Military/Government Protocols Programmer Guide

DC 900-1602J

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Military/Government Protocols Programmer Guide

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Preface

Purpose of Document

This document describes the operation and programming interface for using Protogate's Military/Government Protocols product for the Freeway communications server (or embedded ICP). This product implements several synchronous and asynchronous protocols.

Note

In this document, the term "Freeway" can mean either a Freeway server or an embedded ICP. For the embedded ICP, also refer to the user's guide for your ICP and operating system (for example, the *Freeway Embedded ICP2432 User's Guide for Windows NT*).

Intended Audience

This document should be read by programmers who are interfacing a client application program to Protogate's Military/Government Protocols product running on a Freeway server or an embedded ICP. You should understand the Freeway data link interface (DLI), as explained in the *Freeway Data Link Interface Reference Guide*.

This document supports your protocol-specific *Military/Government Protocols Programmer's Guide* (see the *Protogate References* section on page 15 for a complete list). You must be familiar with the communication message formats detailed in the protocol-specific guide.

Required Equipment

The Military/Government Protocols product requires the following major hardware components to operate:

- a Freeway communications server or an embedded ICP that runs the communications software
- a client computer that runs the following:
  - TCP/IP (for a Freeway server)
  - Freeway DLI
  - the user application program

Organization of Document

Chapter 1 is an overview of Freeway and the Military/Government Protocols product.

Chapter 2 discusses data link interface (DLI) concepts and how they apply specifically to the Military/Government Protocols environment.

Chapter 3 describes how to use the DLI between the client application program and the Military/Government Protocols communications software running on the ICP.

Chapter 4 describes the message formats for Military/Government Protocols synchronous protocol messages.

Chapter 5 describes the message formats for Military/Government Protocols asynchronous protocol messages.

Appendix A describes the Military/Government Protocols loopback test program.

Appendix B is an overview of the configuration process for DLI sessions and TSI connections.

Appendix C is an overview of input data time stamping for Protogate's Military/Government Protocols.

Protogate References

The following general product documentation list is to familiarize you with the available Protogate Freeway and embedded ICP products. The applicable product-specific reference documents are mentioned throughout each document (also refer to the "readme" file shipped with each product). Most documents are available on-line at Protogate's web site, www.protogate.com.

Hardware Support

• *Freeway 3100 Hardware Installation Guide*	DC-900-2002
• *Freeway 3200 Hardware Installation Guide*	DC-900-2003
• *Freeway 3400 Hardware Installation Guide*	DC-900-2004
• *Freeway 3600 Hardware Installation Guide*	DC-900-2005
• *ICP2432B Hardware Description and Theory of Operation*	DC-900-2006
• *ICP2432B Hardware Installation Guide*	DC-900-2009

Freeway Software Installation and Configuration Support

• *Freeway Message Switch User Guide*	DC-900-1588
• *Freeway Release Addendum: Client Platforms*	DC-900-1555
• *Freeway User Guide*	DC-900-1333
• *Freeway Loopback Test Procedures*	DC-900-1533

Embedded ICP Software Installation and Programming Support

• *ICP2432 User Guide for Tru64 Unix*	DC-900-1513
• *ICP2432 User Guide for OpenVMS Alpha*	DC-900-1511
• *ICP2432 User Guide for OpenVMS Alpha (DLITE Interface)*	DC-900-1516
• *ICP2432 User Guide for Solaris STREAMS*	DC-900-1512
• *ICP2432 User Guide for Windows NT*	DC-900-1510
• *ICP2432 User Guide for Windows NT (DLITE Interface)*	DC-900-1514

Application Program Interface (API) Programming Support

• *Freeway Data Link Interface Reference Guide*	DC-900-1385
• *Freeway Transport Subsystem Interface Reference Guide*	DC-900-1386
• *QIO/SQIO API Reference Guide*	DC-900-1355

Socket Interface Programming Support

• *Freeway Client-Server Interface Control Document*	DC-900-1303

Toolkit Programming Support

• *Freeway OS/Protogate Programmer's Guide*	DC-900-2008
• *Freeway Protocol Software Toolkit Programmer's Guide* [with OS/Protogate]	DC-900-2007
• *Freeway Server-Resident Application and Server Toolkit Programmer Guide*	DC-900-1325

Military/Government Protocols Support (Synchronous)

• *Military/Government Protocols Programmer's Guide*	DC-900-1602
• *AIRCAT 500 Military/Government Protocol Programmer's Guide*	DC-908-1605
• *ATDL-1/UDL Military/Government Protocol Programmer's Guide*	DC-908-1606
• *CD2 Military/Government Protocol Programmer's Guide*	DC-900-1607
• *Common Format Military/Government Protocol Programmer's Guide*	DC-908-1608
• *IDL Military/Government Protocol Programmer's Guide*	DC-908-1609
• *Lateral Tell Military/Government Protocol Programmer's Guide*	DC-908-1610
• *Link 1 Military/Government Protocol Programmer's Guide*	DC-908-1604
• *Link 11B (TADIL-B) Military/Government Protocol Programmer's Guide*	DC-908-1601
• *LRR Military/Government Protocol Programmer's Guide*	DC-908-1611
• *MBDL Military/Government Protocol Programmer's Guide*	DC-908-1612
• *MBDL II Military/Government Protocol Programmer's Guide*	DC-908-1613
• *MCC Military/Government Protocol Programmer's Guide*	DC-908-1614
• *Nine-Bit Radar Military/Government Protocol Programmer's Guide*	DC-908-1615
• *RAT-31S Military/Government Protocol Programmer's Guide*	DC-908-1616
• *TACC Military/Government Protocol Programmer's Guide*	DC-908-1617
• *Transparent Bisync Radar Military/Government Protocol Programmer's Guide*	DC-900-1618

Military/Government Protocols Support (Asynchronous)

• *Asynchronous Military/Government Protocol Programmer's Guide*	DC-900-1621
• *ICAO Military/Government Protocol Programmer's Guide*	DC-900-1622

• *GDL Military/Government Protocol Programmer's Guide*	DC-908-1626
• *Link 14 Military/Government Protocol Programmer's Guide*	DC-908-1623
• *MTDL Military/Government Protocol Programmer's Guide*	DC-908-1627
• *NOAH Military/Government Protocol Programmer's Guide*	DC-908-1624
• *SR162 Military/Government Protocol Programmer's Guide*	DC-900-1625

Obsolete Freeway Hardware/Software Support

• *Freeway 1100/1150 Hardware Installation Guide*	DC-900-1370
• *Freeway 1200/1300 Hardware Installation Guide*	DC-900-1537
• *Freeway 2000/4000 Hardware Installation Guide*	DC-900-1331
• *Freeway 8800 Hardware Installation Guide*	DC-900-1553
• *Freeway ICP6000R/ICP6000X Hardware Description*	DC-900-1020
• *ICP6000(X)/ICP9000(X) Hardware Description and Theory of Operation*	DC-900-0408
• *ICP2424 Hardware Description and Theory of Operation*	DC-900-1328
• *ICP2432 Hardware Description and Theory of Operation*	DC-900-1501
• *ICP2432 Electrical Interfaces (Addendum to DC-900-1501)*	DC-900-1566
• *ICP2432 Hardware Installation Guide*	DC-900-1502
• *OS/Impact Programmer Guide*	DC-900-1030
• *Protocol Software Toolkit Programmer Guide* [with OS/Impact]	DC-900-1338

Document Conventions

This document follows the most significant byte first (MSB) and most significant word first (MSW) conventions for bit-numbering and byte-ordering. In all packet transfers between the client applications and the ICPs, the ordering of the byte stream is preserved. However, Military/Government Protocols packed data contains word values that are not byte-swapped.

The term “Freeway” refers to any of the Freeway server models (for example, Freeway 500/3100/3200/3400 PCI-bus servers, Freeway 1000 ISA-bus servers, or Freeway 2000/4000/8800 VME-bus servers). References to “Freeway” also may apply to an embedded ICP product using DLITE (for example, the embedded ICP2432 using DLITE on a Windows NT system).

The serial ports on the ICPs are logically referred to as “links.” This document uses the term “link.” The links are logically numbered from 1–n, where n is the number of physical ports on the ICP.

Program code samples are written in the “C” programming language.

Revision History

The revision history of the *Military/Government Protocols Programmer Guide*, Protogate document DC 900-1602J, is recorded below:

Revision	Release Date	Description
DC 900-1602A	October 1998	Original release.
DC 900-1602B	November 1998	Use “Link Status Notification” terminology.
DC 900-1602C	February 1999	Modify Appendix A to provide loopback test output. Modify Appendix B for embedded ICPs. Modify Figure 2–1 on page 38 for embedded ICPs.
DC 900-1602D	June 1999	Add Configure Link Acknowledgment for asynchronous protocols (Section 5.3.2 on page 101)
DC 900-1602E	July 1999	Minor modifications throughout for clarity. Add iICPStatus field information (Table 3–4 on page 49). Enhance buffer sizing information (Section 4.2.2 on page 62 and Section 4.2.3 on page 62). Add protocol-specific command (Section 4.2.17 on page 71) and response (Section 4.3.17 on page 87).
DC 900-1602F	November 1999	Add common (synchronous and asynchronous) function codes to Table 5–2 on page 97 and Table 5–3 on page 100.
DC 900-1602G	July 2002	Update contact information for Protogate, Inc. Add the Link Configuration Report for synchronous protocols (Section 4.2.9 on page 65). Minor modifications throughout for clarity.
DC 900-1602H	December 2002	Update the description of time-stamping in Appendix C. Change the Set Time Stamp Interval command to Set Time Stamping (Section 4.2.4 on page 63); update its description and the description of the Set Time Stamp Value command (Section 4.2.16 on page 69).

Revision	Release Date	Description
DC 900-1602I	February 2003	Add negative acknowledgements of transmit expirations to the Link Statistics report (Table 4–9 on page 80) and to the Transmit Acknowledgement notification (Section 4.3.19 on page 87). Minor modifications throughout for clarity.
DC 900-1602J	March 2004	Add Configure ICP (Section 4.2.1 on page 55) and ICP Configuration Report (Section 4.3.23 on page 90) -- thus obsoleting Configure Segmentation Buffers, Configure Communication Buffers, Set Time Stamping, Set Signal Monitor Interval, Set Blocking Interval, Request Version ID, and Request ICP Links Report, as well as obsoleting their responses. Add link configuration options to assign the link protocol (thus obsoleting the Set Link Protocol command and its response) and to assign the link blocking interval (Section 4.2.9 on page 65). (The above obsoleted commands do remain supported.)

Customer Support

If you are having trouble with any Protogate product, call us at (858) 451-0865 Monday through Friday between 8 a.m. and 5 p.m. Pacific time.

You can also fax your questions to us at (877) 473-0190 any time. Please include a cover sheet addressed to “Customer Service.”

We are always interested in suggestions for improving our products. You can use the report form in the back of this manual to send us your recommendations.

Chapter 1 Introduction

1.1 Product Overview

Protogate provides a variety of wide-area network (WAN) connectivity solutions for real-time financial, defense, telecommunications, and process-control applications. Protogate's Freeway server offers flexibility and ease of programming using a variety of LAN-based server hardware platforms. Now a consistent and compatible embedded intelligent communications processor (ICP) product offers the same functionality as the Freeway server, allowing individual client computers to connect directly to the WAN.

Both Freeway and the embedded ICP use the same data link interface (DLI). Therefore, migration between the two environments simply requires linking your client application with the proper library. Various client operating systems are supported (for example, UNIX, VMS, and Windows NT).

Protogate protocols that run on the ICPs are independent of the client operating system and the hardware platform (Freeway or embedded ICP).

