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## **Iridium Short Burst Data Service Developers Guide**

Release 2.01  
December 5<sup>th</sup> 2007

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## Revision History

| Version | Date                          | Reason  |
|---------|-------------------------------|---|
| 1.0     | June 1, 2003                  | First Commercial Release  |
| 1.1     | August 24 2005                | Updated Network Features: <ul style="list-style-type: none"> <li>• ISU-ISU SBD</li> <li>• Optional reporting of geographic location on email messages</li> <li>• MTMSN unique for each ISU</li> <li>• Session status fields generated by the GSS</li> </ul> Additional Documentation <ul style="list-style-type: none"> <li>• Multiple MT-SBD destinations in a single email</li> <li>• Multiple MT-SBD payloads in a single email</li> </ul> Incorporation of other documentation: <ul style="list-style-type: none"> <li>• SBD Troubleshooting Guide</li> </ul> Removal of generic 9522 information   |
| 1.2     | February 10, 2006             | Updated to reflect 9601 SBD Transceiver information and updates from network updates to the GSS to Version 4.1  |
| 1.2.1   | February 23 2006              | Updated to correct typographical error in 2.1   |
| 2.0     | March 23 2007                 | Incorporation of other documentation: <ul style="list-style-type: none"> <li>• IP Socket Whitepaper</li> <li>• SBD Security Information</li> </ul> Updated to include features up to and including GSS Version 4.2<br>Removed AT Command Descriptions<br>Various edits for clarity and understanding  |
| 2.01    | December 5 <sup>th</sup> 2007 | <u>Changes Summary:</u> <ul style="list-style-type: none"> <li>• Updates to correct typographical errors and clarifications.</li> <li>• No functionality changes implemented.</li> <li>• Minor feature additions</li> <li>• Revised recommendations and new requirements in Section 6</li> </ul> <u>Specific Changes:</u> <ul style="list-style-type: none"> <li>• New addition: 3.4 Permitted Email Address Formats</li> <li>• New addition: 3.5 Bit Bucket for MO-SBD Messages</li> <li>• 4.1.4.2 Clarifications on SBD Ring Alerts</li> <li>• Table 5-6 Values corrected for ‘Overall Message length’, and ‘MT Confirmation Header Message Length’. Removal of ‘MT Confirmation IEI’ and ‘MT Confirmation Length’ Fields.</li> <li>• Table 5-7 – Corrected to show correct table names.</li> <li>• 5.4.2.7 Clarification of epoch reference</li> <li>• Section 6.0 significantly updated and re-titled from ‘Optimal Message Size Selection’ to ‘Practical Considerations and Requirements for SBD Applications Design and Solution Certification.’</li> </ul> |

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## Table of Contents

|       |  |    |
|-------|--|----|
| 1.0   | Introduction .....   | 6  |
| 1.1   | Purpose .....  | 6  |
| 1.2   | Scope .....  | 6  |
| 1.3   | References .....   | 6  |
| 1.3.1 | Specifically Referenced Documents .....  | 6  |
| 1.3.2 | Other Useful Documents .....   | 6  |
| 1.4   | Definitions, Acronyms, and Abbreviations.....  | 7  |
| 1.5   | Transceiver Message Sizes .....  | 8  |
| 2.0   | Overview .....   | 9  |
| 2.1   | Overview of the Iridium Satellite Network for Short Burst Data .....                 | 9  |
| 2.2   | Transceiver Overview.....  | 11 |
| 3.0   | Vendor Application to GSS Email Interface Description.....                           | 12 |
| 3.1   | Mobile Terminated Messages .....   | 13 |
| 3.2   | Mobile Originated Messages Sent Via Email .....                                      | 17 |
| 3.3   | Examples of SBD Usage .....  | 19 |
| 3.3.1 | Mobile Originated (MO) Message.....  | 19 |
| 3.3.2 | Mailbox Check / Mobile Terminated (MT) Message .....                                 | 20 |
| 3.3.3 | Mobile Originated and Mobile Terminated Message .....                                | 21 |
| 3.4   | Permitted Email Address Formats .....  | 22 |
| 3.5   | Bit Bucket for MO-SBD Messages .....   | 22 |
| 4.0   | SBD Automatic Notification for Mobile Terminated Messages and ISU-ISU Messages ..... | 23 |
| 4.1   | SBD Automatic Notification for Mobile Terminated Messages .....                      | 23 |
| 4.1.1 | Automatic Notification Registration.....   | 23 |
| 4.1.2 | Retrieval of a MT-SBD Message using SBD Automatic Notification .....                 | 24 |
| 4.1.3 | SBD Ring Alert Status Information .....  | 25 |
| 4.1.4 | Field Application Implementation.....  | 25 |
| 4.1.5 | SBD Automatic Notification: Automatic Registration (+SBDAREG).....                   | 29 |
| 4.1.6 | SBD Automatic Notification: Registration (+SBDREG) with Optional GPS Parameter ..... | 30 |
| 4.2   | ISU- ISU Messages .....  | 31 |
| 5.0   | Direct Internet Protocol Socket “DirectIP” GSS Interface .....                       | 32 |
| 5.1   | DirectIP Concept of Operation .....  | 32 |
| 5.1.1 | DirectIP Overview .....  | 32 |
| 5.1.2 | MO DirectIP Deliveries .....   | 33 |
| 5.1.3 | MT DirectIP Deliveries .....   | 33 |
| 5.1.4 | MT Disposition Flags .....   | 33 |
| 5.2   | MT and MO DirectIP Application Requirements .....                                    | 34 |
| 5.2.1 | MO DirectIP Server/Client Requirements.....  | 34 |
| 5.2.2 | MT DirectIP Server/Client Requirements .....   | 34 |
| 5.3   | MO and MT Message Specifications .....   | 36 |
| 5.3.1 | Overall Message Structure .....  | 36 |
| 5.3.2 | Information Elements.....  | 36 |
| 5.3.3 | Successful MO Message Delivery Example.....  | 37 |
| 5.3.4 | Failed MO Message Delivery Example .....   | 38 |
| 5.3.5 | MT Message Delivery Example.....   | 38 |
| 5.4   | Information Element Specifications .....   | 39 |
| 5.4.1 | Information Element Identifiers.....   | 39 |
| 5.4.2 | MO DirectIP Header .....   | 40 |
| 5.4.3 | MO Payload .....   | 41 |
| 5.4.4 | MO Location Information .....  | 41 |
| 5.4.5 | MT DirectIP Header .....   | 43 |
| 5.4.6 | MT Payload .....   | 43 |
| 5.4.7 | MT Message Confirmation Message.....   | 44 |

|         |   |    |
|---------|---|----|
| 6.0     | Practical Considerations and Requirements for SBD Applications Design and Solution Certification. | 46 |
| 6.1     | Optimal Message Size Selection .....  | 46 |
| 6.1.1   | Economic Message Size .....   | 46 |
| 6.1.2   | Technical Message Size .....  | 46 |
| 6.1.2.1 | Mobile Originated Message Size .....  | 46 |
| 6.1.2.2 | Mobile Terminated Message Size .....  | 46 |
| 6.2     | Practical Requirements and Considerations for SBD Applications Design .....                       | 47 |
| 6.2.1   | Field Applications with scheduled reporting times.....  | 47 |
| 6.2.2   | Field Application Response to Network Events.....   | 48 |
| 7.0     | Iridium Short Burst Data Service Security Features.....   | 49 |
| 7.1     | Purpose.....  | 49 |
| 7.2     | Iridium Security Features.....  | 49 |
| 7.2.1   | Authentication Security.....  | 49 |
| 7.2.2   | Iridium Channel Security .....  | 50 |
| 7.2.3   | Gateway to Vendor Application .....   | 51 |
| 7.2.4   | Additional Considerations.....  | 51 |
| 8.0     | Basic Trouble Shooting.....   | 52 |
| 8.1     | Hardware Requirements .....   | 52 |
| 8.2     | Provisioning .....  | 52 |
| 8.3     | SIM PIN .....   | 52 |
| 8.4     | Network Registration Status.....  | 53 |
| 8.5     | Satellite Signal Strength Indicator .....   | 53 |
| 8.6     | Power Supply .....  | 54 |

## 1.0 Introduction

### 1.1 Purpose

The purpose of this document is to provide technical and operational information sufficient for an Iridium Value Added Reseller to be able to develop an integrated data application that utilizes Iridium's Short Burst Data Service (SBD). Additional information will be required by the developer for the AT Commands to be utilized with the transceiver selected for use with SBD.

An overview of the satellite network is provided as well as descriptions of the terminal equipment and the end to end communications protocol for SBD. This document is intended for use by technical personnel and assumes a reasonable level of technical skill and familiarity with satellite and/or wireless data applications.

### 1.2 Scope

This document provides an explanation of:

1. How the Mobile Originated and Mobile Terminated SBD protocol works through an overview and command descriptions.
2. Specific SBD related AT commands and responses as it relates to Mobile Originated and Mobile Terminated SBD messages
3. Interface requirements between the GSS and the Vendor Application

Additional documents are referenced which provide more specific detail on certain topics and these are listed in Section 1.3 of this document. This document does not specifically define the provisioning process, although it does reference it. This document assumes a working knowledge of the Iridium satellite system.

### 1.3 References

#### 1.3.1 Specifically Referenced Documents

[1] ISU AT Command Reference

[2] Either the 9522 "Sebring" L-Band Transceiver Interface Specification or the 9522A "Daytona" L-Band Transceiver Product Information Guide

[3] 9601 SBD Transceiver Developers Guide

[4] **Compliance & Test Requirements For Self-Certification Testing Of Short Burst Data Solutions**

These documents are accessible from the <http://developer.iridium.com>, web site that is available only to Iridium authorized Value Added Resellers, Manufacturers or Developers.

#### 1.3.2 Other Useful Documents

These documents are accessible from the Iridium public web site: <http://www.iridium.com>.

- Data Services Overview: The document includes Frequently Asked Questions (FAQs) for both Dial-up and Direct Internet Data Services. Both of these services are circuit switched.

- Dial-Up Data User's Guide: Provides detailed description of the set-up and use of dial-up data services
- Mobile Terminated Data User's Guide: Provides a detailed description of the set-up, operation, and constraints as it relates to terminating data calls.

## 1.4

### 1.5 Definitions, Acronyms, and Abbreviations

|                          |  |
|--------------------------|--|
| API                      | Application Programming Interface  |
| ATC                      | AT Command   |
| CDR                      | Call Detail Record   |
| DB                       | Data Base  |
| DSC                      | Delivery Short Code  |
| DTE                      | Data Terminal Equipment  |
| ECS                      | ETC Communications Subsystem   |
| ETC                      | Earth Terminal Controller  |
| ETS                      | ETC Transmission Subsystem   |
| FA                       | Field Application  |
| GPS                      | Global Positioning System  |
| GSS                      | Gateway Short Burst Data Subsystem   |
| IE                       | Information Element  |
| IEI                      | Information Element Identifier   |
| IMEI                     | International Mobile Equipment Identity  |
| IP                       | Internet Protocol  |
| ISU                      | Iridium Subscriber Unit  |
| LBT                      | L-Band Transceiver   |
| Message                  | The complete data transfer between the Vendor Application and the GSS including a head, optional sets of information and the payload to be transmitted over the air. |
| MIME                     | Multipurpose Internet Mail Extensions  |
| MO                       | Mobile Originated  |
| MOMSN                    | Mobile Originated Message Sequence Number  |
| MSN                      | Message Sequence Number  |
| MT                       | Mobile Terminated  |
| MTMSN                    | Mobile Terminated Message Sequence Number  |
| Mobile Terminated Buffer | This is the buffer in the ISU in which an SBD message sent from the GSS to the ISU will be stored.   |
| Payload                  | The actual user data to be transmitted over the Iridium network  |
| PIN                      | Personal Identification Number   |
| SBD                      | Short Burst Data   |
| Session                  | SBD network related activity such as SBD Network Registration, MO and MT message transfer.   |
| SIM                      | Subscriber Identify Module   |
| SPNet                    | Iridium's proprietary provisioning tool for contracted business partners   |
| Mobile Originated Buffer | This is the buffer in the ISU in which an SBD message to be sent from the ISU to the GSS will be stored.   |
| SEP                      | SBD ETC Processor  |
| SPP                      | SBD Post Processor   |
| UTC                      | Coordinated Universal Time   |
| VA                       | Vendor Application   |

## **1.6 Transceiver Message Sizes**

In order to ensure consistency and provide a useful reference, the following table should be consulted for the maximum message size capabilities of various transceivers:

| Transceiver Name | Maximum Mobile Originated Message Size (Bytes) | Maximum Mobile Originated Message Size (Bytes) | Minimum Firmware Revision Required |
|------------------|--|--|------------------------------------|
| 9522A            | 1960   | 1890   | IS06001                            |
| 9601             | 340  | 270  | TD06002                            |

The message sizes given above are for application or user data. All network headers, overhead and administration data/bytes are not included and the applications developer only needs to pay attention to the number of bytes that the Field Application and the Vendor Application are sending.



## 2.0 Overview

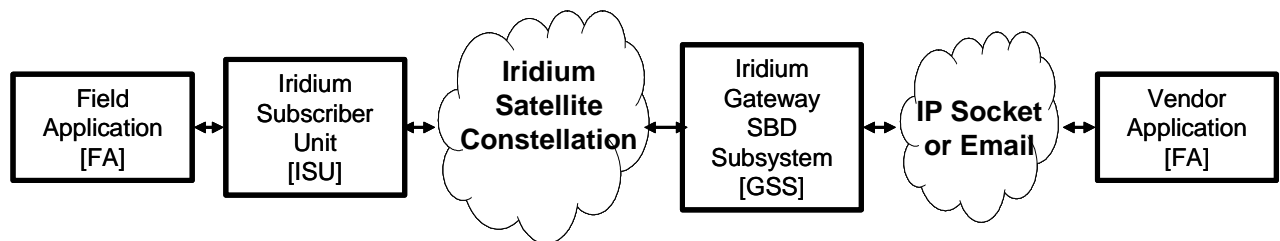
The overview is split into two sections: network and transceiver

### 2.1 Overview of the Iridium Satellite Network for Short Burst Data

Iridium's Short Burst Data Service (SBD) is a simple and efficient satellite network transport capability to transmit short data messages between field equipment and a centralized host computing system. The maximum Mobile Originated (MO) SBD and Mobile Terminated (MT) SBD message sizes are transceiver specific and are described in Section 1.6 of this document. [Note that a zero (0) byte MO SBD message is referred to as a "Mailbox Check."] (See reference documents [2] and [3] in addition to Section 1.6.)

The primary elements of the end-to-end SBD architecture are shown in Figure 2-1. Specifically, the elements consist of the Field Application (FA), the Iridium Subscriber Unit (ISU), the Iridium satellite constellation, the Gateway SBD Subsystem (GSS) located at the Iridium gateway, the Internet, and the Vendor Application (VA.) More details on the system architecture are shown in Figure 2-2.

The Field Application represents the hardware and software that is configured by the VAR for specific applications such as collecting and transmitting GPS location information. The ISU is an Iridium L-Band Transceiver (LBT) with the SBD feature available in firmware and the service activated on the Iridium network. The GSS is responsible for storing and forwarding messages from the ISU to the Vendor Application and storing messages from the Vendor Application to forward to the ISU. The ISU communicates with the GSS via the Iridium satellite constellation.



