Enterprise Messaging Infrastructure

Vitria Interface Engine

Laboratory Data Sharing and Interoperability

Service Integration Design Document



Department of Veterans Affairs

**April 2016**

**Version 1.2**

Revision History

| Version | Description/Comments | Author | Delivery Date |
| --- | --- | --- | --- |
| 0.01 | Initial document creation and review |  | 03/10/2015 |
| 0.02 | Updated to incorporate “as built” details | . | 07/09/2015 |
| 0.03 | * Updated to incorporate eMI IT review comments from * Front material - Consolidated Revision History table and ROC into one table * Appendix A - Added signature page * Section 1.0 - Updated to provide more transition, results, and benefits information | .  . | 09/14/2015 |
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| 1.0 | Completed first version of the document | . | 12/14/2015 |
| 1.1 | Updated contents and diagrams |  | 3/01/2016 |
| 1.2 | Tech writer review and added VA SharePoint link for eMI SDD |  | 3/30/2016 |

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1. Introduction

The Laboratory Data Sharing and Interoperability (LDSI) Enterprise Messaging Infrastructure (eMI) application facilitates the exchange of laboratory (lab) orders and results between the Department of Defense (DoD) Composite Health Care System (CHCS) and the Department of Veterans Affairs (VA) Veterans Health Administration (VHA).

* 1. Purpose

This document presents the software interface requirements among the DoD, the Veterans Health Information System and Technology Architecture (VistA) Interface Engine (VIE), and the Lab Server. The purpose of this document is to specify the existing interface requirements that the Enterprise Messaging Infrastructure (eMI) must meet in order for the migration to be successful. It describes the concept of operations for the interface, defines the message structure and protocols that govern the interchange of data, and identifies the communication paths along which the data currently flows.

* 1. Scope

The scope of this document is to describe the message flow between the eMI LDSI interface to the DoD CHCS and to the VA VistA systems. This document serves as both requirement and design specification for the LDSI message flow.

The eMI LDSI application receives lab request data from the DoD over Socket for transmission to the VA VistA over Socket. The eMI LDSI application receives the results of the lab requests from VistA over Socket and transmits them to the DoD over Socket. The flow is bi-directional such that the eMI LDSI application also receives lab request data from VistA over Socket for transmission to the DoD over Socket and the results of the lab requests from the DoD over Socket for transmission to VistA over Socket. LDSI receives approximately 244 messages per day, averaging two kilobyte messages per payload.

The scope items include, but are not limited to:

1. Message Types
2. Validation
3. Ports and Protocol
4. Transformation
5. Error Handling
6. Routing
7. Security

The details of the above are described in the following sections. Also, the common architectural specifications, such as security, logging, exception handling, etc. that apply to all VistA Interface Engine (VIE) message flows, are defined in eMI Software Design Document (SDD).

The definitions of the Health Level 7 (HL7) messages that are generated by VistA to be sent to LDSI are not in the scope of this document. Details of eMI architecture, physical addresses, and system specification are not in the scope of this document.

* 1. Audience

This document provides implementation details for project owners and serves as a blueprint for managers, architects, developers, and testers building the system. It is assumed that the readers have a moderate knowledge of Message Broker and HL7.

* 1. References

eMI SDD on the Department of Veterans Affairs (VA) eMI SharePoint site.

1. Interface Requirement

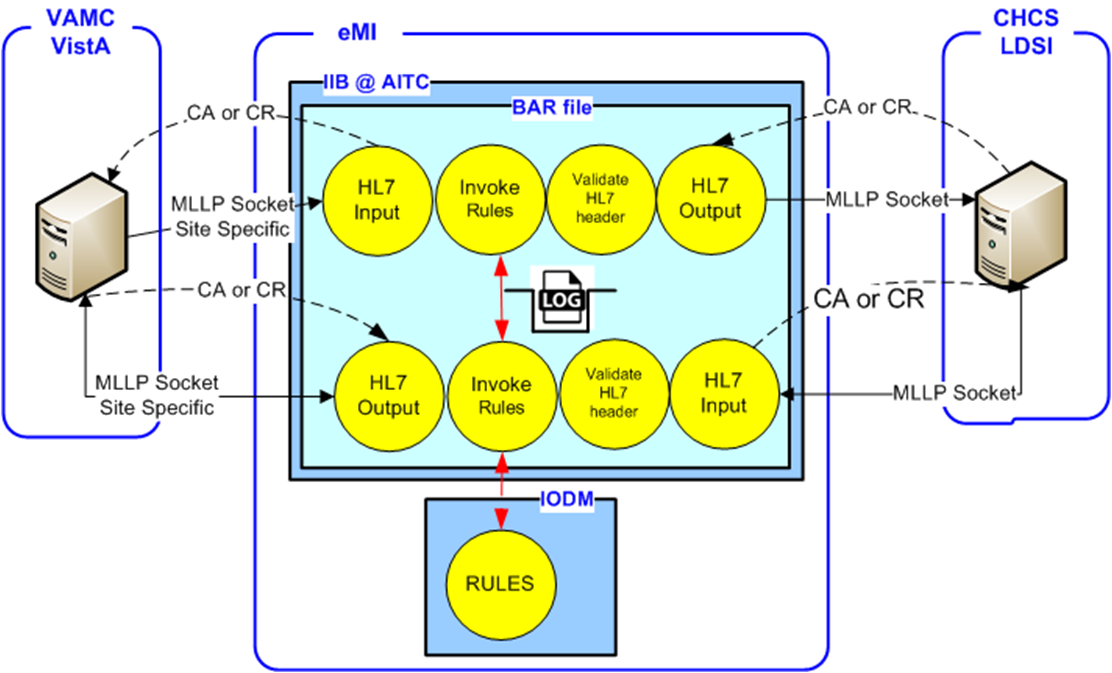
Table 1 lists the software interfaces that are implemented.

