

docproperty CustomerName *
mergeformat GVSU, Steelcase Library
Grand Rapids, MI

DOCVARIABLE ProposalORProject * MERGEFORMAT
Project

DOCPROPERTY ProductName * MERGEFORMAT
StagingDirector

Information in this document is subject to change without notice. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of Dematic Corp.

© 2013 Dematic Corp. All rights reserved.

This document contains confidential information, trade secrets and/or know-how which is the property of Dematic Corp., and may not be disclosed to any third party without the written permission of Dematic Corp.

Product and company names herein may be the trademarks of their respective owners.

Hereinafter Dematic Corp. shall be written as Dematic.

Dematic Corp.
507 Plymouth Avenue
Grand Rapids, MI 49505
616-913-6200

Release Dates

Release Date	Version	Description	Author
2008-April-18	1.0	Initial release.	Bill Swart
2008-June-20	1.1	Updated based upon changes learned from initial testing with Sierra.	Bill Swart
2008-July-9	1.2	1. Enhanced functionality associated with “ES” (Expected Store) message. 2. Enhanced functionality associated with “IA” (Inventory Add) message. 3. Added support for new “IR” (Item Returned) message.	Bill Swart
2008-July-10	1.3	For “SM” (Status Message), added Reject Reason of “002” so that Sierra can differentiate between “SKU not in database” and “Inventory not in database” conditions.	Bill Swart
2013-October-29	1.4	For “SM” (Status Message), added Reject Reason of “010” to cover the scenario of a carrier in suspense.	Bill Swart
2013-November-11	1.5	Corrected StagingDirector IP address.	Bill Swart

Contents

1	Introduction	1
1.1	Related Documents	1
1.2	Definition of Terms	1
2	Overview	3
2.1	The OSI Model	4
2.2	StagingDirector Host Interface Layers	5
3	TCP/IP Socket-Based Data Exchange	6
3.1	Details	6
3.2	Restrictions and Data Flow	7
3.3	IP Addresses and Ports	9
4	Message Basics	10
4.1	Basic Message Rules	10
4.2	Message Description Layout	10
4.3	Constant Field Sizes	12
5	Message Summary	14
6	Message Formats	15
6.1	Sierra-Initiated Messages	15
6.1.1	Inventory Add ("IA")	15
6.1.2	Status Check ("SC")	17
6.1.3	Pick Request ("PR")	18
6.1.4	Inventory Delete ("ID")	20
6.1.5	Expected Store ("ES")	21
6.2	StagingDirector-Initiated Messages	22
6.2.1	Inventory Confirm ("IC")	22
6.2.2	Delete Confirm ("DC")	23
6.2.3	Status Message ("SM")	24
6.2.4	Item Returned ("IR")	26
6.3	Control Messages	27
6.3.1	Heartbeat ("HM")	27
6.3.2	Transaction Response ("TR")	28
6.4	Unsupported Messages	29
7	Message Field Contents	30
8	Messaging Sequence Examples	32

8.1	Item Status Check	32
8.2	SKU Add Request	33
8.3	SKU Delete Request	34
8.4	Item Pick Request	35
9	Signatures	36

1 Introduction

This document defines the new StagingDirector-to-Host interface being created for the existing automated material handling system installed at GVSU's Steelcase Library in Grand Rapids, Michigan. This new interface is with the Sierra integrated library system which is replacing the existing Voyager system.

This specification serves as a method of communication between GVSU and Dematic. It is provided for GVSU review. Feedback is used by Dematic to revise this document as necessary to ensure an accurate understanding of the requirements by all concerned parties. When the specification reflects this understanding, signed approval of the document is required.

1.1 Related Documents

The following documents may be referenced for additional information:

- Software Functional Specification.doc (from 2002 project)

1.2 Definition of Terms

A listing of common terms and acronyms used in this document is defined in the table below.

Table 1 : Definition of Terms	
Term	Definition
ASRS	Automated Storage/Retrieval System.
Carrier	The container in which items (books and periodicals) are placed. The carrier is stored and retrieved by the SRM.
Host	Generic name for Sierra.
Sierra	The GVSU host system.
SKU	Stock Keeping Unit - A unique identifier, used to refer to a specific book or periodical. There can be a maximum of one item of inventory per SKU.
StagingDirector	The Dematic StagingDirector system.
TCP/IP	An abbreviation for "transmission control protocol / internet protocol".

Table 1 : Definition of Terms	
Term	Definition
TCP/IP Client	A program at one end of a socket connection that attempts to establish a connection. Once the connection is established, data may flow in either direction over the connection.
TCP/IP Server	A program at one end of a socket connection that accepts a connection. Once the connection is established, data may flow in either direction over the connection.

