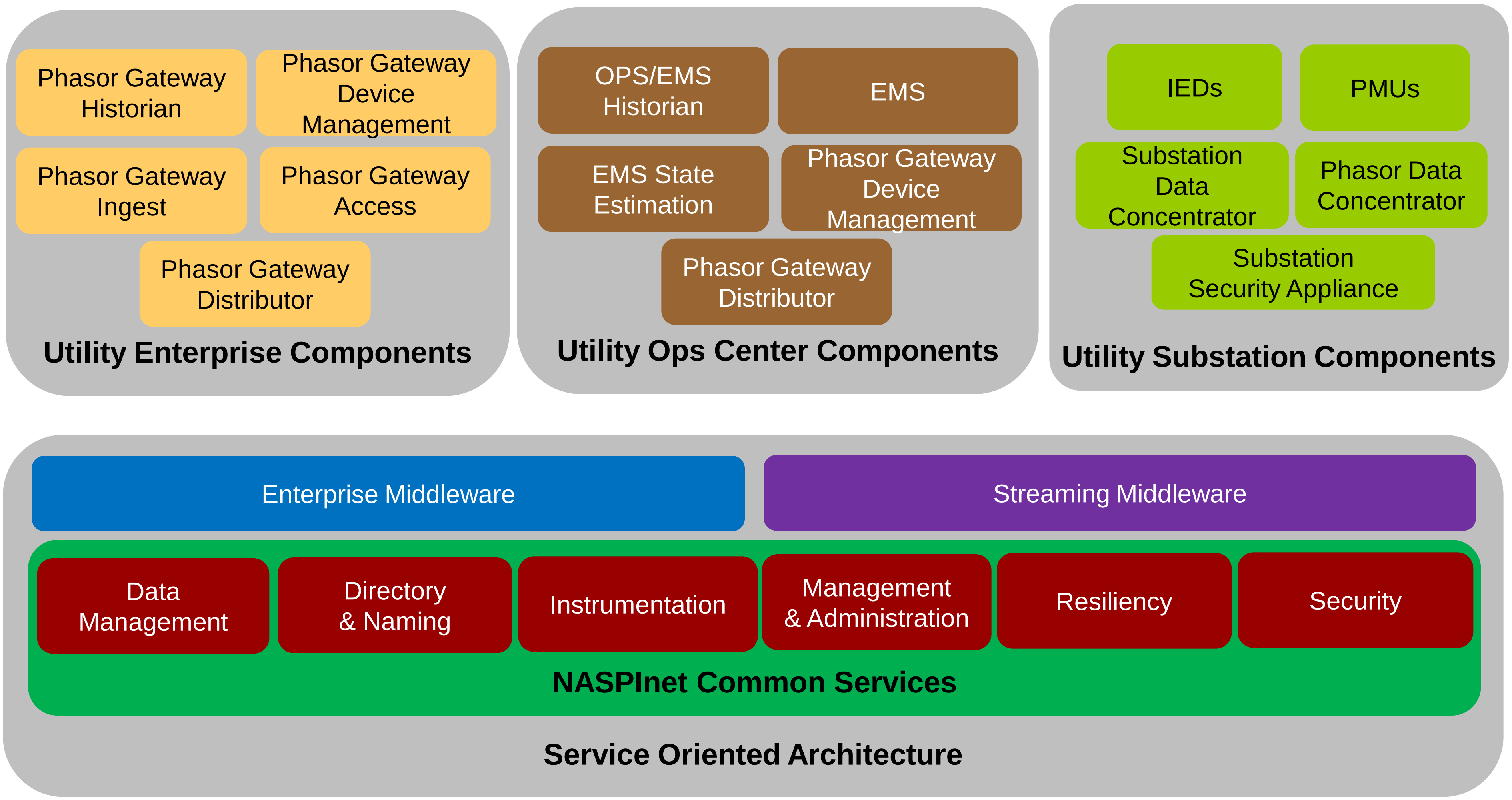