Table 1 – Software Interfaces

| Application | Interface |
| --- | --- |
| DoD CHCS 🡪 eMI | Utilizes Socket to push the lab orders and results as HL7 messages to eMI |
| eMI 🡪 VA VistA | Utilizes Socket to push the lab orders and results as HL7 messages to VistA |
| VA VistA 🡪 eMI | Utilizes Socket to push the lab orders and results as HL7 messages to eMI |
| eMI 🡪 DoD CHCS | Utilizes Socket to push the lab orders and results as HL7 messages to CHCS |

* The DoD CHCS 🡪 eMI – eMI interface utilizes Socket to receive the lab orders and results from the DoD CHCS.
* The eMI 🡪 VA VistA – eMI interface utilizes Socket to send the received lab orders and results from the DoD CHCS to VistA.
* The VA VistA 🡪 eMI – eMI interface utilizes Socket to receive the lab orders and results from the VA VistA.
* The eMI 🡪 DoD CHCS – eMI interface utilizes Socket to send the received lab orders and results from VistA to the DoD CHCS.
  1. Logical System Overview

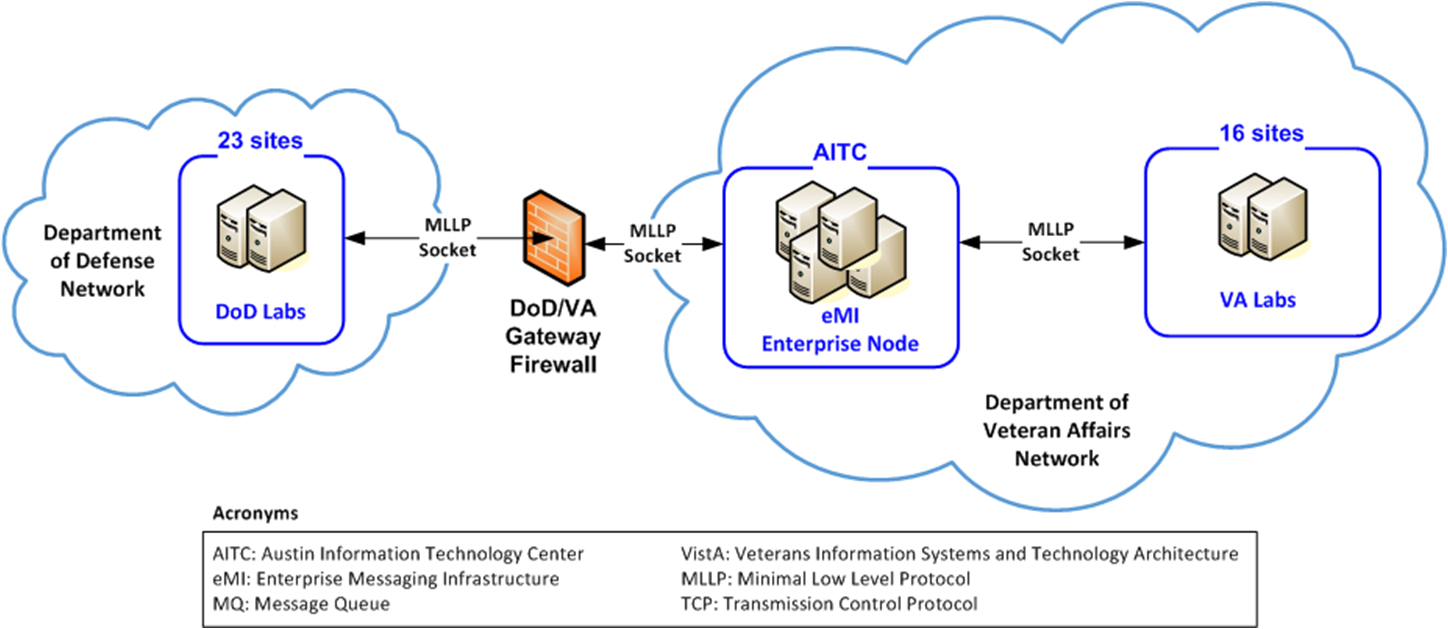
Figure 1-- LDSI-- eMI Logical System Overview



