ADDITIONAL INFORMATION ON SBD

Version 4.0

February 1st, 2012

9300 West Courthouse Road
Manassas, Virginia 20110 USA
Phone: 703-392-1136 x203
E-mail: contact@nalresearch.com

LEGAL DISCLAIMER AND CONDITIONS OF USE

This document contains information for the Iridium modem and accompanying accessories ("Product") is provided "as is." Reasonable effort has been made to make the information in this document reliable and consistent with specifications, test measurements and other information. However, NAL Research Corporation and its affiliated companies, directors, officers, employees, agents, trustees or consultants ("NAL Research") assume no responsibility for any typographical, technical, content or other inaccuracies in this document. NAL Research reserves the right in its sole discretion and without notice to you to change Product specifications and materials and/or revise this document or withdraw it at any time. User assumes the full risk of using the Product specifications and any other information provided.

NAL Research makes no representations, guarantees, conditions or warranties, either express or implied, including without limitation, any implied representations, guarantees, conditions or warranties of merchantability and fitness for a particular purpose, non-infringement, satisfactory quality, non-interference, accuracy of informational content, or arising from a course of dealing, law, usage, or trade practice, use, or related to the performance or nonperformance of any products, accessories, facilities or services or information except as expressly stated in this guide and/or the Product and/or satellite service documentation. Any other standards of performance, guarantees, conditions and warranties are hereby expressly excluded and disclaimed to the fullest extent permitted by the law. This disclaimer and exclusion shall apply even if the express limited warranty contained in this guide or such documentation fails of its essential purpose.

In no event shall NAL Research be liable, whether in contract or tort or any other legal theory, including without limitation strict liability, gross negligence or negligence, for any damages in excess of the purchase price of the Product, including any direct, indirect, incidental, special or consequential damages of any kind, or loss of revenue or profits, loss of business, loss of privacy, loss of use, loss of time or inconvenience, loss of information or data, software or applications or other financial loss caused by the Product (including hardware, software and/or firmware) and/or the Iridium satellite services, or arising out of or in connection with the ability or inability to use the Product (including hardware, software and/or firmware) and/or the Iridium satellite services to the fullest extent these damages may be disclaimed by law and whether advised of the possibilities of such damages. NAL Research is not liable for any claim made by a third party or made by you for a third party.

1.0 SBD OPERATIONAL OVERVIEW

The short-burst data (SBD) service is a success based protocol, the response codes returned to the sender indicate if the message was successfully received by the next node or not. There are two types of message types that are delivered via SBD Services, Mobile Originated (MO) and Mobile Terminated (MT) messages.

1.1 Delivery of MO Messages

In the delivery of MO messages the user first clears the buffer, then frames the message and moves it to the transmit buffer of the Iridium modem (i.e. A3LA series and 9602 series). After the application receives the 'OK' response, it initiates the SBD session. The session includes acquiring the satellite, authenticating the Iridium modem, sending the MO messages, receiving a MT message if one is available, exchanging status information and performing the final ACK/NAK.

If the MO status response codes indicate a success, the MO message was delivered successfully to the GSS (Iridium gateway). If the response codes indicate a failed transmission (e.g. RF link drop, inter-satellite handoff, etc), the message remains in the transmit buffer and the user must resend it. The message is either successfully delivered to the GSS or remains in the transmit buffer, but it is not 'lost'.

Once the MO message arrives at the GSS, it is passed to either the email or Direct IP servers for delivery. Once the message is posted to the email, Iridium has no control over the delivery. With the Direct IP, the connection to the destination server is opened, the message sent to the destination, and the connection is closed. This is a very high reliability delivery method.

If the MO messages cannot be delivered, usually because the destination server is off-line and the GSS will queue them until the server comes back on line. The system is configured to hold 10,000 messages per application at the GSS.

For DirectIP MO messages, when sizing network capacity, the general guideline is that one IP address: port pair can support a delivery rate of 100 messages per minute from the Iridium server to the partner server. A partner may configure the number of IP address: port pairs based on expected peak throughput levels for any given day.

The 9601 and 9602 modems were designed with only one transmitter (versus secondary transmitter on the A3LA series), so there will be instances when an SBD call is not completed due to the call dropping as it moves from one satellite beam to another beam. Partners may see duplicate MOMSN numbers being created due to this beam handoff phenomenon. The reason for is problem that the SBD-MO message is received at the Iridium gateway, and as the acknowledgement is sent back to the remote device, the connection gets dropped. The remote device never receives the acknowledgement and retransmits the same message using the same MOMSN.