1.1.1 Freeway Server

Protogate's Freeway communications servers enable client applications on a local-area network (LAN) to access specialized WANs through the DLI. The Freeway server can be any of several models (for example, Freeway 3100, Freeway 3200, Freeway 3400, or Freeway 3600). The Freeway server is user programmable and communicates in real time. It provides multiple data links and a variety of network services to LAN-based clients. Figure 1–1 shows the Freeway configuration.

To maintain high data throughput, Freeway uses a multi-processor architecture to support the LAN and WAN services. The LAN interface is managed by a single-board computer, called the server processor. It uses the commercially available BSD Unix operating system (VxWorks on older Freeway systems) to provide a full-featured base for the LAN interface and layered services needed by Freeway.

Freeway can be configured with multiple WAN interface processor boards, each of which is a Protogate ICP. Each ICP runs the communication protocol software using Protogate's real-time operating system.

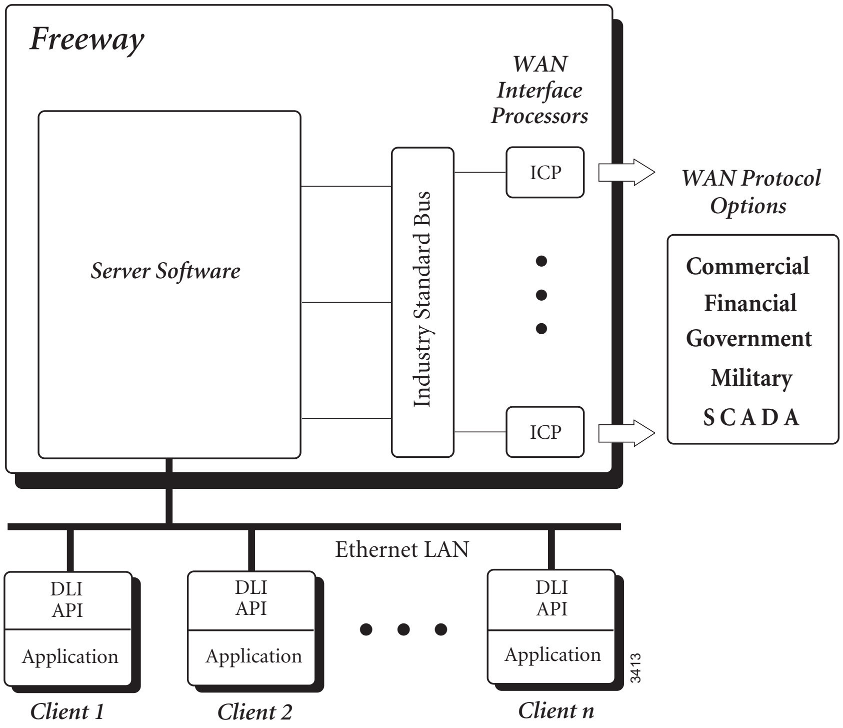


Figure 1–1: Freeway Configuration

1.1.2 Embedded ICP

The embedded ICP connects your client computer directly to the WAN (for example, using Protogate's ICP2432B PCIbus board). The embedded ICP provides client applications with the same WAN connectivity as the Freeway server, using the same data link interface (via the DLITE embedded interface). The ICP runs the communication protocol software using Protogate's real-time operating system. Figure 1–2 shows the embedded ICP configuration.

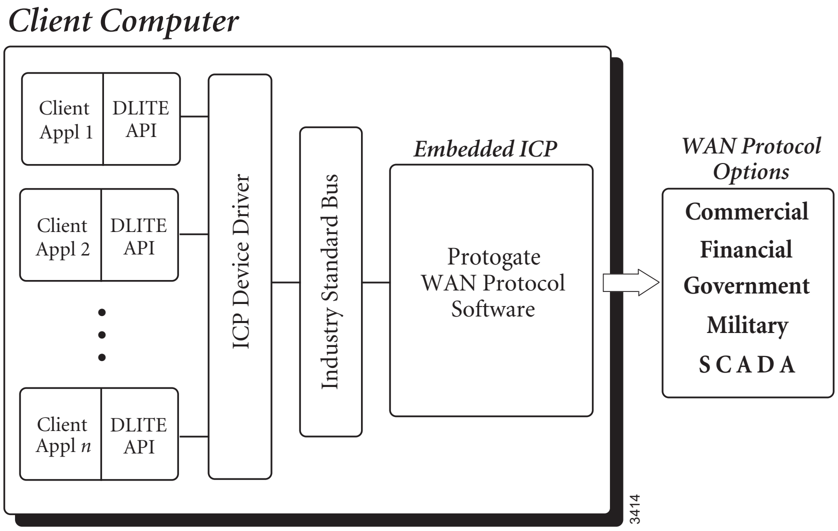


Figure 1–2: Embedded ICP Configuration

Summary of product features:

- Provision of WAN connectivity either through a LAN-based Freeway server or directly using an embedded ICP
- Elimination of difficult LAN and WAN programming and systems integration by providing a powerful and consistent data link interface
- Variety of off-the-shelf communication protocols available from Protogate which are independent of the client operating system and hardware platform
- Support for multiple WAN communication protocols simultaneously
- Support for multiple ICPs (two, four, eight, or sixteen communication lines per ICP)
- Wide selection of electrical interfaces including EIA-232, EIA-449, EIA-530, and V.35
- Creation of customized server-resident and ICP-resident software, using Protogate's software development toolkits
- Freeway server standard support for Ethernet and Fast Ethernet LANs running the transmission control protocol/internet protocol (TCP/IP)
- Freeway server standard support for FDDI LANs running the transmission control protocol/internet protocol (TCP/IP)
- Freeway server management and performance monitoring with the simple network management protocol (SNMP), as well as interactive menus available through a local console, telnet, or rlogin

1.2 Freeway Client-Server Environment

The Freeway server acts as a gateway that connects a client on a local-area network to a wide-area network. Through Freeway, a client application can exchange data with a remote data link application. Your client application must interact with the Freeway server and its resident ICPs before exchanging data with the remote data link application.

One of the major Freeway server components is the message multiplexor (MsgMux) that manages the data traffic between the LAN and the WAN environments. The client application typically interacts with the Freeway MsgMux through a TCP/IP BSD-style socket interface (or a shared-memory interface if it is a server-resident application (SRA)). The ICPs interact with the MsgMux through the DMA and/or shared-memory interface of the industry-standard bus to exchange WAN data. From the client application's point of view, these complexities are handled through a simple and consistent data link interface (DLI), which provides dlOpen, dlWrite, dlRead, and dlClose functions.

Figure 1–3 shows a typical Freeway connected to a locally attached client by a TCP/IP network across an Ethernet LAN interface. Running a client application in the Freeway client-server environment requires the basic steps described in Section 1.4.

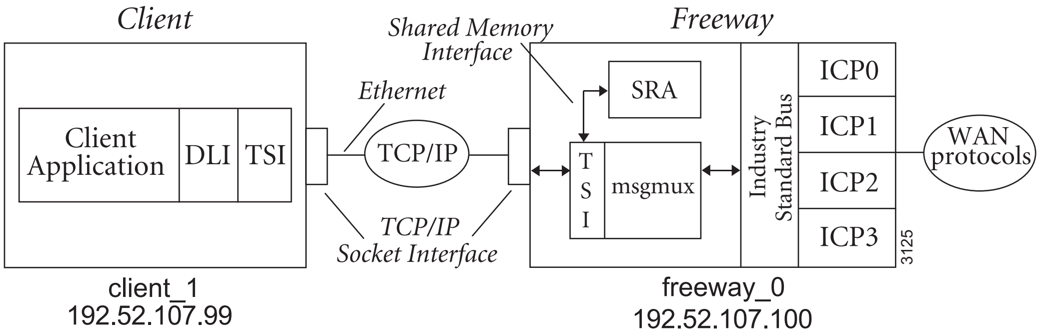


Figure 1–3: A Typical Freeway Server Environment

1.2.1 Establishing Freeway Server Internet Addresses

The Freeway server must be addressable in order for a client application to communicate with it. In the Figure 1–3 example, the TCP/IP Freeway server name is freeway_0, and its unique Internet address is 192.52.107.100. The client machine where the client application resides is client_1, and its unique Internet address is 192.52.107.99. Refer to the *Freeway User Guide* to initially set up your Freeway and download the operating system, server, and protocol software to Freeway.

1.3 Embedded ICP Environment

Refer to the user's guide for your embedded ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*) for software installation and setup instructions. The user's guide also gives additional information regarding the data link interface (DLI) and embedded programming interface descriptions for your specific embedded environment. Refer back to Figure 1–2 on page 23 for a diagram of the embedded ICP environment. Running a client application in the embedded ICP environment requires the basic steps described in Section 1.4

1.4 Client Operations

1.4.1 Defining the DLI and TSI Configuration

You must define the DLI sessions and the transport subsystem interface (TSI) connections between your client application and Freeway (or an embedded ICP). To accomplish this, you first define the configuration parameters in DLI and TSI ASCII configuration files, and then you run two preprocessor programs, dlicfg and tsicfg, to create binary configuration files (see Appendix B). The dlInit function uses the binary configuration files to initialize the DLI environment.

1.4.2 Opening a Session

After the DLI and TSI configurations are properly defined, your client application uses the dlOpen function to establish a DLI session with an ICP link. As part of the session establishment process, the DLI establishes a TSI connection with the Freeway MsgMux through the TCP/IP BSD-style socket interface for the Freeway server, or directly to the client driver for the embedded ICP environment.

1.4.3 Exchanging Data with the Remote Application

After the link is enabled, the client application can exchange data with the remote application using the dlWrite and dlRead functions.

1.4.4 Closing a Session

When your application finishes exchanging data with the remote application, it calls the dlClose function to disable the ICP link, close the session with the ICP, and disconnect from Freeway (or the embedded ICP).

1.5 Software Description

Protogate's Military/Government Protocols product includes the following major software components:

- A group of communications software downloadable images:

    1. Freeway server or embedded ICP software

    2. Real-time operating system (OS/Protogate)

    3. Military/Government Protocols communications software

- DLI library for linking with client applications

- Test program (milalp.c) to check product installation (see Appendix A)

The *Freeway User Guide* or the user's guide for your particular embedded ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*) describes the software installation procedures. The DLI provides an interface by which data is exchanged between the client application and Freeway; refer to the *Freeway Data Link Interface Reference Guide*.

1.6 Hardware Description

A typical Freeway configuration of Protogate's Military/Government Protocols product requires the following hardware:

- Freeway communications server (for example, Freeway 3100, Freeway 3200 or Freeway 3400) or an embedded ICP (for example the PCIbus ICP2432B)

- Ethernet connection to a client running TCP/IP (for a Freeway server)

1.7 Military/Government Protocols Summary

Protogate's Freeway Military/Government Protocols product implements various synchronous and asynchronous communications protocols. These protocols are typically for tactical data-link or radar interfaces, such as Link 11B for tactical data and CD2 for radar. They may operate simultaneously and cooperatively in an arbitrary combination across the ports of a single ICP. In doing so, they make use of a common interface to the client.

The hardware is Protogate's Freeway communications server (or an embedded ICP) that interfaces a client application with communication data links to local or remote terminals. The software consists of general-purpose Protogate software that has been modified to support the specialized Military/Government Protocols. The combination of this hardware and software off-loads the communication processing from the client computer.

Each link on the Freeway ICPs operates independently and can be assigned any of the implemented protocols, with the result that any combination of the implemented protocols can operate simultaneously on the ICP.