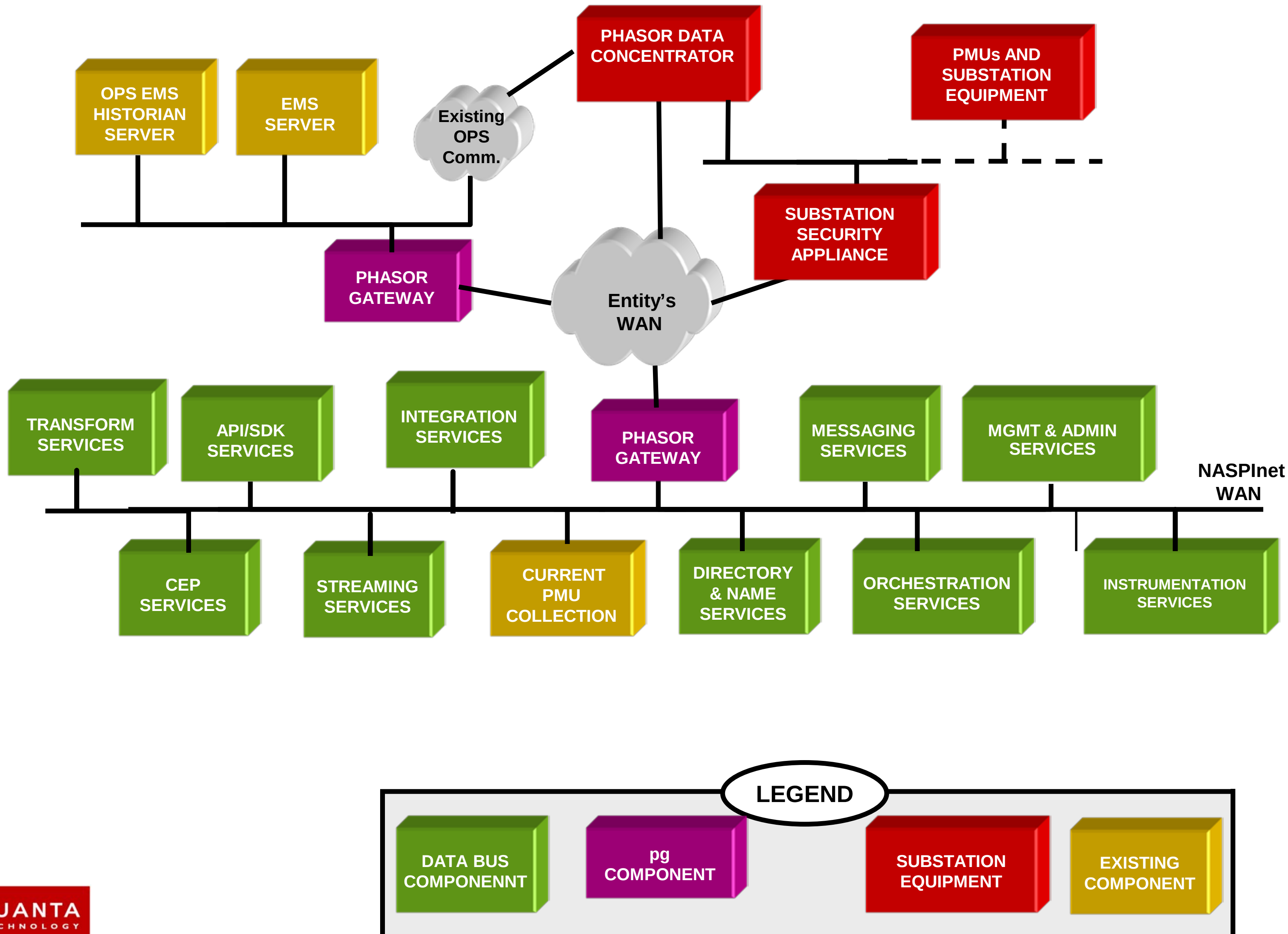