1.2 Delivery of MT Messages

In the delivery of MT messages the vendor application creates a message and sends it to the GSS; either via email or the Direct IP connection. The GSS sends a receipt to the vendor application indicating the GSS received the MT message and queued for delivery to the Iridium modem.

The GSS does not automatically attempt to deliver the MT messages. Since the SBD is a success based protocol, the GSS will not send the MT message unless the destination is ready to receive it. The destination Iridium modem must therefore request delivery of the queued MT message. This is done by initiating a SBD session. The session can be either a valid MO message or a 'mailbox check.' A 'mailbox check' is a MO message with a 0-byte message payload.

If the Iridium modem is configured to receive the automatic Ring Alerts (RA), and there is a line of sight between the unit and the satellite, the GSS will send the RA to the Iridium modem notifying the device that a message is waiting to be retrieved.

If the Iridium modem is powered off or not in view of the satellite, the MT messages remains queued at the GSS. The GSS can queue up to 50 MT messages for each IMEI. A MT message can remain queued at the GSS for 5 days from receipt at the gateway. If a MT message is not retrieved by the application within this 5-day window, the daily maintenance program at the GSS purges the queue for this IMEI.

For DirectIP MT messages, all partners should immediately disconnect their socket connection after the data has been transferred and an acknowledgement is received from the Iridium server. Additionally, there should be a timeout period of 5 seconds once the partner server had sent the SBD payload data to the Iridium server, and is awaiting a response back from the Iridium server. All partners need to configure their server to allow a maximum of 20 simultaneous connections to the Iridium server. This will ensure access for all partners.

2.0 AUTOMATIC RING ALERT (RA)

The Automatic RA feature notifies the Iridium modem when a MT-SBD message is queued for this IMEI. When the modem receives the RA, a number of unsolicited events occur; if the device is in verbose mode, the modem sends the ASCII string SBDRING across the data port to the connected DTE (data terminal equipment), if it is not in verbose mode, the modem sends the string 126. Also the RI (ring indicator) bit is asserted and the RA bit in the modem is set.

These events notify the DTE that a MT-SBD message is waiting and the DTE can then send a +SBDIXA 'mailbox check' to retrieve the message. If the DTE does not reply with a +SBDIXA 'mailbox check' within 20 seconds, the gateway sends a second RA to the modem. If there is still no response, the RA are cancelled and the modem will not receive another RA until another MT-SBD is queued for this device or the Host 'forces' a RA using the Direct IP.

The forced RA feature consumes Iridium network resources. Currently there is not charge for the use of a forced ring alert; however, unreasonable use of the feature could force Iridium to evaluate this position. In order to use the RA feature, a few steps must be followed:

- First, the RA option must be selected in the provisioning for this IMEI. This is done by an Iridium airtime service provider from the SPNet tool.
- Second, the DTE must configure the modem to listen for the RA signal using the +SBDMTA command.
- Lastly, the modem must be 'attached' to the gateway. This may be done with the +SBDREG command or initiating a SBD session with the +SBDIX command.

3.0 ATTACHING A MODEM TO THE GATEWAY

The 'attach' process performs two functions; it indicates to the gateway that the modem is configured to receive the RA and it updates the geo-location of the modem on the gateway so the RA signal can be routed to the device. The 'attach' can be accomplished in two ways — (1) +SBDREG or (2) +SBDIX.

The +SBDREG command 'attaches' the modem to the gateway so it can receive the RA. When used, it notifies the gateway this IMEI is configured to receive the RA and updates the geo-location data. This command only needs to be executed one time. Once a device is attached, it remains attached until it is 'detached' by the DTE. This is done by issuing the +SDBDET detach command or using the +SBDI command to initiate a SBD session.

Every time the DTE issues the +SBDIX command the gateway attempts to 'attach' the device. For a fixed site or a device that operates in a limited geography, this will keep the device 'attached'. This mitigates the need for using the +SBDREG command.

The +SBDNET command 'detaches' a device from the gateway so it no longer can receive the automatic RA, and also returns status information to the modem which indicates if an MT-SBD message is queued at the gateway from this device.