The ICP software transfers individual protocol data messages at the links using relatively small blocks called communication buffers. The ICP/client interface transfers protocol data messages using relatively large blocks called segmentation buffers. Message segmentation reduces the number of client I/O requests, often for a substantial gain in efficiency. The ICP blocks individual data messages received from a serial link, supplying them to the client in a single buffer. The ICP deblocks individual data messages supplied by the client in a single buffer, for transmission to the links. The current incoming-data segmentation buffer for a link is flushed to the client when it becomes full, when its client-configured segmentation timer expires, or when a reportable link status change (such as loss of modem signal) occurs.

See Figure 1–4 for the usage of the segmentation and communication buffers. Section 4.2.2 on page 62 and Section 4.2.3 on page 62 describe the configuration of the respective buffer sizes by the client.

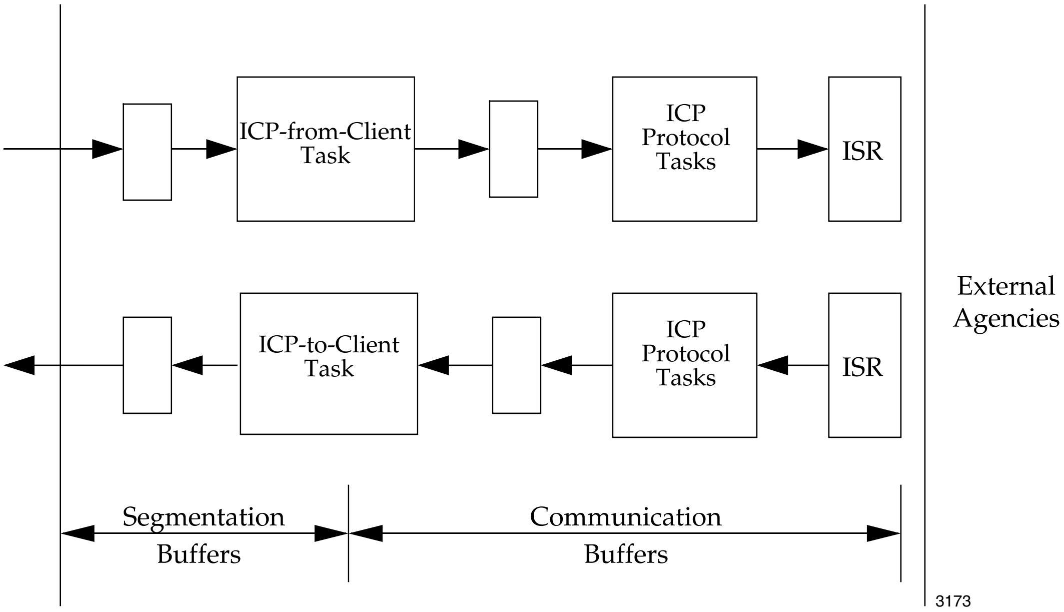


Figure 1–4: Segmentation and Communication Buffer Usage

1.7.1 Client Configuration of the Military/Government Protocols Environment

After the Military/Government Protocols software image is downloaded to the ICP (as described in the *Freeway User Guide* or the appropriate user's guide for your embedded ICP), the client application can configure the Military/Government Protocols software environment with the following features:

- One required General Session for the ICP as a whole, plus optional link-specific sessions.
- Segmentation buffers that contain up to 8128 bytes of data

- Communication buffers that contain up to 2048 bytes of data
- Modem signal monitoring
- Time stamping of received data messages
- Periodicity of flushing to client of accumulated receive data
- Link-by-link protocol selection
- Custom link configuration options appropriate to the selected protocol (data rate, clocking source, receive message size, etc.)

For protocol-specific operational and link-configuration details, refer to the individual protocol programmer's guides (listed in the *Protogate References* section on page 15).

1.7.2 Client Control

After client configuration of the environment is performed, the client can control the link activity. The client application uses messages to perform actions such as the following:

- Enable or disable a link for data exchange
- Provide transmit data messages
- Request link statistics, link status, and other reports

The ICP generates messages in response to client commands, such as the following:

- Confirmations of client commands
- Requested reports

The ICP generates messages to notify the client application of changes in the ICP environment. These messages contain information such as the following:

- Received data
- Modem signal changes
- Loss of receive data
- Statistics counter overflow
- Transmit and receive clocking signal status
- Receive data bit-stream anomalies (such as idle pattern loss)

The client application uses the DLI sessions to exchange messages with the ICP. Military/Government Protocols general message formats are described in Chapter 4 (for synchronous protocols) and in Chapter 5 (for asynchronous protocols). For protocol-specific message details, refer to the individual protocol programmer's guides (listed in the *Protogate References* section on page 15).

Chapter

2

DLI Concepts for the Military/Government Protocols Environment

Note

The term “Freeway” can mean either a Freeway server or an embedded ICP. For the embedded ICP, also refer to the user’s guide for your ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*).

This chapter first considers general data link interface (DLI) concepts and then addresses the specific DLI details affecting Military/Government Protocols.

2.1 Summary of DLI Concepts

The DLI presents a consistent, high-level, common interface across multiple clients, operating systems, and transport services. It implements functions that permit your application to use data link services to access, configure, establish and terminate sessions, and transfer data across multiple data link protocols. The DLI concepts are described in detail in the *Freeway Data Link Interface Reference Guide*. This section summarizes the basic information.

2.1.1 Configuration in the Freeway Environment

Several types of configuration affect how a client application runs in the Freeway environment:

- Freeway server configuration
- data link interface (DLI) session configuration

- transport subsystem interface (TSI) connection configuration
- protocol-specific ICP link configuration

The Freeway server is normally configured only once, during the installation procedures described in the *Freeway User Guide*. DLI session and TSI connection configurations are defined by specifying parameters in DLI and TSI ASCII configuration files (Section 2.2.1 gives an example DLI ASCII configuration file). You must then run two preprocessor programs, dlicfg and tsicfg, to create binary configuration files. For a description of the configuration process, refer to Appendix B of this document, as well as the *Freeway Data Link Interface Reference Guide* and the *Freeway Transport Subsystem Interface Reference Guide*. You must perform ICP link configuration within the client application (described in Section 4.2.10 on page 67 or Section 5.2.2 on page 97).

2.1.2 Non-blocking I/O

Note

Earlier Freeway releases used the term “asynchronous” for non-blocking I/O. Some parameter names (for example, the asyncIO DLI configuration parameter) reflect the previous terminology.

Non-blocking I/O applications are useful when doing I/O to multiple channels with a single process where it is not possible to “block” on any one channel waiting for I/O completion.

In the Freeway environment, the term non-blocking I/O indicates that the dlOpen, dlClose, dlRead and dlWrite functions might return after the I/O has been queued at the client, but before the transfer to Freeway is complete. The client must handle I/O completions at the software interrupt level in the completion handler established by the dlInit or dlOpen function, or by periodic use of dlPoll to query the I/O completion status.

For an application session to use non-blocking I/O, the asyncIO DLI configuration parameter must be set to “yes” (the default is “no”). The alwaysQIO DLI configuration parameter further qualifies the operation of non-blocking I/O activity. Refer to the *Freeway Data Link Interface Reference Guide* for more information.

2.1.3 Buffer Management

The default interrelated Freeway, DLI, and TSI buffer sizes correspond to the default ICP segmentation buffer data area size of 2048 bytes. This translates into the requirement of a maxBufSize TSI configuration parameter value of at least 2160 bytes in the client and server TSI configuration files. This is because room must also be provided for the segmentation buffer header (8 bytes; see Section 4.1.1 on page 52), the segmentation buffer system parameters area (28 bytes; see Section 4.3.14 on page 81), and a Freeway DLI header (76 bytes). The delivered Military/Government Protocols configuration files specify 2200 bytes.

Caution

If you need to change a buffer size for your application, refer to the *Freeway Data Link Interface Reference Guide* for explanations of the factors that you must consider.

2.2 Using the DLI in the Military/Government Protocols Environment

In the Freeway system, the client addresses Freeway sessions through the DLI. All DLI requests in the Military/Government Protocols client application must use the DLI *Raw* operation, which is discussed in detail in the *Freeway Data Link Interface Reference Guide*.

2.2.1 Initializing the DLI

The client application calls dlInit to initialize its interface to Freeway. This call specifies a DLI binary configuration file, which is generated off-line from a text file (see Appendix B for details of the configuration process). The text file contains definitions of the sessions that can be opened, as described in the following Section 2.2.2.

Since *Raw* operation does not perform automatic link configuration, no protocol-specific link configuration parameters are specified in the DLI configuration file.

2.2.2 Military/Government Protocols DLI Session Configuration

The DLI text configuration file consists of the following sections (the parameters are described in the *Freeway Data Link Interface Reference Guide*):

- A “main” section which specifies the DLI configuration for non-session-specific operations

- One section for each of the ICPs, defining its General Session.

- One or more additional sections, each specifying a session associated with a particular serial communication link (port). Each link can be configured independently of the other links.

For a Freeway server, each session has an associated TSI connection name (the transport parameter) which you also must specify in your TSI configuration file, though multiple sessions can use the same TSI connection. Embedded ICPs do not use a TSI configuration file.

Figure 2–1 (for a Freeway server) and Figure 2–2 (for an embedded ICP) show an example DLI configuration file defining the "main" section, the General Session, and two Military/Government Protocols sessions. You need to include only those session parameters whose values differ from the defaults. For Military/Government Protocols sessions, the required values which are different from the default values are:

- alwaysQIO = "yes"
- asyncIO = "yes"
- cfgLink = "no"
- enable = "no"
- localAck = "no"
- protocol = "raw"

Although the Military/Government Protocols link numbering is 1-based (employing the range of 1–*n*, where *n* is the number of physical ports), the DLI link designations are 0-based, employing the range 0–(*n*-1). For example, the DLI configuration for a session must specify "portNo=0" for link 1. DLI configuration of ICP numbers also is 0-based.

2.2.3 Opening and Attaching DLI Sessions

The client application calls dlOpen to open a required session to an ICP, called the General Session, in order to communicate with that ICP. The General Session is not link-specific. It is intended as the means of configuring and controlling the ICP as a whole. It is also the default session for sending all messages to the client. However, the client normally opens additional sessions to specific links. A link-specific session is mapped to a single link. Each link is allowed to have only one link-specific session mapped to it, although messages for any link can continue to be transferred either way through the General Session. The General Session is indicated in client commands to the ICP by specifying 0 in place of a link number.

```
main                                // DLI “main” section:                  //
{
    asyncIO = “yes”;                // Use non-blocking I/O                 //
    tsiCfgName = “miltcfg.bin”;     // TSI binary config file               //
}
ICP0General                         // General Session name:                //
{                                   // Client-related parameters:           //
    alwaysQIO = “yes”;              //     Queue I/Os even if complete      //
    asyncIO = “yes”;                //     Use non-blocking I/O             //
    cfgLink = “no”;                 //     Client configures links          //
    enable = “no”;                  //     Client enables links             //
    localAck = “no”;                //     Client processes transmit ack    //
    boardNo = 0;                    //     First ICP is zero                //
    portNo = 0;                     //     First ICP link is zero           //
    protocol = “raw”;               //     Use raw operation                //
    transport = “ConnG”;            //     TSI connection name specified    //
                                    //       in TSI configuration file      //
}
ICP0link0                           // First session name:                  //
{                                   // Client-related parameters:           //
    alwaysQIO = “yes”;              //     Queue I/Os even if complete      //
    asyncIO = “yes”;                //     Use non-blocking I/O             //
    cfgLink = “no”;                 //     Client configures links          //
    enable = “no”;                  //     Client enables links             //
    localAck = “no”;                //     Client processes transmit ack    //
    boardNo = 0;                    //     First ICP is zero                //
    portNo = 0;                     //     First ICP link is zero           //
    protocol = “raw”;               //     Use raw operation                //
    transport = “Conn0”;            //     TSI connection name specified    //
                                    //       in TSI configuration file      //
}
ICP0link1                           // Second session name:                 //
{                                   // Client-related parameters:           //
    alwaysQIO = “yes”;              //     Queue I/Os even if complete      //
    asyncIO = “yes”;                //     Use non-blocking I/O             //
    cfgLink = “no”;                 //     Client configures links          //
    enable = “no”;                  //     Client enables links             //
    localAck = “no”;                //     Client processes transmit ack    //
    boardNo = 0;                    //     First ICP is zero                //
    portNo = 1;                     //     Second ICP link is one           //
    protocol = “raw”;               //     Use raw operation                //
    transport = “Conn0”;            //     TSI connection name specified    //
                                    //       in TSI configuration file      //
}
```