1. The DoD CHCS initiates the transfer of a lab order or result as an HL7 message via Socket.
2. The eMI validates the Message Header (MSH) and identifies the routing information.
3. The eMI sends the received HL7 message to the identified system based on the routing rule, receives a Commit Acknowledgement (CA) or Commit Rejection (CR) from the VA VistA, and returns the response to the DoD CHCS.
4. The VA VistA system initiates the transfer of a lab order or result as an HL7 message via Socket.
5. The eMI validates the MSH and identifies the routing information.
6. The eMI sends the received HL7 message to the identified system based on the routing rule, receives a CA or CR from the DoD CHCS, and returns the response to the VA VistA.
   1. Deployment Overview

The eMI Message Broker hosts the message flow that listens for HL7 messages from the VA VistA over Transmission Control Protocol (TCP)/Minimal Lower Layer Protocol (MLLP) and routes these messages to the respective DoD CHCS. Similarly, the eMI Message Broker hosts the message flow that listens for HL7 messages from the DoD CHCS over TCP/MLLP and routes these messages to the respective VA VistA. Figure 2 shows the boundaries, gateway, and locations of sending and receiving systems.

Figure 2 – LDSI – eMI Deployment Overview



* 1. LDSI – eMI Interface Requirements

1. The eMI system shall receive incoming HL7 messages via Socket from both DoD and VA. The eMI system is expected to receive HL7 messages such as ORM^O01, ORR^O02, and ORU^R01.
2. The eMI system shall skip messages that are less than four bytes or messages that start with “SKIP.”
3. The eMI system shall route the message to the given Internet Protocol (IP) and port of the DoD system or VA system as defined in the Operational Decision Management (ODM). The eMI system shall look up the IP and port based on the incoming message’s Receiving Application (MSH05) and Receiving Facility (MSH06).
4. In the event the eMI system is unable to identify the routing information, it shall generate a CR and send it to the message sending system and emit a monitoring event with the error message.
5. The MSH segment field MSH03 “Sending Application” and field MSH04 “Sending Facility” contain both the sending and receiving site information separated by the “V” character of the messages that are received from DoD. The eMI system shall remove receiving site information and the character “V” before sending the message to VA. The following is an example.

Before transformation:

MSH^\|~&^LA7V HOST 459V0052^459V0052^LA7V REMOTE 459^459^20060831090300^^ORU\R01^A0101-512812251^P^2.2^^^AL^ER^

After transformation:

MSH^\|~&^LA7V HOST 0052^0052^LA7V REMOTE 459^459^20060831090300^^ORU\R01^A0101-512812251^P^2.2^^^AL^ER^

1. The eMI system shall update the MSH segment before sending the message to DoD by adding receiving site information separated by the “V” character. The following is an example.

Before transformation:

MSH^~|\&^LA7V REMOTE 501^501^LA7V HOST 7219^7219^20060831131439-0700^^ORM~O01^50159934094^P^2.2^^^AL^AL^

After transformation:

MSH^~|\&^LA7V REMOTE 501^501^LA7V HOST 501V7219^501V7219^20060831131439-0700^^ORM~O01^50159934094^P^2.2^^^AL^AL^

1. MSH transformation shall occur as defined in REQ-5 and REQ-6 only when either MSH03 “Sending Application” or MSH05 “Receiving Application” starts with “LA7V.”
2. MSH transformation shall not occur if any one of the following segments is empty: MSH03, MSH04, MSH05, or MSH06.
3. The eMI system shall keep the connection open with the sending system until the receiving system sends the Accept Acknowledgement (CA or CR).
4. eMI Guidelines

This section captures the data related to governance, business units, Enterprise Shared Service (ESS) design patterns, IBM design patterns, auditing, security, Service Level Agreements (SLAs), protocols, and port details.

Table 2 defines the agency, role, and PoC (accurate as of 12/2015) for the DoD Business Unit.

Table 2 – DoD Business Unit

| DoD Business Unit | |
| --- | --- |
| Agency | DoD |
| Sending Application | CHCS |
| POC Name |  |
| Title | DoD, CHCS (Government) Product Line Manager |
| Address |  |

Table 3 defines the agency, role, and PoC (accurate as of 12/2015) for the VistA Business Unit.

Table 3 – VistA Business Unit

| VistA Business Unit | |
| --- | --- |
| Agency | VA |
| Sending Application | VistA |
| POC Name |  |
| Title | Milwaukee Department of Veterans Affairs Medical Center |
| Address | Hines Office of Information Field Office |

Although LDSI does not have a service owner, the source of the data belongs to the DoD CHCS and VA VistA system.

