Iridium Router-based Unstructured Digital Information Connectivity Solution (RUDICS) Developer's Guide

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Revision History

Date	Version	Description	Author
03/01/2012	1.0	First Draft	Tina Dempsey Jones

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1.0 Introduction

The purpose of this document is to provide technical and operational information sufficient for an Iridium Value Added Reseller or Value Added Manufacturer to be able to develop an integrated data application that utilizes Iridium's Router-based Unstructured Digital Information Connectivity Solution (RUDICS). An overview of the satellite network is provided. 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.

1.1 Glossary of Terms

SV – Space Vehicle

ISU – Iridium Subscriber Unit

MO – Mobile Originated

MT – Mobile Terminated

FTP – File Transfer Protocol

HDLC – High-Level Data Link Control

PPP – Point to Point Protocol

MLPP – MulitLink Point to Ponit Protocol

2.0 RUDICS Overview

This section will provide information for the different connectivity capabilities of the RUDICS system in the Iridium network.

2.1 Product Description

RUDICS is a data service that allows customers to send and receive data traffic over the Iridium network using a circuit switched data channel. Connections are established via a dial-up modem and ISDN for low-bandwidth data transfer for ISUs, enabling a host application to originate and terminate numerous connections simultaneously. This solution utilizes Network Access Servers to provide modem ports, supporting both Mobile-Originated (MO) and Mobile-Terminated (MT) Circuit Switch Data calls.

2.2 RUDICS Features and Benefits

RUDICS offers features to help benefit the customer's data communications. These features and benefits include: Security, Enhanced Connection Speed, Data communication efficiency and Operating efficiency.

Security features that are built into RUDICS that includes the ability to allow only designated users of the service access.The RUDICS device must call the special specific number assigned for a particular RUDICS group. The MSISDN of the calling unit is validated before access is granted. This is a secure feature in that only group members are allowed to connect. This built in security reduces the need for username/password verification by the host.

RUDICS offers enhanced data connection speeds, by providing faster data set-up time. ISU-ISU and ISU-PSTN data calls typically take 25-30 seconds, while RUDICS calls typically establish in 9-13 seconds (end-to-end). RUDICS service is efficient for customers because it provides the most efficient circuit switched data connection across the Iridium Network with quality, reliability and maximized data throughput. End users do not have to allow for additional training time with the service by providing analog modem training, because using RUDICS service is like placing a phone call, lowering a customer's overall call costs.

RUDICS provides flexibility in both the operating system and transfer protocol utilized. The only requirement for an operating system is that it must facilitate the utilization of AT commands through a modem driver. PPP RUDICS allows connectivity for applications requiring a TCP/IP stack. A Standard RUDICS connection is connected between the Iridium gateway and the host server via a telnet connection which allows the application itself to be transfer protocol agnostic.

3.0 RUDICS Operations

This section provides the information necessary to interface an Iridium Subscriber Unit (ISU) to the Router-based Unstructured Digital Information Connectivity Solution (RUDICS) communications system.

3.1 Call Processing - Interconnection Model for Data Services

In order to process a RUDICS call, there are specific requirements that an ISU needs to follow; these requirements apply to interactions between ISU and data terminal equipment.

Iridium follows the GSM paradigm in support of data services. Within this paradigm, any data communications (MO/MT) from the ISU is transferred via the L-Band channel to a modem at the Gateway using the Iridium network. The peer-to-peer relationship between the ISU and the Gateway Interworking function (IWF) is carried by Iridium versions of the GSM Radio Link Protocol (RLP) and Layer 2 Relay (L2R) procedures. These are referred to as IRLP and IL2R, respectively.
The interconnection model is shown in the diagram at the layer 2 level. IL2R and IRLP are described in subsequent sections of this specification.

3.1.1 Modem Configuration

In order to use a RUDICS implementation, the field application must have a modem driver installed which supports AT commands. The communication between the ISU (Iridium Subscriber Unit) and the DTE (Data Terminal Equipment) follows the ITU-T V.24 (RS-232) recommendation. ITU-T V.24 (RS-232) is a standard for the interchange of serial binary data between devices. This standard is required for any data call, but the following shows commands specific to RUDICS.