**Figure 2-1: Short Burst Data Architecture.**

The interface between the Vendor Application and the GSS uses either standard Internet mail protocols or an IP Socket type interface to send and receive messages. Mobile terminated messages are sent to the GSS using a common email or IP address, identifying the specific ISU by encoding the unique ISU IMEI in the subject line of the email or as part of the IP Socket payload. For email the data message itself is transported as a binary attachment to the email. For IP Socket the data message is part of the payload. Messages sent to the Vendor Application are delivered to a specific email or IP address that is configured when the IMEI is provisioned. The delivery address for each IMEI can be changed on-line by the VAR using the Iridium SPNet provisioning tool.

It is also possible for one ISU to send a message direct to another ISU(s) without the message passing to the Vendor Application. The second ISU destination IMEI must be programmed on-line by the VAR using the Iridium SPNet provisioning tool. However, only one delivery type (email or ISU-ISU) is permitted. Up to five email addresses or five ISU IMEIs or one IP Socket address can be provisioned as destinations for MO-SBD messages.

The interface between the FA and the ISU is a serial connection with extended proprietary AT commands. This interface is used to load and retrieve messages between the ISU and the Field Application.

For a Mobile Originated SBD Message (MO-SBD) the message is loaded into the MO buffer in the ISU using the +SBDWB or +SBDWT AT Commands, a message transfer session between the ISU and the GSS is initiated using the AT Command +SBDI[X]. For a Mobile Terminated SBD Message (MT-SBD) the ISU can either initiate a Mailbox Check using the AT Command +SBDI to check whether a MT message is queued at the GSS; or the ISU can use the (suitably configured) "SBD Ring Alert" capability to be told when a MT message is queued at the GSS. The ISU must then retrieve the MT-SBD message from the GSS by issuing the +SBDIXA command. When the message is received from the GSS it can be retrieved from the MT buffer in the ISU by the Field Application using the +SBDREB or +SBDRT AT Commands. Additionally a MT-SBD message can also be retrieved in the same network transaction by the ISU when a MO-SBD message is sent from the ISU.

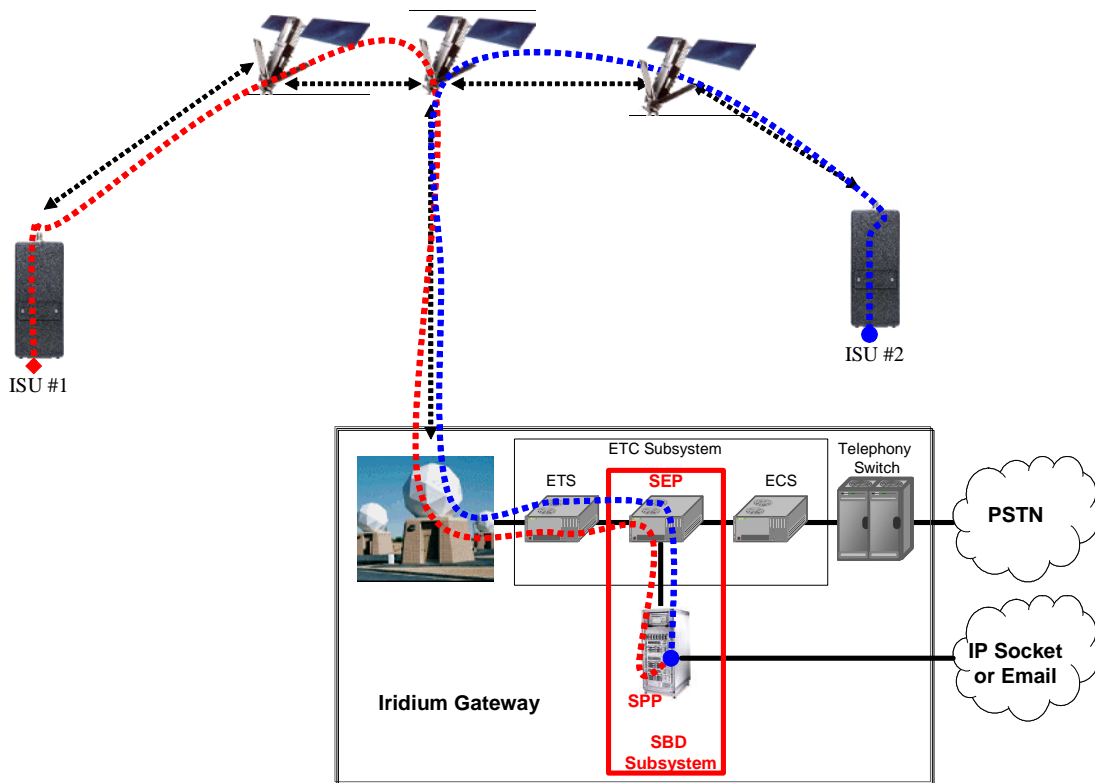


Figure 2-2: SBD System Architecture

Messages are transferred between the ISU and the GSS using a reliable transport mechanism that ensures the message is delivered error free. If the ISU was not able to send or receive messages, an indication is passed to the FA via the serial interface.

The MO and MT message buffers in the ISU will maintain messages as long as the ISU is powered on. Once a message is transferred from the FA to the MO buffer in the ISU, it will remain there even after it is successfully sent to the GSS. If a MT message is received at the ISU from the GSS, it will remain in the MT buffer even after the FA reads it. The buffers in the ISU will be cleared only when either given an explicit command (+SBDD) or when the ISU is power cycled or is overwritten with new data. The MT buffer will be cleared when a SBD session is initiated with the +SBDI command.

All MO and MT messages between the VA and the GSS are routed to the Internet by default. Iridium offers additional cost options for Virtual Private Network (VPN) and leased line routing of email or IP Socket messages to provide additional security, capacity and/or redundancy if required for the application. ISU-ISU SBD messages remain entirely within the Iridium network infrastructure, however it should be noted that they pass through the Iridium gateway and do not transfer directly from one ISU to another.

## 2.2 Transceiver Overview

The following Iridium transceivers are capable of Short Burst Data Service.



Developers should consult the appropriate developers guide document for the transceiver hardware.

### **3.0 Vendor Application to GSS Email Interface Description**

Applications that utilize SBD will communicate to the Iridium network via the GSS interface. This interface utilizes email or IP Socket interfaces for the transfer of data messages to and from the Vendor Application. This section describes how to utilize the GSS interface in both Mobile Originated and Mobile Terminated cases. Mobile Terminated messages are messages originated by the Vendor Application (or another ISU), that are sent to the Field Application. Mobile Originated messages are messages originated by the Field Application that are sent to either the Vendor Application or to another ISU.

In the case of ISU-ISU SBD messages, the originating message from the first IMEI is a Mobile Originated Message. Once received and processed in the GSS the message then becomes a Mobile Terminated Message with respect to the second ISU.

For ISU's provisioned to use email, each MO or MT message the VA will receive an email for each session that reaches the GSS regardless of any message transfer, unless one or both of the ISUs are provisioned to send to another ISU, in which case only the ISU provisioned to send to an email address will receive email notifications.

This section describes in more detail the operation of Mobile Terminated, Mobile Originated in email mode. 'ISU to ISU' mode, which is independent of email or IP Socket, is described separately in Section 4.2.

### 3.1 Mobile Terminated Messages

In order to send a MT message from the Vendor Application to the Field Application, the Vendor Application must send the message to the GSS where it will be queued for delivery awaiting contact from the ISU to retrieve it. The message will remain in the queue for up to five (5) days awaiting contact from the ISU to retrieve it. After five days all the messages are removed from the queue automatically by the GSS. There are two methods for the ISU to retrieve a queued MT messages from the GSS. The methods are hardware and firmware dependant. For specific capabilities consult the firmware release notes for the particular ISU type. Iridium recommends using the latest release of firmware available in order to provide the best performance and compatibility to the functionality described herein.

The first method, called “Polling,” is universal to all ISUs that are capable of SBD. In this method the mailbox check command (AT+SBDI with an empty Send Buffer) is sent from the Field Application to the ISU. The ISU contacts the GSS and transfers the MT message if one is queued.

The second method is called “SBD Ring Alert.” In this method the GSS automatically notifies the ISU that a message is queued at the GSS. Note that the MT message is not automatically delivered to the ISU. The application designer has to program the Field Application to respond in an appropriate manner to the SBD Ring Alert. Figure 3-1 provides an example MT email message. MT messages must follow the formatting rules are outlined below:

- The ISU must be provisioned in SPNet to send SBD Ring Alerts. If this is not done the GSS will not send any SBD Ring Alerts even if new MT messages are queued by the Vendor Application and/or the ISU is suitably configured.
- Messages sent to an ISU from the VA are sent to the email address: [data@sbd.iridium.com](mailto:data@sbd.iridium.com)
- Placing at least one, and up to a total of four, IMEI(s) into the subject line of the email identifies the destination ISU(s).
  - If there is more than one destination IMEIs then list the additional IMEIs on the subject line separated with a single space between each IMEI.
- The message must contain a properly formatted sender (“From:” address), otherwise the message will be dropped by the GSS.
- The data message to the ISU must be carried as an attachment to the email:
  - The attachment name must have a ‘.sbd’ file name extension: E.g. ‘importantdata.sbd’
  - File names can be up to 80 characters. (Including the .sbd extension.)
  - File names are not case sensitive.
    - The maximum size of the binary message (*not the Base64 version*) is ISU specific and is between one byte and the maximum MT message size stated in Section 1.6
    - The GSS will reject message sizes that are too large for a particular ISU type.
  - The attachment must use standard Multipurpose Internet Mail Extensions (MIME) Base64 encoding as defined in RFC 2045.
- Multiple messages may be queued by a single email by including the additional separate attachments in the email message, subject to the maximum number of messages permitted in the queue.
  - Note that if one of the attachments has an incorrect extension (.sbd), while others are correct then no error indication email will be sent.
  - A single email with multiple attachments creates a MT-SBD message for each attachment. In other words – one email with ten attachments creates ten MT-SBD messages for the destination ISU.
- A maximum of 50 messages may be in any ISU’s queue at any one time regardless of whether they were sent as an individual message with attachment or a single message with multiple attachments. The GSS will reject any message over this limit.
- The message body plays no role in the message transfer process; any information contained in the body will be discarded by the GSS.

```
To: data@sbd.iridium.com  
From: VA@VendorDomain.com  
Subject: 304050607080903
```

**Figure 3-1: Mobile Terminated Email Message**

The GSS validates each MT message upon receipt and returns a disposition notification email to the MT message originator. The format of this email is shown in Figure 3-2 and the definition of the email header and body descriptors is shown in Table 3-1. A sample success notification is shown in Figure 3-3. If there is more than one destination ISU a disposition notification email will be sent for each destination ISU. If the Vendor Application attempts to queue more than 50 messages for delivery at the GSS, a rejection notice email similar to Figure 3-4 will be sent to the message originator (From address).

```
To: VA@VendorDomain.com  
From: techops@iridium.com  
Subject: <Result Description>: <ISU IMEI>  
  
<Description>  
  
IMEI: <IMEI number>  
Time: <Date>
```

**Figure 3-2: MT-SBD Email disposition notification message field layout.**

**Table 3-1 SBD-MT disposition notification email header and message body field descriptors**

| Field Name  | Description  |   |             |                     |  |                          |   |             |  |
|---|--|---|-------------|---------------------|--|--------------------------|---|-------------|--|
| <Result Description>  | This field will have one of the following values:  |   |             |                     |  |                          |   |             |  |
|   | SBD Mobile Terminated Message Queued for Unit: <ISU IMEI>  |   |             |                     |  |                          |   |             |  |
|   | Error: SBD Mobile-Terminated Message Not Queued for Unit: <ISU IMEI>   |   |             |                     |  |                          |   |             |  |
| <ISU IMEI>  | <table border="1"> <thead> <tr> <th>Field Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>(No IMEI specified)</td> <td>No IMEI provided in the subject line of the email sent to the GSS.</td> </tr> <tr> <td>(Invalid IMEI specified)</td> <td>The IMEI in the subject line of the email sent to the GSS was not in the proper format. Additional information can be found in the reason code in the body of the message</td> </tr> <tr> <td>Actual IMEI</td> <td>The actual 15 digit IMEI of the destination ISU is returned if it was validated.</td> </tr> </tbody> </table> | Field Value   | Description | (No IMEI specified) | No IMEI provided in the subject line of the email sent to the GSS. | (Invalid IMEI specified) | The IMEI in the subject line of the email sent to the GSS was not in the proper format. Additional information can be found in the reason code in the body of the message                   | Actual IMEI | The actual 15 digit IMEI of the destination ISU is returned if it was validated. |
|   | Field Value  | Description   |             |                     |  |                          |   |             |  |
|   | (No IMEI specified)  | No IMEI provided in the subject line of the email sent to the GSS.  |             |                     |  |                          |   |             |  |
|   | (Invalid IMEI specified)   | The IMEI in the subject line of the email sent to the GSS was not in the proper format. Additional information can be found in the reason code in the body of the message |             |                     |  |                          |   |             |  |
| Actual IMEI   | The actual 15 digit IMEI of the destination ISU is returned if it was validated.   |   |             |                     |  |                          |   |             |  |
| Additional text expanding on the queuing disposition in the subject line. It will have one of the following values:<br>The following mobile-terminated message was queued for delivery:<br>The following mobile-terminated message was not queued for delivery: |  |   |             |                     |  |                          |   |             |  |
| IMEI  | The hardware identification number of the unit to which the message was to be queued.  |   |             |                     |  |                          |   |             |  |
|   | <table border="1"> <thead> <tr> <th>Field Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>(none specified)</td> <td>No IMEI provided in the subject line of the email sent to the GSS.</td> </tr> <tr> <td>Received IMEI</td> <td>The IMEI was received by the GSS. In the case of Success, this is the 15 numeric-digit IMEI of the ISU. In the case of Error, this is the invalid Alpha-numeric string received by the GSS.</td> </tr> </tbody> </table>   | Field Value   | Description | (none specified)    | No IMEI provided in the subject line of the email sent to the GSS. | Received IMEI            | The IMEI was received by the GSS. In the case of Success, this is the 15 numeric-digit IMEI of the ISU. In the case of Error, this is the invalid Alpha-numeric string received by the GSS. |             |  |
|   | Field Value  | Description   |             |                     |  |                          |   |             |  |
| (none specified)  | No IMEI provided in the subject line of the email sent to the GSS.   |   |             |                     |  |                          |   |             |  |
| Received IMEI   | The IMEI was received by the GSS. In the case of Success, this is the 15 numeric-digit IMEI of the ISU. In the case of Error, this is the invalid Alpha-numeric string received by the GSS.  |   |             |                     |  |                          |   |             |  |
| The timestamp, in UTC, when the acknowledgement was sent from the GSS.  |  |   |             |                     |  |                          |   |             |  |
| Attachment Filename   | The filename of the attachment received by the GSS.  |   |             |                     |  |                          |   |             |  |
| Attachment Size   | The size of the attachment received by the GSS.  |   |             |                     |  |                          |   |             |  |
| <Reason & Descriptive Text>   | One of the following values will be displayed:<br>The MTMSN is XX, and the message is number N in the queue<br>Reason: IMEI length (M) is invalid – must be 15 characters.<br>Reason: The IMEI is not provisioned on the SBD system.<br>Reason: No attachment with a '.sbd' file extension was found<br>Reason: Payload size is too large (max size allowed is XXXX bytes).<br>Reason: Mobile-termination message queue for the IMEI is full (max of 50 allowed).  |   |             |                     |  |                          |   |             |  |

```
To: VA@VendorDomain.com  
From: sbdservice@sbd.iridium.com  
Subject: Success: SBD Mobile-Terminated Message Queued for Unit  
300001001247240
```

