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Digi m10

Technical Overview And Reference

Date: 12 January 2012

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About This Manual

This manual provides a detailed technical overview on how the Orbcomm satellite network operates, available message types, specific Digi message extensions, and other related technical information.

Target Audience

The target audience for this document is comprised engineers and other individuals with a technical background. A typical reader is an engineer who is familiar with the general concept of wireless data communications.

Symbols Used in This Manual

Symbol	Description
	Provides additional information corresponding to the current topic.
	Warning! If ignored, may cause permanent damage to the JumpStart Kit or injury to a person. Caution! Failure to comply with a caution may result in failure or damage to the device. Danger! Failure to comply with a danger symbol may result in serious injury.

Reference Documents

The following documents were used to create this user guide, and provide more information about the technologies and standards involved using the Digi m10 ORBCOMM Satellite Modem.

- Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests, MIL STD 810E
- European Telecommunications Standards Institute, EN 300 832 (A1 version 1.1.1), Electromagnetic Compatibility for Mobile Earth Stations.
- International Electrotechnical Commission, IEC 1000-4-4, Testing and Measurement Techniques -- Immunity to Fast Transient / Burst Immunity Test.
- International Electrotechnical Commission, IEC 61000-4-6, Testing and Measurement Techniques -- Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields.
- ORBCOMM Serial Interface Specification, E80050015.
- ORBCOMM Subscriber Communicator (SC) Standards and Specifications, E25050102.
- ORBCOMM Subscriber Communicator Type Approval Plan, A25TP0017.
- ORBCOMM System Overview, A80TD0008.
- RoHS FAQ -- <http://www.rohs.gov.uk/FAQs.aspx#10>
- Society of Automotive Engineers, SAE J1455, Joint SAE / TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy-Duty Trucks).
- Technical Requirements for Satellite Earth Stations and Systems (SES); Mobile Earth Stations (MES) Providing Low Bit Rate Data Communications (LBRDC) using Low Earth Orbiting (LEO) satellites operating below 1 GHz, EN 3200 721.

Where to Get Help

For additional information or clarifications regarding this user manual, please get in touch with Digi International using the contact information provided below.

Address	11001 Bren Road East Minnetonka, MN 55343
Phone	952-912-3456
E-mail	http://www.digi.com/support/eservice/login.jsp

1. General Description

This chapter provides an overview of the Digi m10 Satellite Modem and its features.

1.1 Background

The ORBCOMM system is a two-way system that supports communication to and from mobile or fixed satellite modems, also called [Subscriber Communicators \(SCs\)](#). In most applications, a [message](#) or other data is first generated by an SC. From that source, the message is transmitted to the nearest ORBCOMM satellite. The satellite downlinks the message to the [Gateway Earth Station \(GES\)](#), which then transmits the message to the desired [Gateway Control Center \(GCC\)](#). Within the GCC, the message is processed and forwarded to its ultimate destination by the [Gateway Message Switching System \(GMSS\)](#). The destination may be another satellite modem, a pager, a corporate resource management system or any personal or business e-mail or Internet address.

The ORBCOMM system is available to transfer information for an end user whenever a satellite is in view of the SC. If the satellite is connected to a GES, the satellite is considered in real-time messaging mode, and the message is passed immediately through to the GCC for routing to its final destination. If the satellite is not connected to a GES, the satellite switches to a store-and-forward mode to accept [Global Grams](#). Global Grams are short messages (up to approximately 200 bytes) stored on-board the satellite until it connects to the SC's host GCC through an affiliated GES.

For detailed information on the ORBCOMM system, refer to the ORBCOMM System Overview document that was provided as part of your Digi JumpStart Kit..

1.2 Communication using a Digi m10 Satellite Modem

Once an antenna is properly hooked up to the Digi m10 and it has a clear line of sight to the sky, the Digi m10 can start communicating with satellites as they move overhead. Availability of satellites is highly dependent on regional location and how busy a satellite currently is; that is, the availability of slots.