Figure 2–1: Example DLI Configuration File for Two Freeway Server Links

```
main                                  // DLI “main” section:               //
{
    asyncIO = “yes”;                  // Use non-blocking I/O              //
    tsiCfgName = "."                // Location of NT log/trace svc    //
                                      //    (tsiCfgName unused for VMS)  //
    maxBuffers = 1024;              // Maximum number of buffers          //
    maxBufSize = 2200;      // Allows 2048 ICP data area, plus 8 extra  //
}
ICP0General                           // General Session name:             //
{                                     // Client-related parameters:        //
    alwaysQIO = “yes”;                //     Queue I/Os even if complete   //
    asyncIO = “yes”;                  //     Use non-blocking I/O          //
    cfgLink = “no”;                   //     Client configures links       //
    enable = “no”;                    //     Client enables links          //
    localAck = “no”;                  //     Client processes transmit ack //
    boardNo = 0;                      //     First ICP is zero             //
    portNo = 0;                       //     First ICP link is zero        //
    protocol = “raw”;                 //     Use raw operation             //
    maxBufSize = 2200;      // Allows 2048 ICP data area, plus 8 extra  //
}
ICP0link0                             // First session name:               //
{                                     // Client-related parameters:        //
    alwaysQIO = “yes”;                //     Queue I/Os even if complete   //
    asyncIO = “yes”;                  //     Use non-blocking I/O          //
    cfgLink = “no”;                   //     Client configures links       //
    enable = “no”;                    //     Client enables links          //
    localAck = “no”;                  //     Client processes transmit ack //
    boardNo = 0;                      //     First ICP is zero             //
    portNo = 0;                       //     First ICP link is zero        //
    protocol = “raw”;                 //     Use raw operation             //
    maxBufSize = 2200;      // Allows 2048 ICP data area, plus 8 extra  //
}
ICP0link1                             // Second session name:              //
{                                     // Client-related parameters:        //
    alwaysQIO = “yes”;                //     Queue I/Os even if complete   //
    asyncIO = “yes”;                  //     Use non-blocking I/O          //
    cfgLink = “no”;                   //     Client configures links       //
    enable = “no”;                    //     Client enables links          //
    localAck = “no”;                  //     Client processes transmit ack //
    boardNo = 0;                      //     First ICP is zero             //
    portNo = 1;                       //     Second ICP link is one        //
    protocol = “raw”;                 //     Use raw operation             //
    maxBufSize = 2200;      // Allows 2048 ICP data area, plus 8 extra  //
}
```

Figure 2–2: Example DLI Configuration File for Two Embedded ICP Links

Using *Raw* operation, the client's dlOpen call to open a session allows only the client DLI and Freeway to handle that session. A separate step is required to allow the ICP to handle the session. To accomplish this, the client sends a DLI Attach command in the first dlWrite issued to the session. This informs the ICP's Freeway interface of the session, and returns the ICP session ID to be used to communicate with that session. After a session is opened and attached, writes to the ICP through the session reach the Military/Government Protocols software itself, and the Military/Government Protocols software can write to the client through the session. The ICP's Freeway interface needs only the ICP session ID to route the message to the intended session and to send responses associated with that session to the client.

When using *Raw* operation, the client application must employ the DLI optional arguments data structure (Section 3.2.1 on page 47) to issue dlWrite commands to a session. However, the Military/Government Protocols system requires only a subset of the optional arguments fields (see Table 3–3 on page 48). These are limited to the fields which direct the command through the server and to the correct ICP. The optional arguments structure is also supplied to the client by completed dlRead requests (see Table 3–4 on page 49).

All other data needed by the ICP or by the client is contained in the message buffer itself. The link number, function code, error status, and data size are in the message header, and the data is in the message data area.

2.2.4 Detaching and Closing DLI Sessions

To close a session, the client application first must detach it from the ICP. To accomplish this, the client sends a DLI Detach command using a dlWrite issued to the session. This informs the ICP's Freeway interface that the client is ending the session. When the ICP's Detach response is received in the final dlRead for the session, the client calls dlClose to end the session within the DLI and Freeway. The dlRead optional arguments are shown in Table 3–3 on page 48.

2.2.5 Error Reporting

In the Freeway Military/Government Protocols environment, errors related to the DLI functions are reported in two ways:

- Errors can be returned directly by the DLI function call. Typical errors are those described in the *Freeway Data Link Interface Reference Guide.*

- Errors generated by the Military/Government Protocols software are *not* reported using the DLI optional arguments structure. Instead, there are error status fields in the header associated with each Military/Government Protocols message. These fields are described in detail in Section 4.1.1.4 on page 52 and Section 4.1.1.6 on page 53 for synchronous protocols, or Table 5–1 on page 96 for asynchronous protocols.

Chapter 3 Military/Government Protocols DLI Functions

Note

For convenience, the term "Freeway" here can mean either a Freeway server or an embedded ICP. The client-system interfaces to the two are nearly identical. For the embedded ICP, also refer to the user's guide for your ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*).

This chapter describes how to use the data link interface (DLI) functions to write client applications interfacing to the Freeway Military/Government Protocols software. You should be familiar with the concepts described in the *Freeway Data Link Interface Reference Guide* (summary information was provided in Chapter 2).

The following might be helpful references while reading this chapter:

- Table 3–1 lists a typical sequence of DLI function calls using non-blocking I/O
- The *Freeway Data Link Interface Reference Guide* gives complete DLI error code descriptions.
- The *Freeway Data Link Interface Reference Guide* provides a generic code example which can guide your application program development, along with the program described in Appendix A of this manual.

3.1 Example Military/Government Protocols Call Sequences

Table 3–1 shows the sequence of DLI function calls to send and receive data using non-blocking I/O example. The remainder of this chapter and the *Freeway Data Link Interface Reference Guide* give further information about each function call. Section 2.1.2 on page 34 describes non-blocking I/O.

Table 3–1: DLI Call Sequence for Military/Government Protocols (Non-blocking I/O)

1. Call dlInit to initialize the DLI operating environment.
   The first parameter is your DLI binary configuration file name.
2. Call dlOpen to get a session ID for the Military/Government Protocols General Session.
3. Call dlOpen for link-specific session ID (optional).
4. Call dlPoll to confirm the success of each session ID obtained in Step 2 and Step 3.
5. Call dlBufAlloc for all required input and output buffers.
6. Call dlRead to queue the initial read request.
7. Call dlWrite[a] to attach each session from Step 2 and Step 3 to the ICP. (Section 2.2.3 on page 37)
8. Call dlWrite[a] to configure the Military/Government Protocols environment (Section 1.7.1 on page 30).
9. Call dlWrite[a] to configure and enable the ICP links (Section 4.2.9 on page 65/Section 4.2.10 on page 67 or Section 5.2.2 on page 97/Section 5.2.3 on page 98).
10. Call dlWrite to send requests and data to Freeway (Section 4.2 on page 54 or Section 5.2 on page 97).
11. Call dlRead to queue reads to receive responses and data from Freeway (Section 4.3 on page 73 or Section 5.3 on page 100).
12. As I/Os complete and the I/O completion handler is invoked, call dlPoll to confirm the success of each dlWrite and to accept the data from each dlRead.
13. Repeat Step 10 through Step 12 until you are finished writing and reading.
14. Call dlWrite[a] to disable the ICP links (Section 4.2.11 on page 67 or Section 5.2.4 on page 98).
15. Call dlWrite[a] to detach each session from Step 7 (Section 2.2.4 on page 40).
16. Call dlBufFree for all buffers allocated in Step 5.
17. Call dlClose for each session ID obtained in Step 2 and Step 3.
18. Call dlPoll to confirm that each session was closed in Step 17.
19. Call dlTerm to terminate your application's access to Freeway.

[a] After this dlWrite call, wait for the proper response to arrive using calls to dlRead/dlPoll before continuing (see Step 12).

3.2 Overview of DLI Functions for Military/Government Protocols

After the Military/Government Protocols software is downloaded to the Freeway ICP, the client and Freeway can communicate by exchanging messages. These messages configure and activate each ICP link and transfer data. The client application issues reads and writes to transfer messages to and from the ICP.

This section summarizes the DLI functions used in writing a client application. The simplest view of using the DLI functions is:

- Start up communications (dlInit, dlOpen, dlBufAlloc)
- Send requests and data using dlWrite
- Receive responses using dlRead
- For blocking I/O, use dlSyncSelect to query read availability status for multiple sessions
- For non-blocking I/O, handle I/O completions at the software interrupt level in the completion handler established by the dlInit or dlOpen function, or by periodic use of dlPoll to query the I/O completion status
- If necessary, reset and download the protocol software to the ICP using dlControl
- Shut down communications (dlBufFree, dlClose, dlTerm)

Table 3–2 summarizes the DLI function syntax and parameters, listed in the most likely calling order. Refer to the *Freeway Data Link Interface Reference Guide* for details.

Table 3–2: DLI Functions: Syntax and Parameters (Listed in Typical Call Order)

DLI Function	Parameter(s)	Parameter Usage
int dlInit	(char *cfgFile, char *pUsrCb, int (*fUsrIOCH)(char *pUsrCb));	DLI binary configuration file name Optional I/O complete control block Optional IOCH and parameter
int dlOpen[a]	(char *cSessionName, int (*fUsrIOCH) (char *pUsrCB, int iSessionID));	Session name in DLI config file Optional I/O completion handler Parameters for IOCH
int dlPoll	(int iSessionID, int iPollType, char **ppBuf, int *piBufLen, char *pStat, DLI_OPT_ARGS **ppOptArgs);	Session ID from dlOpen Request type Poll type dependent buffer Size of I/O buffer (bytes) Status or configuration buffer Optional arguments
int dlpErrString	(int dlErrNo);	DLI error number (global variable dlerrno)
char *dlBufAlloc	(int iBufLen);	Minimum buffer size
int dlRead	(int iSessionID, char **ppBuf, int iBufLen, DLI_OPT_ARGS *pOptArgs);	Session ID from dlOpen Buffer to receive data Maximum bytes to be returned Optional arguments structure
int dlWrite	(int iSessionID, char *pBuf, int iBufLen, int iWritePriority, DLI_OPT_ARGS *pOptArgs);	Session ID from dlOpen Source buffer for write Number of bytes to write Write priority (normal or expedite) Optional arguments structure
int dlSyncSelect	(int iNbrSessID, int sessIDArray[], int readStatArray[]);	Number of session IDs Packed array of session IDs Array containing read status for IDs
char *dlBufFree	(char *pBuf);	Buffer to return to pool
int dlClose	(int iSessionID, int iCloseMode);	Session ID from dlOpen Mode (normal or force)
int dlTerm	(void);	
int dlControl	(char *cSessionName, int iCommand, int (*fUsrIOCH) (char *pUsrCB, int iSessionID));	Session name in DLI config file Command (*e.g.* reset/download) Optional I/O completion handler Parameters for IOCH

[a] It is critical for the client application to receive the dlOpen completion status before making any other DLI requests; otherwise, subsequent requests will fail. After the dlOpen completion, however, you do not have to maintain a one-to-one correspondence between DLI requests and dlRead requests.