The following mobile-terminated message was queued for delivery:

```
IMEI: 300001001247240  
Time: Mon Oct 27 17:24:29 2003  
Attachment Filename: TestFile518chars.sbd  
Attachment Size: 518 bytes  
The MTMSN is 6870, and the message is number 12 in the queue
```

**Figure 3-3: Mobile Terminated Email Message – Successful Queuing Notice**

```
To: VA@Vendordomain.com  
From: sbdservice@sbd.iridium.com  
Subject: Error: SBD Mobile-Terminated Message Not Queued for Unit:  
300001001247240
```

The following mobile-terminated message was not queued for delivery:

```
IMEI: 300001001247240  
Time: Mon Oct 27 17:23:30 2003  
Attachment Filename: TestFile518chars.sbd  
Attachment Size: 518 bytes  
  
Reason: Mobile-termination message queue for the IMEI is full (max of 50  
allowed).
```

**Figure 3-4: Mobile Terminated Email Message - Rejection Notice**



### **3.2 Mobile Originated Messages Sent Via Email**

Messages sent from the ISU to the GSS are processed at the GSS where they are immediately formatted and sent to the destination email address that was provisioned when the ISU IMEI was provisioned. The message sent to the Vendor Application from the ISU will be carried as a binary attachment to an email from the GSS to the Vendor Application. The binary attachment is encoded using standard MIME Base64 encoding as defined in RFC 2045. Unlike Mobile Terminated messages sent to the GSS, Mobile Originated messages sent to the Vendor Application carry additional information in the email message body. This information includes the Mobile Originated Message Sequence Number (MOMSN), the time of the session, the session status, the message size, and ISU specific geo-location information. The format of such an email message is provided in Figure 3-5, details of the email message fields are provided in Table 3-2. Note that it is possible to tell the GSS not to send the geographic location fields on a device by device basis. This is achieved by using SPNet and un-checking the "Include Geo-Data" box for the specific ISU IMEI. An example of an email message with no geo-location information is shown in Figure 3-6.

A MO-SBD message may be sent to up to five email destinations. The five destinations are programmed into the GSS by using the SPNet provisioning tool available to Value Added Resellers. Note that only one delivery method is permitted: Either email or ISU-ISU, it is not possible to mix delivery types. [See also Section 4.2 "ISU to ISU Messages."]

```
From: sbdservice@sbd.iridium.com
Sent: Tuesday, August 13, 2002 16:51 PM
Subject: SBD Msg From Unit: 304050607080903

MOMSN: 2
MTMSN: 239
Time of Session (UTC): Tue Aug 13 16:51:04 2002
Session Status: 00 - Transfer OK
Message Size (bytes): 1230
```

**Figure 3-5: Mobile Originated Email Message Showing Geo-location information**

```
From: sbdservice@sbd.iridium.com
Sent: Friday, July 8, 2005 00:12 AM
Subject: SBD Msg From Unit: 300003000210150

MOMSN: 652
MTMSN: 644
Time of Session (UTC): Fri Jul 8 00:12:55 2005
```

**Figure 3-6: Mobile Originated Email Message without Geo-location information**

**Table 3-2: Mobile Originated Message Email Message Field Description**

| Field Name                | Description   |   |    |                   |    |                   |  |
|---------------------------|---|---|----|-------------------|----|-------------------|--|
| From                      | This field identifies the sender of the email message as the SBD Service. This field normally contains "sbdservice@sbd.iridium.com"   |   |    |                   |    |                   |  |
| Sent                      | This field provides the time at which the message was emailed from the GSS to the Vendor Application. The timestamp is in UTC.  |   |    |                   |    |                   |  |
| Subject                   | This field provides the ISU IMEI of the unit that sent the MO message.  |   |    |                   |    |                   |  |
| MOMSN                     | This is the Message Sequence Number set by the ISU when the message was sent from the ISU to the GSS. The value is an integer in the range 0 to 65,535 and is incremented each time an SBD session is successfully completed between the ISU to the GSS. It is a wrap around counter which will increment to 0 after reaching 65535.  |   |    |                   |    |                   |  |
| MTMSN                     | This is the Message Sequence Number used by the GSS when the message was sent from the GSS to the ISU. The value is an integer in the range 0 to 65,535 and is incremented each time the GSS forwards a message to a particular ISU. It is a wrap around counter which will increment to 1 after reaching 65535. It will have a value of zero (0) if no MT message transfer attempt occurred to the specific ISU.   |   |    |                   |    |                   |  |
| Time of Session           | This field provides the UTC timestamp of the ISU session between the ISU and the GSS. A text string is sent with the following format: "DDD MMM dd HH:MM:SS yyyy".  |   |    |                   |    |                   |  |
|                           | <b>Value</b>  |   |    |                   |    |                   |  |
|                           | <b>Description</b>  |   |    |                   |    |                   |  |
|                           | DDD   | Day of the week (Sun, Mon, Tue, Wed, Thu, Fri, Sat)   |    |                   |    |                   |  |
|                           | MMM   | Month of the year (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)  |    |                   |    |                   |  |
|                           | dd  | Day of the month (01 to 31)   |    |                   |    |                   |  |
| Session Status            | hh  | Hour (00 to 23)   | mm | Minute (00 to 59) | ss | Second (00 to 59) |  |
|                           | yyyy  | Year  |    |                   |    |                   |  |
|                           | There are seven possible results of the SBD session which are described below:  |   |    |                   |    |                   |  |
|                           | <b>Session Status</b>   | <b>Description</b>  |    |                   |    |                   |  |
| 00 - Transfer OK          | The SBD session between the ISU and the GSS completed successfully.   |   |    |                   |    |                   |  |
| 01 - MT Message Too Large | The MT message queued at the GSS is too large to be transferred within a single SBD session   |   |    |                   |    |                   |  |
| 10 - SBD Timeout          | The SBD Session timed out before session completion   |   |    |                   |    |                   |  |
| 12 - MO Message Too Large | The MO message being transferred by the ISU is too large to be transferred within a single SBD session  |   |    |                   |    |                   |  |
| 13 - Incomplete Transfer  | A RF link loss occurred during the SBD session  |   |    |                   |    |                   |  |
| 14 - SBD Protocol Error   | An ISU protocol anomaly occurred during the SBD session   |   |    |                   |    |                   |  |
| 15 - SBD Denial           | The ISU is not allowed to access the system   |   |    |                   |    |                   |  |
| Message Size              | This field provides an indication of the size, in bytes, of the attached message in decoded form. This is not the length of the MIME encoded data.  |   |    |                   |    |                   |  |
| Unit Location             | These fields are optional at the time that the ISU is provisioned. These fields provide the geographic location of the ISU. The latitude and longitude provide a center point and the CEP Radius provides the radius (measured in Kilometers) around the center point within which the unit is located. This reported position is accurate (within the reported circle) 80% of the time. Note that activating or deactivating the inclusion of the ISU location can only be accomplished via SPNet. It cannot be controlled by or from the ISU and is enabled by default. |   |    |                   |    |                   |  |
|                           | Unit Latitude   | This field provides the geographic latitude of the ISU measured in degrees. Positive represents north, negative represents south. When GEO location data is provisioned to "off" the latitude the field is not included in the email. |    |                   |    |                   |  |
|                           | Unit Longitude  | This field provides the geographic longitude of the ISU measured in degrees. Positive represents east, negative represents west. When GEO location data is provisioned to "off" the longitude the field is not included in the email. |    |                   |    |                   |  |
|                           | CEPRadius   | This field provides an estimate of the accuracy of the ISU's location. This position is reported in Kilometers. When GEO location data is provisioned to "off" the CEPRadius the field is not included in the email.                  |    |                   |    |                   |  |

### 3.3 Examples of SBD Usage

This section outlines some generic examples of SBD usage scenarios. The scenarios are merely examples and developers may use the SBD AT Commands in other permutations and combinations.

#### 3.3.1 Mobile Originated (MO) Message

The FA will load a Mobile Originated message into the ISU, initiate a SBD session, evaluate and act on the results of the SBD session (Table 3-3). Finally, the GSS will forward the MO message to the Vendor Application. (Figure 3-7.)

**Table 3-3 FA to ISU Interface, MO Message**

| To ISU (from DTE) | To DTE (from ISU)          | Description   |
|-------------------|----------------------------|---|
| AT+SBDWB=351↵     |                            | The FA instructs the ISU that it will write a 351 byte message into the ISU.  |
|                   | READY↵                     | The ISU informs the FA that it is ready to receive the message  |
| Binary transfer   |                            | The FA sends the 351 byte message followed by the two byte checksum to the ISU. This transfer is not echoed.                            |
|                   | 0↵                         | The ISU will send a zero result code to the FA indicating that the message was loaded without error.                                    |
| AT+SBDI↵          |                            | The FA instructs the ISU to initiate an SBD transfer.   |
|                   | +SBDI: 1, 23, 0, -1, 0, 0↵ | The ISU informs the FA that the message was sent successfully using MOMSN 23. No MT message was received and no MT messages are queued. |
| AT+SBDD0↵         |                            | The FA instructs the ISU to clear the message from the Mobile Originated buffer.  |
|                   | 0↵                         | The ISU informs the FA that the message buffer was cleared successfully.  |

```

From: sbdservice@sbd.iridium.com
Sent: Tuesday, August 13, 2002 12:49 PM
Subject: SBD Msg From Unit: 304050607080903

MOMSN: 23
MTMSN: 0
Time of Session (UTC): Tue Aug 13 16:51:04 2002
Session Status: 00 - TRANSFER OK
Message Size (bytes): 351
Unit Location: Lat = 59.372463 Long = 75.309806
CEPradius = 3

Message is Attached.

```

**Figure 3-7 VA to GSS Interface, MO Message**

### 3.3.2 Mailbox Check / Mobile Terminated (MT) Message

The GSS does not have the ability to automatically notify the ISU that a Mobile Terminated message is waiting for it at the GSS. The FA is required to perform a Mailbox Check by initiating an SBD session with an empty MO buffer. If a MT message is waiting for the ISU at the GSS, the MT message is transmitted to the ISU.

In this scenario, a MT message is sent from the Vendor Application to the GSS (Figure 3-8.) The FA will initiate an SBD session, evaluate the results of the SBD session, and read the MT message from the ISU (Table 3-4). After the SBD session completes, the GSS sends an email message to the Vendor Application indicating the disposition of the SBD session (Figure 3-9).

To: [Data@SBD.Iridium.com](mailto:Data@SBD.Iridium.com)  
From: [VA@VendorDomain.com](mailto:VA@VendorDomain.com)  
Subject: 304050607080903

**Figure 3-8 VA to GSS Interface, Mailbox Check / MT Message**

From: <Iridium SBD Service (Tempe, AZ)>  
Sent: Tuesday, August 13, 2002 12:49 PM  
Subject: SBD Msg From Unit: 304050607080903

MOMSN: 498  
MTMSN: 237  
Time of Session (UTC): Tue Aug 13 16:51:04 2002  
Session Status: 00 - TRANSFER OK  
Message Size (bytes): 0

**Figure 3-9 GSS to VA Interface, Status Message.**

**Table 3-4 FA to ISU Interface, Mailbox Check / MT Message**

| To ISU (from DTE) | To DTE (from ISU)              | Description   |
|-------------------|--------------------------------|---|
| AT+SBDD0          |                                | The FA instructs the ISU to clear the send buffer.  |
| AT+SBDI↵          |                                | The FA instructs the ISU to initiate an SBD transfer.   |
|                   | +SBDI: 0, 498, 1, 237, 561, 2↵ | The ISU informs the FA that no MO message was sent and a 561 byte MT message was successfully received with MTMSN 237. Two additional MT messages are queued. |
| AT+SBDRB↵         |                                | The FA instructs the ISU to transfer the MT message.  |
|                   | Binary transfer                | The ISU sends a two-byte length indicator followed by the 561 byte message followed by the two byte checksum to the FA.                                       |

### 3.3.3 Mobile Originated and Mobile Terminated Message

When the Field Application needs to send a Mobile Originated data message and the Vendor Application needs to send a Mobile Terminated Message, the following scenario assumes that the MT Message is waiting at the GSS before the MO message is sent.

In this scenario, the Vendor Application will send the MT message to the GSS (Figure 3-10); the FA will load the MO message into the ISU, initiate an SBD session, evaluate the results of the SBD session, and read the Mobile Terminated message from the ISU (Table 3-5). Finally the Vendor Application will receive the MO message (Figure 3-11).

To: [Data@SBD.Iridium.com](mailto:Data@SBD.Iridium.com)  
From: [VA@VendorDomain.com](mailto:VA@VendorDomain.com)  
Subject: 304050607080903

**Figure 3-10 Vendor Application to GSS Interface, MT Message**

**Table 3-5 FA to ISU Interface, Mobile Originated and Mobile Terminated**

| To ISU (from DTE) | To DTE (from ISU)              | Description  |
|-------------------|--------------------------------|--|
| AT+SBDWB=351␣     |                                | The FA instructs the ISU that it will write a 351 byte message into the ISU.   |
|                   | READY␣                         | The ISU informs the FA that it is ready to receive the message   |
| Binary transfer   |                                | The FA sends the 351-byte message followed by the two byte checksum to the ISU. This transfer is not echoed.   |
|                   | 0␣                             | The ISU will send a zero result code to the FA indicating that the message was loaded without error.   |
| AT+SBDI␣          |                                | The FA instructs the ISU to initiate an SBD transfer.  |
|                   | +SBDI: 1, 2173, 1, 87, 429, 0␣ | The ISU informs the FA that the message was sent successfully using MOMSN 2173. A 429-byte message was received using MTMSN 87. No additional messages are queued. |
| AT+SBDD0␣         |                                | The FA instructs the ISU to clear the message from the send buffer.  |
|                   | 0␣                             | The ISU informs the FA that the message buffer was cleared successfully.   |
| AT+SBDRB␣         |                                | The FA instructs the ISU to transfer the received message.   |
|                   | Binary transfer                | The ISU sends a two-byte length indicator followed by the 429byte message followed by the two byte checksum to the FA.   |

```
From: <Iridium SBD Service (Tempe, AZ)>
Sent: Tuesday, August 13, 2002 12:49 PM
Subject: SBD Msg From Unit: 304050607080903

MOMSN: 2173
MTMSN: 87
Time of Session (UTC): Tue Aug 13 16:51:04 2002
Session Status: 00 - TRANSFER OK
Message Size (bytes): 351
```

Figure 3-11 VA to GSS Interface, MO Message

## 3.4 Permitted Email Address Formats

The following formats of email address are permitted for Mobile Originated messages:

- [Name@domain.com](#)
  - E.g. IridiumSBDProcessor@Iridium.varname.com
- Name@IP\_address
  - E.g. [IridiumSBDProcessor@172.16.254.1](#)

Note that Iridium encourages the use of Name@domain.com. Use of Name@IP\_address is discouraged as per the relevant RFC2821.