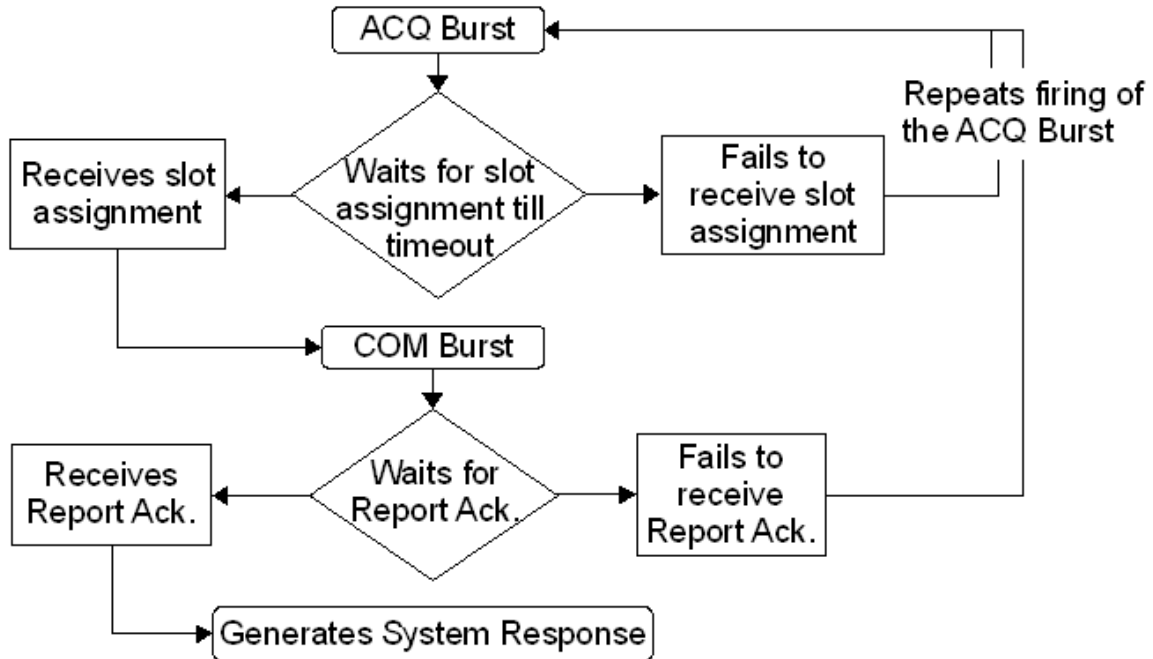


Figure 1: SCO Report Transmission Cycle

To transmit a message through the Digi m10 to the satellite, a user must create a message and communicate it serially to the Digi m10. See the section referring to the types of [Communication methods](#) or the available types of messages that can be sent. At this time, various [acknowledgement](#) and [priority](#) levels can be set as well. Once a message has been queued up for transmission and there is a satellite overhead, the Digi m10 will attempt to transmit the message to the satellite following the cycle shown in the above figure. When the satellite accepts the message and transmits to the GES, the message then routes to the specified destination.

When receiving a message through the Digi m10, a user creates a message using an SMTP client and sends it to the ORBCOMM GCC using the appropriate e-mail address (typically serial#X1@orbcomm.net for North America or serial#X1@orbcomm2.net for the rest of the world). When the message is received by the GCC, the GCC transmits it through the GES to the satellite in orbit, which then transmits the message down to the Digi m10. Once the message is received by the Digi m10, the user can query for the message serially. Note the Data Available signal asserts when the Digi m10 has received a message.

The message packets sent between the Digi m10 Satellite Modem and the Satellite are optimized at 107 bytes of user data. This allows for a single packet to be sent to the Satellite with a single acknowledgement back. After that, the next optimized size is 228 bytes of user data, and then in 111 byte increments.

Alternatively, users can provision their Digi m10 Satellite Modems for IP Gateway usage. This usage allows customers to use HTTP POST and GET commands with XML to send and receive messages against a specified host server. When the Digi m10 Satellite Modem is set up for an IP Gateway account, speed dial 1 is used to route messages to the host server.



Note: If the Digi m10 is powered off, all existing messages in its transmit and receive queues are lost.

2. Types of Communication Methods

2.1 Data Reports

A Data Report is the basic service element the Digi m10 uses to transmit or receive a single packet containing 6 bytes or less of user-defined data. A Data Report can require an acknowledgment of successful delivery to the ORBCOMM Gateway, but this acknowledgment can be omitted to save space segment resources. A Data Report can only use speed dials to indicate where the message should be delivered.