3.2.1 DLI Optional Arguments

Section 4.2 and Section 4.3 describe the dlWrite and dlRead functions for a Military/Government Protocols application. Both functions use the optional arguments parameter to provide the protocol-specific information required for *Raw* operation. The "C" definition of the optional arguments structure is shown in Figure 3–1.

```
typedef struct          _DLI_OPT_ARGS
{
    unsigned short      usFWPacketType;
    unsigned short      usFWCommand;
    unsigned short      usFWStatus;
    unsigned short      usICPClientID;
    unsigned short      usICPServerID;
    unsigned short      usICPCommand;
    short               iICPStatus;
    unsigned short      usICPParms[3];
    unsigned short      usProtCommand;
    short               iProtModifier;
    unsigned short      usProtLinkID;
    unsigned short      usProtCircuitID;
    unsigned short      usProtSessionID;
    unsigned short      usProtSequence;
    unsigned short      usProtXParms[2];
}   DLI_OPT_ARGS;
```

Figure 3–1: "C" Definition of DLI Optional Arguments Structure

Section 2.2 on page 36 describes using the DLI in the Military/Government Protocols environment. The required dlWrite optional arguments fields for a Military/Government Protocols client application are shown in Table 3–3. The relevant Military/Government Protocols dlRead optional arguments are shown in Table 3–4.

Table 3–3: Required dlWrite Optional Arguments Fields

dlWrite Optional Arguments Field	Value	Usage
usFWPacketType	FW_DATA	
usFWCommand	FW_ICP_WRITE	
usICPCommand	DLI_ICP_CMD_ATTACH DLI_ICP_CMD_WRITE DLI_ICP_CMD_DETACH	Send an Attach request for a session Write a message buffer to a session Send a Detach request for a session
usProtLinkID	Attach: ICP link number associated with session (1–8 or 1–16 for physical links, 0 for General Session) Write and Detach: (unused)	
usProtSessionID	Attach: (unused) Write and Detach: ICP session ID	

Table 3–4: Relevant dlRead Optional Arguments Fields

dlRead Optional Arguments Field	Value	Usage
usFWPacketType	FW_DATA	
usFWCommand	FW_ICP_READ	
usICPCommand	DLI_ICP_CMD_ATTACH DLI_ICP_CMD_READ DLI_ICP_CMD_DETACH	Acknowledgment of Attach Message buffer from session Acknowledgment of Detach
iICPStatus	Attach: DLI_ICP_ERR_NO_ERR DLI_ICP_ERR_BAD_NODE DLI_ICP_ERR_BAD_LINK DLI_ICP_ERR_BAD_SESSID DLI_ICP_ERR_ALREADY_ATTACHED	Status return for Attach
	Read: Always DLI_ICP_ERR_NO_ERR	Status return for Read
	Detach: DLI_ICP_ERR_NO_ERR DLI_ICP_ERR_BAD_SESSID	Status return for Detach
usProtSessionID	Attach: ICP session ID Read and Detach: (unused)	

Chapter

4 Synchronous Protocol Messages

4.1 Synchronous Protocol Message Formats

After the Military/Government Protocols software is downloaded to the ICP, the client and ICP can communicate by exchanging messages. Military/Government Protocols messages are transmitted and received using *Raw* dlWrite and dlRead requests, as described in Section 3.2 on page 45. The message data area might contain link configuration options, status information, or actual data to or from the serial link. Figure 4–1 shows the format of a synchronous protocol message.

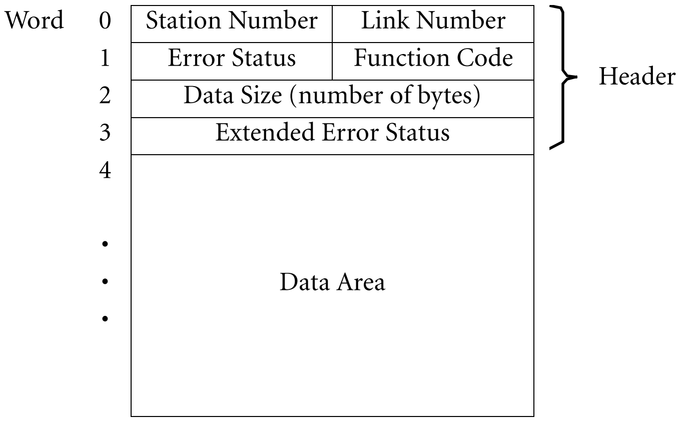


Figure 4–1: Client Synchronous Protocol Message Format

Note

In Figure 4–1, the lower byte addresses are depicted on the right, and the higher byte addresses on the left.

4.1.1 Message Header Format

All messages sent to and received from the ICP begin with a standard 8-byte header, as shown in Figure 4–1.

4.1.1.1 Link Number Field (Byte 0)

This 8-bit field contains the ICP serial link number (if applicable) to which the message pertains. The links are numbered from 1–*n*. A value of 0 in this field pertains to the ICP as a whole (i.e., it pertains to the General Session, as opposed to a Link Session).

4.1.1.2 Station Number Field (Byte 1)

This 8-bit field contains a station number, for any protocol that needs to define stations that share a link. Station conventions are protocol-specific.

4.1.1.3 Function Code Field (Byte 2)

This 8-bit field contains the code for the type of message that the client is sending to or receiving from the ICP.

4.1.1.4 Error Status Field (Byte 3)

This 8-bit field contains status bits set by the ICP to indicate error conditions. Table 4–1 describes the bits.

Table 4–1: Message Header Error Status Field Bits

Bit	Status Reported	Reference
0	Error in Received Data	See Chapter 3 of the Programmer's Guide for the pertinent protocol for which errors may be reported.
1	Rejected Client Command	See the description of the client command in Section 4.2 for the possible causes of the rejection.
2	Transmit NAK	See the Transmit Acknowledgment message (Section 4.3.19 on page 87).

4.1.1.5 Data Size Field (Word 2)

This 16-bit field contains the number of bytes of information that follow the eight bytes of the message header.

4.1.1.6 Extended Error Status Field (Word 3)

This 16-bit field contains information pertaining to the error status indicated in the Error Status field.

When the Error Status field indicates a receive data error, the Extended Error Status contains one or more bits to define which error(s) occurred; refer to the individual protocol programmer's guides for details (page 16 shows a list of guides).

When the Error Status field indicates a rejected client command, the Extended Error Status may contain data concerning the rejection, as described for the pertinent ICP response messages in Section 4.3.

4.1.2 Data Area (beginning at Byte 9 / Word 4)

The Data Area of a command holds the data associated with that command, if any. The amount of data is specified by the Data Size field of the message header.

4.2 Overview of Requests using Raw dlWrite

Section 4.2.2 through Section 4.2.20 describe the dlWrite requests (commands, report requests, and data to be transmitted) that the client application can send to the ICP. The dlWrite requests can be transferred via the General Session or via an optional link-specific session, as described in Section 2.2.3 on page 37. Table 4–2 lists the requests by the value placed in the Function Code field of the message header.

Table 4–2: Synchronous Protocol Messages Originating in the Client

Code	Name	Reference
0	Configure ICP	Section 4.2.1 on page 55
1	Configure Segmentation Buffers[a]	Section 4.2.2 on page 62
2	Configure Communication Buffers[a]	Section 4.2.3 on page 62
3	Set Time Stamping[a]	Section 4.2.4 on page 63
4	Set Signal Monitor Interval[a]	Section 4.2.5 on page 63
5	Set Blocking Interval[a]	Section 4.2.6 on page 64
6	(reserved)	n/a
7	Set Link Protocol	Section 4.2.8 on page 64
8	Configure Link	Section 4.2.9 on page 65
9	Enable Link	Section 4.2.10 on page 67
10	Disable Link	Section 4.2.11 on page 67
11	Request Link Status Report	Section 4.2.12 on page 68
12	Request Link Statistics Report	Section 4.2.13 on page 68
13	Request Queued Output Message Count[a]	Section 4.2.14 on page 68
14	Output Data Block	Section 4.2.15 on page 69
15	Set Time Stamp Value	Section 4.2.16 on page 69
16	(protocol-specific command)	Section 4.2.17 on page 71
17	Request Version ID[a]	Section 4.2.18 on page 71
18	Request ICP Links Report[a]	Section 4.2.19 on page 71
19	Request Buffer Status Report	Section 4.2.20 on page 72
20	(reserved)	n/a

[a] This command is obsolete (but still supported).

4.2.1 Configure ICP [0]

This command assigns values to specified configuration items for an ICP and receives an ICP Configuration Report in response (Section 4.3.23 on page 90). The data field contains a data pair of 16-bit words for each specified ICP configuration option. Any subset of the seven options (including none) may be specified, in any order. See Table 4–3 for their descriptions. The first word of the data pair contains the code (1-7) for an item; the second word contains the value being assigned to that item. Set the message header data size field to four times the number of data pairs specified. If a data size of zero is specified, the only action is the solicitation of the ICP Configuration Report.

Table 4–3: ICP Configuration Options

Code	Option	Valid Values	Initial Value
1	Segmentation Buffer Data Size	256-8192 bytes	2048
2	Communication Buffer Data Size	32-2048 bytes	depends on protocol mix
3	Timing Type	Internal, Not Running (0) Internal, Running (>0) Host (-2)	Internal, Not Running
4	Signal Monitor Interval	0 1-60 seconds	0 (no signal monitor)
5	Blocking Interval	10-10000 milliseconds	1000
6	ICP Buffer Report Period	0 1-65535 seconds	0 (no periodic reports)
7	ICP Buffer Report Threshold	0 1-99 percent	0 (no threshold reports)

The Configure ICP command was created to make it relatively simple to initialize and modify the desired ICP configuration. However, each ICP configuration item may also be set by an individually dedicated command (many of which are technically obsolete, but all of which are still supported and will remain so indefinitely). These obsolete commands are described in Section 4.2.2 through Section 4.2.6.

The ICP validates each specified ICP configuration data pair. If an invalid specification is found, an ICP Configuration Report is not returned; instead, the command is rejected with the appropriate error code in the Extended Error Status field of the message header, leaving unmodified the ICP configuration items specified by the command. These error codes are given in Table 4–4.

Table 4–4: Configure ICP Command Error Codes

Code	Error
-2	Invalid data size value in header
-1	Invalid option code in data pair
1	Invalid Segmentation Buffer Data Size
2	Invalid Communication Buffer Data Size
3	Invalid Timing Type
4	Invalid Signal Monitor Interval
5	Invalid Blocking Interval
6	(not used)
7	Invalid ICP Buffer Report Threshold

Section 4.2.1.1 through Section 4.2.1.7 describe the meaning, validation, and implementation of each of the ICP configuration options.

4.2.1.1 Segmentation Buffer Data Size

Note

1. This item may also be modified by the obsolete Configure Segmentation Buffers command (Section 4.2.2 on page 62).

2. This ICP configuration option must be specified within one of the first eight `DLI_ICP_CMD_WRITE` commands following the downloading of the ICP.

The segmentation buffer data size is used to configure the ICP's segmentation buffer pool. Segmentation buffers are used for all messages conveyed on the client/ICP interface. The ICP creates as many buffers as will fit in the ICP's segmentation buffer pool.

A default value of 2048 is set at ICP startup. The valid range is from 256 to 8192 bytes. The value should be even. Typically, a value near the low end of this range is most convenient, since it results in the availability of many more segmentation buffers. 512 bytes is safely larger than the maximum needed for anything aside from blocked input or output data. Unless the user wishes to block input or output messages at greater length, it is suggested that 512 bytes be specified.

Caution

If the ICP segmentation buffer sizes are to be raised above the default value of 2048 bytes, the client must take care that the maxBufSize parameter in both the client TSI configuration file and the server TSI configuration file is adequate. See Section 2.1.3 on page 35.

