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EP

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DESCRIPTION OF CHANGES: If this is a new document steps 1 through 5 need not be completed

1) This Revision /Addenda Supersedes Revision No.: ____

2) List the Paragraph / Sections Changed:

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1 Introduction

1.1 Purpose

The purpose of this document is to provide the formal software requirements for the software product called “Loom”, a server application that is a part of the split acquisition system called “Gemini”. Engineers and developers will use this document to design and implement “Loom”, and third party engineering vendors will use this document to develop an interfacing module that will interact with “Loom” to meet the requirements listed in FDS-100.0.

1.2 Scope

This document, SRS-100.0, provides the Software Requirements Specification for Loom, and is referenced by the associated Software Design Description document, SDD-100.0. This document was created based on the requirements listed in FDS-100.0. Other requirements listed in this document not directly related to FDS-100.0 exist for practical purposes, such as a Web User Interface (Web UI) for network administration and user convenience.

1.3 Definitions, acronyms, and abbreviations

The following are the definitions and abbreviations of terms used within this document:

Gemini - split acquisition system that removes the need for at-the-valve testing at Nuclear Power Plants.

Gemini network - a network whose only nodes are the ones used within Gemini for a single MOV. This network therefore will compose of only three network nodes: one node at the valve (i.e., DAU at the MOV), one node at the MCC (i.e., DAU at the MCC), and one node within Loom (i.e., one of Loom’s network interfaces).

Gemini node - a network node within a Gemini network.

DAU node - a network node corresponding to a DAU (Data Acquisition Network) within a Gemini network.

TCP/IP - Transmission Control Protocol / Internet Protocol: A protocol for sending data over Ethernet and the internet. This protocol includes full transmission error checking and retries logic.

UDP - User Datagram Protocol: A faster protocol than TCP/IP for sending data over Ethernet, but with less error checking.

DHCP – Dynamic Host Configuration Protocol: A protocol for negotiating addresses on a network.

VLAN - Virtual Local Area Network: a separate network within a physical network used for logical network separation; often used to isolate unwanted network traffic within a network.

RPC - Remote Procedure Call: a protocol used to execute functions on a remote system from a local call.

gRPC - google Remote Procedure Call: an RPC implementation by Google using protocol buffers for binary serialization.

MVC - Model View Controller: an architectural design pattern used to separate business logic from the user interface. Typically used for web applications.

PTP - Precise Time Protocol: a protocol used to synchronize clocks within a computer network, with accuracy surpassing NTP (Network Time Protocol). Algorithm specifications described in IEEE1588.

ASP.Net Core MVC - a web framework within the .NET ecosystem that uses MVC.

Seed Vitda - a vitda file generated using specific valve-related information to be used for configuring new tests using DAU data.

MasterTest - a test with all test configuration except that which will be received from the DAUs.

1.4 References

FDS-100.0, MOV Online Diagnostic System Functional Design Specification

QEP-100 Product Development Process

QAP-10.0, Inspection/Verification

QAP-12.0, Control of Measuring and Test Equipment

SQAP, Software Quality Assurance Plan

QEP-100, Product Development Process

QEP-103, Design Specifications

GCD-XX, Goals and Constraints for Gemini

IEEE-830, IEEE Standard related to SRS

IEEE-802.3, IEEE Standard related to Ethernet

IEEE-802.11, IEEE Standard related to Wi-Fi

IEEE-1588, IEEE Standard related to PTP

1.5 Overview

Loom shall be a server application following the distributed client-server architecture that provides the following four interfaces (see Figure 1.1):