## 3.5 Bit Bucket for MO-SBD Messages

In certain circumstances a VAR may want to cause all MO-SBD messages to be discarded and not sent to the Vendor Application. If a SBD IMEI is provisioned in SPNet to "devnull@devnull.iridium.com", then all mobile originated messages will be immediately discarded after leaving the SPP. The emails are not stored or sent anywhere, but literally sent to the /dev/null device of the mail servers. Additionally all mailbox check email notifications are also immediately discarded. **To summarize, if devnull@devnull.iridium.com is provisioned for an IMEI then *\*all\* email messages and notifications that result from a MO-SBD transaction are discarded and it is *\*not\** possible to recover such messages.***

This email address is not accessible outside of Iridium and is only available for emails generated within the GSS. An email sent to this address from outside of Iridium will be rejected.

**Even if a message is delivered to [devnull@devnull.iridium.com](#), the message will still be charged for.** Messages sent to devnull cannot be retrieved.

## 4.0 SBD Automatic Notification for Mobile Terminated Messages and ISU-ISU Messages

The Iridium Short Burst Data service is a fully acknowledged protocol that confirms the delivery of the messages between the ISU and the GSS. By design, Mobile Originated messages are fully acknowledged as the ISU is in full control of the transmission. For Mobile Terminated messages the protocol does not permit the GSS to send an unsolicited MT-SBD message to an ISU as the ISU may not be ready or available to receive such a message and acknowledge it. Each time the GSS receives a MT-SBD message for an ISU, it is queued at the GSS until the ISU requests delivery. A capability of notifying the ISU that it has a queued MT-SBD message waiting for it has been implemented and that capability is called SBD Automatic Notification.

Prior to the release of SBD GSS Version 4.1, the ISU did not receive a notification that a MT-SBD message had been queued at the GSS. In order to determine if a message was queued for delivery, the ISU sent either a MO-SBD message or a 'mailbox check' and then the application checked the status codes returned from the GSS to determine if a MT-SBD message was received by the ISU and whether additional messages were still queued at the GSS. For applications that required timely notification of queued MT-SBD messages this process was less than optimal.

To provide a more optimal solution Iridium implemented the SBD Automatic Notification feature in SBD GSS Version 4.1. This feature notifies the ISU that a MT-SBD message has been queued for it at the GSS. It does not automatically deliver the MT-SBD message. The actual notification is called a SBD Ring Alert. The application developer will need to implement an appropriate algorithm in the Field Application to process the SBD Ring Alert and then initiate a SBD session to receive the queued message.

### 4.1 SBD Automatic Notification for Mobile Terminated Messages

This section provides basic examples of how to configure the ISU. Please also consult the relevant AT Command set documentation for more detailed information. **SBD Automatic Notification requires both the correct configuration of the ISU through use of AT Commands and the activation of this feature at the time of provisioning through the use of SPNet.**

#### 4.1.1 Automatic Notification Registration

To implement the SBD Ring Alert feature there are a number of implementation steps required:

1. The ISU must have the firmware revision that supports this feature. See Section 1.6. These versions can be downloaded from the extranet site if required.
2. In the SPNet provisioning database, the SBD Ring Alert option needs to be selected in the provisioning screen for the ISU. This option indicates to the GSS that SBD Ring Alerts are intended to be used with this ISU. NOTE: In the majority of the instances where it is reported that "ring alerts are not working," it is due to not selecting the Ring Alert option in SPNet for the ISU.
3. The Field Application is required to execute AT commands to configure the ISU to listen for SBD Ring Alerts and then the ISU has to complete SBD Network Registration which notifies the GSS

that the ISU is ready to receive SBD Ring Alerts.

- a. The Field Application executes +SBDMTA command to configure the ISU to listen for SBD Ring Alerts sent from the GSS. Failure to complete this step will result in the ISU not listening for SBD Ring Alerts as this is the default setting. To configure the ISU to receive the SBD Ring Alert the command is: AT+SBDMTA=1.
- b. The Field Application next executes the +SBDREG command which will attempt to complete the SBD Network Registration. SBD Network Registration performs two functions. First it notifies the GSS that the ISU is configured and ready to receive SBD Ring Alerts and second it provides the required geo-location coordinates so that the GSS knows where to route the SBD Ring Alert(s) to. To complete the SBD Network Registration the command is: AT+SBDREG.

The table below describes the following: The FA verifies its registration state, performs a registration in order to be able to receive automatic notifications, and enables automatic notification indications.

| To ISU (from FA) | To FA (from ISU) | Description  |
|------------------|------------------|--|
| AT+SBDMTA=1      |                  | Tell the ISU to listen for (enable) SBD Ring Alerts.               |
|                  | OK               |  |
| AT+SBDREG?       |                  | Query the ISU SBD Network Registration status                      |
|                  | +SBDREG:0        | ISU has not completed SBD Network Registration, ie it is detached. |
| AT+SBDREG        |                  | Tell the ISU to register for SBD Ring Alerts                       |
|                  | +SBDREG:2,0      | ISU is now registered for SBD Ring Alerts                          |
| AT+SBDREG?       |                  | Query the ISU SBD Network Registration status                      |
|                  | +SBDREG:2        | ISU is registered for SBD Ring Alerts                              |

#### 4.1.2 Retrieval of a MT-SBD Message using SBD Automatic Notification

The ISU must send a MO-SBD message in order to retrieve the MT-SBD message queued at the GSS. The MO-SBD may simply be a 'mailbox check' which has a zero-byte message payload or a valid MO-SBD message (i.e. payload size greater than zero bytes.) Either one will cause the next MT-SBD message queued at the GSS, if there is one, to be delivered to the ISU and retrieve the status information from the GSS.

If the application is configured to use the SBD Automatic Notification, the +SBDIX and +SBDIXA commands must be used to initiate the MO-SBD message. To respond to a SBD Ring Alert the Field Application should use the +SBDIXA command to retrieve the MT-SBD message. If the Field Application is sending an unsolicited MO-SBD message, the +SBDIX command is used. [Note: The +SBDI command can still be used, however, it also 'detaches' or stops SBD Ring Alerts being sent from GSS.]



In the table below: The FA verifies its registration state. Upon receiving a SBD Ring Alert the FA initiates an SBD session to receive an MT message.

| To ISU (from FA) | To FA (from ISU)        | Description  |
|------------------|-------------------------|--|
| AT+SBDREG?       |                         | Query the ISU SBD Network Registration status  |
|                  | +SBDREG:2               | ISU is registered for SBD Ring Alerts  |
|                  | ...                     | Vendor Application sends an MT message to the GSS. GSS sends a SBD Ring Alert to ISU   |
|                  | +SBDRING                | ISU indicates an incoming message. The RI line also toggles.   |
| AT+SBDIXA        |                         | FA initiates an SBD session in response to the SBD Ring Alert  |
|                  | +SBDIXA:0,23,1,237,90,2 | ISU informs FA that a 90-byte message was successfully received with MTMSN 237, and that two further MT messages are queued at the GSS |
| AT+SBDRB         |                         | FA retrieves the received message from the ISU   |
|                  | <binary transfer>       |  |

### 4.1.3 SBD Ring Alert Status Information

During a SBD message transfer, status information is transferred between the GSS and the ISU. This status information is retrieved from the ISU by using the +SBDSX command which returns six values: MO flag, MOMSN, MT flag, MTMSN, RA flag and number of messages waiting at the GSS. The parameters MO flag, MOMSN, MT flag, MTMSN are the same as those returned by the +SBDS command. The new parameters are the RA flag and the messages waiting. The RA flag indicates whether the ISU received a SBD Ring Alert from the GSS that has not been answered. The messages waiting value is the number of MT messages queued at the GSS waiting to be delivered. This information can be used by the Field Application to retrieve the queued messages.

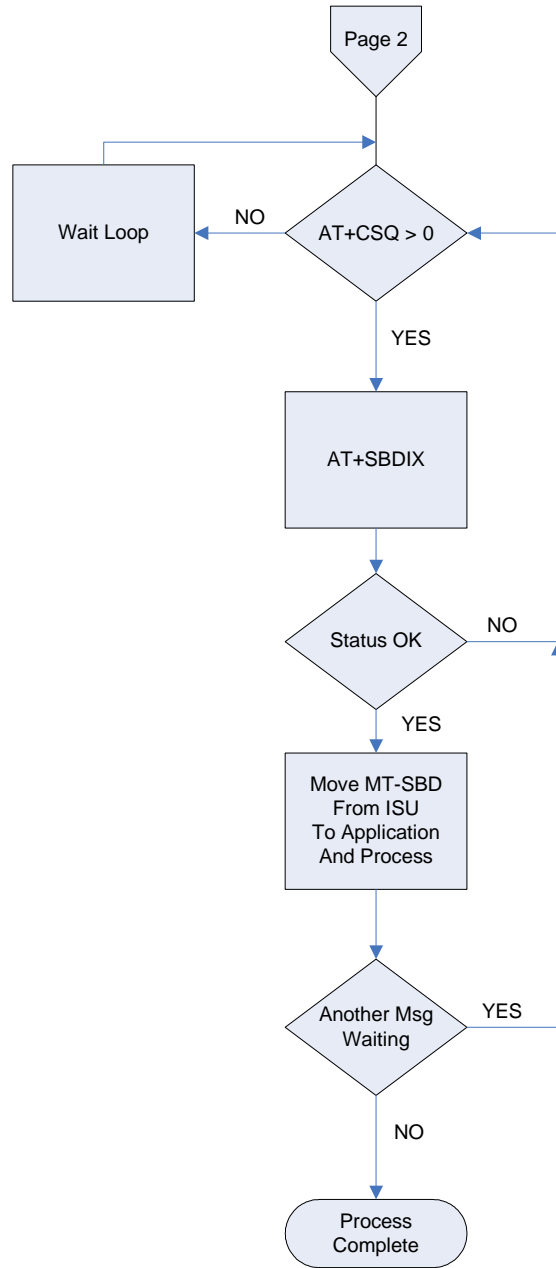
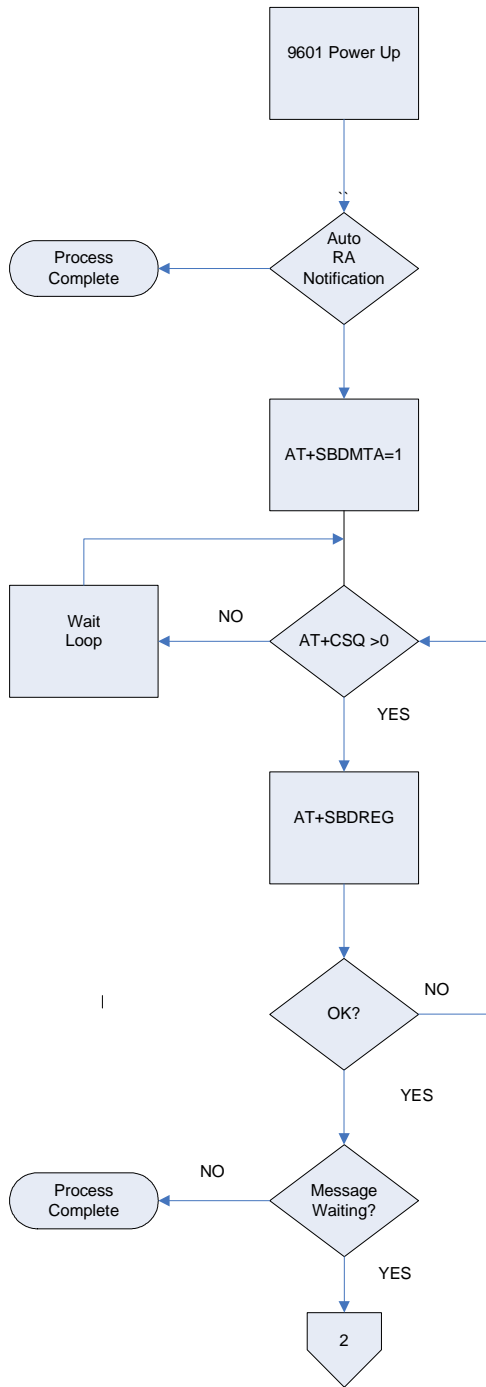
This status information is updated every time there is a SBD session between the ISU and the GSS. The commands that initiate an SBD session are: +SBDI, +SBDIX[A], +SBD[A]REG, +SBDDDET. The +SBDSX command can be properly used following any of these commands.

### 4.1.4 Field Application Implementation

#### 4.1.4.1 Power Up

- On power up, the Field Application configures the ISU to receive the SBD Ring Alert with the +SBDMTA command.
- This should be followed by the +SBDREG to complete SBD Network Registration of the ISU with the GSS.
- After the response code for +SBDREG has been received that the ISU has successfully completed SBD Network Registration, the Field Application can check the current status response with the +SBDSX command.
  - If the GSS received a MT-SBD message for this ISU while it was powered off, it will be indicated by the RA status flag.
  - If there are MT-SBD messages queued for delivery, this is indicated by the 'message waiting' parameter which is a count of the number of messages queued. If there are messages queued for delivery to this ISU, the application can initiate a SBD session and retrieve them.

### 9601 Power Up Process



#### **4.1.4.2 Automatic SBD Ring Alert Notification & Retry Scheme**

When the GSS receives a MT-SBD message and the destination ISU is both configured to listen for SBD Ring Alerts, and it has successfully completed SBD Network Registration, the GSS sends a SBD Ring Alert to the ISU. If the ISU does not respond in approximately 13 seconds, a second SBD Ring Alert is sent. If the ISU does not respond to the second SBD Ring Alert, no further SBD Ring Alerts are sent until another new MT-SBD is queued for this specific ISU.

If a subsequent MT-SBD message is received at the GSS for this ISU, the SBD Ring Alert process repeats itself. However, the GSS will not send a SBD Ring Alert if the subsequent MT-SBD is received within 10 seconds of the receipt of the previous MT-SBD.

Note that while the transfer of MO or MT SBD messages is via a reliable (duplex) protocol, SBD Ring Alerts are sent on a simplex channel. **If the ISU is turned off or is blocked from seeing the satellite, then a SBD Ring Alert will not be received by the ISU and the GSS has no knowledge of whether an ISU eventually received a specific SBD Ring Alert or not.**

If an ISU, configured to receive SBD Ring Alerts, is not powered on and a MT-SBD message is queued at the GSS then, assuming the ISU is configured in the GSS for SBD Ring Alerts, the SBD Ring Alert will be sent out. However because the ISU is not powered on, the ISU will not receive the SBD Ring Alert. A subsequent power-on of the ISU will not cause the SBD Ring Alert to be delivered by the GSS. The GSS has no direct knowledge of the power on status of ISUs. In order for a Field Application to know whether there was a queued MT-SBD message at the GSS during the time that the ISU was powered off, the ISU can use either the +SBDSX command or it could send a MO-SBD message (+SBDI[X]) as specified in [3].

If an ISU is on, and suitably configured, but does not have sufficient line of sight to the satellite due to terrestrial physical blockage the impact may be similar to the description of the powered off ISU just given. The behavior will depend on the amount of blockage. Applications designers should not rely on the use of +CSQ for determining whether an ISU can see a satellite at an instantaneous point in time on the 9601. To conserve power the +CSQ algorithm uses averaging over time.