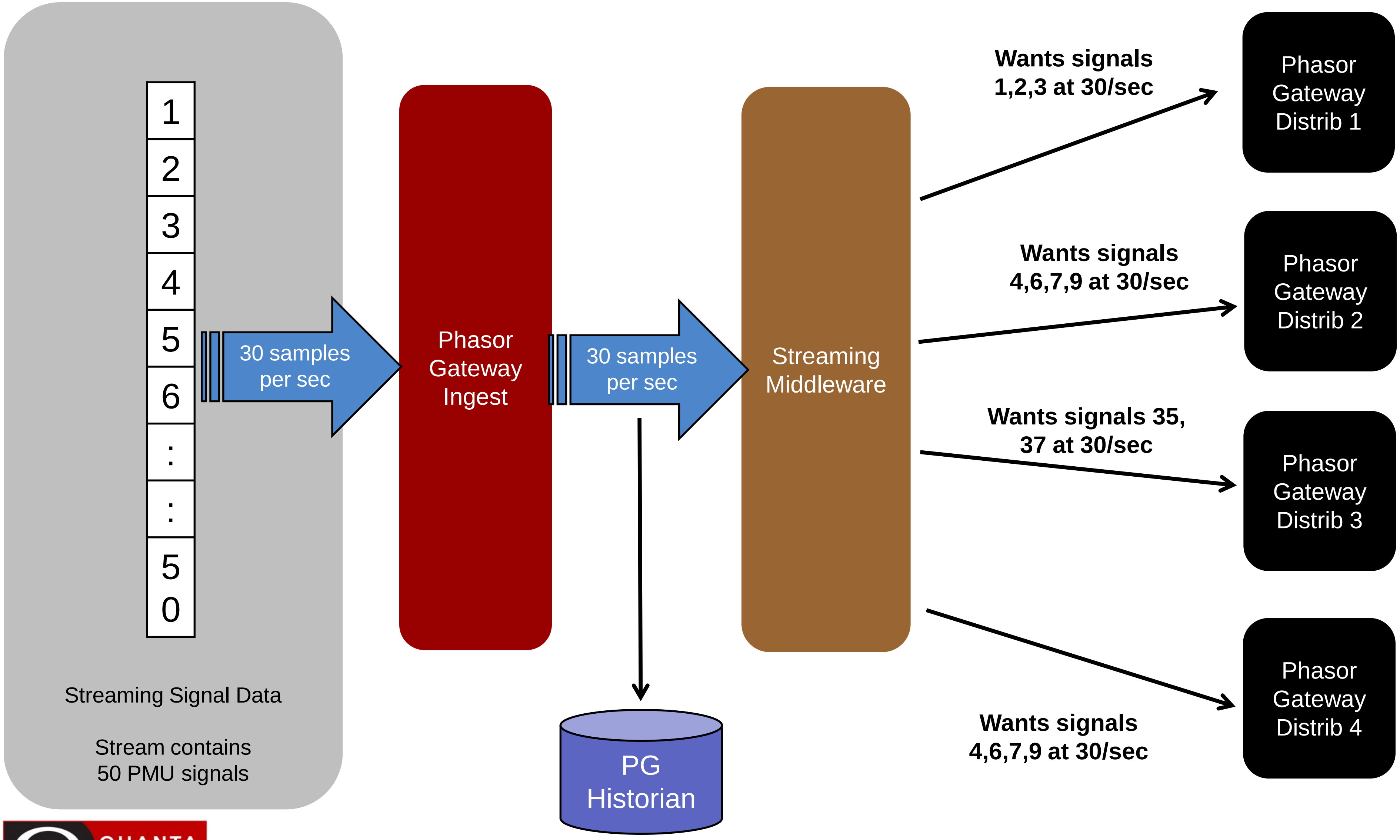
Conceptual Architecture