More documentation can be found on the CD provided with the JumpStart Kit. To learn more, please refer to corresponding sections in the ORBCOMM Serial Interface Specification document.

2.2 Messages

A Message is the basic service element the Digi m10 uses to transmit or receive a longer sequence of data. To ensure reliability, messages are transferred over the satellite reservation channels via short packets containing a checksum, with all packets acknowledged or retransmitted. Messages must fit within a 1024-byte packet. Messages can either use a speed dial to indicate the message delivery destination or an e-mail address.

2.3 Global Grams

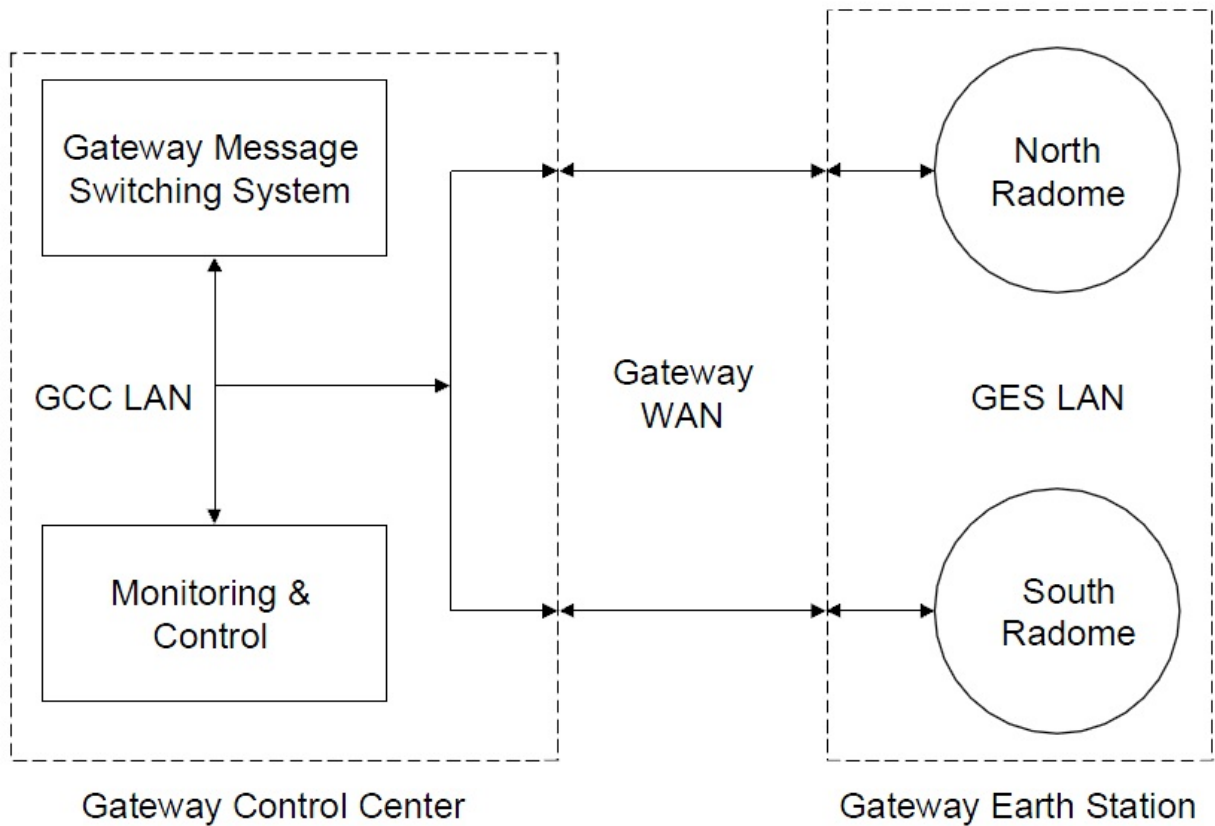
A GlobalGram is the basic service element the Digi m10 uses to transmit or receive a single, self-contained data packet to or from a satellite that is not currently in view of an [ORBCOMM Gateway](#). This allows remote and oceanic areas to be served in a “store-and-forward” mode. For an SC-Terminated GlobalGram, the relaying satellite stores the data packet in memory and transmits it upon request from the destination Digi m10. An SC-Terminated GlobalGram contains 182 bytes of user data. For an SC-Originated GlobalGram, the satellite receives the GlobalGram from the Digi m10, acknowledges it and archives it in satellite memory until the destination ORBCOMM Gateway establishes contact with the satellite. An SC-Originated GlobalGram contains 229 bytes of user data. A Global Gram can only use speed dials to indicate where the message should be delivered.