2 Overview

The following sections provide an overview of host communications in general and provide some background information on the StagingDirector host interface.

Communications occur between Sierra and StagingDirector for the following purposes:

- To allow Sierra to add/delete a SKU to/from StagingDirector's database.
- To allow Sierra to request the inventory status for a SKU.
- To allow Sierra to request the retrieval of an item of media (based upon its SKU) from the ASRS.
- To allow StagingDirector to send unsolicited status messages to Sierra.

2.1 The OSI Model

The ISO Open Systems Interconnection (OSI) model defines seven layers of data communications as shown in *Table 2 : OSI Layers*.

Table 2 : OSI Layers

	Layer	Name	Function
	7	Application	The Application layer is responsible for program-to-program communication.
	6	Presentation	The Presentation layer is responsible for data representation conversion.
	5	Session	The Session layer is responsible for establishing and maintaining communication channels between the systems.
	4	Transport	The Transport layer is responsible for end-to-end integrity of data transmission.
	3	Network	The Network layer is responsible for the routing of data from one node to another.
	2	Data Link	The Data Link layer is responsible for the physical passing of data from one node to another.
	1	Physical	The Physical layer is responsible for getting the data onto the network media and taking the data off of the network media.

2.2 StagingDirector Host Interface Layers

The StagingDirector host interface combines several of the OSI layers together as shown in *Table 3 : StagingDirector Host Interface Layers*.

Table 3 : StagingDirector Host Interface Layers

	Host Interface Layer	OSI Model Layer	Description
	Application	7 – Application 6 – Presentation 5 – Session	This layer is responsible for the actual processing of the messages between StagingDirector and Sierra. The actual message definition and the process by which the messages are exchanged is defined in this layer.
	Transport	4 - Transport	This layer is responsible for moving the data from the network link to the destination node. Industry standard mechanisms, such as TCP, are used.
	Network	3 - Network	This layer is responsible for moving the data obtained from the data link around on the network. Industry standard mechanisms, such as Internet Protocol (IP) are used.
	Data Link	2 - Data Link	This layer is responsible for moving the data from the physical devices to the network. Industry standard protocols, such as Ethernet, are used. The chosen protocol is used to "package" and "unpackage" the data for transmission across the network medium.
	Physical	1 - Physical	This layer refers to the physical devices used to get the data to the data link layer. Industry standard devices are used such as actual Ethernet connectors and signal level interfaces.

The actual StagingDirector host interface is concerned with only the top-most host interface layer (the "Application" layer). The rest of the layers are defined and implemented using industry standards. Those layers are transparent to the StagingDirector host interface and this document.

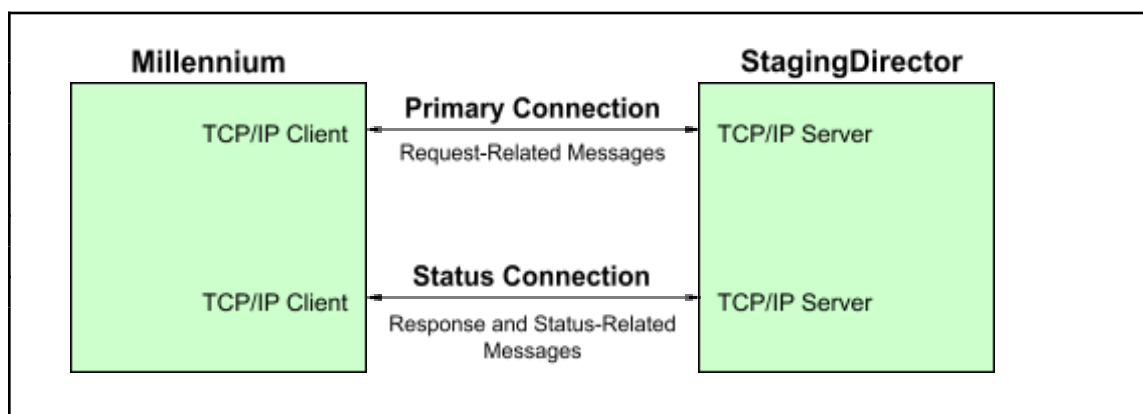
3 TCP/IP Socket-Based Data Exchange

StagingDirector will exchange data with the Sierra computer via TCP/IP sockets. In socket communications, the systems are connected over the TCP/IP network with one system on the connection acting as a "server" and the other system on the connection acting as a "client". The systems are connected via sockets (ports) known to each system. In order for communication to occur, the client must connect to the server.