The data area should be set large enough to accommodate the desired maximum number of blocked data messages. For example, if the protocol specifies 14 bytes/message for the client-to-ICP and ICP-to-client formats, and the segmentation buffer size is set to 512, up to twenty-three messages would fit in the Output Data Block command:

(8 header bytes + 14 data bytes) * 23 = 506 bytes

Similarly, up to nineteen messages would fit in the Input Data Block ICP response:

(8 header bytes + 4 time stamp bytes + 14 data bytes) * 19 = 494 bytes

The ICP will reject this configuration selection per Table 4–4 on page 56 if:

- the initial window of opportunity for this command has closed (see Note above)
- the specified data size is too small to hold at least one communication buffer
- the specified data size is greater than 8192 bytes

- periodic or threshold Buffer Status Reports have been requested
- any ports are enabled

4.2.1.2 Communication Buffer Data Size

Note

1. This item may also be modified by the obsolete Configure Communication Buffers command (Section 4.2.3 on page 62).

2. This ICP configuration option must be specified within one of the first eight `DLI_ICP_CMD_WRITE` commands following the downloading of the ICP.

The communication buffer data size is used to configure the ICP's communication buffer pool. Communication buffers are used for individual messages being processed on the communication interface and transmitted/received on the serial ports. The ICP creates as many buffers as will fit in the ICP's communication buffer pool.

A default value of 64 is set at ICP startup.The valid range is from 32 to 2048 bytes. The value should be even.

The ICP will reject this configuration selection per Table 4–4 on page 56 if:

- the initial window of opportunity for this command has closed (see Note above)
- the specified data size is less than the number of bytes required by any of the resident protocols
- the specified data size is greater than 2048 bytes
- the specified data size would result in a communication buffer size (counting header and time stamp) too large to fit into a segmentation buffer
- any ports are enabled

4.2.1.3 Timing Type

Note

This item may also be modified by the obsolete Set Time Stamping command (Section 4.2.4 on page 63).

The timing type specifies the mode of the ICP time-stamping (see Appendix C). The modes of time-stamping are Internal (Not Running), Internal (Running), and Host. The timing type is set to Internal (Not Running) at ICP startup.

A data value of zero sets the mode to Internal (Not Running), meaning that the time-stamp value is not incremented over time by the ICP. Any positive data value sets the mode to Internal (Running), meaning that the ICP time-stamp value is incremented over time by the ICP.

A value of -2 sets the mode to Host, meaning that the ICP time-stamp value is assigned and maintained by the host-system ICP driver.

The ICP will reject this configuration selection per Table 4–4 on page 56 if Host timing is specified when the host-system ICP driver does not support this feature, or if a negative value other than -2 is specified.

Note

This configuration item does not set the *value* of the ICP time-stamp. For the two Internal modes, the time-stamp value is initially zero, and must be set and maintained by the Set Time Stamp Value command (Section 4.2.16 on page 69). For Host mode, the host-system ICP driver sets and maintains the ICP time-stamp, and the Set Time Stamp Value command is rejected by the ICP.

4.2.1.4 Signal Monitor Interval

Note

This item may also be modified by the obsolete Set Signal Monitor Interval command (Section 4.2.5 on page 63).

The signal monitor interval is the minimum period of time (in seconds) required for the sustained loss or recovery of a modem signal, or of some other ambient condition of the link, before the ICP informs the client of that loss/recovery event with a Link Status Notification (Section 4.3.15 on page 85). A change is reported to the client when the new condition has been present for a period greater than one monitor interval but less than or equal two.

An interval of 0 disables the monitoring process. A default value of 0 is set at ICP startup. The ICP will reject this configuration selection per Table 4–4 on page 56 if the specified interval is outside the range 0-60.

Each protocol monitors its particular set of modem signals (and some protocols monitor none). The interface signals that may be monitored are Clear to Send (CTS), Data Carrier Detect (DCD), and Data Set Ready (DSR). Some protocols also use this interval for monitoring and reporting the sustained loss or recovery of a protocol-specific idle pattern of received bits. Refer to the applicable protocol programmer's guide for the set of events monitored by a given protocol.

4.2.1.5 Blocking Interval

Note

This item may also be modified by the obsolete Set Blocking Interval command (Section 4.2.6 on page 64).

The blocking interval is the length of time (in milliseconds) during which an input data segmentation buffer will collect received messages from the associated link before being sent to the client with an Input Data Block command. (The buffer will be sent immediately if it fills.)

The specified value is assigned to all links. It is specified in milliseconds. The allowed range is from 10 to 10000 (10 milliseconds to ten seconds). A default value of 1000 (one second) is set at ICP startup for each link. The ICP will reject this configuration selection per Table 4–4 on page 56 if the specified interval is outside the range 10-10,000.

4.2.1.6 ICP Buffer Report Period

Note

This item may also be modified by the Request Buffer Status Report command (Section 4.2.20 on page 72).

The ICP buffer report period is the length of time (in seconds) between successive periodic ICP Buffer Reports being sent to the client. A value of 0 is set at ICP startup, meaning that periodic ICP Buffer Reports are disabled. The ICP accepts any 16-bit value as a buffer report period (thus no associated error is listed in Table 4–4 on page 56). See the Buffer Status Report response (Section 4.3.22 on page 89) for a description of this report.

4.2.1.7 ICP Buffer Report Threshold

Note

This item may also be modified by the Request Buffer Status Report command (Section 4.2.20 on page 72).

The ICP buffer report threshold is the crossing level (in percent) of buffer pool usage (segmentation or communication) for sending an unsolicited ICP Buffer Report to the client. A value of 0 is set at ICP startup, and means that unsolicited ICP Buffer Reports are disabled. The valid range is 0-99 percent. The ICP rejects this configuration selection per Table 4–4 on page 56 if the specified interval is outside the range 0-99. See the Buffer Status Report response (Section 4.3.22 on page 89) for a description of this report.

4.2.2 Configure Segmentation Buffers [1]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command initializes the ICP segmentation buffer space. Set the message header data size field to 2. Set word zero of the message data area to the size (in bytes) for the segmentation buffer data area. Section 4.3.1 on page 73 describes the confirmation response.

This command may be issued only as one of the first eight DLI_ICP_CMD_WRITE commands following the downloading of the ICP. For the validation of the specified size, and the implementation of this command, please see the discussion of this ICP configuration item in Section 4.2.1.1 on page 56.

4.2.3 Configure Communication Buffers [2]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command initializes the ICP communication buffer space. Set the message header data size field to 2. Set word zero of the message data area to the size (in bytes) for the communication buffer data area. Section 4.3.2 on page 75 describes the confirmation response.

This command may be issued only as one of the first eight DLI_ICP_CMD_WRITE commands following the downloading of the ICP. Thereafter the communication buffer size cannot be changed. For the validation of the specified size, and the implementation of this command, please see the discussion of this ICP configuration item in Section 4.2.1.2 on page 58.

4.2.4 Set Time Stamping [3]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command sets the mode of the ICP's time-stamping (see Appendix C). Set the message header data size field to 2. Set word zero of the message data area to the timing type. Section 4.3.3 on page 75 describes the confirmation response.

For the validation of the specified mode, and the implementation of this command, please see the discussion of this ICP configuration item in Section 4.2.1.3 on page 59.

4.2.5 Set Signal Monitor Interval [4]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command sets the signal monitor interval. Set the message header data size field to 2. Set word zero of the message data area to the signal monitor interval. Section 4.3.4 on page 75 describes the confirmation response.

For the validation of the specified interval, and the implementation of this command, please see the discussion of this ICP configuration item in Section 4.2.1.4 on page 60.

4.2.6 Set Blocking Interval [5]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55) for purposes of setting the blocking intervals for all links, and by the Configure Link command (Section 4.2.9 on page 65) for purposes of setting the blocking interval for a specific link. However, this command may still be used.

This command sets the blocking interval for one or all links on the ICP. Set the message header data size field to 2. Set word zero of the message data area to the blocking interval value. Section 4.3.5 on page 76 describes the confirmation response.

For the validation of the specified interval, and the implementation of this command, please see the discussion of this ICP configuration item in Section 4.2.1.5 on page 60.

4.2.7 (reserved) [6]

Command 6 is reserved.

4.2.8 Set Link Protocol [7]

This command assigns a protocol to a specified link. Set the message header data size field to 2. Set word zero of the message data area to the desired protocol selection code as specified in the individual protocol programmer’s guide. Section 4.3.7 on page 76 describes the confirmation response.

(An alternate method is to specify the protocol as the *first* parameter listed in a Configure Link command (Section 4.2.9 on page 65).)

If the link number field specifies zero, all links are assigned the specified protocol. Otherwise the specified protocol is assigned to the specified link. The assigning of a protocol to a link includes setting that link with the default link configuration parameters for that protocol. To assign non-default values, use the Configure Link command.

The ICP will reject this message if:

- the specified protocol code does not identify a protocol that is resident in the ICP
- the specified link number is invalid
- the specified link is not in a disabled state

4.2.9 Configure Link [8]

This command sets link configuration options for an ICP link. The data field contains a data pair of 16-bit words for each specified link configuration option. The first word of the pair contains the configuration option number and the second word contains the value for that option. The list of pairs is terminated by a 16-bit terminator word containing zero. Set the message header data size field to the number of bytes in the configuration data, including the zero terminator word. Figure 4–2 on page 66 gives an example of the link configuration command, with two options specified. Refer to your individual protocol programmer's guide for descriptions of the options and their values.

Section 4.3.8 on page 76 describes the confirmation response, which contains a Link Configuration report.

Two link configuration parameters are independent of the current protocol (if any) that is assigned to the link, and thus may be described in this document.

1. The Protocol ID. A new protocol that is to be assigned to the link (with the subsequent parameters in the command applying to this new protocol). The option code for assigning a protocol to the link is -1.This parameter is allowed only as the first-specified option/value pair; otherwise the command is rejected. The associated value is the new protocol number, identical to the value that would have been specified in a Set Link Protocol command (Section 4.2.8 on page 64).
2. The Blocking Interval. The option code for assigning a blocking interval to the link is 36, for all protocols. The meaning of the parameter value is the same as

Station Number	Link Number	0
Error Status	Function Code = 8	1
Data Size = 10		2
Extended Error Status		3
Configuration Option = -1 (Protocol)		4
Configuration Value = 11		5
Configuration Option = 1 (Data Rate)		6
Configuration Value = 9600		7
0		8

Figure 4–2: Link Configuration Block with Two Options

when specified for the blocking interval with the Configure ICP command (Section 4.2.1.5 on page 60), except that it pertains only to the specified link.

The Configure Link command solicits a Link Configuration Report (Section 4.3.8 on page 76) as the confirmation. This consists of a list of the configuration values for the link as they now are set, including any the parameters that were not specified in the Configure Link command. This data is in the form of a series of option/value data pairs terminated by a 0 option code, in the format used by the Configure Link command.

When no data pair is specified (i.e., the data size field contains zero), the link configuration is not changed, but a Link Configuration Report is still returned. This provides a means of soliciting a Link Configuration Report at any time.

The ICP will reject this message if:

- the specified link number is invalid
- the specified link is not in the disabled state
- the specified link is not yet assigned a protocol *and* the first option/value data pair in the command does not identify a protocol that is resident in the ICP
- a protocol-setting option/value data pair appears as other than the first pair.

- an option code is specified that is invalid for the protocol assigned to the link
- an option value is specified that is invalid for the valid option

4.2.10 Enable Link [9]

This command enables a link. Set the message header data size field to zero. Set the link number field to the desired link number. Upon receiving this command, the ICP activates the link for transmission and reception of data according to the current configuration settings for all protocols. Certain protocols have a more complex use for the Enable Link command, as noted in the pertinent protocol programmer's guides. Section 4.3.9 on page 77 describes the Enable Link response.