At the present time, all Iridium phones are Hayes compatible. The Hayes AT command set, the de facto standard language for controlling modems, was originally developed by Hayes Microcomputer Products.

In addition to the standard Hayes commands, additional command support is provided. The additional command support includes support for some AT commands specified for GSM handsets as well as some Iridium-specific commands. Since the Iridium phones are Hayes compatible, control and configuration is very much the same as for the vast majority of modems in use today. This also results in the ISU being interoperable with most commonly used communications software.

The ISU also supports a full 9-wire interface to the DTE, incorporating hardware handshaking and flow control. A 3-wire DTE interface, where only transmit, receive, and ground signals are used, is supported in those ISUs where the AT&D0 command has been revised to ignore the DTR (Data Terminal Ready) signal. When operating with a 3-wire connection, the following limitations apply:

- AT&Dn must be set to AT&D0 to ignore the DTR input from the DTE, as it will not be present as an input from the DTE
- AT&Kn must be set to AT&K0 for no flow control or AT&K4 for XON/XOFF software flow

control, as RTS (Request To Send) and CTS (Clear To Send) hardware flow control signals will not be present
- AT&Cn setting will have no effect, as DCD (Data Carrier Detect) output to the DTE will not be present
- AT&Sn setting will have no effect, as DSR (Data Set Ready) output to the DTE will not be present
- RI (Ring Indicate) output to the DTE will not be present

3.1.2 Configuration Settings

The ISU allows the DTE to configure the communication parameters. The three configuration types are active, factory default, and stored.

- **Active** - The active configuration is the set of parameters currently in use. This configuration can be changed by the DTE individually via specific AT commands.
- **Factory Default** - The factory default configuration is stored in permanent memory. This configuration can be recalled at any time by through use of the AT&Fn command. **Stored** - Two groups of settings, or "profiles", can be stored as user-defined configuration. The DTE first creates desired active configurations and then writes them to memory using the AT&Wn command. These profiles can be designated to be loaded as the active configuration upon ISU power-up through use of the AT&Yn command. Similarly, the ISU can be reset without loss of power to these profiles through use of the ATZn command.

Most of the configuration settings are reflected in "S-register" locations. S-register is the term used by Hayes-compatible modems for a specific physical location in memory.

3.2 Production Environment - RUDICS Configurations

There are three types of services, or call types offered by RUDICS in the production environment:

1) RUDICS Standard Mobile Originated (STD-MO);

2) RUDICS Point to Point Protocol (PPP-MO) or Multilink Point to Point (MLPP-MO), which is the same as PPP, just using multiple connections; and

3) RUDICS Mobile Terminated (MT).

The following section will lay the groundwork for a customer to integrate their system onto the appropriate production environment configuration. It provides an overview of RUDICS STD – Mobile Originated messages, RUDICS PPP/MLPPP – Mobile Originated messages and RUDICS – Mobile Terminated (MT) messages.

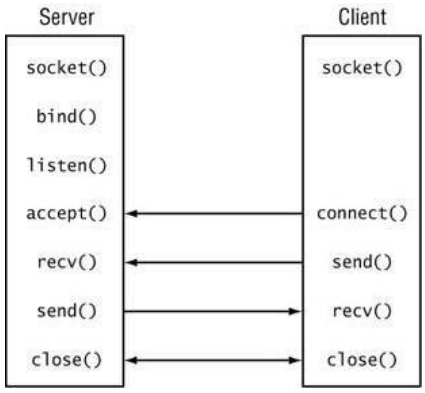
3.2.1 RUDICS STD – Mobile Originated (MO)

The RUDICS Standard configuration for Mobile Originated messages provides connectivity to a single IP and Port. This session will open a 2-way data session between the Field Application and the customer's host application. The connection becomes just a communications pipe; which provides data transfer services to the custom device.