3.1 Details

StagingDirector will support TCP/IP socket communication with Sierra utilizing a pair of bi-directional socket connections. Communication is achieved via the use of standard Berkeley Sockets "send" and "recv" commands (or equivalent). These connections are depicted below.

Figure 1 Socket Data Exchange



Sierra-initiated request-related messages occur over the Primary connection while StagingDirector response and status-related messages occur over the separate Status connection.

In this configuration, StagingDirector acts as the server on both connections, while Sierra acts as the client on both connections. When the client is started, it initiates a connection to the server. After a successful connection, communications will proceed.

This architecture permits StagingDirector to send new, unsolicited messages over the Status connection (potentially of new types) to Sierra (for logging purposes, etc.) in the future. However, the definition of these potential message types is beyond the scope of this project.

3.2 Restrictions and Data Flow

Messages must conform to the following rules:

- The socket-based communication between StagingDirector and Sierra is full duplex. In general, either node can initiate communication with the other node when desired. There is no master/slave relationship. However, in this configuration, Sierra initiates messages on the Primary connection while StagingDirector initiates messages on the Status connection.

Note that the phrase “initiates messages” applies to the connection *after* it has been established. It has no relevance to which party initiates the connection (the client/server aspect of the connection).

- Since messages sent over TCP/IP links are not always atomic or singular (one message per received packet), some mechanism must be provided to indicate where one message ends. StagingDirector will employ the following logic:
 - The first three fields in every message consist of the Message Type, Transaction Number, and Timestamp. Consider these combined fields to be the “message header”. This “message header” is always the same length. If StagingDirector receives enough data to comprise a message header, it will perform a sanity check on each of the fields in the message header. Sanity check rules are as follows:
 - The Message Type must be known.
 - The Transaction Number must be numeric and within range.
 - The Timestamp must conform to a valid timestamp format.
 - If the message header fails the sanity check, StagingDirector closes the socket and waits for a reconnect from Sierra. It does this because the sanity check failure implies that it is out-of-sync with the messaging. Forcing the connection to be reestablished is the means to re-sync the data.
 - If the message header passes the sanity check, StagingDirector checks to see if it has received enough bytes to comprise the complete message (based upon the Message Type):
 - If the message is not complete, StagingDirector waits until the remainder of the message is received (and then processes it).
 - If the message is complete. StagingDirector processes the message normally.
- No null (binary zero) characters may appear in the message.

- The messages must follow the message structure and message restrictions as defined in section 6 - *Message Formats*.
- All messages, except for the Transaction ("TR") message itself, require an acknowledgement of receipt via a "TR" message. The "TR" message is sent by the receiver after the message has been secured by the receiver. If a message is unacceptable for some reason (but still intelligible), the problem should be logged by the receiver, but the message must still be acknowledged via the "TR" message. The "TR" message is always sent on the same connection (Primary or Status) as the message it is acknowledging.
- The timeout/retry logic varies based upon the connection type and the sender:
 - On the Primary connection, if Sierra sends a message (requiring acknowledgement) that is not acknowledged by StagingDirector within 20 seconds, Sierra must close its connection and reestablish it. After StagingDirector accepts the new connection, Sierra must resend the message.
 - On the Status connection, if StagingDirector sends a message (requiring acknowledgement) that is not acknowledged by Sierra within 20 seconds, StagingDirector must close the connection and discard the message (the message is forever lost). StagingDirector will then wait for Sierra to reestablish the connection.
 - Note that no behavior is described for the Primary connection regarding StagingDirector-initiated messages since StagingDirector never initiates any messages on the Primary connection.
 - Note that no behavior is described for the Status connection regarding Sierra-initiated messages since Sierra never initiates any messages on the Status connection.
- There may be only one outstanding, unacknowledged message at any time from a particular sender's point of view. This means that the sender must wait for an acknowledgement (the "TR" message) before sending its next message.
- Each node will assume the responsibility of detecting and handling duplicate messages. This may be accomplished by comparing the received message against the last received message. If the messages match exactly, the received message is a duplicate. The duplicate message must be acknowledged (in the form of a "TR" message) but not acted upon beyond the acknowledgement.
- Connection maintenance/timeout behavior:
 - If no message has been transmitted on the Primary connection for 30 seconds, Sierra will send a Heartbeat ("HM") message to keep the connection "alive".
 - If no message has been transmitted on the Status connection for 30 seconds, StagingDirector will send a Heartbeat ("HM") message to keep the connection "alive".

- If no message is received for 60 seconds (the "dead-air" timeout) on the Primary connection, StagingDirector (the TCP/IP server) must close and reopen the socket, then wait for a new connection.