3. Terms and definitions:

3.1 Gateway

An ORBCOMM Gateway consists of a Gateway Control Center (GCC) and one or more Gateway Earth Station (GES) sites, as well as the network components that provide interfacility communications. The principal role of the ORBCOMM Gateway is to provide message processing and subscriber management for a defined service area. This role includes serving as the “home” for ORBCOMM system subscribers, as well as providing the interface between the subscriber and the interconnected public and private data networks and the Public Switched Telephone Network (PSTN)

The current ORBCOMM Gateways consist of the Western Hemisphere (Gateway ID of 1), the Eastern Hemisphere (Gateway ID of 120), and Japan (Gateway ID of 130).



3.2 Gateway Earth Station (GES)

The role of the Gateway Earth Station (GES) is to provide an RF communications link between the message switch and the satellite constellation. It consists of medium gain tracking antennas, RF and modem equipment, and communications hardware and software for sending and receiving data packets. The GES equipment and site are designed for unattended operation. The GES uses radome-enclosed, VHF full-motion antennas with approximately 17 dB of gain. Two fully independent antenna systems, and associated RF and control equipment, provide complete functional redundancy at a GES site.

3.3 Subscriber Communicator (SC)

The term Subscriber Communicator (SC) refers in general to the satellite modem or a device incorporating a satellite modem.

3.4 SC Terminated

Messages sent to the SC from the GES



More documentation can be found on the kit installation CD. To learn more, navigate to C:\Program Files\Digi\Digi m10 JumpStart Kit\documents please refer to either ORBCOMM Serial Interface Specification > SC-TERMINATED MESSAGE or ORBCOMM Serial Interface Specification > Figure 4.8 SC-Terminated Message.

3.5 SC Originated

Messages sent from the SC to the GES

More documentation can be found on the kit installation CD. To learn more, navigate to C:\Program Files\Digi\Digi m10 JumpStart Kit\documents please refer to either ORBCOMM Serial Interface Specification > SC-ORIGINATED MESSAGE or ORBCOMM Serial Interface Specification > SC-ORIGINATED MESSAGE.

3.6 Global Gram

Global Gram messaging, or store-and-forward message transfer, is available in instances when a satellite is in view of a satellite modem, also referred to as Subscriber Communicator (SC), but there are no ORBCOMM gateways connected to the satellite. Examples of such instances include ocean areas and locations where there is no gateway, but regulatory approval for a satellite modem to communicate with a satellite has been granted. Global Grams allow satellites and satellite modems to archive short messages when the destination ORBCOMM gateway is

inaccessible by the satellite constellation. The stored messages are transmitted when an ORBCOMM Gateway comes into satellite-transmission range. This concept applies to both sending (SC-Originated) and receiving (SC-Terminated) from a satellite modem point of view.



More documentation can be found on the kit installation CD. To learn more, navigate to C:\Program Files\Digi\Digi m10 JumpStart Kit\documents please refer to either ORBCOMM Serial Interface Specification > Figure 4.5 SC-Originated Globalgram & Figure 4.6 SC-Terminated Globalgram or ORBCOMM Serial Interface Specification > SC-ORIGINATED GLOBALGRAM & SC-TERMINATED GLOBAL.

3.7 Message Blocking

Message Blocking is an optional feature that allows customers to restrict the addresses to which their satellite modems can send messages, and those addresses that are allowed to send to a satellite modem. The Speed Dial addresses are used as permitted addresses.

3.8 Message Priority

Message priority is a feature that allows messages to be processed in order of importance. The higher the priority, the faster the message moves through the network. However, the ORBCOMM message switch (OMS) does not terminate message sessions in progress; a new urgent message will remain queued until any active lower-priority message is completed.

ORBCOMM will only implement priority restrictions during periods of very heavy usage. If the system is lightly loaded and no queues, or only very short queues, are formed, there is little user benefit gained from the priority feature.