The ICP will reject this message if:

- the specified link number is invalid
- the specified link is not in the disabled state
- the specified link has not been assigned a protocol

4.2.11 Disable Link [10]

This command disables a link. Set the message header data size field to zero. Set the link number field to the desired link number. Upon receiving this command, the ICP deactivates the link for transmission and reception of data. Section 4.3.10 on page 77 describes the Disable Link response.

If any transmission acknowledgements of already-completed data transmissions are pending, they are sent to the client before the Disable Link confirmation response is sent. (Refer to Section 4.3.19 on page 87.)

The ICP will reject this message if:

- the specified link number is invalid

- the link is not in the enabled state
- the link has not been assigned a protocol

4.2.12 Request Link Status Report [11]

This command requests a Link Status report, consisting of information about the status of a specified link or all links, including the serial port modem control and clocking signal states. Set the message header data size field to zero. Set the link number field to the desired link number for a single-link report, or to zero for a separate report for each link. Section 4.3.11 on page 77 presents the format of the Link Status report. The ICP will reject this message if the specified link number is invalid.

4.2.13 Request Link Statistics Report [12]

This command requests a Link Statistics report for the specified link. Set the message header data size field to zero. Set the message header link number field to the desired link number. Section 4.3.12 on page 80 discusses the format of the Link Statistics report returned to the client. The ICP will reject this message if the specified link number is invalid.

4.2.14 Request Queue Count Report [13]

Note

This command is obsolete and is superseded by the Transmit Acknowledgment response (Section 4.3.19 on page 87), which facilitates an event-driven rather than poll-driven flow control. However, it may still be used.

This command requests a Queue Count report, consisting of the count of messages queued for transmission to the specified link, or to all links. Set the message header data size field to zero. Set the link number field to the desired link number, or to zero to request a Queue Count report on all links. Section 4.3.13 on page 81 discusses the format of the Queue Count report returned to the client. The ICP will reject this message if the specified link number is invalid.

4.2.15 Output Data Block [14]

This command supplies a data block that contains one or more Output Data messages, each of which contains data to be transmitted in an individual message for the protocol assigned to the specified link. Set the message header data size field to the total number of bytes in the data area.

Each blocked Output Data message consists of a message header and the data associated with it. Set this header's data size field to the actual number of data bytes in that data area. Set its message header link number field to the desired link number. Each blocked message must start on a word boundary. Thus for protocols that supply an odd number of data bytes to the ICP, an unused one-byte pad must be inserted; nonetheless, the data size field must specify the odd number.

The data for a blocked message is formatted by the ICP protocol software to produce the proper transmit bit-stream. This typically involves such steps as the insertion of a message start sequence, mark bits at regular intervals, a data-check value, last-byte bit padding for purposes of seamlessly merging with a possible time-fill bit pattern, etc.

Figure 4–3 illustrates the structure of an output data block. The segmentation and communication header formats are shown in Figure 4–1 on page 51 and described in Section 4.1 on page 51.

4.2.16 Set Time Stamp Value [15]

This command sets the ICP's time-stamp (see Appendix C) to the specified value. Set the message header data size field to 4. Set the first longword of the data area to the 32-bit time-stamp value that is to replace the current value on the ICP. Section 4.3.16 on page 87 describes the confirmation response. This command is rejected by the ICP if a Set Time Stamping command has specified Host timing.

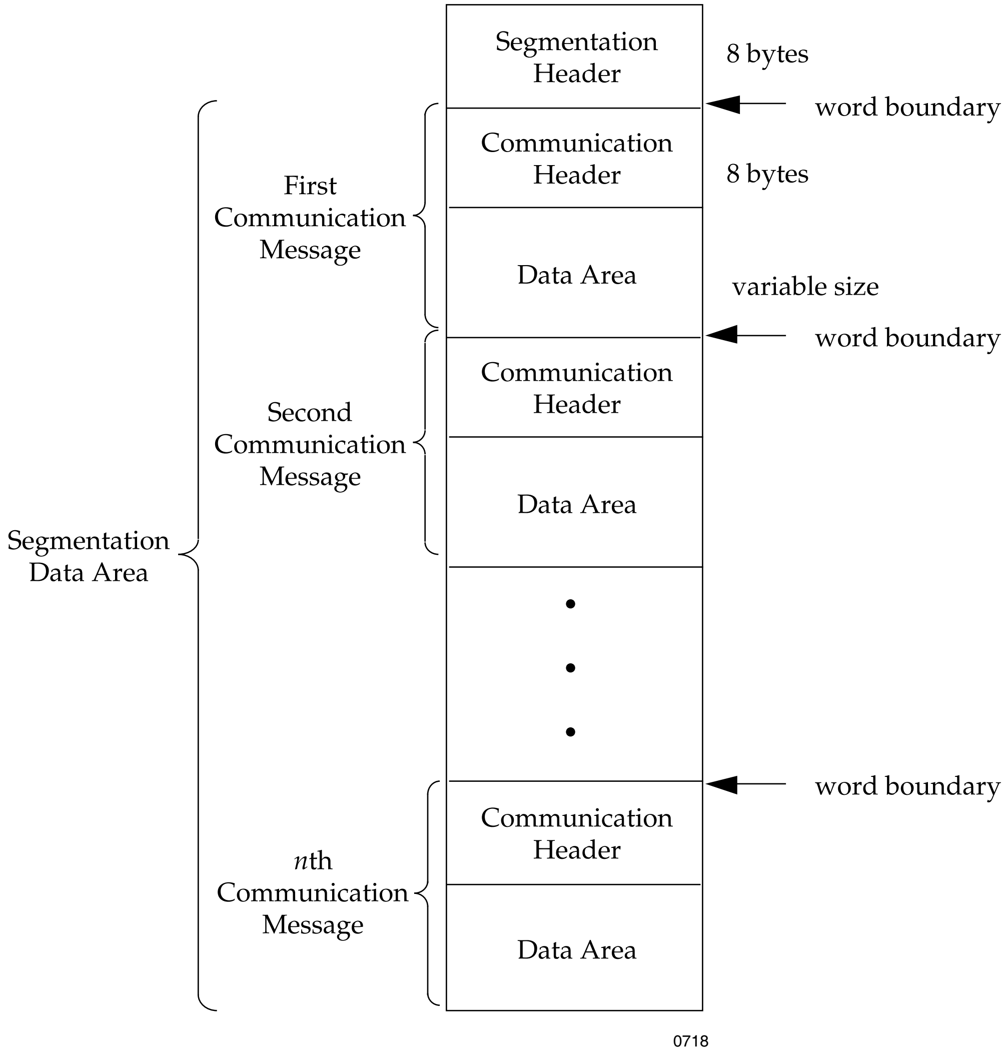


Figure 4–3: Output Data Block

4.2.17 Protocol-specific Command [16]

This client command (function code 16) is protocol-specific. It is described in the individual programmer's guides for those Military/Government Protocols that use it. If the individual guide does not describe a command 16, then that protocol does not use it. This command is rejected by the ICP if sent for a link that is not assigned a protocol that uses it.

4.2.18 Request Version Report [17]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command requests a Version report for the Military/Government Protocols software that is running on the ICP. Set the message header data size field to zero. The link number field is unused. Section 4.3.20 on page 88 discusses the format of the Software Version report returned to the client.

4.2.19 Request ICP Links Report [18]

Note

This command is obsolete and is superseded by the Configure ICP command (Section 4.2.1 on page 55). However, it may still be used.

This command requests an ICP Links report, which provides the number of serial ports on the ICP. Set the message header data size field to zero. The link number field is unused. Section 4.3.21 on page 88 discusses the format of the ICP Links report returned to the client.

4.2.20 Request Buffer Status Report [19]

This command requests a Buffer Status report. Set the message header data size field to 2 or 4, depending on the number of parameters (as explained below). The link number field is unused. Section 4.3.22 on page 89 discusses the format of the Buffer Status report returned to the client.

The Buffer Status report is a diagnostic tool available for monitoring buffer usage on the ICP and diagnosing the abnormal accumulation of buffers in particular ICP queues. The receipt of this command by the ICP causes a Buffer Status report, called a direct-response report, to be sent immediately to the client. In addition, the command data can also request that subsequent reports, called periodic reports, be generated on a specified timed basis. The command data can also request that an event-driven Buffer Status report, called an unsolicited report, be generated when either the communication buffer usage or the segmentation buffer usage rises above or falls below a specified threshold.

The command contains one or two 16-bit words of data. The first word is the requested Buffer Status report interval, in units of seconds. It controls the generation of the periodic reports. A value of zero disables periodic reports. A value of negative one asks for an immediate report without affecting the current periodicity. A positive value specifies the period to be used. The default is zero (periodic reports disabled).

The second word, if included, specifies the buffer usage threshold for the generation of unsolicited reports. It is in units of percent, and can range from zero to 99. This percentage value is applied to both the communication buffer pool and the segmentation buffer pool, and an unsolicited report is issued when this threshold is reached for either pool. After the threshold is reached and the unsolicited report is issued, another unsolicited report is issued when the usage of each pool is again below the threshold. Thus the client is informed both when buffer usage reaches the threshold and when it falls below the threshold. A zero threshold disables unsolicited reports, and a positive threshold enables them. The default is zero (unsolicited reports disabled).

4.3 Overview of Responses using Raw dlRead

Section 4.3.1 through Section 4.3.22 describe the dlRead responses (confirmations, reports, notifications, and received data) that the client application can receive from the ICP. The dlRead responses to link-specific commands are transferred via the appropriate Link Session, if any. Other responses are transferred via the General Session. Table 4–5 on page 74 lists the responses by function code number.

Commands sent by the client that are unable to be successfully processed by the ICP are returned as-is to the client, with the addition of the Rejected Command bit set in the message's Error Status field (refer back to Table 4–1 on page 52). This means that the rejected command retains its original function code.

Note

The first five ICP responses listed (Section 4.3.1 through Section 4.3.5) are obsolete (but still supported), because the corresponding client commands are obsolete.

4.3.1 Configure Segmentation Buffers Response [21]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Configure Segmentation Buffer response signifies that the Configure Segmentation Buffer command (Section 4.2.2 on page 62) was processed successfully. The message header data size field is set to 2. Word zero of the data area contains the number of buffers created in the segmentation buffer pool.

Table 4–5: Synchronous Protocols Messages Originating in the ICP

Code	Name	Reference
21	Configure Segmentation Buffers Response[a]	Section 4.3.1 on page 73
22	Configure communication Buffers Response[a]	Section 4.3.2 on page 75
23	Set Time Stamping Response[a]	Section 4.3.3 on page 75
24	Set Signal Monitor Interval Response[a]	Section 4.3.4 on page 75
25	Set Blocking Interval Response[a]	Section 4.3.5 on page 76
26	(reserved)	n/a
27	Set Link Protocol Response	Section 4.3.7 on page 76
28	Configure Link Response / Link Configuration Report	Section 4.3.8 on page 76
29	Enable Link Response	Section 4.3.9 on page 77
30	Disable Link Response	Section 4.3.10 on page 77
31	Link Status Report	Section 4.3.11 on page 77
32	Link Statistics Report	Section 4.3.12 on page 80
33	Queued Output Message Count Report	Section 4.3.13 on page 81
34	Input Data Block	Section 4.3.14 on page 81
35	Link Status Notification	Section 4.3.15 on page 85
36	Set Time Stamp Value Response	Section 4.3.16 on page 87
37	(protocol-specific response)	Section 4.3.17 on page 87
38	(reserved)	n/a
39	Transmit Acknowledgment	Section 4.3.19 on page 87
40	Version Report	Section 4.3.20 on page 88
41	ICP Links Report	Section 4.3.21 on page 88
42	Buffer Status Report	Section 4.3.22 on page 89
43	ICP Configuration Report	Section 4.3.23 on page 90

[a] This response is obsolete (but still supported), because the corresponding client command is obsolete.