The LDSI implementation uses a two-way delivery pattern as defined in the Enterprise Messaging Capability and Message Exchange Patterns document. The LDSI implementation also uses an IBM HL7-to-HL7 pattern within eMI to process the incoming and outgoing HL7 messages and acknowledgments.

* 1. Security

LDSI is system-to-system communication and does not require individual users to be authenticated. LDSI has no unique security requirements outside of the current eMI security guidelines and will follow the security pattern used by eMI to secure and control connections between systems. Authentication relies on system-to-system mutual trust and firewall rules and will be addressed by the existing eMI configuration.

* 1. Auditing and Monitoring

The LDSI application uses asynchronous logging patterns that place messages onto a logging queue. The queue is then processed by an independent eMI logging application that utilizes the IIB Monitoring Event implementation.

Error handling in LDSI application handles both application errors and system errors. Application errors occur when the eMI LDSI application is unable to find the routing information. It creates the error logs and moves messages to an error queue. Tier 2 and Tier 3 teams monitor the error queues and notify the corresponding system POC.

1. LDSI Design

The following sections refer to the LDSI design aspects.

* 1. Architecture Deviations

The LDSI message flow will use HL7-to-HL7 Data Format Description Language (DFDL) pattern. The architecture design supports both MRM and DFDL patterns, and there is no impact on the performance or functionality.

* 1. Pattern

The LDSI message flow is an instance of an HL7-to-HL7 DFDL pattern. The following options are specified in the tool configuration due to the requirements of the interface requirements.

* No sequencing
* No journaling
* Unchecked canonical feed, report remainders, check duplicates
* Publish to queue
  1. Protocol

The LDSI integration service uses the protocols described in Table 4, Table 5, Table 6, and Table 7 to interface with the sending and receiving systems.

Table 4 – DoD CHCS to eMI Interface

| DoD CHCS to eMI | |
| --- | --- |
| Protocol: | MLLP over TCP/IP |
| Message Type: | HL7 v.2.2 ORM^O01, ORR^O02, and ORU^R01 |
| DoD CHCS hostname: | DoD CHCS applications |
| eMI hostname: | Austin Information Technology Center (AITC) Load balancer |

Table 5 – eMI Interface to VA VistA

| eMI To VA VistA | |
| --- | --- |
| Protocol: | MLLP over TCP/IP |
| Message Type: | HL7 v.2.2 ORM^O01, ORR^O02, and ORU^R01 |
| eMI hostname: | AITC Message Brokers |
| VA VistA hostname: | Reference Table 3 |

Table 6 – VA VistA to eMI Interface

| VA VistA to eMI | |
| --- | --- |
| Protocol: | MLLP over TCP/IP |
| Message Type: | HL7 v.2.2 ORM^O01, ORR^O02, and ORU^R01 |
| VA VistA hostname: | VA VistA applications |
| eMI hostname: | AITC Load balancer |

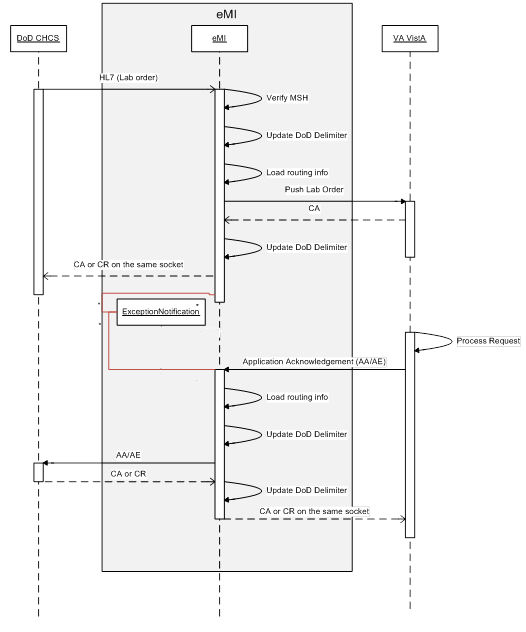
Table 7 – eMI to DoD CHCS Interface

|  |  |
| --- | --- |
| eMI to DoD CHCS | |
| Protocol: | MLLP over TCP/IP |
| Message Type: | HL7 v.2.2 ORM^O01, ORR^O02, and ORU^R01 |
| eMI hostname: | AITC Message Brokers |
| DoD CHCS hostname: | Reference Table 2 |

* 1. Nominal LDSI Message Flow

Figure 3 shows the message flow from the DoD CHCS to the VA VistA system using the eMI.