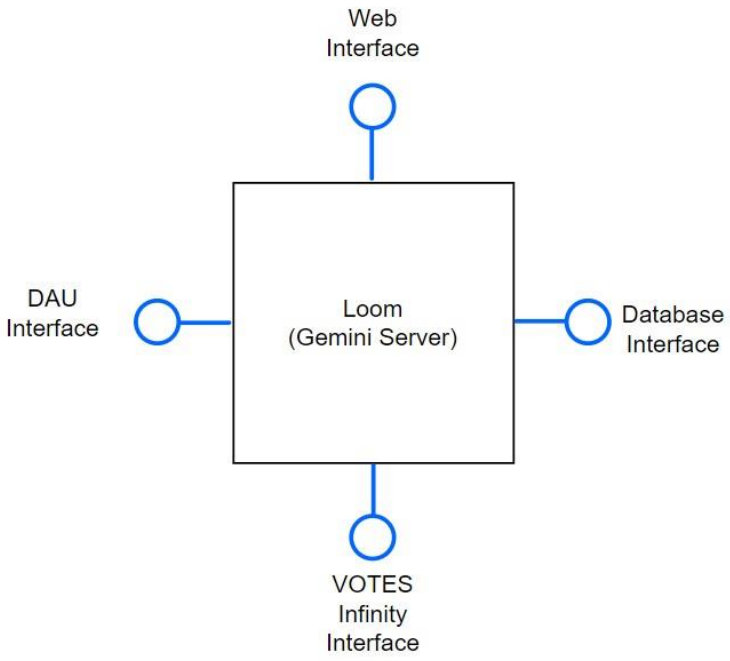

Figure 1.1: Loom, four interfaces

1. DAU interface: interface to interact with the Gemini DAUs within the Gemini system.
2. Web interface: interface to provide browser clients the ability to interact with the Gemini system.
3. Database interface: interface to perform specific database operations with a relational or non-relational database server for the Gemini system.
4. VOTES Infinity interface: interface to communicate with a VOTES Infinity application for the purpose of remote procedure calls for the Gemini system.

The DAU and database interfaces are necessary to meet FDS-100.0, while the web and VOTES Infinity interfaces are not. The web interface is for network administration user convenience, providing an easy way to configure or troubleshoot the Gemini system using a web browser. The VOTES Infinity interface is for future enhancements and expansions of Loom's capabilities (e.g., by leveraging the existing data analysis tools within the VOTES Infinity application).

Loom will not, with the current version(s), directly perform or provide the following features:

– data analytics
– configure any hardware or software except for licensed components with the Gemini system (such as Gemini DAUs)
– monitor and test AOVs

2 Overall Description

2.1 Product Perspective

Loom will operate within the following high-level constraints:

- User interfaces
  - Loom will interface with the users through the user interface (using a web client), which will give the following Loom parameters: The required license data for the DAUs, the setup of which DAUs are associated with each valve, the Seed vitda
- Hardware interfaces
  - Loom will have a hardware interface with the DAU Node.
- Software Interfaces
  - Loom, once it has created valid Tests, will store them in the server in a basic file system
  - These storage files must be readable and de-serializable by VOTES Infinity software versions 3.0 and later
- Communications interfaces
  - TCP/IP for user interface
  - TCP/IP for final data storage
- Memory constraints
  - 512 MB RAM minimum

2.2 Product Functions

This section lists the major functions that software will perform.

- Configure and troubleshoot Gemini DAUs through Web UI
- Health monitor, calibrate, and serve as communication medium among network of Gemini DAUs
- Retrieve data from Gemini DAU
- File new Gemini DAU configuration