System Component View



Stream Processing Conceptual Example



Data Granularity

- Signal level granularity adopted for final implementation
  - Disaggregate and re-aggregate/reconstituting PMU C37.118 frames required
  - Access control
    - "It's OK for that subscriber to see my frequencies, but not my currents."
  - Encryption issues are complex, but solutions are available
- PMU device level granularity for initial implementation
  - Avoid the complexity of disaggregate and re-aggregate/ reconstituting PMU C37.118 frames
  - May have penalties to communication bandwidth usage
    - Sending full data frames when only portion of the data is subscribed

Historical Data Handling

- Historical data stored external to NASPInet will have
  - Different storage systems (databases, files, etc.)
  - Different data formats
  - Different access methods
- Specify storing historical data in PGs/DB?
  - Will have uniform data storage and access methods with one data format, but
  - It will greatly expand the project scope from “data exchange only” to “data exchange + data storage system”
- Current proposal
  - Use NASPInet as a historical data broker
  - Require PG be customizable on an individual PG basis to interface with each external historical data source

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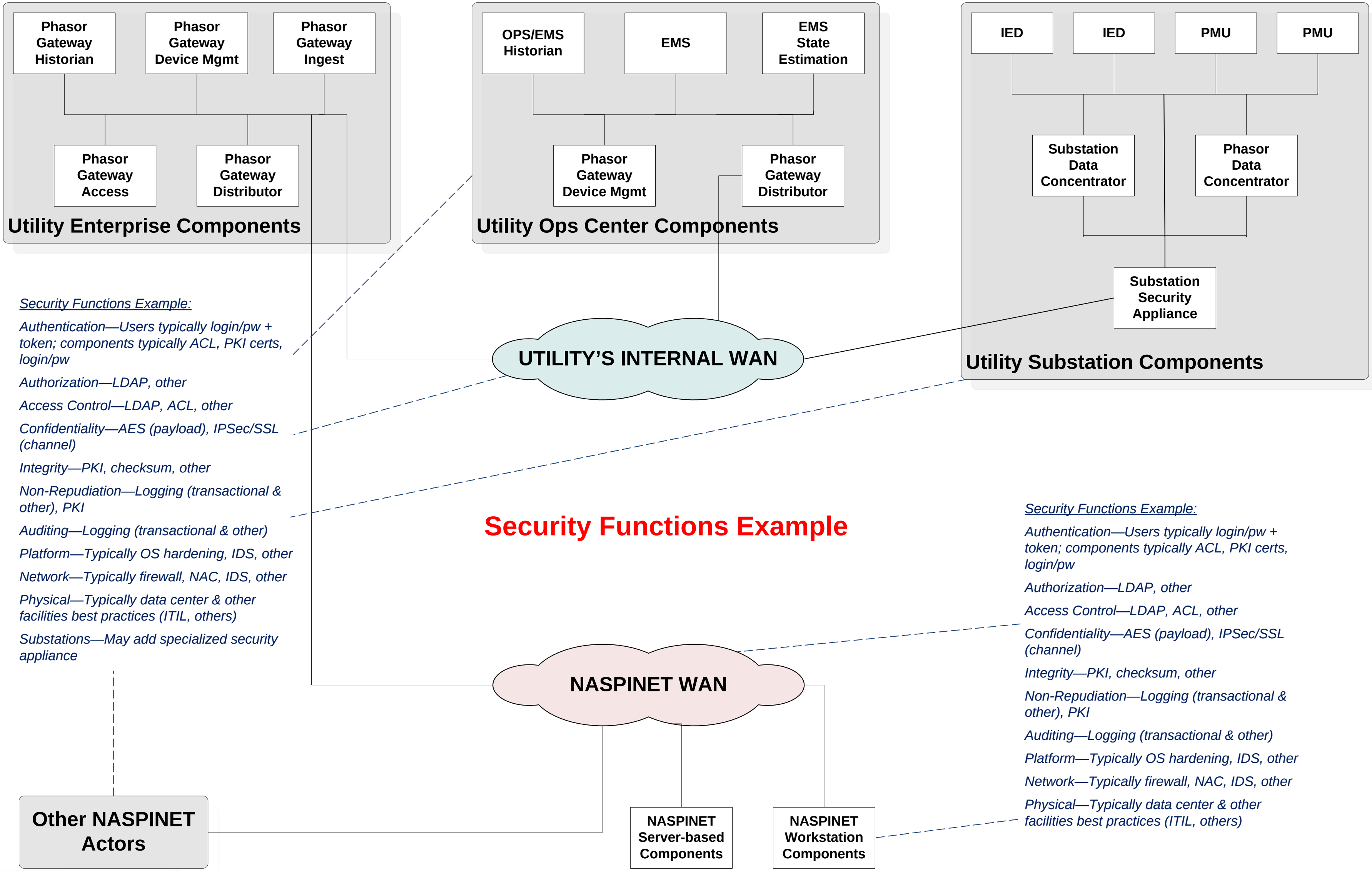
Quality of Service Management

- Delivered via Stream Processing Middleware in the Data Bus
  - Stream Processing Middleware operates above the network layer. The underlying network architecture provides QoS and other mechanisms
- StreamBase – an EXAMPLE of a reference product – built for high volume, low latency, and high availability
  - Field proven in managing financial transactions
  - Benchmarks of up to 500K messages trade messages processed per second, per CPU
  - Assuming conservative performance weighting of ~200K messages/second on a typical rack/blade server of $20-30K

System Security

- Commercial Public Key Infrastructure (PKI), Identity Management (IM), Trust Management (TM), Key Management (KM) components will act as broad enablers in the following areas:
  - Authentication – Multiple factors and contexts, PKI
  - Authorization & Access Control – Role-based, grant by exception
  - Confidentiality – Channel/payload encryption, KM
  - Audit & Compliance – Multi-level logging (transactions, events, user activities, devices, etc.) and incremental penetration testing
  - Non-Repudiation – Multi-level logging, PKI, IM
- Infrastructure – Intrusion Detection Systems (IDS), Network Access Control (NAC), Information Leakage Protection (ILP), as well as traditional perimeter components (such as firewalls) will act as broad enablers to prevent unauthorized access, changes and usage
- Physical – Industry recognized data center attributes such as Uptime Institute's Level IV Tier classification