Figure 3 – DoD CHCS to VA VistA Sequence



1. The DoD CHCS initiates the transfer of an HL7 message via Socket.
2. The eMI validates the MSH.
3. The eMI keeps the Socket open to return a CA or CR.
4. The eMI updates the DoD delimiter in the MSH segment.
5. The eMI loads the routing information from the Operational Decision Management (ODM) to identify the IP and Socket based on the destination.
6. The eMI delivers the HL7 message to the IP and Socket identified in Step 5.
7. The eMI receives the CA or CR from the VA VistA.
8. The eMI updates the DoD delimiter in the MSH segment.
9. The eMI sends the CA or CR to the DoD CHCS.

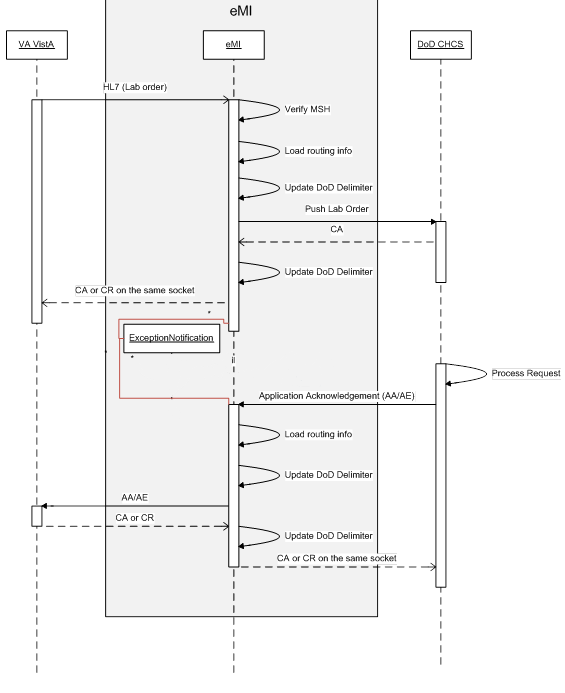
Error Flow: If the eMI is unable to find routing information in Step 5, then it sends the CR back to the DoD CHCS and emits a monitoring event with the error message about the exception. For any other exceptions that occur during Steps 2 through 8, the eMI does not send a response back to the DoD CHCS.

1. After processing the HL7 message, the VA VistA system initiates the transfer of an HL7 acknowledgement message (ACK) via Socket.
2. The eMI validates the MSH.
3. The eMI keeps the Socket open to return a CA or CR.
4. The eMI loads the routing information from the Operational Decision Management (ODM) to identify the IP and Socket based on the destination.
5. The eMI updates the DoD delimiter in the MSH segment.
6. The eMI delivers the HL7 ACK to the DoD IP and Socket identified in Step 13.
7. The eMI receives the CA or CR from the DoD CHCS.
8. The eMI updates the DoD delimiter in the MSH segment.
9. The eMI sends the CA or CR to the VA VistA.

Error Flow: If the eMI is unable to find routing information in Step 13, then it sends the CR back to the VA VistA and emits a monitoring event with the error message about the exception. For any other exceptions that occur during Steps 11 through 17, the eMI does not send a response back to the VA VistA.

Figure 4 shows the message flow from the VA VistA system to the DoD CHCS using the eMI.

Figure 4 – VA VistA to DoD CHCS Sequence



1. The VA VistA system initiates the transfer of an HL7 message via Socket.
2. The eMI validates the MSH.
3. The eMI keeps the Socket open to return a CA or CR.
4. The eMI loads the routing information from the Operational Decision Management (ODM) to identify the IP and Socket based on the destination.
5. The eMI updates the DoD delimiter in the MSH segment.
6. The eMI delivers the HL7 message to the DoD IP and Socket identified in Step 4.
7. The eMI receives the CA or CR from the DoD CHCS.
8. The eMI updates the DoD delimiter in the MSH segment.
9. The eMI sends the CA or CR to the VA VistA.

Error Flow: If the eMI is unable to find routing information in Step 4, then it sends the CR back to the VA VistA and emits a monitoring event with the error message about the exception. For any other exceptions that occur during Steps 2 through 8, the eMI does not send a response back to the VA VistA.

1. After processing the HL7 message, the DoD CHCS initiates the transfer of an HL7 message via Socket.
2. The eMI validates the MSH.
3. The eMI keeps the Socket open to return a CA or CR.
4. The eMI updates the DoD delimiter in the MSH segment.
5. The eMI loads the routing information from the Operational Decision Management (ODM) to identify the IP and Socket based on the destination.
6. The eMI delivers the HL7 message to the IP and Socket identified in Step 14.
7. The eMI receives the CA or CR from the VA VistA.
8. The eMI updates the DoD delimiter in the MSH segment.
9. The eMI sends the CA or CR to the DoD CHCS.

Error Flow: If the eMI is unable to find routing information in Step 14, then it sends the CR back to the DoD CHCS and emits a monitoring event with the error message about the exception. For any other exceptions that occur during Steps 10 through 17, the eMI does not send a response back to the DoD CHCS.