Functionally, within the ORBCOMM gateway congestion control mechanisms use priority to stop satellite modems from sending messages not meeting a customer-designated priority threshold. The satellite broadcasts the identification number of connected gateways and their minimum message priority thresholds in the downlink control information. All listening satellite modems that have messages queued for a listed gateway must refrain from sending messages below the specified priority threshold. Only queued messages with a priority at or above the minimum priority threshold are sent. Messages below the minimum priority remain in the queue until channel utilization falls below the threshold.

The available priority levels are:

0. Non-urgent
1. Normal
2. Urgent
3. Special Delivery

3.9 Speed Dial

The ORBCOMM gateway maintains a list of up to eight speed dials, or originator/recipient addresses for each satellite modem. Typically, these speed dials contain the e-mail addresses of frequent recipients or originators of messages to and from the satellite modem. The use of speed dials results in a reduced number of bytes in a message. The speed dials can also be used with message blocking to restrict addresses that can send to the satellite modem and those to which the satellite modem can send.



NOTE: For the Digi m10 JumpStart Kits, Digi provides automatic e-mail forwarding for messages with speed-dial destinations. This greatly simplifies your overall evaluation and development experience by allowing you to define speed dial configurations online at any given time, without changing the actual satellite service provisioning of your modem. Please refer to the online help of the Digi Satellite Dashboard application for more information about the speed dial forwarding. If you have any additional questions, please contact Digi technical support.”

3.10 Message Acknowledgments

Acknowledgments allow a customer to have confidence that SC-originated messages have reached the Gateway successfully. While ORBCOMM’s implementation of extended SMTP (ESMTP) allows for delivery notification information for SC-originated messages, the destination mail server and any mail servers relaying mail along the path to the destination server must also support the extended version of the protocol. In cases where the customer hosts support ESMTP, delivery notification is returned to the originating SC in a System Response. In other cases, results described in a System Response as referring to delivery to the message recipient can be misleading. An acknowledgment from the ORBCOMM Gateway is implicit in the delivery protocol for MESSAGES, and is implemented regardless of the specified acknowledgment level. No acknowledgment by the Gateway is available for Global Grams. For Data Reports, the service type specified for the message determines the acknowledgment level.

Service Level	Description
0	No Acknowledgment
1	Acknowledgment is generated only if message fails to reach the GCC.
2	Acknowledgment is generated when message has successfully reached (or failed to reach) the GCC.
3	Acknowledgment is generated only if message fails to reach recipient.
4	Acknowledgment is generated when message has successfully reached (or failed to reach) the recipient.
Note that service levels 0 and 1 are only used for SC-originated traffic and refer to acknowledgments between the SC and any device terminal equipment in use.	

Table 1: Message Acknowledgements



More documentation can be found on the kit installation CD. To learn more, navigate to C:\Program Files\Digi\Digi m10 JumpStart Kit\documents. For more information please refer to the ORBCOMM Messaging Services Description > Appendix B SMTP Acknowledgment Service

3.11 Alternate Terminating Address (ATA) / Message Forwarding

Message forwarding allows copies of all SC-terminated messages to be sent to an alternate terminating address (ATA). Any valid e-mail address can be set as the ATA, and any of three forwarding rules can be applied: carbon copy, conditional, or unconditional. The appropriate address and rule should be specified when the satellite modem is provisioned.

3.12 Delivery Plan

A delivery plan is the scheme the ORBCOMM gateway uses to attempt delivery of SC-terminated messages. Delivery plans have four main characteristics:

- **Automatic delivery attempts:** the number of times, immediately upon receipt and at one-minute intervals, the ORBCOMM Gateway will attempt to deliver an SC-terminated message
- **Time to hold:** the maximum time the ORBCOMM Gateway will hold the message before returning it as undeliverable
- **Deletion after final attempt:** whether the message should be deleted after the automatic delivery attempts are exhausted, or held until the time to hold has been reached
- **Use of piggybacking:** whether a message delivery attempt should be triggered by successful delivery of another message in either direction

3.13 GES-to-Satellite Channels

The RF links that connect an ORBCOMM Gateway GES to an ORBCOMM satellite use a single 57.6-kbps uplink and downlink channel that uses the TDMA protocol. This protocol permits simultaneous RF links between a single satellite and several GES installations within the satellite footprint. It also provides a virtually seamless hand-over of a satellite from GES to GES under the centralized control of the GMSS.