3.3 IP Addresses and Ports

Two independent bi-directional connections are created between Sierra and StagingDirector.

Each StagingDirector TCP/IP server connection has a unique port (socket) assigned to it. The connection types, IP addresses, and port assignments are as follows:

Connection Type	IP Address (StagingDirector)	TCP/IP Server Port Number
Primary	148.61.16.192	6282
Status	148.61.16.192	6281

4 Message Basics

This section of the document describes the general aspects of the messages exchanged between StagingDirector and the host (a.k.a. Sierra).

4.1 Basic Message Rules

The format of each specific message is listed in its own section of this document, but all messages must follow the general rules listed below.

- A message is comprised of a number of fixed length fields, based upon the Message Type.
- Each message may contain only printable ASCII characters.
- No null (binary zero) characters may appear in the message.
- All fields specified in the message must be present and of the specified length unless stated otherwise:
 - Character fields must be left justified and padded with trailing spaces.
 - Numeric fields must be right justified and padded with leading zeros.
 - After receipt and processing, the trailing spaces on character fields are removed for storage into the database.
- All messages are of a fixed length. This length varies from message type to message type, but each message must be of the specified length for the respective message type.
- When examples are given for the valid data for the message, the quotation marks are not to be included in the message itself unless otherwise noted in the message description. For example, a message that listed a valid value of "All" for a given message element would appear without the quotation marks (for example, All) in the actual message being sent.

4.2 Message Description Layout

In the sections that follow, each message is described and provides the following:

- A general description of the message.
- The allowed direction of each message (Sierra □ StagingDirector or StagingDirector □ Sierra).
- The TCP/IP connection (Primary and/or Status) to which this message applies.

- Whether an acknowledgement ("TR" message) is expected in response to the message.
- A table identifying the fields within each message. The table will contain the following columns:
 - The "Field" column contains the name of the field.
 - The "Field Type" column indicates the data type represented by the field. The data type is indicated according to the following values:
 - "Alphanumeric"

The field represents an "alphanumeric" field. Alphanumeric fields allow any printable character except the backslash and the single quote. Note that printable characters are defined as ASCII character codes 32 - 126 (0x20 - 0x7E).

An alphanumeric field is a character type field and must be formatted as described in section 4.1 - *Basic Message Rules*.

This data type classification may be further restricted based upon the actual field being represented. Any restrictions are listed in the description of the actual message.

— "Reduced Alphanumeric"

The field represents an "alphanumeric" field, but with a "reduced" set of valid values. Reduced alphanumeric fields allow only the uppercase characters "A" to "Z", the numbers "0" to "9", the underscore ("_"), the minus sign ("-"), and the space character. Note that the space character is not allowed within the data value itself, but is allowed for padding.

A reduced alphanumeric field is a character type field and must be formatted as described in section 4.1 - *Basic Message Rules*.

This data type classification may be further restricted based upon the actual field being represented. Any restrictions are listed in the description of the actual message.

— "Numeric"

The field represents a "numeric" field. The entire field must be comprised of only the characters "0" to "9" inclusive. Numeric fields must be formatted as described in section 4.1 - *Basic Message Rules*.

— "Timestamp"

The field represents a calendar date and contains an alphanumeric timestamp value. The format of this field is "YYYYMMDDHHMMSS" where:

- "YYYY" is the four digit year.
 - "MM" is the two-digit month ("01"-"12").
 - "DD" is the two-digit day of the month ("01"-"31").
 - "HH" is the two-digit hour of the day ("00"-"23").
 - "MM" is the two-digit minute of the hour ("00"-"59").
 - "SS" is the two-digit second of the minute ("00"-"59").
 - Example: March 27, 2008 at 3:41:52 PM would be "20080327154152". All portions of the timestamp field must be present.
- The "Field Size" column indicates the size of the data represented by the field.
 - The field must be exactly this number of characters.
 - Common fields may indicate a "constant" value in this column instead of a number.
 - See section 4.3- *Constant Field Sizes* for information on the constant values.
 - The "Description" column provides a description of the use of the field and may contain sample values.

4.3 Constant Field Sizes

All of the message fields sent to StagingDirector from Sierra and to Sierra from StagingDirector are of a fixed size. Some messages contain the same types of fields. To ensure consistency, the following table provides "constants" that are referenced in the tables instead of specifying the size directly in the table.

Table 4 : Standard Field Sizes and Format

	Constant	Value	Description / Comments
	Author_Size	35	Size for "Author" fields. Note that the existing Voyager interface has a size of 100 for this field.
	Call_Num_Size	50	Size for "Call Number" fields.
	Error_Reason_Size	3	Size for "Error Reason" fields.
	Msg_Type_Size	2	Size for "Message Type" fields.