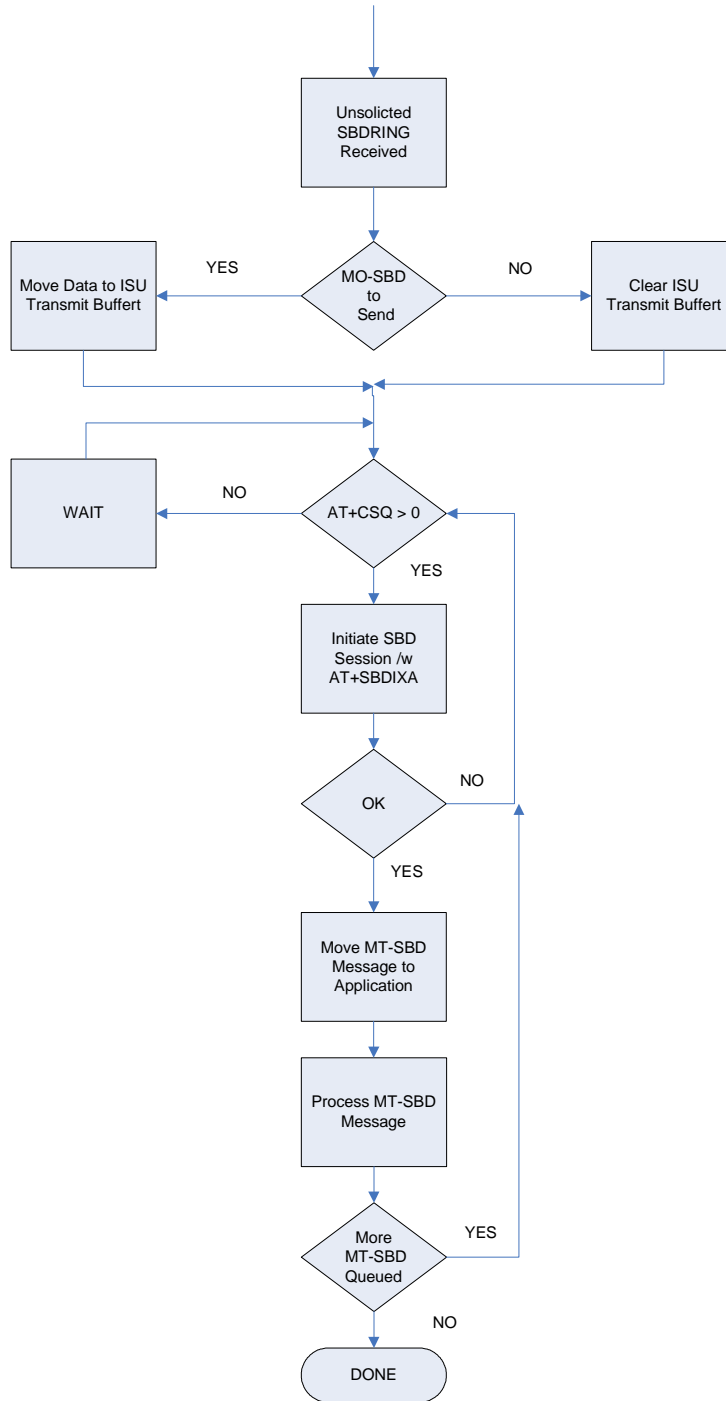
#### **4.1.4.3 Retrieving MT-SBD Message from the GSS when notified by the SBD Ring Alert**

The GSS queues the MT-SBD message for the ISU and sends SBD Ring Alert. The ISU receives the SBD Ring Alert and sends an unsolicited response to the Field Application. This response is either SBDRING in Verbose Mode or "2" in Numeric Mode. The Field Application interprets the response and initiates a SBD session with the +SBDIXA command. The "A" suffix indicates this is a response to the SBD Ring Alert.

If the Field Application has a MO-SBD message to send, it moves the data into the transmit buffer prior to issuing the AT command. If the Field Application has nothing to send and just wants to retrieve the queued MT-SBD message, it clears the MO transmit buffer before initiating the session. The response codes from the +SBDIXA command indicate if there are additional MT-SBD messages waiting to be retrieved.

Applications where the ISU will move significant distances fairly quickly (e.g. aircraft) and applications where the ISU will move through an environment where the ISU may not always have a good view of the sky (e.g. cities, mountainous regions) should use the Automatic SBD Network Registration capability if a high degree of reliability/low latency of delivered MT-SBD messages is desired.

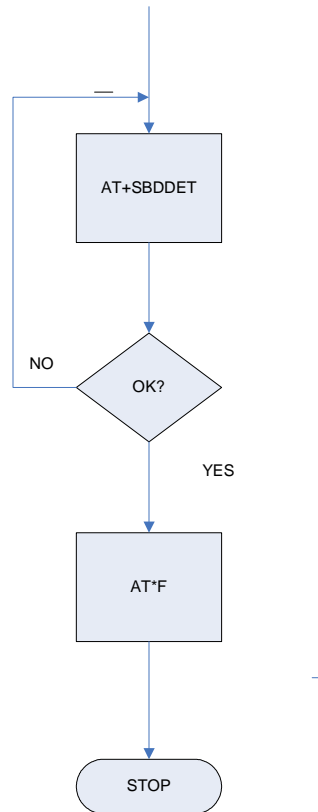
### Respond to SBD Ring Alert Notification to Retrieve MT-SBD Message



#### 4.1.4.4 Power Down

1. Before turning the ISU off, the Field Application should tell the GSS not to send any further SBD Ring Alerts. The Field Application will need to issue the +SBDDDET to the ISU which will tell the GSS to “stop sending SBD Ring Alerts” or DETach from the GSS.
2. When the response code for +SBDDDET indicates a successful detach the ISU can be powered off.
3. At power up the method described in Section 4.1.4.1 should be used to restart the GSS sending SBD Ring Alerts.

9601 Power Down Process



#### 4.1.5 SBD Automatic Notification: Automatic Registration (+SBDAREG)

In order for the ISU to receive the SBD Ring Alert Notification, the GSS must have the current location of the ISU. This location is updated by the SBD Network Registration and each time a SBD session takes place. For fixed location ISUs and ISUs that do not travel more than approximately 100 miles between SBD sessions, the +SBDREG command is sufficient. If the ISU is mobile and can possibly move more than 100 miles between SBD sessions, the +SBDAREG command should be used for SBD Network Registration. Both commands perform the same SBD Network Registration, however, the +SBDAREG command continually runs an algorithm which estimates the distance the ISU has moved since the previous SBD session. If the result indicates the ISU has moved 'too' far, the ISU automatically issues an updated SBD Network Registration.

The FA verifies its registration state and enables automatic registration using the “Ask” mode.

| To ISU (from FA) | To FA (from ISU) | Description                                      |
|------------------|------------------|--|
| AT+SBDREG?       |                  | Query the ISU registration status                |
|                  | +SBDREG:2        | ISU is registered                                |
| AT+SBDAREG=2     |                  | FA sets the automatic registration to “Ask” mode |
|                  | OK               |  |
|                  | ...              | ISU is moved                                     |
|                  | +AREG:0,0        | ISU notifies FA that it needs to register        |
| AT+SBDREG        |                  | FA instructs the ISU to register                 |
|                  | +SBDREG:2,0      | Registration is successful                       |

#### 4.1.6 SBD Automatic Notification: Registration (+SBDREG) with Optional GPS Parameter

The SBD Network Registration uses a Doppler calculation to update the geo-location at the GSS. This geo-location is inherently imprecise but is adequate for the majority of applications using SBD Automatic Notification. However, it may not be suitable for ISUs installed on very fast moving vehicles, such as aircraft. In this case, it is recommended that the Field Application provide the optional GPS parameter with the manual SBD Network Registration command +SBDREG.

## 4.2 ISU- ISU Messages

Messages from ISU #1 are to a second ISU (ISU #2) without leaving the Iridium network. [See Figure 4-1.] This option requires provisioning by the Value Added Reseller through SPNet. ISU #1 can be provisioned to send the same MO-SBD message to up to five ISUs. Note that only one delivery method is permitted: Either email or ISU-ISU, it is not possible to mix destination types.

ISU-ISU SBD messages are billed twice. Once as a MO-SBD message to the initiating ISU IMEI and once as a MT-SBD message to the terminating ISU IMEI.

The MO-SBD message from ISU #1 is placed into the MT-SBD queue of ISU #2 when it has been received by the GSS. The MO-SBD message is never delivered to the Vendor Application as no email address can be programmed for the Vendor Application. No SBD session descriptors are delivered to either the originating or terminating ISU. However if ISU #2 is provided to send MO-SBD messages to a VA, then the mailbox check or sending of a MO-SBD message will cause an email message indicating the mailbox check or the transmission of the MO-SBD message to the Vendor Application. There are five error conditions that can occur in ISU-ISU SBD messaging as shown in Table 4-1 below.

**Table 4-1: Mobile Originated Message Email Message Field Description**

| Error Condition   | Action  |
|---|---|
| Message size = 0 bytes  | MT-SBD message will not be queued and will be deleted                           |
| Message Size >270 bytes when ISU #2 is a 9601 SBD Transceiver | MT-SBD message will not be queued and will be deleted                           |
| Message size >1890 bytes when ISU #2 is a 9522 or 9522A LBT   | MT-SBD message will not be queued and will be deleted                           |
| Destination ISU MT queue > 50 messages                        | If the destination ISU MT queue is full the MT-SBD message will not be queued   |
| Destination ISU is not provisioned                            | If the destination ISU is not provisioned the MT-SBD message will not be queued |

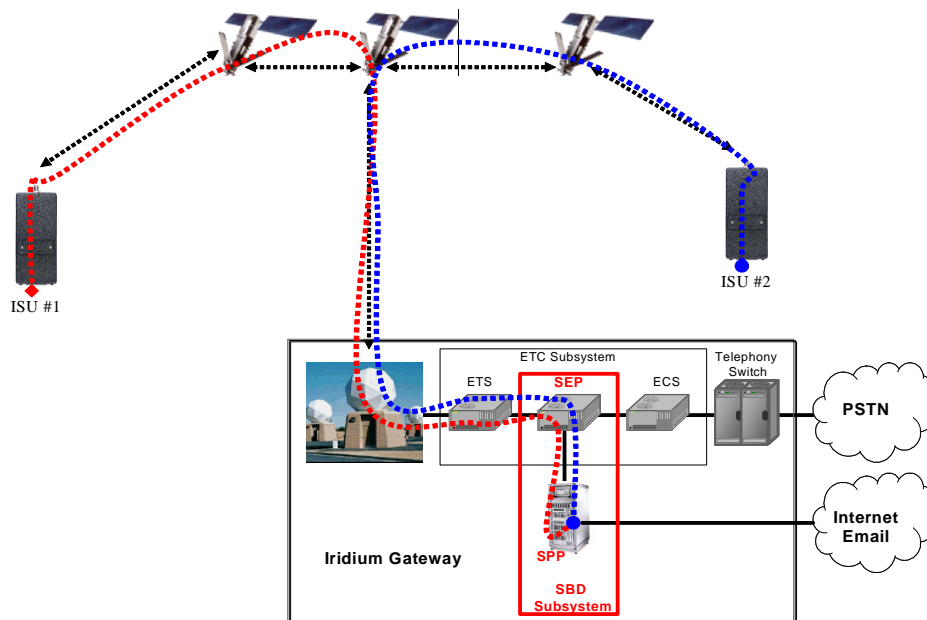


Figure 4-1 SBD Call Routing for ISU-ISU SBD Messages

## 5.0 Direct Internet Protocol Socket “DirectIP” GSS Interface

DirectIP is a socket-based delivery mechanism for Mobile Originated and Mobile Terminated SBD Messages. The name references the basic concept of directly connecting to a distant IP address for data delivery and reception. This section of the SBD Developers Guide is the DirectIP interface control document between the GSS and the Vendor Application(s). It does not provide details of the DirectIP processing within the GSS.

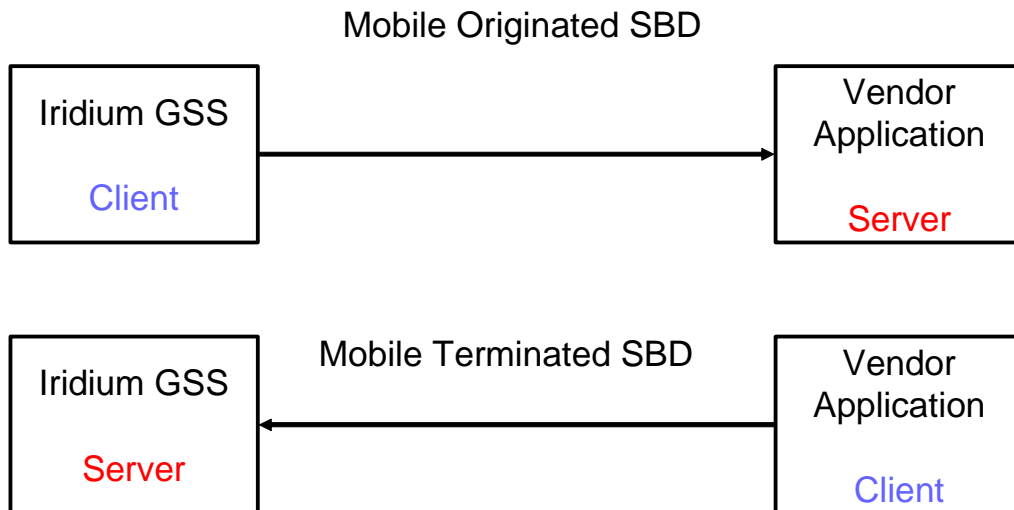
The Vendor Application interface to DirectIP requires software development by the applications developer. Iridium does not provide finished software, reference code, or applications software support for the Vendor Application. Applications developers will need to develop software to handle both Mobile Originated and Mobile Terminated DirectIP Connections.

### 5.1 DirectIP Concept of Operation

#### 5.1.1 DirectIP Overview

DirectIP is an efficient method of transferring SBD data between the Iridium Gateway and the Vendor Application. DirectIP provides lower delivery latency than the existing email protocol. It consists of a specialized socket-oriented communications protocol that utilizes direct connections between the Iridium gateway SBD subsystem (GSS) and the Vendor Application.

Similar to SBD processing of MO and MT e-mail messages, DirectIP is composed of separate MO and MT GSS components. The MO DirectIP component acts as a client to the Vendor MO DirectIP server application. The MT DirectIP component acts as a server to the vendor MT DirectIP clients. In other words, the GSS MO component seeks to establish a connection to the vendor server for MO transfers while the GSS MT component actively listens for connections from the vendor clients for MT transfers. In either direction, clients only attach to the server when they are delivering data.



Both MO DirectIP and MT DirectIP protocols utilize bi-directional TCP/IP socket connections. The MO DirectIP protocol only delivers SBD MO messages from the GSS client to the vendor server. No acknowledgement is expected from the server. In contrast, the MT DirectIP protocol delivers SBD MT



messages from the vendor client to the GSS server, and a confirmation is passed from the server back to the client indicating the success or failure of the processing of the message.

The specific TCP/IP ports and IP addresses for both MO and MT DirectIP are provided to authorized VARs in a separate document available from their Iridium account manager.