The server side application should be a socket based application and is the responsibility of the

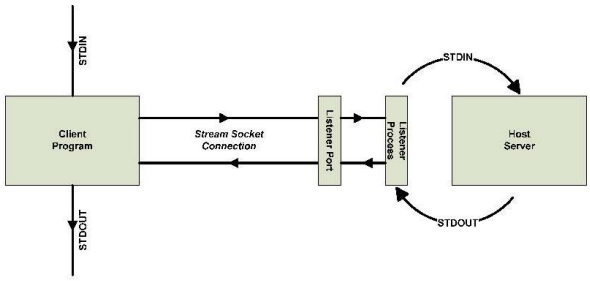
customer. This allows for the RUDICS system to make a single or multiple connections to a single IP Address and Port.

Figure 3.0 – Socket server application diagram



In a connection-oriented socket, the TCP protocol is used to establish a session (connection) between two IP Address endpoints. The socket on the server process waits for requests from a client. The server first establishes (binds) an address that clients can use to connect to the server. When the address is established, the server waits for clients to request a service. The client-to-server data exchange takes place when a client connects to the server through a socket.

Figure 3.1 - Connection oriented socket



The Group number is assigned based on Dialed Number Identification Service (DNIS), i.e. "881600005XX".

Once the Group has been assigned the SP or controller of the account will be allowed to add members to the Group. The member is the Iridium phone number, e.g. "8816314XXXXX". The members, when dialing the Group number will be authenticated using both the Origination number and Termination number. This means that ONLY a member of that Group will be able

to reach the Server IP and Port.

For a RUDICS Standard call the two parameters returned are: a telnet command to tell the access server where to send the call and a command to indicate that no further authentication is needed. Below is an example:

- AvPair1: shell:autocmd=telnet 212.165.122.34 1528 /quiet /noecho /stream
- AvPair2: preauth:auth-required=0

Using an application that can initiate "AT" commands users perform the following steps to originate a call to the RUDICS STD system.

Transmit:	at+cbst=71,0,1
Receive:	OK
Transmit:	atdt00881600005XX (Note: This is the Group number assigned.)
Receive:	Connect <Baud Rate>
Note:	The Baud Rate is reflected is that of the unit to the ISU and is dependent upon the unit capability.
Receive:	Trying X.X.X.X, Port … Open (Note: the X.X.X.X, Port is the destination TCP/IP address and Port.)

The Receive side of a socket will vary from configuration to configuration. Typically the information displayed is set to off. The following is a theoretical example of this configuration.

- Iridium customer calls RUDICs via the ISU modem.
- After the modem answers the call and establishes a physical connection, the ISU sends RUDICs a series of LCP packets in the payload field of one or more PPP frames. These packets and their responses select the PPP parameters to be used.
- Next a series of NCP packets are sent to configure the network layer.
- ISU device gets dynamic IP address from the RUDICs Router.
- The ISU is now automatically connected to a pre-defined Server and Port.
- The ISU finishes its session and NCP tears down the network layer connection and frees the IP address.
- LCP shuts down the data link connection.
- The FA tells the ISU to hang up, releasing the physical connection.

3.2.2 RUDICS PPP/MLPPP – Mobile Originated (MO)

3.2.2.1 Point-to-Point Protocol Multilink Protocol (MLPPP)

PPP Multilink Protocol (MLPPP) is a solution that will combine multiple physical links between a fixed pair of systems, providing a single virtual link with greater bandwidth.

MLPPP is an optional feature of PPP; it is designed to integrate seamlessly into regular PPP operation. To accomplish this, MLPPP is implemented as a new architectural “sub-layer” within PPP. A MLPPP sub-layer is inserted between the “regular” PPP mechanism and any network layer protocols using PPP.

To use MLPPP, both devices must have it implemented as part of their PPP software and must negotiate its use. This is done by LCP as part of the negotiation of basic link parameters in the Link Establishment phase. A system indicates to its peer that it is willing to do multilink by sending the multilink option as part of the initial LCP option negotiation. This negotiation indicates three things:

- The system offering the option is capable of combining multiple physical links into one logical link.
- The system is capable of receiving upper layer protocol data units (PDU) fragmented using the multilink header (described later) and reassembling the fragments back into the original PDU for processing.
- The system is capable of receiving PDUs of size N octets where N is specified as part of the option even if N is larger than the maximum receive unit (MRU) for a single physical link.