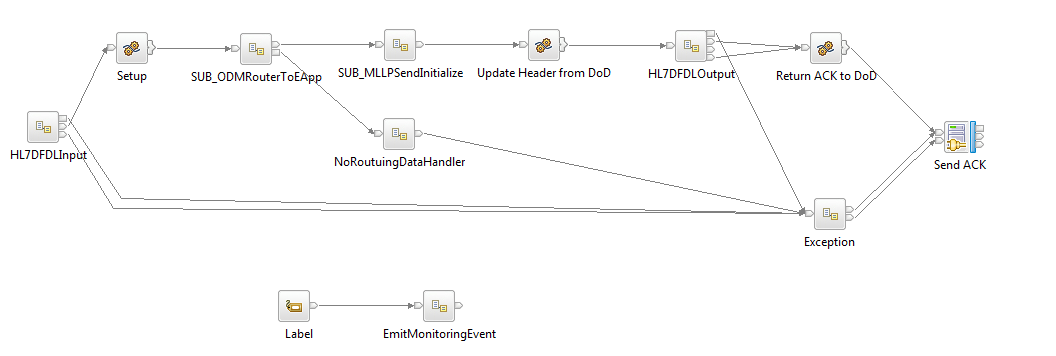
1. Implementation Details

For the LDSI application, there is one main message flow that supports the synchronous flow of messages from the DoD CHCS to VA VistA systems. The main message flow has two sub-flows: HL7Input flow (Figure 6) and HL7Output flow (Figure 7).

NOTE: The same instance of this flow applies to messages from the VA VistA systems to DoD CHCS.

* 1. LDSI CHCS to VistA Flow

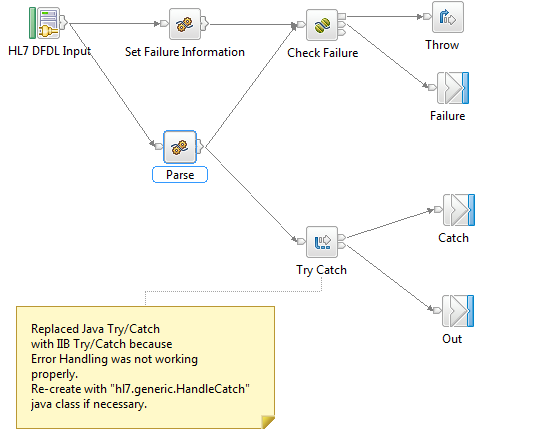
Figure 5 – CHCS to VistA Flow



The message flows receive HL7 messages from the DoD CHCS using MLLP over TCP/IP. As Figure 5 shows, the receiver flow of the HL7 to HL7 pattern is updated in the following manner to support additional requirements.

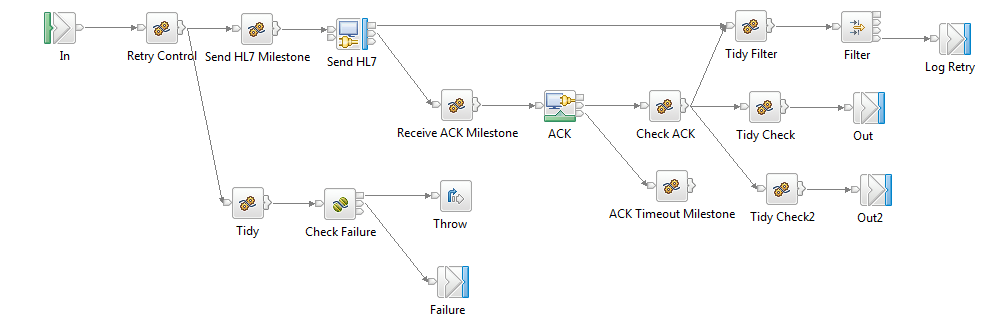
* Updated ‘Receiver Flow’ of the HL7-to-HL7 pattern to:
* Support additional MSH field validation as per requirements
* Update to support synchronous return of CA and/or CR received from VA VistA
* Add routing rules in the decision table in the Operational Decision Manager (ODM). The flow uses the decision service to connect to the ODM to retrieve and execute the rules; refer to Section 5.2 for routing details.
* Replaced GenericHL7Input node with HL7Input message sub-flow to suppress validation of HL7 segments in received HL7 messages against the HL7v25P message definition set; Figure 6 shows the HL7Input message sub-flow.

Figure 6 – HL7 Input Flow



* Replaced GenericHL7Output node with HL7Output message sub-flow to avoid treating the CR, Commit Error (CE), Application Rejection (AR), and Application Error (AE) as exceptions and prevent retries; Figure 7 shows the HL7Output message sub-flow.