Security Functions – Example



NASPInet Name Service Method

- NASPInet name service needs
  - Uniquely identify any physical or virtual device and the logical signals that these devices provide across the NASPInet
  - Enable applications to find and select any device/signal that they are authorized to see
- Proposed name service method
  - Owner registers device and signals provided by filling out a standard form (next slide)
  - Unique signal ID assigned by the service for each registered signal
  - Entity can map NASPInet signal ID to its own naming convention or notation used in its own systems and applications

NASPInet Device/Signal Registration Info

- Metadata includes
  - Physical location of the device (Country, State, Geo-coordinates, etc.)
  - Location identification (substation name, building name, etc.)
  - Type of device (PMU, PDC, etc.)
  - Device identification (device name, sequence number, etc.)
  - Device configuration (physical & logical)
  - Complete signal description (type of signal, reporting rate, data format, etc.)
  - Signal origin (e.g., original PMU signal that a PDC signal is derived from)
  - Signal source (measurement CT/PT, source devices, etc.)
  - Signal processing methods (if not original signal)
  - Signal quality (data class – latency, reliability, etc.)
  - Signal access method through P-PG (1-to-1, 1-to-N, etc.)
  - Ownership (entity name)
  - Name convention used by the device owner
  - Universal Name
  - …

Reference Deployment View

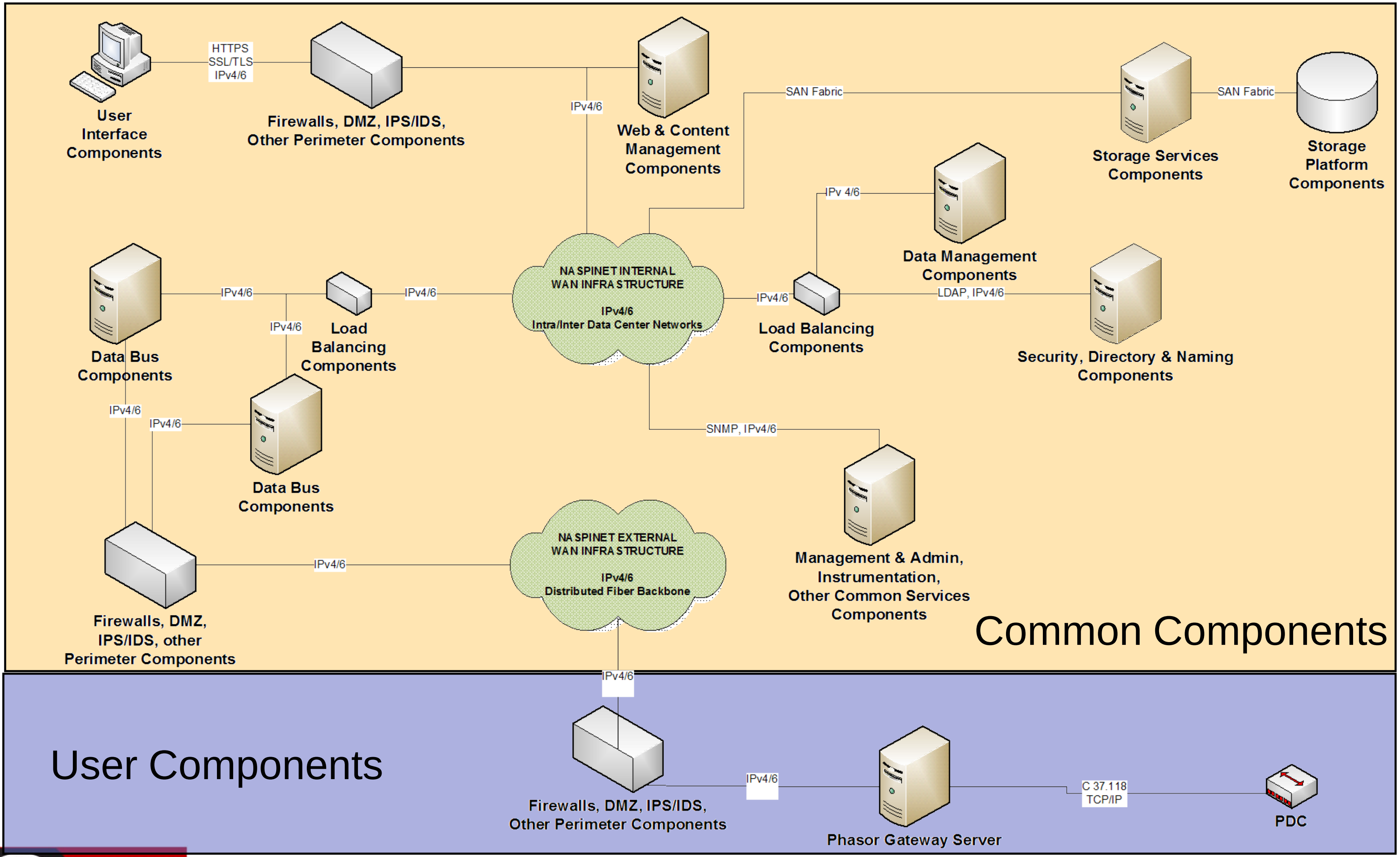


Table of Contents

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Specification Outline

1 INTRODUCTION AND PROJECT OVERVIEW
- 1.1 About the CUSTOMER
- 1.2 Project Background and Overall Objective
- 1.3 Overview of Key <DB/PG> Requirements
- 1.4 Overview of Conceptual NASPInet Architecture
- 1.5 Scope of Supply
- 1.6 CUSTOMER and Contractor Responsibilities
- 1.7 Organization of the Technical Specifications

2 NASPINET FUNCTIONAL REQUIREMENTS
- 2.1 General Requirements
- 2.2 System Administration
- 2.3 Operational Functions

3 SYSTEM ARCHITECTURE
- 3.1 Architectural Foundation
- 3.2 Architectural Representation
- 3.3 Data Flow View
- 3.4 Logical View
- 3.5 Component View
- 3.6 Security View
- 3.7 Data View
- 3.8 Network View
- 3.9 Deployment View