Once multilink has been successfully negotiated and an LCP link exists for each of the physical links, a virtual bundle is made of the LCP links and MLPPP is enabled.

3.2.2.2 RUDICS PPP/MLPPP - MO

A RUDICS PPP/MLPPP type of connectivity is designed for DTE devices with a TCP/IP Stack. Utilizing Dial-Up Internet access the user is able to dial the Group number and be connected to the Internet. This connection is designed for mobile originated only.

From a RUDICS Standard device the ISU calls the Group number assigned to the TCP/IP Customer. To call this number the phone must be configured to make an ISDN call. This is performed by setting the Call Bearer service on the ISU as follows "at+cbst=71,0,1". This sets the phone to make a 9600 UDI type of call. The number to be dialed looks as follows "00881600005XX". Once the call comes into the RUDICS system, two validations are performed. The first is the validation of the Group Number; the second is the validation of the originating number.

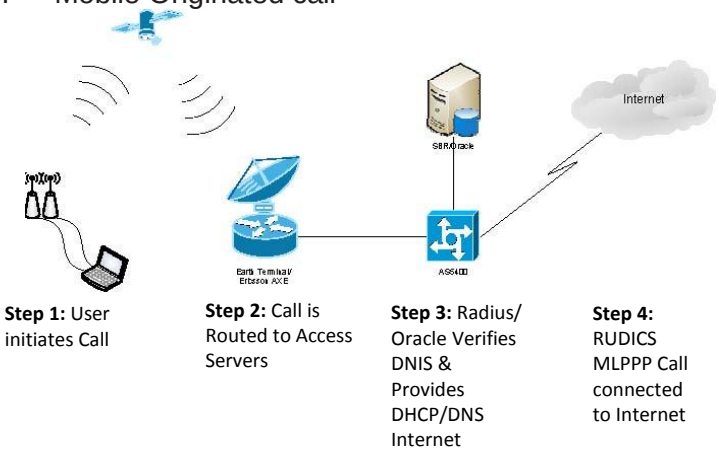
For a PPP/MLPPP call a parameter is returned indicating that further authentication is required and sends two DNS servers to the access servers. The access server then performs authentication with the client, this is used primarily for logging. The DNS servers are ignored by the access servers and are passed to the client along with DHCP Address. An example of the PPP attributes is below:

AVPair1: preauth:auth-required=1
DNS1: 12.127.17.72
DNS2: 204.97.212.10

Using an application that can initiate “AT” commands users can perform the following steps to originate a call to the RUDICS STD system.

Transmit:	**at+cbst=71,0,1**
Receive:	OK
Transmit:	atdt00881600005XX (Note: This is the Group number assigned.)
Receive:	Connect <Baud Rate>
Note:	The Baud Rate is reflected is that of the unit to the ISU and is dependent upon the unit capability.
Receive:	Trying X.X.X.X, Port … Open (Note: the X.X.X.X, Port is the destination TCP/IP address and Port.)

Figure 3.2 – PPP/MLPPP – Mobile Originated call



1. Iridium customer calls RUDICs via the ISU modem.
2. After the modem answers the call and establishes a physical connection, the ISU sends RUDICs a series of LCP packets in the payload field of one or more PPP frames. These packets and their responses select the PPP parameters to be used. LCP and NCP are functions within the PPP protocol.
3. Next a series of NCP packets are inside the PPP data gram and are fields within long string of data that is sent to the RUDICS Router from the ISU [FROM WHERE TO WHERE USING WHAT?] to configure the network layer.
4. ISU device gets dynamic IP address from the RUDICs Router or an assigned static IP, if RUDICs VPN is configured.
5. The ISU is now an Internet host that can send and receive IP packets.
6. Iridium customer can initiate additional calls to increase bandwidth. Using the MLPPP protocol to initiate another call and that call will be bonded to the existing call so that bandwidth is increases to the bandwidth of the new call.
7. The ISU finishes its session and NCP tears down the network layer connection and frees the IP address.
8. LCP shuts down the data link connection.
9. The ISU device tells the ISU modem(s) to hang up, releasing the physical connection.