Table 4 : Standard Field Sizes and Format

	Constant	Value	Description / Comments
	Patron_Barcode_Size	20	Size for "Patron Barcode" fields.
	Patron_Name_Size	40	Size for "Patron Name" fields. Note that the existing Voyager interface has a size of 70 for this field.
	Pickup_Location_Size	6	Size for "Pickup Location" fields. Note that the existing Voyager interface has a size of 50 for this field.
	Priority_Size	1	Size for "Priority" fields.
	Rej_Reason_Size	3	Size for "Reject Reason" fields.
	SKU_Size	14	Size for "SKU" (a.k.a. "barcode") fields. Note that the existing Voyager interface has a size of 25 for this field.
	Timestamp_Size	14	Size for "Timestamp" fields.
	Title_Size	35	Size for "Title" fields. Note that the existing Voyager interface has a size of 100 for this field.
	Trans_Num_Size	5	Size for "Transaction Number" fields.

5 Message Summary

This section provides of summary of all message types used with the Sierra-StagingDirector interface.

Category	Message	Originator
Inventory	Status Check ("SC")	Sierra
	Status Message ("SM")	StagingDirector
	Inventory Add ("IA")	Sierra
	Inventory Confirm ("IC")	StagingDirector
	Inventory Delete ("ID")	Sierra
	Delete Confirm ("DC")	StagingDirector
Picking	Pick Request ("PR")	Sierra
Storing	Expected Store ("ES")	Sierra
	Item Returned ("IR")	StagingDirector
Control	Heartbeat ("HM")	Either
	Transaction Response ("TR")	Either

6 Message Formats

6.1 Sierra-Initiated Messages

6.1.1 Inventory Add ("IA")

This message is sent by Sierra when an item is changed from a status of "on shelf" to "in storage". It indicates that the item will soon be received by StagingDirector and is the means by which a SKU is added to the StagingDirector database.

Note that the names "Inventory Add" and "Inventory Confirm" are a bit misleading as no inventory is created, but rather the SKU. Inventory is not actually created within StagingDirector until the item is identified as physically received and placed in a carrier.

- If the SKU has an invalid format, a diagnostic message is logged, and nothing is added. However, StagingDirector immediately responds back to Sierra with an Inventory Confirm ("IC") message indicating why the SKU was not added.
- If the SKU already exists, a diagnostic message is logged, and nothing is added. However, StagingDirector immediately responds back to Sierra with an Inventory Confirm ("IC") message indicating why the SKU was not added.
- If the SKU does not exist, the SKU is added and StagingDirector immediately responds back to Sierra with an Inventory Confirm ("IC") message indicating that the SKU was added.

Direction: **Sierra** □ **StagingDirector**

Connection: **Primary**

Acknowledgement ("TR" message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "IA".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a "TR" message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.

Field	Field Type	Field Size	Description
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to be added to the StagingDirector database.
Call Number	Numeric	Call_Num_Size	Ignored for GVSU.
Title	Alphanumeric	Title_Size	Title of book/periodical. This is a “pass-through” field and is only used for display purposes.
Author	Alphanumeric	Author_Size	Ignored for GVSU within the context of <i>this</i> message.

6.1.2 Status Check (“SC”)

This message is sent by Sierra to determine the availability of a given SKU within the ASRS.

- If the SKU has an invalid format, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU does not exist or does not have any inventory, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU exists but has already been committed to an order, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU exists, has inventory, and is available, StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the SKU availability.

Direction: **Sierra** □ **StagingDirector**

Connection: **Primary**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always “SC”.
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier for which StagingDirector is to perform a status check.

6.1.3 Pick Request (“PR”)

This message is sent by Sierra to place a request for an item to be retrieved from storage and picked.

- If the SKU has an invalid format, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU does not exist or does not have any inventory, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU exists but has already been committed to an order other than this pick request, a diagnostic message is logged, and StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the problem with the request.
- If the SKU exists, has inventory, and was just allocated to the Pick Request (“PR”) which initiated this response, StagingDirector immediately responds back to Sierra with a Status Message (“SM”) message indicating the SKU availability.

Direction: **Sierra** □ **StagingDirector**

Connection: **Primary**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "PR".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier for the item to be retrieved.
Pickup Location	Alphanumeric	Pickup_Location_Size	Destination for pick up. This is a “pass-through” field and is only used for display purposes.
Priority	Reduced Alphanumeric	Priority_Size	Ignored for GVSU.