4.0 INVALID GEO-LOCATION AUTO RE-ATTACH/SBDAREG

The gateway relies on a current geo-location to determine which spot beams to route the RA to a modem. If the unit is mobile, it may move outside of the RA radius without updating its geo-location by a +SBDIX command. When this occurs the mobile device will not receive the RA from the gateway. This can be addressed in two ways; periodically issue a +SBDIX command to re-attach or use the +SBDAREG command. **NOTE:** the +SBDIX is a billable event based on the number of bytes sent (a zero byte message is considered a mailbox check if there is no MT message awaiting delivery).

When executed, the +SBDAREG performs a passive geo-location which estimates the distance the modem has moved since the last attach. If this indicates the device may have moved beyond the RA radius, it automatically re-attaches the device. The DTE does not need to monitor the frequency of MO-SBD messages or issues periodic +SBDAREG commands.

The +SBDAREG works if the device is power cycled and moved. The caveat is that when the device is powered on, the calculation may take minutes to determine the geo-location and re-attach. The +SBDAREG command is local to the modem and must be issued after the modem has been successfully attached to the gateway. It is NOT an alternative to the +SBDREG command, it is a complement.

To use the +SBDAREG command:

- Attach the modem to the gateway. This may be done with the +SBDREG command or initiating a SBD session with the +SBDIX command.
- Check that the response code indicates as successful 'attach'
- Issue AT+SBDAREG <mode>

5.0 RECOGNIZING AND RESPONDING TO THE RING ALERT (RA)

The DTE can be configured to look for the unsolicited ASCII string SBDRING or 126 to indicate that the RA was received by the modem. The RI pin is also asserted on the modem when the Ring Alert is received.

There are two additional commands available to the developer for checking the status of the RA pin. These are the +CRIS, Ring Indication Status, and the +SBDSX, Status Extended commands.

The +CRIS command returns the reason for the most recent assertion of the RI signal. There are separate indications for telephony and SBD. For the Iridium modem (not phone), the SBD indicator is the only valid response.

The +SBDSX returns the status of the last successful SBD session and the RA flag. The RA flag indicates whether an SBD ring alert has been received and still needs to be answered. This flag is cleared by a successful SBD session, including 'mailbox checks'.

If the designer does not wish to handle the unsolicited ASCII strings, the DTE can periodically check the RA status with either of these commands instead to determine if a RA was received.

Once the DTE has determined that the modem received a RA, it can initiate a SBD session to retrieve the queued message. Typically this is accomplished with a 'mailbox check' which is a MO-SBD message with a 0-byte payload. The MT-SBD message waiting at the gateway is delivered as part of the SBD session. A MO-SBD message with a valid payload also retrieves the pending message. The DTE should use the +SBDIXA command when responding to the RA.

6.0 NETWORK SATELLITE AVAILABILITY

Iridium operates on the principle of line-of-sight communications and requires that the antenna maintains a clear view of the satellite. Since the Iridium satellites operate in low earth orbits, this view may at times be obstructed. The modem contains features that indicate to the DTE that a satellite is within view of the antenna. These are the Network Available pin, +CSQ/+CSQF commands and +CIER/+CIEV command.

6.1 Network Available Pin

Some of the Iridium modems have a network available pin and is asserted when the satellite is within view of the powered device. The pin is not asserted if the device is powered off. The DTE can be designed to make use of this input.

6.2 +CSQ and +CSQF Commands

The +CSQ and +CSQF commands return the Relative Signal Strength Indicator value to the DTE. The commands return a value between 0 and 5. The value indicates strength of the signal relative to the noise floor. A value of 0 indicates no discernable signal and the communications will not work. A value of 1 is the minimum signal strength required to transmit. Every incremental value is an additional 2 dB of margin. For example; 2 is +2 dB, 3 is +4 dB and 5 is +8dB.

The +CSQ results are not 'instantaneous' and the calculation may take seconds. The +CSQF command immediately returns the results of the last RSSI (signal strength) calculation to the user. The user must keep in mind this value may be 'old', perhaps up to 15 seconds.

6.3 +CIER and +CIEV Commands

These commands enable 'Indicator Event Reporting', which sends the unsolicited +CIEV result codes to the DTE. The command affects two parameters; the RSSI value and the Network Availability. When the parameter is enabled, the modem sends the new value to the DTE. This is an unsolicited response and is delivered as long as the data port to the modem is available.