– Verify License

– Create new MasterTest from Seed Vitda

– Export new tests

– Store internal configuration data

– Combine MasterTest with new data

See Figure 2.1

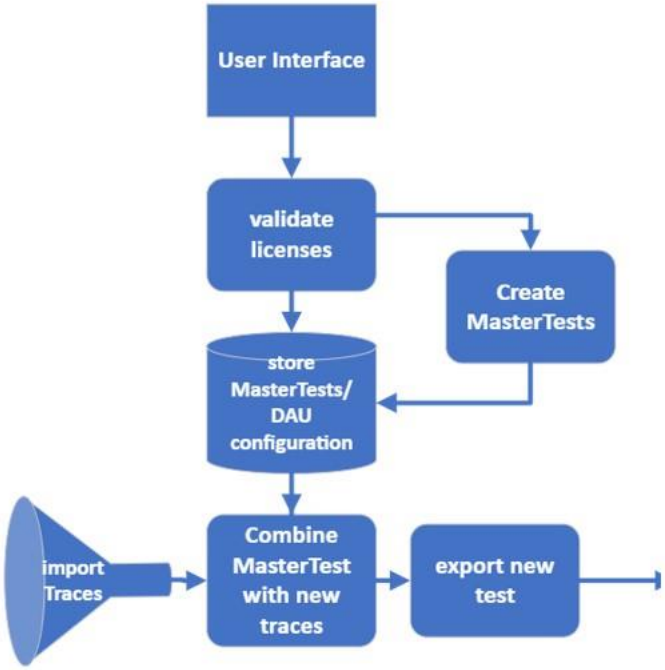

Figure 2.1: Product Functions of Loom

2.3 Constraints

This section lists the general constraints for the Loom application.

– The system shall follow the guidelines within NRC Cyber Security Guide (10CFR73.54).

– The system shall follow the guidelines within EPRI 3003008206, Cyber Security, Isolation for Maintenance, Monitoring, and Diagnostic Applications in Nuclear Power Facilities.

- The system shall adhere to the security and privacy policies of all Crane Nuclear PFT Corp software.
- The system shall comply with any regulations and procedures associated with plant data.

2.4 Assumptions and Dependencies

This section lists the Assumptions and Dependencies of the Loom application.

- Loom will operate within a reliable and performant network.
- The DAU interface will depend on a custom Ethernet-based protocol.
- The Web interface will only be used by the following web clients: Google Chrome, Mozilla Firefox, Microsoft Edge, and DuckDuckGo. More specific details (e.g., browser version) about the allowed web clients are shown in a list that contains all of the allowable User-Agents.
- The Database interface will depend on data storage system used by the database server on the network.
- The VOTES Infinity interface will depend on the VOTES Infinity server version.

2.5 Apportioning of Requirements

This section lists the requirements that may be delayed until further notice.

- The VOTES Infinity interface can only interact with versions of the VOTES Infinity application that exposes a port for the Loom connection.
- Any direct interactions with networks outside of the Gemini networks (e.g., the public internet).

3 Specific Requirements

This chapter lists the detailed requirements, enough for designers and implementers to produce a sufficient system.

3.1 External Interfaces

This section lists all of the external interfaces that Loom will use to interact with hardware clients (e.g., Gemini DAU) and software clients (e.g., web clients, database servers, applications) within the Gemini network.

- DAU Interface: Loom will use this interface to interact with Gemini DAUs. Communication will be done over a custom Ethernet-based protocol.
- Web Interface: Loom will use this interface to interact with web clients, mainly browsers.
- Database Interface: Loom will use this interface to interact with database applications.
- VOTES Infinity Interface: Loom will use this interface to interact with the VOTES Infinity application. Communication will be done over TCP/IP.

3.2 Functions

This section lists the functional requirements for Loom. It is broken into 4 subsections: Subsection 3.2.1 for the DAU Interface Functions, Subsection 3.2.2 for the Web Interface Functions, Subsection 3.2.3 for the Database Interface Functions, and Subsection 3.2.4 for the VOTES Infinity Interface Functions.

3.2.1 DAU Interface Functions

This subsection lists the functional requirements from the DAU Interface.