Field	Field Type	Field Size	Description
Patron Barcode	Reduced Alphanumeric	Patron_Barcode_Size	Ignored for GVSU.
Patron Name	Alphanumeric	Patron_Name_Size	The name of the requesting library patron. This is a “pass-through” field and is only used for display purposes.
Call Number	Numeric	Call_Num_Size	Ignored for GVSU.
Title	Alphanumeric	Title_Size	Title of book/periodical. This is a “pass-through” field and is only used for display purposes.
Author	Alphanumeric	Author_Size	Author of book/periodical. This is a “pass-through” field and is only used for display purposes.

6.1.4 Inventory Delete ("ID")

This message is sent by Sierra when an item is changed from a status of "in storage" to "on shelf". It indicates that the item is no longer in storage and is the means by which a SKU is removed from the StagingDirector database.

Note that the name "Inventory Delete" is a bit misleading as no inventory is deleted, but rather the SKU. For StagingDirector to successfully complete the "Inventory Delete" request, the inventory must have already been removed from the carrier based upon a pick request or a local inventory adjustment.

- If the SKU has an invalid format, a diagnostic message is logged, and the SKU is not deleted. However, StagingDirector immediately responds back to Sierra with a Delete Confirm ("DC") message indicating why the SKU was not deleted.
- If the SKU does not exist, a diagnostic message is logged, and the SKU is not deleted. However, StagingDirector immediately responds back to Sierra with a Delete Confirm ("DC") message indicating why the SKU was not deleted.
- If the SKU exists but has inventory, a diagnostic message is logged, and the SKU is not deleted. However, StagingDirector immediately responds back to Sierra with a Delete Confirm ("DC") message indicating why the SKU was not deleted.
- If the SKU exists and there is no inventory, the SKU is deleted and StagingDirector immediately responds back to Sierra with a Delete Confirm ("DC") message indicating that the SKU was deleted.

Direction: **Sierra** ☐ **StagingDirector**

Connection: **Primary**

Acknowledgement ("TR" message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "ID".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a "TR" message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to be deleted.

6.1.5 Expected Store (“ES”)

This message is sent by Sierra when an item has been checked in at the circulation desk and is expected to be stored.

StagingDirector uses this message to update the status for the item to indicate that it is, in effect, between the circulation desk and the storage system. It uses this status to intelligently respond to requests relating to the item.

Direction: **Sierra** ☐ **StagingDirector**

Connection: **Primary**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "ES".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier specific to the message.

6.2 StagingDirector-Initiated Messages

6.2.1 Inventory Confirm (“IC”)

This message is sent by StagingDirector (in response to an Inventory Add (“IA”) message) to provide feedback as to the request to add the SKU to StagingDirector’s database.

The message contains a “Reject Reason” field to indicate whether the request was successful or not. See the table below for possible values.

Note that the names “Inventory Add” and “Inventory Confirm” are a bit misleading as no inventory is created, but rather the SKU. Inventory is not actually created within StagingDirector until the item is physically received and placed in a carrier.

Direction: **StagingDirector** □ **Sierra**

Connection: **Status**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "IC".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to which the message applies.
Reject Reason	Numeric	Rej_Reason_Size	The reject reason code. Possible values are: “006” – Invalid SKU format “008” – SKU already in database “000” – SKU added successfully

6.2.2 Delete Confirm (“DC”)

This message is sent by StagingDirector (in response to an Inventory Delete (“ID”) message) to provide feedback as to the request to delete the SKU from StagingDirector’s database.

The message contains a “Reject Reason” field to indicate whether the request was successful or not. See the table below for possible values.

Note that the name “Inventory Delete” is a bit misleading as no inventory is deleted, but rather the SKU. For StagingDirector to successfully complete the “Inventory Delete” request, the inventory must have already been removed from the carrier based upon a pick request or a local inventory adjustment.

Direction: **StagingDirector** □ **Sierra**

Connection: **Status**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "DC".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to which the message applies.
Reject Reason	Numeric	Rej_Reason_Size	The reject reason code. Possible values are: “006” – Invalid SKU format “003” – SKU not in database “009” – SKU has inventory “000” – SKU deleted successfully

6.2.3 Status Message (“SM”)

This message is sent by StagingDirector for two reasons:

1. In response to a Status Check (“SC”) message to provide feedback as to whether the item is available within StagingDirector.
2. In response to a Pick Request (“PR”) message to indicate that the item is now allocated to the Pick Request.

The message contains a “Reject Reason” field to indicate the status of the item. See the table below for possible values.

Direction: **StagingDirector** □ **Sierra**

Connection: **Status**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "SM".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to which the message applies.