For the signal quality, it returns the latest RSSI value; from 0 to 5. For the network, 'service availability' the modem returns either 0 or 1. The +CIEV, is the unsolicited text string returned with the +CIER value.

7.0 INITIATING SBD SESSION

7.1 +SBDI

There are three commands available for initiating an SBD session: +SBDI, +SBDIX and +SBDIXA. +SBDI is the legacy command from the initial release of the SBD service. It can be used for sending SBD messages. But in the current network system design, there are a couple drawbacks to using this command. The +SBDI will detach the modem from the gateway. If the DTE uses, or intends to use, automatic RA feature, the +SBDI command cannot be used. Also, the status response codes from the +SBDI command are limited and not very useful in diagnosing possible connectivity problems. Iridium recommends using the +SBDIX command rather than the +SBDI.

7.2 +SBDIX

+SBDIX command is the recommended command for initiating a SBD session. It ensures the modem won't become detached inadvertently; it maintains the current geo-location for the RA and provides a more extensive set of response codes.

7.3 +SBDIXA

If the modem is configured to receive the automatic RA, and the device is attached to the gateway, when the Host sends a MT-SBD message a RA is sent as the message is queued. If the DTE does not respond to the RA within 20 seconds, a second RA is sent to the modem. If the DTE is initiating a SBD session in response to the RA, it should use the +SBDIXA command. The +SBDIXA command functions the same, but it cancels the second RA. This prevents a possible race where the gateway would send a RA after the message has been retrieved.

8.0 INTERPRETING COMMAND RESPONSE CODES

Each AT command returns to the DTE a result code that indicates the disposition of the command. Depending on the command, the codes may indicate status, condition or other related information. It is important to program the DTE to interpret these commands and properly execute logic based on the results.

Occasionally, a new command is introduced which provide additional features and may be used in place of exiting commands, such as +SBDIX and +SBDI. The +SBDIX can be used in place of the +SBDI, and is recommended; however, the response codes for the commands are different. Just replacing the one command with the other and not modifying how the codes are interpreted can introduce a major bug. Thus, when a command is used, check the possible response codes and how to interpret them.

9.0 ADAPTIVE RETRY

There are a variety of reasons why a SBD message may not get through from the modem to the satellite. Since this is a line-of-sight system, the most obvious cause of a link failure is an obstruction. However, it can be due to inter-satellite handoff or contention for satellite resources. The response codes indicate that the message failed, but do not always give a precise reason.

When a SBD session fails, the exception logic in the DTE should determine what action to take. Typically if a session fails once or twice, the DTE immediately initiates another session. If the resends fail beyond this,

and a satellite is in view, there may be an issue with contention for satellite resources. In this case, it is better to incrementally adjust the time interval between the resend attempts.

A suggested retry scheme might be:

Initiate SBD session

If that fails attempt resend within a random time of 0 – 5 seconds (2 x)

If still unsuccessful wait a random time of 0 – 30 before attempting a resend (2X)

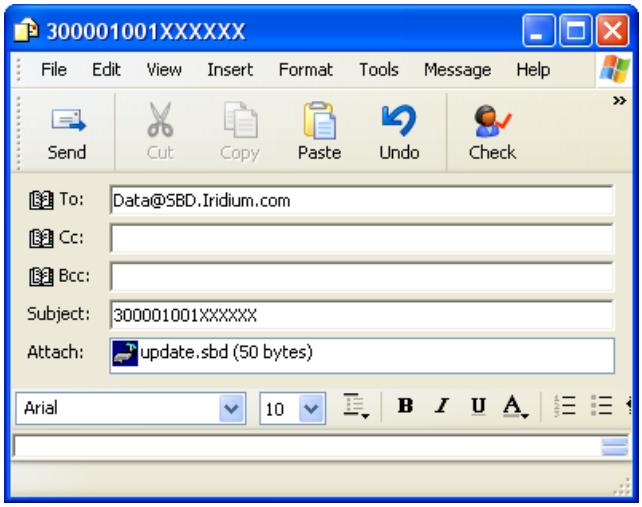
If these attempts fail, increment the delay to 5 minutes.

This logic should cover almost any anomaly with the network.

10.0 SENDING MT SBD MESSAGES VIA E-MAIL

Messages can be sent to an Iridium modem via SBD from almost any e-mail program (Outlook, Outlook Express, etc.). If there is an e-mail message in queue at the Iridium gateway designated to a specific Iridium modem, the Iridium modem can receive the message the next time it performs an AT+SBDI session.