- Interacts with Gemini DAUs using a custom Ethernet-based protocol
- Converts raw data it acquires from the Gemini DAUs to generate valid signal trace that can get stored in a format usable by the VOTES Infinity application
- Deliver firmware updates to the Gemini DAUs
- Perform a health monitoring function according to a predefined schedule

- Perform calibration according to a procedure and predefined schedule
- Verify valid licenses
- Handle and process trigger events
- Enable or disable Gemini DAUs
- Handles authentication for communication with Gemini DAUs
- Handles authorization for communication with Gemini DAUs – Communicate using payloads with binary serialization.
- Provide a proxy service for interaction among Gemini DAUs

3.2.2 Web Interface Functions

This subsection lists the functional requirements from the Web Interface.

- Provides a user interface that can be used to configure and set the following parameters and settings:
  - Device ID
  - Trigger setup parameters for event detection
  - Data acquisition time durations for pre and post triggers
  - Fault detection settings
  - Communications settings
  - Transmission status
  - Security settings
  - Auto update configurations
  - Health monitoring schedules
  - Calibration schedules
- Routes traffic from frontend to necessary backend functions and services
- Handles authorization for communication with web clients
- Handles authentication for communication with web clients
- Supports common web browsers, such as Google Chrome, Mozilla Firefox, Microsoft Edge, and DuckDuckGo

– Utilizes the ASP.NET Core framework

3.2.3 Database Interface Functions

This subsection lists the functional requirements from the Database Interface.

– Provides a data export service

– Provides a data import service

– Provides a data processing service

– Interacts with Microsoft SQL Server

– Interacts with accessible mounted drives

3.2.4 VOTES Infinity Interface Functions

This subsection lists the functional requirements from the VOTES Infinity Interface.

– Invoke remote procedure calls with valid VOTES Infinity applications

3.3 Performance Requirements

This section lists the performance requirements for Loom.

– The system shall be able to handle at least 100 Gemini networks, which approximately implies at least 200 DAU nodes.

– The system shall be able to have a response time of at most 5 minutes for each DAU interaction; that is, if given a request to a DAU node from the user, then a request should be provided by at most 5 minutes from the request being sent out. Otherwise, the user will assume the DAU nonfunctional.

– The system shall be able to handle a database of at least 10000 records without any performance issues.

– The system shall load up within 5 minutes of user request.

3.4 Logical database requirements

The only internally stored data will hold the information for each valve which includes the two DAUs connected to monitoring it and the existing MasterTest which holds all related valve data that will be consistent for every test captured.

- Database will be updated when new Gemini DAUs are added to the Gemini Network
- Loom will only output valve information to the part of the software which combined MasterTests with new trace data
- Each valve will be associated with a Gemini DAU at the valve, a Gemini DAU at the MCC, and MasterTest
- The only Gemini DAU information needed is the Device ID, so that the new data can be connected to the other Gemini DAU on the Gemini Network and to the MasterTest associated with the valve
- The internal database's tables will exist under the same relational constraints as the tables in external database management tools.

3.5 Design Constraints

This section lists the design constraints for the Loom application.

- The system shall be able to operate within a Windows 10 Operating System (latest feature version, 2H1, or newer)
- The system shall be able to use a custom Ethernet-based protocol to communicate with the DAUs.
- The system shall use TLS for data in transit and AES for data at rest.
- The system shall be provide patches and firmware updates to the DAUs using Crane Nuclear PFT Corp. specific software tools; these include tools developed by third party engineering vendors specifically for Crane Nuclear PFT Corp's Gemini system.

- The system shall be able to operate well with a 2GHz processor 64-bit Operating System with at least 4 GB RAM and at least 25 GB of storage.
- The system shall be developed using the .NET 8.0 platform from Microsoft, using the C# programming language.

3.6 Software System Attributes

This section lists the system attributes that Loom shall satisfy.

- Reliability
  - System will automatically restart on failure
  - System will log error events
  - System will have logic for re-trying connections when they fail and other systems to increase reliability
- Security
  - Logging of all activities necessary for troubleshooting
  - Principle of Least Privilege regarding the availability of each module to information and other modules
  - Use should be based on service account credentials
  - Only have read/write access to non-system directories
- Portability
  - Operational only on Windows
  - Operational only in English