Field	Field Type	Field Size	Description
Reject Reason	Numeric	Rej_Reason_Size	The reject reason code. Possible values are: "006" – Invalid SKU format "002" – Inventory not in database "003" – SKU not in database "001" – Inventory already committed to an order "007" – Inventory is available "010" – Inventory is not available

6.2.4 Item Returned (“IR”)

This message is sent by StagingDirector and, unlike most other StagingDirector-initiated messages, is unsolicited. It is sent when an item being returned to the AS/RS, has been placed in a carrier. It allows Sierra to change the item’s status from “In Transit” to “Available”.

Direction: **StagingDirector** □ **Sierra**

Connection: **Status**

Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "IR".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
SKU	Reduced Alphanumeric	SKU_Size	The unique SKU identifier to which the message applies.
Reject Reason	Numeric	Rej_Reason_Size	The reject reason code. For this message type, it always contains “000”.

6.3 Control Messages

6.3.1 Heartbeat (“HM”)

This message type is sent by Sierra (only on the Primary connection) or StagingDirector (only on the Status connection) if there are no other messages within a defined timeframe. It indicates that the respective entity is available and communicating. The message provides a means for detecting the loss of a connection.

See “Connection maintenance/timeout behavior” area in section 3.2 - *Restrictions and Data Flow* for details of the use of the Heartbeat (“HM”) message.

Direction: **Sierra** ☐ **StagingDirector** and **StagingDirector** ☐ **Sierra** Connection: **Primary** and **Status**
Acknowledgement (“TR” message) Required: **Yes**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always "HM".
Transaction Number	Numeric	Trans_Num_Size	A unique numeric string, formulated by the sending entity (and echoed in a “TR” message by the receiving entity).
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.

6.3.2 Transaction Response (“TR”)

This message type is the response sent to each and every message (other than the “TR” message itself). Each entity must send it for the messages it receives (even if the message has another message-specific response such as a Status Message (“SM”) message), and expect it in return for every message it sends.

It is an acknowledgement that the message has been received. See section 3.2 - *Restrictions and Data Flow* for the expected behavior when a Transaction Response (“TR”) message is not received in a timely manner.

Notes:

1. The “Error Reason” field will always contain a value of “000”, regardless of the originator.
2. StagingDirector will respond with a “TR” response, even for known message types that will not be processed. See section 6.4 - *Unsupported Messages* for details.

Direction: **StagingDirector** □ **Sierra** and **Sierra** □ **StagingDirector**

Connection: **Primary** and **Status**

Acknowledgement (“TR” message) Required: **No**

Field	Field Type	Field Size	Description
Message Type	Reduced Alphanumeric	Msg_Type_Size	Always “TR”.
Transaction Number	Numeric	Trans_Num_Size	The unique numeric string originating from the message the “TR” message is acknowledging.
Timestamp	Timestamp	Timestamp_Size	Only used to correlate historical information.
Error Reason	Numeric	Error_Reason_Size	Always “000”.

6.4 Unsupported Messages

Messages in this category may be received by StagingDirector and will be acknowledged, but not processed.

This category exists to ensure that StagingDirector is minimally aware of the existence of a message. Otherwise, upon receipt of an unrecognized message, it would falsely believe that it had lost message synchronization and restart the connection. See the “sanity check” portion in section 3.2 - *Restrictions and Data Flow* for details.

Note that at this time, there are no unsupported messages. StagingDirector processes all messages received.

7 Message Field Contents

This section defines the possible contents of most of the message fields defined within this document. The fields are listed in alphabetical order.

Field	Contents
Author	Author of book/periodical. This is a “pass-through” field and is only used for display purposes. It consists of 0 to Author_Size bytes of Alphanumeric data.
Call Number	Ignored for GVSU.
Error Reason	Always “000”.
Message Type	The type of message. Possible values: “DC” (Delete Confirm) “ES” (Expected Store) “HM” (Heartbeat) “IA” (Inventory Add) “IC” (Inventory Confirm) “ID” (Inventory Delete) “PR” (Pick Request) “SC” (Status Check) “SM” (Status Message) “TR” (Transaction Response)
Patron Barcode	Ignored for GVSU.
Patron Name	The name of the requesting library patron. This is a “pass-through” field and is only used for display purposes. It consists of 0 to Patron_Name_Size bytes of Alphanumeric data.
Pickup Location	Destination (e.g. “CrcDsk”, “Allend”, etc.). This is a “pass-through” field and is only used for display purposes. It consists of 0 to Pickup_Location_Size bytes of Alphanumeric data.
Priority	Ignored for GVSU.
Reject Reason	This is a three-digit code indicating the status of a request. It represents a successful operation or some type of problem. See the individual message formats for usage and values.