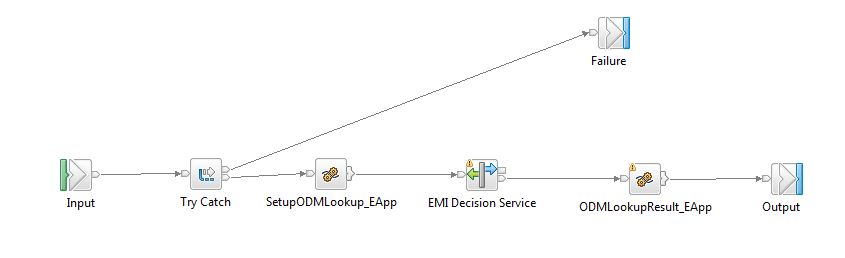
Figure 7 – HL7 Output Flow



* 1. Routing

The eMI determines the routing information (host and port) based on the receiving facility ID and receiving application ID. The eMI uses the Operational Decision Management (ODM) to determine the routing information. Figure 8 shows the message flow that is used to load the configuration.

Figure 8 – Load Routing Information Message Flow

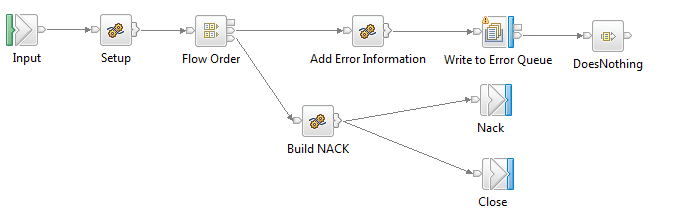


The eMI performs a lookup based on the first word of the receiving application (MSH05) and receiving facility (MSH06). It derives the first word by truncating the receiving application string at the first instance of a space or a dash. For example, if the receiving application is “LA7V Remote 459,” then the first word is “LA7V.” Similarly, if the receiving application is “LA7V-Remote 459,” then the first word is “LA7V.”

The routing configuration table would include the following data:

* Receiving Facility ID
* Receiving Application ID (first word of the receiving application)
* Receiving Application Host
* Receiving Application Port
  1. Error Handling Flows

Figure 9 – Receiver Exception Handler



When the receiver flow is unable to find the routing information during the processing of incoming HL7 messages, it raises an exception. As Figure 9 shows, the receiver exception handler flow handles this raised exception. This flow logs the exception to the ‘VIE.LDSI\_ENT.RECEIVER.ERROR.ENT.L ’ queue first. Once it successfully publishes the message to the queue, it constructs the CR and sends it to the sending application.

* 1. Project Configuration File

Table 8 lists the project configuration file details that are either environment specific or control the flow of messages.

Table 8 – Project Configurable Parameters

| Property | Default Value | Purpose |
| --- | --- | --- |
| healthcare.LDSI\_DoDtoVistA#HL7DFDLInput.connectionDetails | localhost | Port on which eMI would listen for messages coming from DoD |
| healthcare.LDSI\_DoDtoVistA#Send ACK.connectionDetails | localhost | Port from which eMI would send acknowledgements to DoD |
| healthcare.LDSI\_VistAtoDoD#HL7DFDLInput.connectionDetails | localhost | Port on which eMI would listen for messages coming from VA |
| healthcare.LDSI\_VistAtoDoD#Send ACK.connectionDetails | localhost | Port from which eMI would send acknowledgements to VA |
| healthcare.LDSI\_DoDtoVistA#HL7DFDLInput.MsgSource | DoD | Message Logging variable |
| healthcare.LDSI\_VistAtoDoD#HL7DFDLInput.MsgSource | VA | Message Logging variable |

* 1. Queue Details

Table 9 lists the queues that the LDSI flow uses for HL7 messages received from the DoD CHCS.

Table 9 – Queues

| Queue Name | Purpose |
| --- | --- |
| VIE.LDSI\_ENT.RECEIVER.ERROR.ENT.L | Exception flow publishes exceptions that are raised by Receiver Exception Handler |

Table 10 lists the queues that the LDSI flow uses for HL7 messages received from the VA VistA.