3.2.3 RUDICS – Mobile Terminated (MT)

The RUDICS – Mobile Terminated service allows customers to originate a call from a host server on the Internet, and have it directed to the ISU. If the Mobile-terminated feature is requested, a customer is allocated 5 physical ports on one of the Network Access Servers at the Iridium Gateway. AT modem commands are then used to connect to the ISU.

- To access this port, the customer will execute a reverse-telnet session to the Iridium gateway:
    - telnet 12.47.179.50 2005

This service does not require authentication, however the customer's IP address must be in the Iridium firewall to be able to connect to the specified server and ports on the Network Access Server.

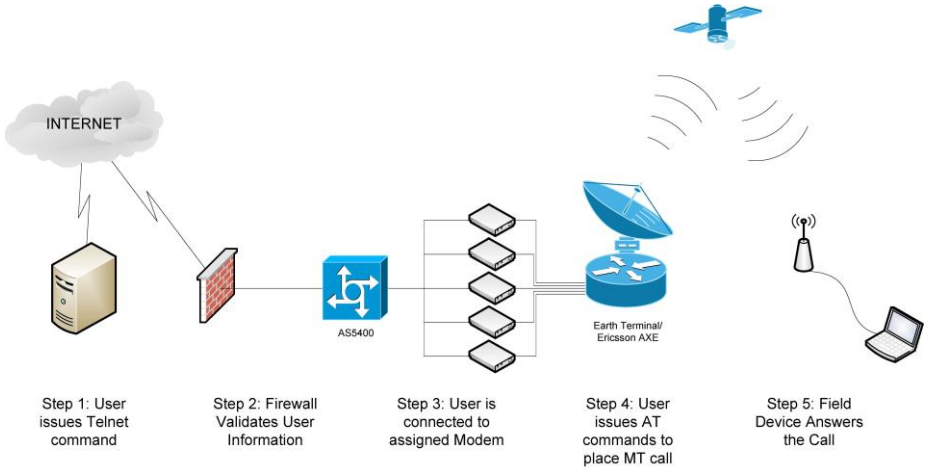
The Firewall rule includes the Customer's Server IP Address, the external IP address of Network Access Server, and the 5 ports allocated upon initial MT configuration are included as part of the data Firewall entry.

After the firewall is opened, the user can then dial any ISU in the system. Using an application that can initiate telnet and commands within the telnet session perform the following steps to originate a call through the RUDI-CS system to an Iridium Subscriber Unit.

The following example outlines steps that can be referenced to dial an ISU in the system.

Transmit:	**"telnet X.X.X.X YYYY"** **(Note: The X.X.X.X and YYYY will be given upon original group configuration)**
Receive:	Blank Screen (Note: Telnet will know if the connection was made or not. If the connection was not established the telnet session will show the connection refused.)
Transmit:	"ats29=8" (Note: This sets the call type to V.110.)
Receive:	"OK"
Transmit:	"ats57=9600" (Note: This sets the call speed to 9600 baud.)
Receive:	"OK"
Transmit:	"atdi008816929XXXXX" (Note: From the RUDICS system only the MSISDN-C number is enabled.) **Good Call:** Receive: "CONNECT 9600 /V110" **If Busy:** Receive: "BUSY" If No Answer: Receive: "No Carrier"

Figure 3.3 – Mobile Terminated Call



- Establish telnet session to RUDICS service
- After a connection is established, the customer initiates a modem call to the ISU; using standard AT commands.
- After the ISU answers the call and establishes a physical connection, RUDICs sends a series of LCP packets in the payload field of one or more PPP frames. These packets and their responses select the PPP parameters to be used.
- Next a series of NCP packets are sent to configure the network layer.
- ISU device gets dynamic IP address from the RUDICs Router and can now send and receive IP packets.
- When the session is finished, NCP tears down the network layer connection and frees the IP address.
- LCP shuts down the data link connection, releasing the physical connection.