## 5.1.2 MO DirectIP Deliveries

Upon the completion of an SBD session between the IMEI and the GSS, the GSS opens a socket, connects to the Vendor Application, and delivers the MO message including SBD session descriptors. Messages to the same Vendor Application are delivered in a first-in-first-out (FIFO) manner so that they are delivered in the same sequence that they are received by the GSS. All other messages destined for the same Vendor Application are queued behind the first message while it is being delivered. Only one message is delivered per socket connection. Once a socket connection is established, a single MO message is delivered, and then the socket is closed. This sequence is repeated for every MO message queued for delivery to the vendor server.

### 5.1.2.1 Vendor Application Server Unavailable

If the initial attempt to connect to the Vendor Application times out, the subsequent MO message delivery will not take place and subsequent connection attempts will be made. The timeout values for the first, second and third connection attempts are 5, 15 and 45 seconds, respectively. After the third attempt, connection attempts continue to be made repeating the three timeout values for up to 12 hours. Each individual message has a lifetime of 12 hours starting at the time that the payload was received at the GSS. If it is not able to be delivered within this lifetime, it will be removed from the delivery queue.

Up to 1000 messages may be queued for a specific Vendor Application. If this limit is exceeded, payloads will be deleted from the front of the queue (the “oldest” payloads.)

## 5.1.3 MT DirectIP Deliveries

When an MT message is to be queued, the Vendor Application client opens a socket, connects to the GSS server, and delivers the MT message with disposition (see Section 5.1.4). The GSS server then parses the message, inserts the payload into the database, and sends a confirmation message back to the Vendor Application.

Once the GSS server has inserted the payload into the database, a different process within the GSS queues the payload for delivery and assigns an MTMSN to each. If the payload is the first in the queue, it is marked as “Pending” and is ready for immediate delivery. Otherwise, it is marked as “Queued”.

## 5.1.4 MT Disposition Flags

Additional features related to MT deliveries are available using MT DirectIP. These features will not be available through other means of queuing MT messages such as email. They are flagged using the MT disposition field in the MT header and are described in the following sections. The disposition field itself is a 2-byte bit map with 16 available flags. Those flags defined are shown in Table 5-14 MT Disposition Flags.

### 5.1.4.1 Flush MT Queue

When this flag is set, all payloads in the MT queue for the given IMEI are deleted. This provides an integrated method to administer MT queues.

When a payload is included in the MT message, it will be queued after the currently queued payloads, if any, have been deleted. This enables the Vendor Application to maintain a queue depth of one, overwriting any previous payload queued.

#### **5.1.4.2 Send SBD Ring Alert – No MT Payload**

When this flag is set, the GSS is directed to send a SBD Ring Alert to the specified IMEI within the bounds of normal SBD Ring Alert processing even though no new MT message is being queued. The bounds refer to the IMEI's SBD Ring Alert enable flag and SBD Network Registration (attach/detach) status. If SBD Ring Alerts are enabled for this IMEI, and it is attached (successful SBD Network Registration where location is known), a single SBD Ring Alert will be sent. [For normal MT SBD Ring Alerts two SBD Ring Alerts are sent.] If either of these conditions are not met, no SBD Ring Alert will be sent. If a SBD Ring Alert is sent, and an MT payload is already queued, that payload will be delivered when the IMEI retrieves the MT-SBD message. This flag has no alternate effect if a new MT payload is included, and the message will be processed normally. If a MT-SBD Message is included, the MT-SBD message delivery will fail with a protocol error. Note that excessive use of this feature could result in restrictions being implemented. This feature should not be used to compensate for poor Field Application design or situations where the IMEI may be frequently powered off. In such cases the Field Application should cause a Mailbox check to occur by executing a +SBDI command with an empty send buffer. See the Section 4.1 for more details.

## **5.2 MT and MO DirectIP Application Requirements**

### **5.2.1 MO DirectIP Server/Client Requirements**

#### **5.2.1.1 MO GSS Client Requirements**

- A. The client will seek to establish a TCP/IP socket connection to the IP address and port provisioned for the originating IMEI.
- B. Once connected, the client will transmit the MO payload and close the socket connection.
- C. If no connection is established, the client will implement the retry scheme outlined in Section 5.1.2.1.
- D. Once the message has been transmitted, the client will close the socket connection. No acknowledgement from the server will be expected.

#### **5.2.1.2 MO Vendor Server Requirements**

- A. The server will listen for TCP/IP socket connections on a specific port
- B. Once connected, the server will receive the entire MO message before parsing.
- C. The server will allow the GSS client to close the socket connection.

### **5.2.2 MT DirectIP Server/Client Requirements**

#### **5.2.2.1 MT GSS Server Requirements**

- A. The server will listen for TCP/IP socket connections on a specific port.
- B. Once connected, the server will receive the entire MT message before parsing.
- C. The server will validate the message to ensure it meets the following criteria:
  - I. IMEI is of a valid format and is provisioned

- II. All other input values in the MT header are valid
- III. Payload length does not exceed the specified maximum (See Section 1.6)
- IV. GSS resources are available (the given IMEIs MT queue, overall number of active MT users)
- D. The server will send a confirmation message indicating the success or failure of processing the message.
- E. The server will terminate the socket connection once the confirmation message is sent.
- F. If the connection fails at any point prior to sending the confirmation message, the MT message will be dropped.

#### **5.2.2.2 MT Vendor Client Requirements**

- A. The client will seek to establish a TCP/IP socket connection to the IP address of the GSS MT DirectIP server on a specified port.
- B. Once connected, the client will transmit the MT payload and wait for the confirmation message.
- C. Once the confirmation message has been transmitted / received, the client will allow the server to close the socket connection.

## 5.3 MO and MT Message Specifications

### 5.3.1 Overall Message Structure

The overall message structure for both MO and MT DirectIP is shown in Table 5-1. When a connection is first established, the receiving application will receive three bytes. The first is a general DirectIP protocol revision number (this document describes revision 1). The following two bytes indicate the number of bytes that make up the body of the message that is made up of some number of information elements.

**Table 5-1 Overall Message Format**

| Field Name                              | Data Type      | Length (bytes) | Range of Values |
|---|----------------|----------------|-----------------|
| Protocol Revision Number                | char           | 1              | 1               |
| Overall Message Length                  | unsigned short | 2              | N               |
| Information Elements Related to Message | variable       | N              | See Section 5.4 |

#### 5.3.1.1 Message Length

The message length value indicates the number of bytes that make up the body of the message being transferred following the initial three bytes. This enables the receiving end to know deterministically when all bytes transferred have been received. This is particularly relevant when multiple receives over the socket are required to read in the entire message.

#### 5.3.1.2 Byte Alignment

The entire message transfer will be treated as a byte stream. This enables the various data types contained within the message to be transferred with no consideration given to the byte alignment of the data types. This also allows for the compacting of the fields to the appropriate sizes. Multi-byte fields are transmitted in network byte order (big endian). For example the four-byte field 0x0a0b0c0d is transmitted as follows:

|              |          |          |          |          |       |
|--------------|----------|----------|----------|----------|-------|
| byte address | 0        | 1        | 2        | 3        | _____ |
| bit offset   | 01234567 | 01234567 | 01234567 | 01234567 |       |
| binary       | 00001010 | 00001011 | 00001100 | 00001101 |       |
| hex          | 0a       | 0b       | 0c       | 0d       | _____ |

### 5.3.2 Information Elements

To maintain maximum flexibility within the protocol, all data to be transferred has been segmented into information elements (IEs). Those IEs currently defined are shown in detail in Section 5.4. The general format of each IE is the same and is shown in Table 5-2.

**Table 5-2 Information Element General Format**

| Field Name                   | Data Type      | Length (bytes) | Range of Values                            |
|------------------------------|----------------|----------------|--|
| Information Element ID (IEI) | char           | 1              | See Table 5-7                              |
| Information Element Length   | unsigned short | 2              | Variable                                   |
| Information Element Contents | variable       | N              | Section Information Element Specifications |

### 5.3.2.1 Information Element Identifiers

Each IE begins with a 1-byte information element identifier (IEI) that uniquely defines the following 2+N bytes. A complete list of the IEs and their associated IEIs is shown in Table 5-7.

### 5.3.2.2 Information Element Length

The two bytes following the IEI give the length of the IE in bytes following the initial three bytes. While the length for all currently defined IEs other than the MO and MT payloads may be represented with a 1-byte field, a 2-byte field is used for consistency across all IEs.

The primary goal for including the length field in every IE as a standard is to allow for new IEs in the future that may or may not be recognized by a Vendor Application based the vendor's upgrade path. If the application does not recognize an IE, it will know that it can read the next two bytes as a length and then skip that number of bytes before checking for the next IEI.

### 5.3.2.3 Parsing Information Elements

Once an entire message has been received, a parser will step through the bytes. The first will be an IEI followed by two bytes representing the number of bytes in the IE following the length. How to interpret these bytes is dictated by the IE type as indicated by the IEI. Once they are parsed, and if there are additional bytes received in the overall message, the next IEI may be checked, etc. If there are too many or too few bytes received as determined by the parser, the overall message will be dropped. For MT message processing, an error will be returned in the confirmation message.

## 5.3.3 Successful MO Message Delivery Example

Table 5-3 gives an example of a byte stream for a typical MO DirectIP message following a successful SBD session. Note that the IMEI has been provisioned such that the geo-location information is not included in the message.

**Table 5-3 MO DirectIP Message Delivery Example – Successful SBD Session**

| Field Name               | Data Type        | Length (bytes) | Value                          |
|--------------------------|------------------|----------------|--------------------------------|
| Protocol Revision Number | char             | 1              | 1                              |
| Overall Message Length   | unsigned short   | 2              | 104                            |
| MO Header IEI            | char             | 1              | 0x01                           |
| MO Header Length         | unsigned short   | 2              | 28                             |
| CDR Reference (Auto ID)  | unsigned integer | 4              | 1234567                        |
| IMEI                     | char             | 15             | 300034010123450                |
| Session Status           | unsigned char    | 1              | 0 (Transfer OK)                |
| MOMSN                    | unsigned short   | 2              | 54321                          |
| MTMSN                    | unsigned short   | 2              | 12345                          |
| Time of Session          | unsigned integer | 4              | 1135950305 (12/30/05 13:45:05) |
| MO Payload IEI           | char             | 1              | 0x02                           |
| MO Payload Length        | unsigned short   | 2              | 70                             |
| MO Payload               | char             | 70             | Payload Bytes                  |

### 5.3.4 Failed MO Message Delivery Example

Table 5-4 gives an example of a byte stream for an MO DirectIP message following a failed SBD session due to an incomplete transfer. Note that no payload is included.

**Table 5-4 MO DirectIP Message Delivery Example – Failed SBD Session**

| Field Name               | Data Type        | Length (bytes) | Value                          |
|--------------------------|------------------|----------------|--------------------------------|
| Protocol Revision Number | char             | 1              | 1                              |
| Overall Message Length   | unsigned short   | 2              | 31                             |
| MO Header IEI            | char             | 1              | 0x01                           |
| MO Header Length         | unsigned short   | 2              | 28                             |
| CDR Reference (Auto ID)  | unsigned integer | 4              | 1301567                        |
| IMEI                     | char             | 15             | 300034010123450                |
| Session Status           | unsigned char    | 1              | 13 (Incomplete Transfer)       |
| MOMSN                    | unsigned short   | 2              | 54322                          |
| MTMSN                    | unsigned short   | 2              | 0                              |
| Time of Session          | unsigned integer | 4              | 1135950325 (12/30/05 13:45:25) |

### 5.3.5 MT Message Delivery Example

Table 5-5 gives an example of a byte stream for a typical MT DirectIP message delivery.

**Table 5-5 MT DirectIP Message Delivery Example**

| Field Name               | Data Type      | Length (bytes) | Value           |
|--------------------------|----------------|----------------|-----------------|
| Protocol Revision Number | char           | 1              | 1               |
| Overall Message Length   | unsigned short | 2              | 97              |
| MT Header IEI            | char           | 1              | 0x41            |
| MT Header Length         | unsigned short | 2              | 21              |
| Unique Client Message ID | char           | 4              | "Msg1"          |
| IMEI (User ID)           | char           | 15             | 300034010123450 |
| MT Disposition Flags     | unsigned short | 2              | 0x0000          |
| MT Payload IEI           | char           | 1              | 0x42            |
| MT Payload Length        | unsigned short | 2              | 70              |
| MT Payload               | char           | 70             | Payload Bytes   |

Table 5-6 shows one potential confirmation response. This example assumes that the given IMEI already had 49 MT message queued (max of 50).

**Table 5-6 MT DirectIP Message Confirmation Example.**

| Field Name                            | Data Type        | Length (bytes) | Value           |
|---------------------------------------|------------------|----------------|-----------------|
| Protocol Revision Number              | char             | 1              | 1               |
| Overall Message Length                | unsigned short   | 2              | 28              |
| MT Confirmation Header Message IEI    | char             | 1              | 0x44            |
| MT Confirmation Header Message Length | unsigned short   | 2              | 25              |
| Unique Client Message ID              | integer          | 4              | "Msg1"          |
| IMEI (User ID)                        | char             | 15             | 300034010123450 |
| Auto ID Reference                     | unsigned integer | 4              | 58473           |
| MT Message Status                     | short            | 2              | 50              |

## 5.4 Information Element Specifications

### 5.4.1 Information Element Identifiers

Table 5-7 summarizes the IEIs for the information elements passed within the DirectIP protocol.

**Table 5-7 Information Elements**

| Information Element         | IEI Value | Described In                          |
|-----------------------------|-----------|---------------------------------------|
| MO Header IEI               | 0x01      | Table 5-8 MO DirectIP Header IE       |
| MO Payload IEI              | 0x02      | Table 5-10 MO Payload IE              |
| MO Location Information IEI | 0x03      | Table 5-11 MO Location Information IE |
| MT Header IEI               | 0x41      | Table 5-13 MT Header IE               |
| MT Payload IEI              | 0x42      | Table 5-15 MT Payload IE              |
| MT Confirmation Message IEI | 0x44      | Table 5-16 MT Confirmation Message IE |

## 5.4.2 MO DirectIP Header

The information in this header is required as part of every DirectIP MO message delivery. It includes all of the information necessary to uniquely identify the SBD MO message. It also includes the overall SBD session status and identifier (MTMSN) for the associated MT message delivery, if any.

**Table 5-8 MO DirectIP Header IE**

| Field Name              | Data Type        | Length (bytes) | Range of Values          |
|-------------------------|------------------|----------------|--------------------------|
| MO Header IEI           | char             | 1              | See Table 5-7            |
| MO Header Length        | unsigned short   | 2              | 28                       |
| CDR Reference (Auto ID) | unsigned integer | 4              | 0 - 4294967295           |
| IMEI                    | char             | 15             | ASCII Numeric Characters |
| Session Status          | unsigned char    | 1              | See Table 5-9            |
| MOMSN                   | unsigned short   | 2              | 1 – 65535                |
| MTMSN                   | unsigned short   | 2              | 0 – 65535                |
| Time of Session         | unsigned integer | 4              | Epoch Time               |

### 5.4.2.1 MO Header Length

This field specifies the number of bytes in the IE following this byte. Even though the length is fixed, the field is included as a standard across all IEs and to allow for maximum flexibility for future enhancements.

### 5.4.2.2 CDR Reference

Each call data record (CDR) maintained in the GSS Database is given a unique value independent of all other information in order to absolutely guarantee that each CDR is able to be differentiated from all others. This reference number, also called the auto ID, is included should the need for such differentiation and reference arise.