Field	Contents
SKU	The SKU identifier consists of any set of characters conforming to the SKU field type specified in the respective message format. It consists of 1 to SKU_Size bytes of Reduced Alphanumeric data.
Timestamp	See section 4.2 - <i>Message Description Layout</i> for details relating to this format. Note that no processing occurs related to this field. It only exists as a convenience to assist when manually reviewing communications log data.
Title	Title of book/periodical. This is a “pass-through” field and is only used for display purposes. It consists of 0 to Title_Size bytes of Alphanumeric data.
Transaction Number	A number with a range of “00001” - “99999” which is created and inserted in the originating message by the sending entity. The Transaction Number is primarily used for duplicate detection. While the transaction number in a “TR” message should match that of the message being acknowledged, there is no actual requirement since each sending entity can only have one outstanding unacknowledged message at any given time. The number typically increments by 1, starting with “00001” and wraps back around to “00001” after “99999”. However, there is no requirement that it increment by 1. All that is important is that it differs from the previously-sent message. Note that the value of “00000” is never used.

8 Messaging Sequence Examples

This section offers examples of message interaction between Sierra and StagingDirector as they relate to system activity. Note that the names of each subsection refer to the actual activity rather than the message names.

Each table contains three columns:

- The “Event” column indicates what generally initiates the message.
- The “Message” / “Direction” column offers the exact message involved, along with the direction of the message.
- Lastly, the “Comments” column offers general clarification related to the message.

8.1 Item Status Check

The sequence illustrates the exchange of messages related to Sierra checking the status of an item.

Event	Message / Direction	Comments
Sierra wishes to know the status of an item.	“SC” Sierra □ StagingDirector	Sierra issues a Status Check request on the <i>Primary</i> connection.
	“TR” StagingDirector □ Sierra	StagingDirector acknowledges receipt of the “SC” message on the <i>Primary</i> connection.
	“SM” StagingDirector □ Sierra	StagingDirector responds with a Status Message message for the item on the <i>Status</i> connection.
	“TR” Sierra □ StagingDirector	Sierra acknowledges receipt of the “SM” message on the <i>Status</i> connection.

8.2 SKU Add Request

The sequence illustrates the exchange of messages related to Sierra requesting a SKU to be added to the StagingDirector database.

Event	Message / Direction	Comments
Sierra wishes to add a SKU to the StagingDirector database.	"IA" Sierra → StagingDirector	Sierra issues an Inventory Add request on the <i>Primary</i> connection.
	"TR" StagingDirector → Sierra	StagingDirector acknowledges receipt of the "IA" message on the <i>Primary</i> connection.
	"IC" StagingDirector → Sierra	StagingDirector responds with an Inventory Confirm message for the item on the <i>Status</i> connection.
	"TR" Sierra → StagingDirector	Sierra acknowledges receipt of the "IC" message on the <i>Status</i> connection.

8.3 SKU Delete Request

The sequence illustrates the exchange of messages related to Sierra requesting a SKU to be deleted from the StagingDirector database.

Event	Message / Direction	Comments
Sierra wishes to delete a SKU from the StagingDirector database.	"ID" Sierra → StagingDirector	Sierra issues an Inventory Delete request on the <i>Primary</i> connection.
	"TR" StagingDirector → Sierra	StagingDirector acknowledges receipt of the "ID" message on the <i>Primary</i> connection.
	"DC" StagingDirector → Sierra	StagingDirector responds with a Delete Confirm message for the item on the <i>Status</i> connection.
	"TR" Sierra → StagingDirector	Sierra acknowledges receipt of the "DC" message on the <i>Status</i> connection.

8.4 Item Pick Request

The sequence illustrates the exchange of messages related to Sierra requesting an item for picking.

Event	Message / Direction	Comments
Sierra requests an item to be retrieved for picking.	"PR" Sierra → StagingDirector	Sierra issues a Pick Request request on the <i>Primary</i> connection.
	"TR" StagingDirector → Sierra	StagingDirector acknowledges receipt of the "TR" message on the <i>Primary</i> connection.
	"SM" StagingDirector → Sierra	StagingDirector responds with a Status Message message for the item on the <i>Status</i> connection.
	"TR" Sierra → StagingDirector	Sierra acknowledges receipt of the "SM" message on the <i>Status</i> connection.

9 Signatures

All parties must sign in the space provided below to signify joint approval of this specification.

GVSU	Representative
Name	Ron Berry
Signature	
Title	
Date	

Dematic	SAE Software Project Lead	SAE Software Technical Lead	Project Management
Name	Dave Mitchell	Bill Swart	Kathy Buckley
Signature			
Title			
Date			