3.14 GES-to-GCC Channels

GES-to-GCC links will operate over 56-kbps or 64-kbps data lines. A typical installation consists of a Channel Service Unit/Data Service Unit (CSU/DSU) with a V.35 interface at both ends. TCP/IP IEEE 802.3 (Ethernet) packet routers, which provide link layer internetworking, connect these interfaces to the GCC and GES facilities. The GES process communicates with the GMSS process using TCP/IP UDP packets.

4. Digi Extended Packets

In addition to the ORBCOMM serial commands defined in the ORBCOMM Serial Specification, the following Digi Extended Packets are available to the host controller:

- Temperature Out of Bounds Packet
- Temperature Query
- Temperature Query Response
- NVM Data Corruption Alert Packet
- Code Upgrade Packet
- RTS/CTS Control Packet

The following sections provide details about these packets.

4.1 Temperature Out of Bounds Packet

Table 2: Temperature Out of Bounds Packet

0	0x05/0x06	Packet Header
1	0x18	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	Temp0	Temperature value in little endian format. (This is a 32 bit floating point number)
6	Temp1	
7	Temp2	
8	Temp3	
9	Fletch0	Fletcher Checksum
10	Fletch1	



NOTE: This packet is sent from the Digi m10 to DTE when temperature of the Digi m10 goes beyond the operating range (-40C to +85 C). DTE should power down the Digi m10 when this packet is received.

4.2 Temperature Query

The Temperature Query packet (see [Table 3](#)) is sent from the host controller to query the Digi m10 temperature.

Table 3: Temperature Query Packet

0	0x85/0x86	Packet Header
1	0x19	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	Fletch0	Fletcher Checksum
6	Fletch1	

4.3 Temperature Query Response

The Temperature Query Response packet (see [Table 4](#)) is sent from the Digi m10 to the host controller, indicating the satellite modem's temperature in degrees Celsius.

Table 4: Temperature Query Response Packet

0	0x05/0x06	Packet Header
1	0x1A	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	Temp0	Temperature value in little endian format.(This is a 32 bit floating point number)
6	Temp1	
7	Temp2	
8	Temp3	
9	Fletch0	Fletcher Checksum
10	Fletch1	



NOTE: This packet is sent from the Digi m10 to DTE and it contains the current temperature of the Digi m10 in degrees Celsius.

4.4 NVM Data Corruption Alert Packet

Table 5: NVM Data Corruption Alert Packet

0	0x05/0x06	Packet Header
1	0x1B	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	Fletch0	Fletcher Checksum
6	Fletch1	



NOTE: This packet is sent from m10 to DTE when NVM data is corrupted and the Digi m10 resets NVM data to factory defaults by itself.

4.5 Code Upgrade Packet

Table 6: Code Upgrade Packet

0	0x85/0x86	Packet Header
1	0x1C	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	Fletch0	Fletcher Checksum
6	Fletch1	



NOTE: DTE should send this packet to m10 before initiating xmodem code upgrade process. DTE receives LLACK in response to this packet.

4.6 RTS/CTS Control Packet

Table 7: RTS/CTS Control Packet

0	0x85/0x86	Packet Header
1	0x1D	Packet Type
2	Length0	Length of the packet
3	Length1	
4	Retry_count/ Pkt Sequence Number	
5	0/1	0 – Disable flow control 1- Enable flow control
6	Fletch0	Fletcher Checksum
7	Fletch1	



The checksum for the received LLACK, in response to DIGI m10 extended RTS/CTS control packet sent by DTE, should be calculated for the first 5 bytes only.

Example:

On sending RTS/CTS enable/disable command, the LLACK that we receive is:

05 01 08 00 00 **00 BD 35** and is 8 bytes in length.

However, in the above LL ACK response, the check sum should be calculated for the first 5 bytes only for verification and byte marked in **red** should be ignored. That means we should calculate checksum for “05 01 08 00 00” only, and validate it with the checksum embedded in the last two bytes which is marked in **green** (BD 35) in this example.



NOTE: DTE can enable or disable RTS/CTS flow control by sending the above packet. DTE receives an 8 byte LLACK in response to the above packet.