### 5.4.2.3 IMEI

The IMEI is the equipment identifier, unique to each Iridium field device, of the IMEI originating the MO message. It is a 15-digit number represented here in ASCII format.

### 5.4.2.4 Session Status

This field provides an indication of success of the SBD session between the IMEI and the GSS associated with the over-the-air payload delivery. The possible values are shown in Table 5-9. If the status was unsuccessful, no payload will be included in the MO message.

Table 5-9 SBD Session Status Values

| Value | Description  |
|-------|--|
| 0     | The SBD session completed successfully.  |
| 1     | The MO message transfer, if any, was successful. The MT message queued at the GSS is too large to be transferred within a single SBD session.  |
| 2     | The MO message transfer, if any, was successful. The reported location was determined to be of unacceptable quality. This value is only applicable to IMEIs using SBD protocol revision 1. |
| 10    | The SBD session timed out before session completion.   |
| 12    | The MO message being transferred by the IMEI is too large to be transferred within a single SBD session.   |
| 13    | An RF link loss occurred during the SBD session.   |
| 14    | An IMEI protocol anomaly occurred during SBD session.  |
| 15    | The IMEI is prohibited from accessing the GSS.   |



#### **5.4.2.5 MOMSN**

This is the mobile-originated message sequence number (MOMSN) associated with the SBD session. This value is set by the IMEI and transmitted to the GSS as part of every SBD session. It is incremented by the IMEI after every successful session.

#### **5.4.2.6 MTMSN**

This is the mobile-terminated message sequence number (MTMSN) associated with the SBD session. This value is set by the GSS at the time that an MT message is queued for delivery and is unique to each IMEI. It is then sent to the IMEI as part of the MT payload transfer. If an MT payload transfer was attempted, the MTMSN will be included in the header regardless of the success of the session. If the session failed, the payload is still queued for delivery. If no MT delivery attempt was made in the session, this value will be zero.

#### **5.4.2.7 Time of Session**

This field provides a UTC timestamp of the IMEI session between the IMEI and the GSS in the format of an epoch time integer. The epoch time is the number of seconds since the start of the epoch at 1/1/1970 00:00:00. This epoch is unrelated to the Iridium network time epoch.

Format: epoch time integer

Resolution: 1 second

### **5.4.3 MO Payload**

This information element includes the actual MO payload delivered from the IMEI to the GSS during the SBD session identified in the header. In an MO message delivery related to an empty mailbox check (EMBC) session or a failed session, no payload will be included.

**Table 5-10 MO Payload IE**

| Field Name        | Data Type      | Length (bytes) | Range of Values |
|-------------------|----------------|----------------|-----------------|
| MO Payload IEI    | char           | 1              | See Table 5-7   |
| MO Payload Length | unsigned short | 2              | 1 – 1960        |
| MO Payload        | char           | 1 – 1960       | Payload Bytes   |

#### **5.4.3.1 MO Payload Length**

This field indicates the number of the bytes in the MO payload.

#### **5.4.3.2 MO Payload**

This is the actual content of the MO payload. The maximum MO payload size is transceiver specific. See Section 1.6 for further information

### **5.4.4 MO Location Information**

The location values included in this IE provide an estimate of the originating IMEI's location. The inclusion of this information in an MO message delivery is optional. Whether or not it is included is established when the IMEI is provisioned and may be changed at any time via SPNet. The CEP radius provides the radius around the center point within which the unit is located. While the resolution of the reported position is given to 1/1000<sup>th</sup> of a minute, it is only accurate to within 10Km 80% of the time.

**Table 5-11 MO Location Information IE**

| Field Name                  | Data Type        | Length (bytes) | Range of Values |
|-----------------------------|------------------|----------------|-----------------|
| MO Location Information IEI | char             | 1              | See Table 5-7   |
| MO Location Info Length     | unsigned short   | 2              | 20              |
| Latitude / Longitude        | double           | 7              | See Table 5-12  |
| CEP Radius                  | unsigned integer | 4              | 1 – 2000        |

**5.4.4.1 MO Location Information Length**

This field specifies the number of bytes in the IE following this byte. Even though the length is fixed, the field is included as a standard across all IEs and to allow for maximum flexibility for future enhancements.

**5.4.4.2 MO Latitude and Longitude**

The latitude and longitude provide a center point of the estimated location and are derived from the LGC coordinates output from the CPLD exchange during the SBD session.

**Table 5-12 MO Location Data Format**

| Location Data Format                         |   |              |             |   |     |     |   | Byte Number | Description & Allowed Values  |
|--|---|--------------|-------------|---|-----|-----|---|-------------|---|
| MSB  |   | Bit Position |             |   |     | LSB |   |             |   |
| 0  | 1 | 2            | 3           | 4 | 5   | 6   | 7 |             |   |
| Reserved                                     |   |              | Format Code |   | NSI | EWI |   | 1           | Reserved & Format Code: 0 (all other values are reserved)<br>NSI: North/South Indicator (0=North, 1=South)<br>EWI: East/West Indicator (0=East, 1=West) |
| Latitude (degrees)                           |   |              |             |   |     |     |   | 2           | Decimal Range: 0 to 90<br>Hex Range: 0x00 to 0x5A   |
| Latitude (thousandths of a minute, MS-Byte)  |   |              |             |   |     |     |   | 3           | Decimal Range: 0 to 59,999 (unsigned integer, American notation)<br>Hex Range: 0x0000 to 0xEA5F   |
| Latitude (thousandths of a minute, LS-Byte)  |   |              |             |   |     |     |   | 4           |   |
| Longitude (degrees)                          |   |              |             |   |     |     |   | 5           | Decimal Range: 0 to 180<br>Hex Range: 0x00 to 0xB4  |
| Longitude (thousandths of a minute, MS-Byte) |   |              |             |   |     |     |   | 6           | Decimal Range: 0 to 59,999 (unsigned integer, American notation)<br>Hex Range: 0x0000 to 0xEA5F   |
| Longitude (thousandths of a minute, LS-Byte) |   |              |             |   |     |     |   | 7           |   |

Resolution: thousandths of a degree

**5.4.4.3 CEP Radius**

The CEP radius provides the radius (in Kilometers) around the center point within which the IMEI is located with a 80% probability of accuracy.

## 5.4.5 MT DirectIP Header

The information in this header is required as part of every DirectIP MT message delivery.

### 5.4.5.1 MT Header Length

This field specifies the number of bytes in the IE following this byte. Even though the length is fixed, the field is included as a standard across all IEs and to allow for maximum flexibility for future enhancements.

**Table 5-13 MT Header IE**

| Field Name               | Data Type      | Length (bytes) | Range of Values                              |
|--------------------------|----------------|----------------|--|
| MT Header IEI            | char           | 1              | See Table 5-7                                |
| MT Header Length         | unsigned short | 2              | 21   |
| Unique Client Message ID | char           | 4              | From client (not MTMSN)                      |
| IMEI (User ID)           | char           | 15             | ASCII Numeric Characters                     |
| MT Disposition Flags     | unsigned short | 2              | Bit Map: See Table 5-14 MT Disposition Flags |

### 5.4.5.2 Unique Client Message ID

The vendor client will include a 4-byte message ID unique within its own application. This value is not used in any way by the GSS server except to include it in the confirmation message sent back to the client. This is intended to serve as a form of validation and reference for the client application. The data type is specified to be characters. However, from the client's perspective, the four bytes may be a character string, an integer, etc.

### 5.4.5.3 IMEI

The IMEI is the equipment identifier, unique to each Iridium field device, of the MT message destination IMEI. It is a 15-digit number represented here in ASCII format.

### 5.4.5.4 MT Disposition Flags

These flags are set by the vendor client to trigger particular actions by the GSS. Combinations of flags are allowed. The field is a 2-byte bit map with 16 available flags. Those defined are shown in Table 5-14.

**Table 5-14 MT Disposition Flags**

| Disposition Flag         | Value  | Description   |
|--------------------------|--------|---|
| Flush MT Queue           | 0x0001 | Delete all MT payloads in the IMEI's MT queue                                 |
| Send Ring Alert – Mo MTM | 0x0002 | Send ring alert with no associated MT payload (normal ring alert rules apply) |

## 5.4.6 MT Payload

This information element includes the actual MT payload to be queued and delivered over the air to the destination IMEI. This inclusion of this IE in the MT delivery is optional based on the disposition flags included in the header.

**Table 5-15 MT Payload IE**

| Field Name        | Data Type      | Length (bytes) | Range of Values |
|-------------------|----------------|----------------|-----------------|
| MT Payload IEI    | char           | 1              | See Table 5-7   |
| MT Payload Length | unsigned short | 2              | 1 – 1890        |
| MT Payload        | char           | 1 – 1890       | Payload Bytes   |

**5.4.6.1 MT Payload Length**

This field indicates the number of the bytes in the MT payload.

**5.4.6.2 MT Payload**

This is the actual content of the MT payload. The MT payload size is transceiver dependent. See Section 1.6 for details.

**5.4.7 MT Message Confirmation Message**

A confirmation message indicating the status of the processing of the MT message is sent to the vendor client from the GSS for every MT message received.

**Table 5-16 MT Confirmation Message IE**

| Field Name                  | Data Type        | Length (bytes) | Range of Values  |
|-----------------------------|------------------|----------------|--|
| MT Confirmation Message IEI | char             | 1              | See Table 5-7  |
| MT Confirmation Msg Length  | unsigned short   | 2              | 25   |
| Unique Client Message ID    | integer          | 4              | From Client (not MTMSN)  |
| IMEI (User ID)              | char             | 15             | ASCII Numeric Characters   |
| Auto ID Reference           | unsigned integer | 4              | 0 – 4294967295   |
| MT Message Status           | short            | 2              | Order of message in IMEI's queue or error reference (see Table 5-17 MT Message Status) |

**5.4.7.1 MT Confirmation Message Length**

This field specifies the number of bytes in the IE following this byte. Even though the length is fixed, the field is included as a standard across all IEs and to allow for maximum flexibility for future enhancements.

**5.4.7.2 Unique Client Message ID**

This field is the unique client IE sent in the MT header in the message sent to the GSS. This is intended to serve as a form of validation and reference for the client application.

**5.4.7.3 IMEI**

The IMEI is the equipment identifier, unique to each Iridium field device, of the MT message destination IMEI. It is a 15-digit number represented here in ASCII format.

**5.4.7.4 Auto ID Reference**

This value provides a unique reference for identifying the MT payload within the SBD database. It is assigned at the time that the payload is inserted into the database as a new record, but prior to the record being queued for delivery and the MTMSN is assigned. This reference is passed instead of the MTMSN in

order for the GSS server to remain independent of all other GSS processes and to allow the socket connection to be closed as soon as possible. This value will be zero when there is an error in processing the message.

**5.4.7.5 MT Message Status**

This field is the status value that is returned with every confirmation indicating that the overall MT message was received and validated and that the payload was queued successfully or that a failure occurred. If successful, the value is a positive number indicating the order of the received payload in the IMEI's associated MT message queue. If not successful, the value will be a negative number serving as an error code specifying the problem detected. Table 5-17 MT Message Status shows the possible status values including the error codes. Note that the last two error values (-8 and -9) only apply when the "Send Ring Alert" disposition flag has been set.

**Table 5-17 MT Message Status**

| Status | Description   |
|--------|---|
| 1 – 50 | Successful, order of message in the MT message queue            |
| 0      | Successful, no payload in message                               |
| -1     | Invalid IMEI – too few characters, non-numeric characters       |
| -2     | Unknown IMEI – not provisioned on the GSS                       |
| -3     | Payload size exceeded maximum allowed<br>(See Section 1.6)      |
| -4     | Payload expected, but none received                             |
| -5     | MT message queue full (max of 50)                               |
| -6     | MT resources unavailable  |
| -7     | Violation of MT DirectIP protocol error                         |
| -8     | Ring alerts to the given IMEI are disabled                      |
| -9     | The given IMEI is not attached (not set to receive ring alerts) |

## 6.0 Practical Considerations and Requirements for SBD Applications Design and Solution Certification.

### 6.1 Optimal Message Size Selection

There are two primary factors that affect optimal message size: Economic and technical.

#### 6.1.1 Economic Message Size

The developer should take into account the specific price plan elements when developing the algorithms that are used in both the Field and Host Applications. The developer should take into account the minimum billable message size of the service plan that the ISU is activated with on the Iridium network. E.g. For a minimum billable message size of 30 bytes, any message actually sent with less than 30 bytes will be billed at 30 bytes regardless of the actual number of bytes sent below 30. Note that this is a minimum and not an increment. E.g. for a minimum billable message size of 30 bytes all messages over 30 bytes will be billed at the exact number of bytes transmitted. The developer should maximize the use of these bytes, and can do so in a number of ways. E.g. the business requirement is to report position every ten minutes. The position information in this case is fifteen bytes. The developer could therefore collect an intermediate position every five minutes and transmit both positions at the required ten-minute intervals to provide more detailed positioning information.

**Note that irrespective of what is written in this document, the developer is responsible for verifying the contracted price plan and optimizing the algorithms used by the Field Application and the Host Application to communicate with the Field Application.**

#### 6.1.2 Technical Message Size

Each type of message whether MO or MT is broken into segments for actual transmission. The length of the segment relative to the absolute message length depends on whether it is a MO or MT message. Between each segment additional signaling and network overhead occurs. If optimizing for minimal latency or power consumption then the minimal number of message segments should be used.

Important: See Section 1.6 for message size limits that are dependent on the transceiver type.

##### 6.1.2.1 Mobile Originated Message Size

|                                   |           |
|-----------------------------------|-----------|
| First user data segment size      | 70 bytes  |
| Subsequent user data segment size | 135 bytes |

E.g. for a 1960 byte message there will be one segment of 70 bytes and 14 segments of 135 bytes  
E.g. for a 71 byte message there will be one segment of 70 bytes and one segment of 1 byte.

##### 6.1.2.2 Mobile Terminated Message Size

|                        |           |
|------------------------|-----------|
| User data segment size | 135 bytes |
|------------------------|-----------|

E.g. for a 1890 byte message there will be 14 segments of 135 bytes  
E.g. for a 71 byte message there will be one segment used.

## 6.2 Practical Requirements and Considerations for SBD Applications Design

The Iridium network, while providing many unique capabilities, also shares some common limitations with other wireless networks. This section provides required recommendations for in both Field and Host Applications that will assist in improving the performance of Field Applications deployed on the network. This section provides recommendations for a variety of application usage scenarios. If you have a scenario not covered then please discuss it with Iridium's field sales support engineers.

### 6.2.1 Field Applications with scheduled reporting times

**The purpose of this section is to state the requirement that SBD applications cannot be deployed where transmissions times of the units occur at the same instant in time. Applications that do this will fail Iridium Solution Certification and the defect will be required to be corrected before deployment can commence. Field Applications that cause a transmission to occur based upon a schedule are required to ensure that each individual unit transmits at a randomized time around the required schedule time.**

Every network, whether wireless, wired or satellite has a finite maximum instantaneous capacity. The key word in the prior sentence is 'instantaneous'. If a network has instantaneous capacity for M calls and N is the number of units on the network then it can readily be seen that when  $N > M$  that congestion will occur if all N units are scheduled to make a call at the same instant in time. At the other end of the spectrum if calls are scheduled to be equally distributed across time, then N would have to be significantly larger than M before congestion would occur. These two scenarios illustrate the boundaries of network utilization. In the real world, usage patterns normally lie somewhere in between and not at the extremes.