1. In order to send e-mail messages to an Iridium modem, the e-mail program must use the standard Multipurpose Internet Mail Extensions (MIME) Base64 encoding as defined in RFC 2045. The following instructions describe how to set this up for Microsoft Outlook Express, but other email clients will have similar settings:
    i. Select "Tools/Options"
    ii. Click the "Send" Tab
    iii. Under "Mail Sending Format", click "HTML Settings…"
    iv. Click MIME
    v. Select "Base 64" for Encode text using
    vi. Click OK
    vii. Under "Mail Sending Format", click "Plain Text Settings…"
    viii. Repeat steps iv –vi
2. Send all e-mail messages to Data@SBD.Iridium.com
3. Place the IMEI number of the modem in the subject line
4. The message should be carried in an attachment, which must have a ".sbd" extension



11.0 MO SBD E-MAIL FORMAT

The table below displays the field descriptors of each SBD messages sent from an Iridium modem. This format will appear in the body of every SBD e-mail message.

FIELD NAME	DESCRIPTION	
MOMSN	Mobile Originated Message Sequence Number (0 – 65535)	
MTMSN	Mobile Terminated Message Sequence Number (0 – 65535)	
Time of Session	The UTC Timestamp of the Iridium Subscriber Unit session between the Iridium Subscriber Unit and the controller subsystem.	
Session Status	Session Status	Description
	TRANSFER OK	The SBD session completed successfully.
	INCOMPLETE CALL	The SBD session did not complete successfully due to a protocol error.
	SBD DENIAL	The modem is not allowed to access the system.
	SBD TIMEOUT	The SBD session did not complete for an unknown reason such as a RF fade
Message Size	The size of the attached message in decoded format. This is not the length of the MIME encoded data.	
Unit Location	The latitude and longitude of the modem when it sent the message. The latitude and the longitude provide a center point and the CEPradius provides the radius of a circle around that center point. The reported position is accurate (within the reported circle) 80% of the time. This location is estimated using Iridium satellites.	
CEPradius	An estimate of the accuracy of the unit in kilometers.	

12.0 MO SBD E-MAIL FORMAT

Since the calculation of the checksum for SBDWB may be confusing, a C code example is given below. Please see +SBDWB in the AT Command Reference for additional information.

```
unsigned short checksum = 0;
int i;
unsigned char c;
char* data = “Test SBD message”;
int length = 16; // Number of characters in data

for (i=0; i < length; i++) {
       c = data[i];
       putch(c); // send a data byte to the ISU
       checksum += c;
}

//Send the 2 byte checksum to the ISU
putch(checksum/256); // High order byte first
putch(checksum%256); // Followed by low order byte
```

13.0 FREQUENTLY ASKED QUESTIONS

What is the Iridium source IP address that Mobile Originated deliveries come from?

12.47.179.11

What is the Iridium domain name for DirectIP Mobile Terminated messages?

directip.sbd.iridium.com / port 10800

What is the current policy regarding DirectIP Mobile Originated TimeToLive setting?

TimeToLive is 12hours

What is the Iridium Mobile Terminated queue policy, before MT messages are purged?

Mobile Terminated messages that are 'queued' for 5 days – (all messages for the destination will be purged at this time)

What is the maximum # of Mobile Terminated messages for a single IMEI?

Maxaximum of 50 messages per IMEI

For SBD DirectIP Mobile Terminated, does the customer need to inform Iridium of the source IP address that will be utilized?

Yes, the source IP address that will be utilized to connect to the Iridium gateway needs to be included within the Iridium network firewalls, to allow for successful connection. This request for DMT access needs to be sent to any of the Iridium service providers.

What happens if the host server is not available to receive messages?

MO-SBD messages are queued at the GSS (gateway). The GSS can store 10,000 messages per server application. If the number of MO-SBD messages exceeds the 10,000 limit, the oldest message is discarded and the newest added to the queue. The expiry for the queued message is 12 hours.

FOR TECHNICAL SUPPORT, PLEASE CONTACT US AT

Phone: 703-392-1136
FAX: 703-392-6795
E-mail: contact@nalresearch.com

Technical documents are also available to download on NAL Research's website

www.nalresearch.com