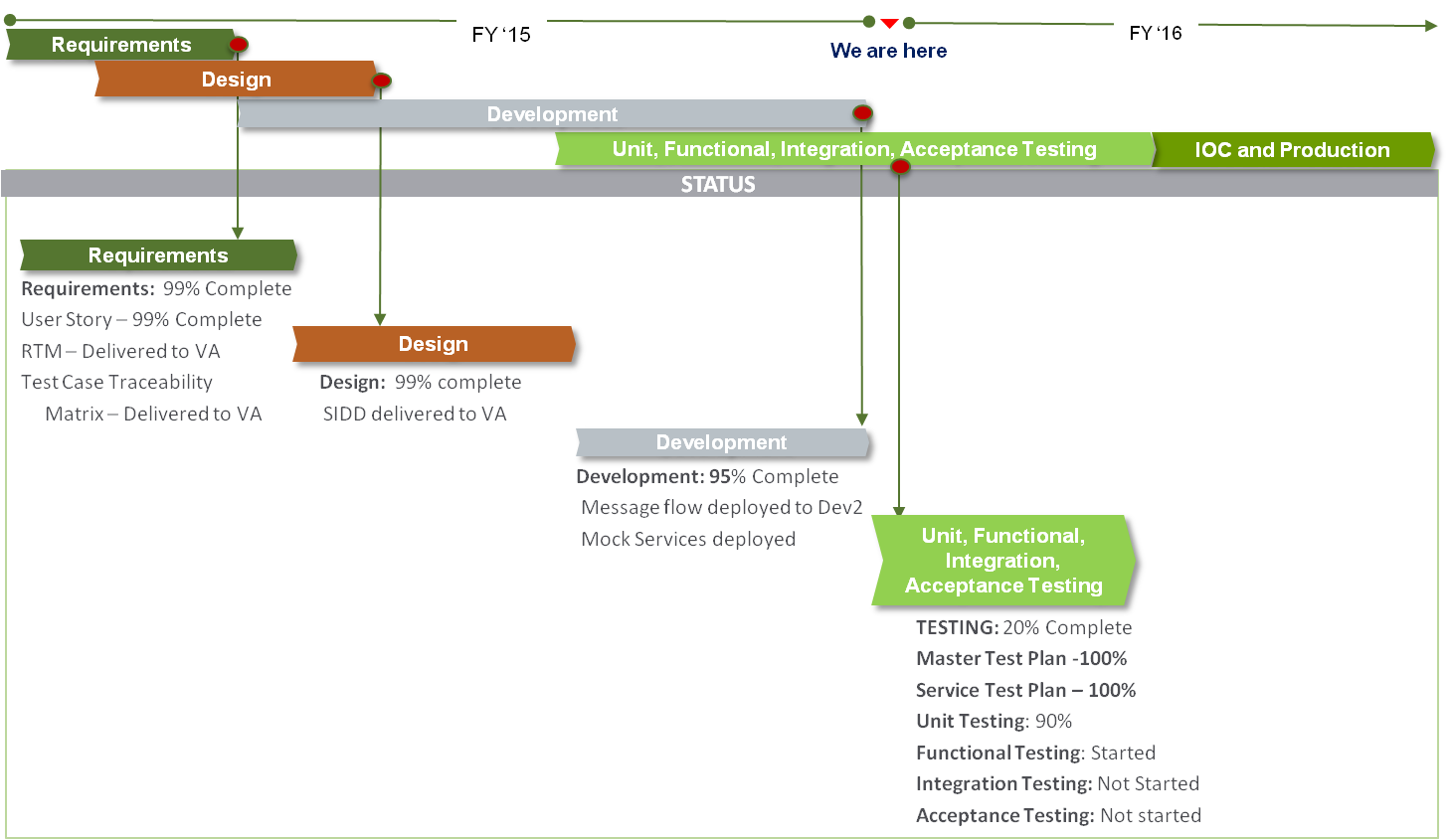
Table 10 – Queues

| Queue Name | Purpose |
| --- | --- |
| VIE.LDSI\_ENT.RECEIVER.ERROR.ENT.L | Exception flow publishes exceptions that are raised by Receiver Exception Handler |

1. Timeline

Figure 10 shows the projected timeline for the LDSI Implementation.

Figure 10 – LDSI Timeline



Appendix A. Approval Signature

REVIEW DATE:

Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Integrated Project Team (IPT) Chair Date

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Business Sponsor Date

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IT Program Manager Date

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Project Manager Date

Appendix B. Acronyms and Abbreviations

Table 11 – Acronyms and Abbreviations

| Abbreviation/Term | Definition |
| --- | --- |
| ACK | Acknowledgement Message |
| AE | Application Error |
| AITC | Austin Information Technology Center |
| APM | Application Performance Management |
| AR | Application Rejection |
| CA | Commit Acknowledgement |
| CE | Commit Error |
| CHCS | Composite Health Care System |
| CR | Commit Rejection |
| DFDL | Data Format Description Language |
| DoD | Department of Defense |
| eMI | Enterprise Messaging Infrastructure |
| ESS | Enterprise Shared Service |
| HL7 | Health Level Seven |
| IBM | International Business Machines Corporation |
| IP | Internet Protocol |
| LDSI | Laboratory Data Sharing and Interoperability |
| MLLP | Minimal Lower Layer Protocol |
| MQ | WebSphere Message Queue |
| MRM | Message Repository Manager |
| MSH | Message Header |
| POC | Point of Contact |
| SLA | Service Level Agreement |
| SOA | Service Oriented Architecture |
| TCP | Transmission Control Protocol |
| VA | Department of Veterans Affairs |
| VHA | Veterans Health Administration |
| VIE | VistA Interface Engine |
| VistA | Veterans Health Information System and Technology Architecture |
| XML | Extensible Markup Language |