Many Field Applications (FA) report or transmit information according to a schedule. The schedule is often referenced to a clock trigger which may be derived from a Global Positioning System (GPS), on-board real time clock, Iridium Time or other source. The business requirement is often that specific information (e.g. the quantity of gas that flowed within the last time period) be determined at a specific point in time, in order for business decisions and processes to be extended to assets in the field. For example, the FA records the gas flow in 1-minute intervals and the business requirement is that every hour the last 60 minutes of data points are transferred to the Host Application for processing.

Commonly used schedules for reporting information are every 5, 10, 15, 30 and 60 minutes. It is also common to reference these schedules to Universal Coordinated Time (UTC) with an appropriate offset for location relative to the UTC origin. I.e. everywhere in the world it is 5 minutes past the hour at exactly the same time instant, although the local hour is different depending where you are located.

To continue with the example of the gas well, if the FA is synchronized to UTC and all the deployed units around the world attempt to transmit every 60 minutes, then it can readily be seen that at some point the instantaneous network capacity will be reached and congestion will occur. Now expanding this to all applications that report in every hour as well as those ones at 5,10,12, 15 and 30 minute intervals which would all occur at the 60 minute time mark, it is readily seen how attempting to transmit data on a scheduled basis synchronized to a clock reference will eventually cause network congestion.

There are a number of strategies for dealing with scheduled events:

- (a) The requirement to collect the data for an hour and the requirement to transmit every hour can be decoupled and the developer can still meet the business requirements, by transmitting at the hour plus a randomly generated offset.

- (b) The data can be collected for “non-standard” intervals e.g. 7 minutes and 30 seconds and once received by the Host Application, the data is inserted into the database in a manner that permits the whole hour’s data to appear as if it were collected every minute and transmitted every minute.

Ultimately, whatever the data collected is, **the fundamental requirement is that it is always transmitted on a random basis and that random basis is different for each FA.** The requirement for the random basis being different across every FA is critical because otherwise the transmit time of each FA still remains synchronized to a clock reference.

From the traffic modeling described at the beginning of this section as the applications developer it should be apparent that the larger the window that you select to actually transmit the required information over, the smaller the probability is that the FA will experience network congestion. E.g. FA collects information for the last hour, and then schedules to transmit that information using a randomizing algorithm that will pick a time within the next 10 minutes past the hour is more likely to be successful than an algorithm that tries to transmit within the first 20 seconds after the hour.

**To summarize:** In order to pass Iridium Solution Certification a FA must not cause all transceivers deployed in the field to transmit on the same instant when there are scheduled events within the FA programming. The FA must be programmed such that each transceiver deployed with the FA transmits on a random basis. Sources for ‘seeds’ for random number generation include the IMEI of the transceiver, GPS information, Iridium time

## 6.2.2 Field Application Response to Network Events

Good Field Applications (FA) design should take into account how to handle potential future network events. From the FA’s perspective a network event could be as simple as being temporarily located where the antenna does not have a clear view of the sky and is unable to “see” the satellite, or, in a rare circumstances, it could be more significant in terms of the short duration when a non-operational satellite passes overhead and is closely followed by an operational one.

Iridium recommends that FA’s keep track of the success/failure to transmit messages (+SBDI[X][A]) and the signal quality indicator (+CSQ). Keeping track of the last five transmissions and associated signal quality will provide useful information to the FA that can be incorporated into a transmit retry algorithm. A typical algorithm is illustrated below and is effective for a wide range of possible network events:

1. *If signal strength before transmission is >1 and message transmission has failed 1 time then wait 15 seconds before attempting to re-transmit.*
2. *If signal strength before each transmission is >1 and message transmission has failed 2 times then wait 30 seconds before attempting to re-transmit.*
3. *If signal strength before each transmission is >1 and message transmission has failed 3 times then wait 60 seconds before attempting to re-transmit.*
4. *If signal strength before each transmission is >1 and message transmission has failed 4 times then wait 180 seconds before attempting to re-transmit.*
5. *If signal strength before each transmission is >1 and message transmission has failed 5 times then wait 500 seconds before attempting to re-transmit.*
6. *If signal strength before each transmission is >1 and message transmission has failed 6 or more times then wait 1 hour before attempting to re-transmit.*



## 7.0 Iridium Short Burst Data Service Security Features

### 7.1 Purpose

The purpose of this section is to provide information sufficient for an Iridium Value Added Reseller to be able to understand the basic security features of Iridium's Short Burst Data Service. It is assumed that the reader is familiar with the Iridium system and Short Burst Data.

### 7.2 Iridium Security Features

The Iridium System supports the GSM-specified algorithm A3 for authentication security, but not algorithms A5/A8 for channel encryption. Table 7-1 summarizes the security features explicitly designed into the Iridium system. Note that A3 is only used in transceivers using a SIM card.

**Table 7-1: Baseline Iridium Security Features**

|   |                                    |
|---|------------------------------------|
| Authentication                            | A3 (128-bit Key)                   |
| Equipment Anti-Theft Validation           | Global Equipment Identity Register |
| Anonymity (User location confidentiality) | TMSI based                         |
| Signaling Message Confidentiality         | Not Available                      |

#### 7.2.1 Authentication Security

Note that Authentication Security is only applicable to Iridium Subscriber Units (ISUs) that utilize a SIM card. The 9601 SBD Transceiver does not utilize a SIM card and thus this section is not applicable to it. The Iridium authentication process is adapted without change directly from the GSM specifications. The GSM algorithm A3 is used to encrypt authentication information transmitted over the air interface.

- Authentication encryption
  - Designed to prevent ISU cloning fraud
  - GSM encryption algorithm A3 is executed on SIM card to generate Signed Result (SRES) response based on the following inputs
- Secret Ki parameter stored in SIM card
- RAND parameter supplied by network

## 7.2.2 Iridium Channel Security

SBD uses the signaling channel and is afforded some security by the limited distribution of the air interface and feeder link interface specifications. The Iridium Air Interface Specification is made available only to Iridium Subscriber Unit (ISU) manufacturers. Feeder link interface specifications are not distributed outside of the original manufacturer.

Figure 7-1 identifies the opportunities for surreptitious monitoring of Iridium bearer channels. An eavesdropper could, in principle, monitor L-band uplink and downlink channels, or K-band uplink and downlink feeder link channels.

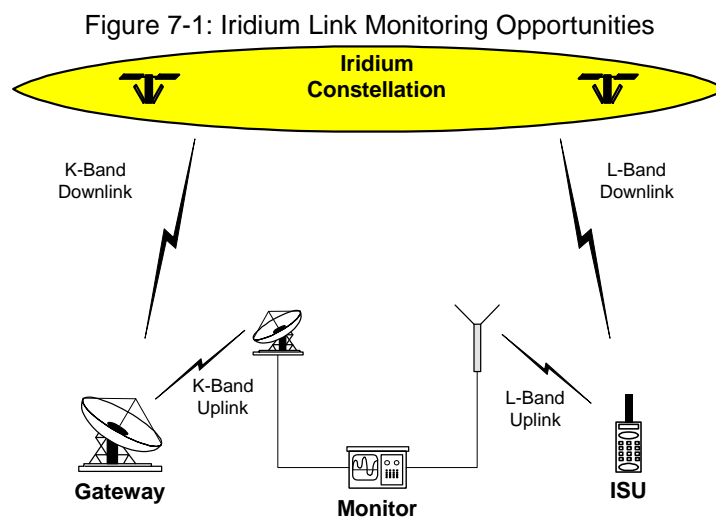
- L-Band Channels
  - Uplink, from ISU to Space Vehicle (SV)
  - Downlink, from SV to ISU
- K-Band Channels
  - Uplink, from gateway to Space Vehicle (SV)
  - Downlink, from SV to gateway

### 7.2.2.1 L-Band Channel Security

To successfully monitor an L-band channel, an eavesdropper must be located within the transmit range of the ISU being monitored, approximately 10 to 30 km from the transmitting ISU. ISU downlink L-Band transmissions could be received over a much wider area. A single SV beam covers an area of about 400 km in diameter. As long as the eavesdropper is within the coverage area of a common beam, downlink L-Band transmissions could be received.

Fortunately, the complexity of the Iridium air interface should make the challenge of developing an Iridium L-Band monitoring device very difficult and probably beyond the reach of all but the most determined adversaries. Among the complications are:

- Large, continually changing Doppler shifts
- Frequent inter-beam and inter-SV handoffs
- Time-division multiplexed burst mode channels
- Complicated modulation, interleaving and coding



### **7.2.2.2 K-Band Channel Security**

To successfully monitor a K-band feeder link channel, a fairly sophisticated monitoring device must be located in the general proximity of an Iridium gateway. The receiver must have a high-gain antenna capable of tracking SVs as they move from horizon to horizon.

Again, the complexity of the feeder link interface poses a formidable technical challenge for prospective eavesdroppers. The cost of the monitoring device alone would be a strong deterrent. Among the technical complications are

- Large, continually changing Doppler shifts
- High capacity, 3.072 Mbps channels
- High-gain tracking antenna required
- Must reacquire new SV every 10 minutes

## **7.2.3 Gateway to Vendor Application**

While this document focuses on the Iridium network, security should be looked at from an end-to-end solution perspective. SBD communications to and from the Iridium Gateway can be protected by two additional cost items:

- (A) Virtual Private Network and/or
- (B) Private leased line communication

## **7.2.4 Additional Considerations**

Depending on the level and sensitivity of the information being communicated the application developer may require additional security. Any additional security measure would require encrypting the information before transmitting to the destination point. This is referred to generically as application level encryption and requires the developer to select and implement an encryption method that provides the required level of security for the application. Any increase in the size of the actual information being sent due to the encryption is not distinguished by the Iridium network from normal user data and the Iridium network will rate the total size of the data message sent.

## 8.0 Basic Trouble Shooting

### 8.1 Hardware Requirements

Table 7-1 lists the available hardware that supports SBD. Firmware versions can be determined by issuing AT+CGMR to the transceiver.

**Table 7-1 Hardware Minimum Firmware Revision for SBD Service Compatibility**

| L-Band Transceiver Product Number | Transceiver "Code Name" | Minimum Firmware revision (see note) | Requires Valid SIM Card? |
|-----------------------------------|-------------------------|--------------------------------------|--------------------------|
| 9522                              | Sebring                 | SAC03xx [where xx are integers]      | Yes                      |
| 9522A                             | Daytona                 | IS05001                              | Yes                      |
| 9601                              | SBD Transceiver         | TD05002                              | No                       |

Note: The minimum firmware revision will not support every SBD feature. Developers are advised to use the most recent firmware revision available.

### 8.2 Provisioning

L-Band Transceivers require two key items in order to be operational on the Iridium Network:

- The IMEI (a 15 digit number beginning with 30 that identifies the hardware device) must be correctly provisioned in Iridium's SPNet with a valid destination defined (email address, another ISU's IMEI or IP Address), to which the MO-SBD messages are to be sent.
- A correctly provisioned SIM card must be installed in the LBT (9522 or 9522A.) This can be one of two flavors:
  - Any standard Iridium SIM card where the LBT will be used for voice and other data services
  - A SBD "Register only" or "Automatic Check" SIM for LBTs that will be just used for SBD
- The 9601 SBD Transceiver does not require a SIM card.

It is important to check that both the IMEI and SIM are properly provisioned. Without verifying these items there is little value in continuing troubleshooting. It is also important to verify that the SIM you are checking on in SPNet is the same SIM that is physically installed in the LBT.

VARs can check in Iridium's provisioning tool 'SPNET' for SBD traffic for specific ISUs. If no SBD messages are being received at the expected Field or Vendor Application the VAR should check to see whether there are messages flowing across the network for that ISU in SPNet. If the network logs show no messages then the application developer should check the Field Application and the Vendor Application. The Vendor Application may also require checks for firewalls, email filters for example.

### 8.3 SIM PIN

Iridium SIM cards are typically created with the PIN activated. The application developer should take this into account in the development of the Field Application.

**This section does not apply to 9601 transceivers as they do not use a SIM card.**

In order to verify that the SIM does not have a PIN utilize the following command: AT+CPIN as described in [1]. If the SIM has a PIN it will require the developer's application to input this PIN correctly via AT Command. If this PIN is not input, the LBT will not be able to register, place calls, or receive calls. Furthermore, if the PIN is input 3 times

incorrectly the SIM will become “blocked”. To unblock the SIM requires sending the AT Command with the PIN1 Unblocking Key (PUK1). The PUK1 is an 8-digit sequence that can be provided by the SP/VAR. The application developer can use “AT+CPIN?” to determine what code the SIM is waiting for or expecting.

In order to turn off the PIN use the following command: AT+CLCK as described in [1]. However Iridium recommends that developers not remove the PIN unless the commercial Field Application will be design to detect and remove the PIN. Commercial SIM cards are issued with the PIN activated.

## **8.4 Network Registration Status**

For the 9522A LBT the following should be checked, it does not apply to the 9601. Check the registration status by issuing the check registration status command: AT+CREG as detailed in [1]. In order to use the Iridium network a SIM based ISU must be registered with a gateway (telephony registration – NOT an SBD Network Registration.) If an ISU is not registered then many of the AT commands and functions of the ISU will be inoperable. Registration cannot be disabled. If the unit is not registered:

- Check the provisioning of the SIM on SPNet
- Power the unit off, wait 10 seconds, power the unit on again and reissue the +CREG command
- If the unit still has not registered, ensure that an antenna is connected correctly and that it has clear line of sight to the sky through 360 degrees azimuth. Then proceed to the “Satellite Signal Strength Indicator” section

## **8.5 Satellite Signal Strength Indicator**

Issue the AT+CSQ command as detailed [1] and observe the response.

Signal strength of 0 indicates that:

- Either the antenna is not connected properly;
- The signal loss in the antenna cable, connectors is too high resulting in excessive signal loss.
  - Ensure that the cable length, type and design frequency is appropriate for Iridium.
    - Iridium operates between 1616 and 1625 MHz
    - The entire RF loss of the antenna installation (including cable, connectors and lightning arrestors) shall not exceed 3dB.
- The antenna does not have a clear view of the sky. The optimal view is 360 degrees of azimuth and above 8 degrees of elevation.
- Interference from a local high power L-Band transmitter. E.g. an Inmarsat terminal.

Signal strength of 1 or higher should permit an SBD call to be made. Check signal strength over a period of 10 to 20 minutes to characterize the received signal strength for your antenna location. If you consistently see:

- A signal strength of 4 or higher you appear have a good installation.
- A varying signal strength ranging from 0/1 to 4/5 then your antenna location appears to have partial line of sight blockage. Identify the blockage and determine if you can relocate the antenna.

It is recommend that development, demonstration and test platforms have high quality installations with optimal line of sight conditions. Having an ideally located antenna removes the possibility that poor signal strength causes application issues and enables more rapid application debugging.

## ***8.6 Power Supply***

It is critical that an appropriate power supply is utilized. While an ISU can turn on using only a portion of the specified maximum current, registration and transmission of data messages will not occur if the transceiver cannot draw enough current from the power source. An under rated power supply can cause erratic behavior when using SBD. Ensure that your power supply can supply the specified peak maximum current for the transceiver that you are using. Check the power supply while operating the transceiver by using an ammeter and volt meter.