4 NETWORKING AND COMMUNICATIONS
- 4.1 Overall NASPInet networking and communication requirements
- 4.2 Scope of the NASPInet Interfaces
- 4.3 Standardized Network Interface/Integration Methodologies
- 4.4 NASPInet WAN requirements
- 4.5 PG Network Interfaces

5 SIZING, PERFORMANCE, AND AVAILABILITY
- 5.1 System Sizing
- 5.2 System Performance Requirements
- 5.3 System Expansion
- 5.4 System Availability
- 5.5 Equipment Operating Life

6 NAPSINET SECURITY REQUIREMENTS
- 6.1 End-to-End Security
- 6.2 Data Bus Security Requirements
- 6.3 Phasor Gateway
- 6.4 Trust Management
- 6.5 Encryption Related Issues
- 6.6 Security and Controllability in a Dynamic Multicast Group
- 6.7 NERC CIP Compliance

7 HARDWARE REQUIREMENTS
- 7.1 General Requirements
- 7.2 Processors and Auxiliary Memory
- 7.3 Archive Storage
- 7.4 Local Area Networks
- 7.5 Time Reference Unit
- 7.6 Spare Parts and Test Equipment
- 7.7 Interconnecting Cables
- 7.8 Equipment Enclosures
- 7.9 Power Supply and Distribution
- 7.10 General Hardware Requirements

8 SOFTWARE REQUIREMENTS
- 8.1 Conformance to Industry Standards
- 8.2 Use of Contractor Standard Support Software
- 8.3 Distributed Computing Environment
- 8.4 Application and System Development
- 8.5 On-Line Help

9 IMPLEMENTATION AND SUSTAINMENT SERVICES
- 9.1 Quality Assurance and Testing
- 9.2 Documentation and Training
- 9.3 Training Requirements
- 9.4 System Implementation and Sustainment

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Table of Contents

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- Discussion Points – partial list
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Summary

- The GOAL of NASPInet
  - Facilitate a secure and QoS guaranteed phasor data exchange among operating/reliability entities
- The SCOPE of the NASPInet Specification Project
  - Develop a conceptual framework of the system
  - Deliver a functional requirement specification that can be used to procure Phasor Gateway and Data Bus assets that meet broad NASPInet requirements
- The TIMELINE for the Specification development
  - Draft specification review on February 3, 2009
  - Draft specification delivered to DOE February 27, 2009
  - Completed specification to be delivered to DOE by April 27, 2009

Questions?

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