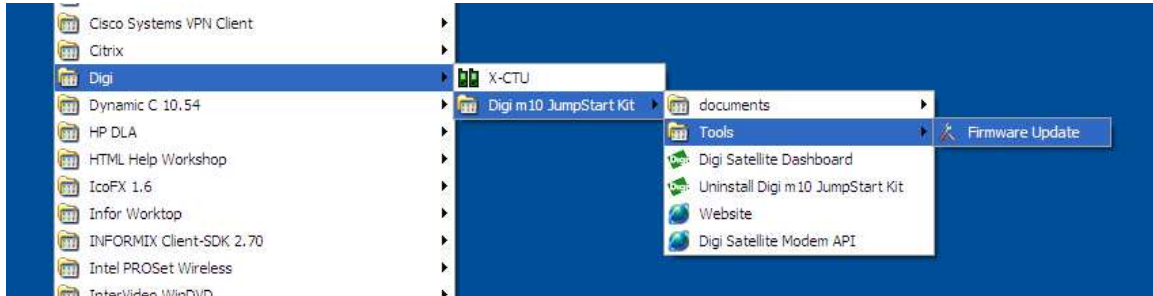


Important:

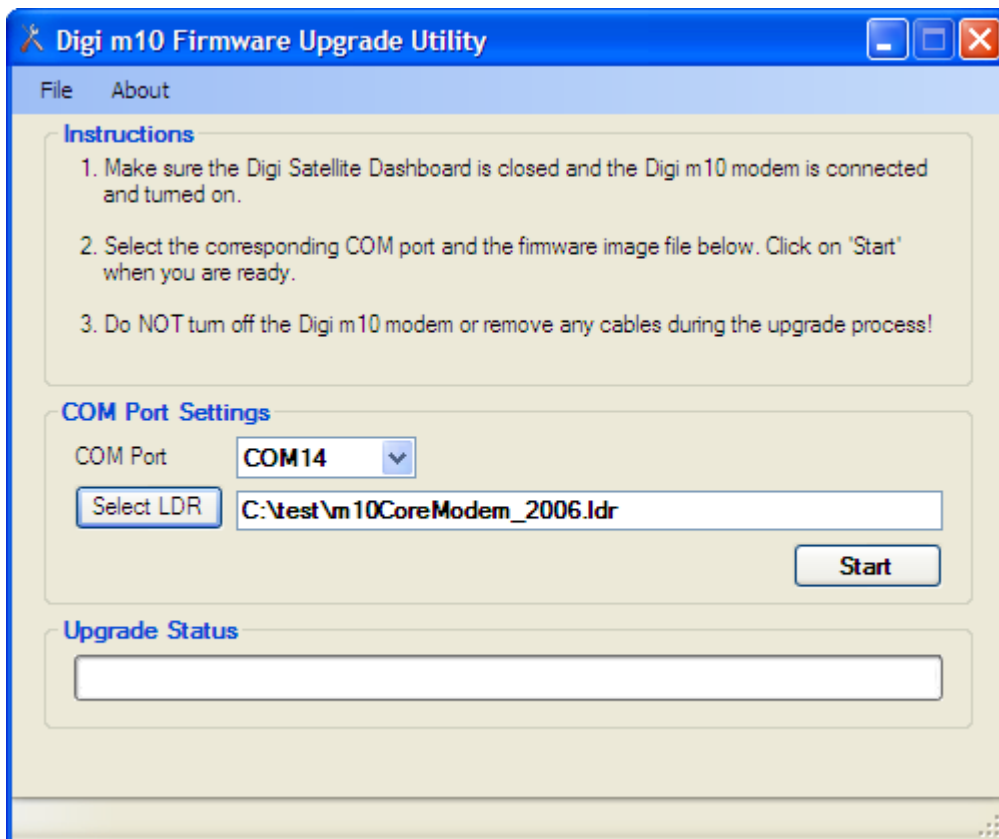
1. Communication over USB will NOT work when RTS/CTS is enabled.
2. DTE should disable RTS/CTS flow control before connecting to the Digi m10 development board using USB.


Appendix A: Update Firmware

- 1) Go to **Start > program Files > Digi > Digi m10 Jumpstart Kit > Tools** and Click on “Firmware update”.



- 2) Once application starts, select COM port and the required firmware file (.ldr) from saved location and click on Start button.



You will see following screen when your modem has upgraded successfully. Click  to close the firmware upgrade utility and start the Digi m10 dashboard application.