4.3.2 Configure Communication Buffers Response [22]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Configure Communication Buffer response signifies that the Configure Communication Buffer command (Section 4.2.3 on page 62) was processed successfully. The message header data size field contains 2. Word zero of the data area contains the number of buffers created in the communication buffer pool.

4.3.3 Set Time Stamping Response [23]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Set Time Stamp Interval response signifies that the Set Time Stamping command (Section 4.2.4 on page 63) was processed successfully. The message header data size field contains 2. Word zero of the data area contains the value specified in the Set Time Stamp Interval command.

4.3.4 Set Signal Monitor Interval Response [24]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Set Signal Monitor Interval response signifies that the Set Signal Monitor Interval command (Section 4.2.5 on page 63) was processed successfully. The message header data size field contains 2. Word zero of the data area contains the value specified in the Set Monitor Interval command.

4.3.5 Set Blocking Interval Response [25]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Set Blocking Interval response signifies that the Set Blocking Interval command (Section 4.2.6 on page 64) was processed successfully. The message header data size field contains 2. Word zero of the data area contains the value specified in the Set Blocking Interval command.

4.3.6 (reserved) [26]

This response code is reserved, in conjunction with the reserving of command 6.

4.3.7 Set Link Protocol Response [27]

The Set Protocol response signifies that the Set Link Protocol command (Section 4.2.8 on page 64) was processed successfully. The message header data size field contains 2. Word zero of the data area contains the value specified in the Set Link Protocol command.

4.3.8 Configure Link Response / Link Configuration Report [28]

The Configure Link response (also called the Link Configuration Report) signifies that the Configure Link command (Section 4.2.9 on page 65) was processed successfully, and provides a Link Configuration Report. The data area consists of a complete list of the configuration values for the link as they now are set (including any parameters that were not addressed in the Configure Link command). This data consists of a series of option/value data pairs terminated by a 0 option code, in the format used by the Configure Link command to specify link configuration changes (refer to Figure 4–2 on page 66). The message header data size field contains the number of bytes occupied by this link configuration data.

4.3.9 Enable Link Response [29]

The Enable Link response signifies that the Enable Link command (Section 4.2.10 on page 67) was processed successfully. The message header data size field is zero.

4.3.10 Disable Link Response [30]

The Disable Link response signifies that the Disable Link command (Section 4.2.11 on page 67) was processed successfully. The message header data size field is zero.

4.3.11 Link Status Report [31]

The Link Status Report is the response to a Link Status Report request (Section 4.2.12 on page 68). This applies to synchronous protocols. Three Link Status Report formats are defined: Type I, Type II, and Type III, depicted in Table 4–6 on page 78, Table 4–7 on page 78, and Table 4–8 on page 79, respectively. Refer to the individual protocol programmer's guide to determine which report type applies, and if any variations on it apply. Type A is for asynchronous protocols, and is shown in Table xxx on page yyy.

Link status is reported in word pairs. The first word of each pair is the code for the parameter being reported. The second word is the value of that parameter. If a Set Signal Monitor Interval command has been issued with a non-zero interval, modem signal statuses will be the value last reported by a Link Status Notification (or, if no changes have occurred, the initial status). If modem signals are not being monitored, the immediate modem signal status is reported.

.

Table 4–6: Link Status Report (Type I)

Parameter (First word)	Description	Value (Second word)
1	Data Carrier Detect (DCD)	0 = On 1 = Off
2	Clear to Send (CTS)	0 = On 1 = Off
3	Receive clocking	0 = Clocking present 1 = Clocking lost
4	Transmit clocking	0 = Clocking present 1 = Clocking lost
5	Receive data status	0 = No data lost 1 = Receive data lost
6	Data Set Ready (DSR) (for certain protocols)	0 = On 1 = Off

Table 4–7: Link Status Report (Type II)

Parameter (First word)	Description	Value (Second word)
1	Idle Pattern	0 = Present 1 = Lost
2	Modem signals	See Figure 4–4.
3	Receive clocking	0 = Clocking present 1 = Clocking lost
4	Transmit clocking	0 = Clocking present 1 = Clocking lost
5	Receive data status	0 = No data lost 1 = Receive data lost

Table 4–8: Link Status Report (Type III)

Parameter (First word)	**Description**	**Value (Second word)**
1	Receive synchronization status	Refer to your protocol-specific programmer’s guide.
2	Modem signals	See Figure 4–4.
3	Receive clocking	0 = Clocking present 1 = Clocking lost
4	Transmit clocking	0 = Clocking present 1 = Clocking lost
5	Receive data status	0 = No data lost 1 = Receive data lost

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	RTS		DTR		CTS	DCD	DSR

0 = signal absent
1 = signal present

Figure 4–4: Link Status Report Type II — Word 2

4.3.12 Link Statistics Report [32]

The Link Statistics Report is the response to a Link Statistics Report request (Section 4.2.13 on page 68). The message header data size field is set to 40, and the data area contains the link statistics, as shown in Table 4–9 on page 80. If a statistics counter overflows, the client receives a Link Statistics report as an unsolicited notification (showing the overflowing count as the maximum positive 16-bit value (32,767). The statistics counters are cleared after being reported to the client; thus the client must keep running totals.

Table 4–9: Link Statistics Report

Location	Description
Byte 0	Protocol value (as assigned by Set Link Protocol command (Section 4.2.8 on page 64)
Byte 1	(reserved)
Word 1	Data rate (bits per second)
Word 2	Clocking signal source (1 = External; 2 = Internal)
Word 3	Messages received
Word 4	protocol-dependent (refer to the individual protocol programmer's guide)
Word 5	protocol-dependent (refer to the individual protocol programmer's guide)
Word 6	Receive character overruns
Word 7	Transmit character underruns
Word 8	Messages received with no errors
Word 9	Messages received with errors
Word 10	protocol-dependent (refer to the individual protocol programmer's guide)
Word 11	protocol-dependent (refer to the individual protocol programmer's guide)
Word 12	protocol-dependent (refer to the individual protocol programmer's guide)
Word 13	protocol-dependent (refer to the individual protocol programmer's guide)
Word 14	protocol-dependent (refer to the individual protocol programmer's guide)
Word 15	protocol-dependent (refer to the individual protocol programmer's guide)
Word 16	protocol-dependent (refer to the individual protocol programmer's guide)
Word 17	Messages transmitted
Word 18	Lost input messages (due to lack of available buffer for link data)
Word 19	Messages not transmitted because of expiration or other error

4.3.13 Queued Output Message Count Report [33]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Queued Output Message Count Report is the response to the Queue Count report request (Section 4.2.14 on page 68). The message header data size field is set to 2. If the message header link field specified a specific link, the 16-bit data area of the report contains the number of messages queued for transmission on that link. If the message header link field was set to 0, the data area contains the sum of the messages queued for transmission across all the links on the ICP.

4.3.14 Input Data Block [34]

The Input Data Block notification contains one or more protocol messages formatted for the client application from the bit-streams received at the links. When received via a Link Session, this notification contains data from only that link. When received via the General Session, this notification may contain data from any or all of the active links. Notification is always made via the Link Session for a link that has its own session; links with no specific Link Session defined use the General Session.

An Input Data Block is sent by the ICP upon either of two events. First, when an ICP segmentation buffer allocated for the accumulation of Input Data messages becomes full or is found to have too little remaining room for the next received message). Second, when the Blocking Interval for an ICP segmentation buffer expires and the buffer has accumulated at least one message.

Figure 4–5 on page 82 illustrates the structure of an Input Data Block. The block is composed of a segmentation header, a System Parameters area, and a data area containing one or more Input Data messages.

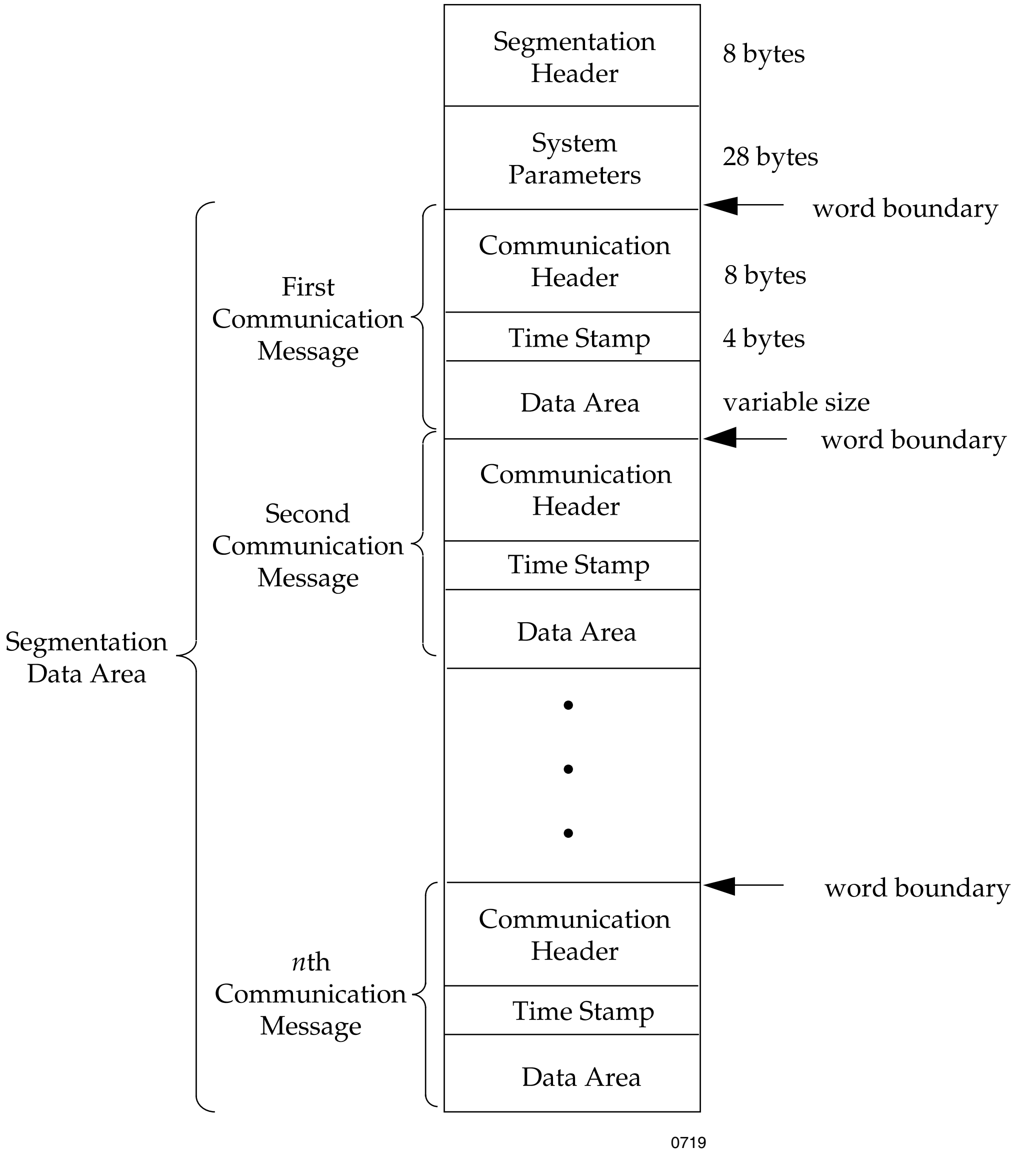
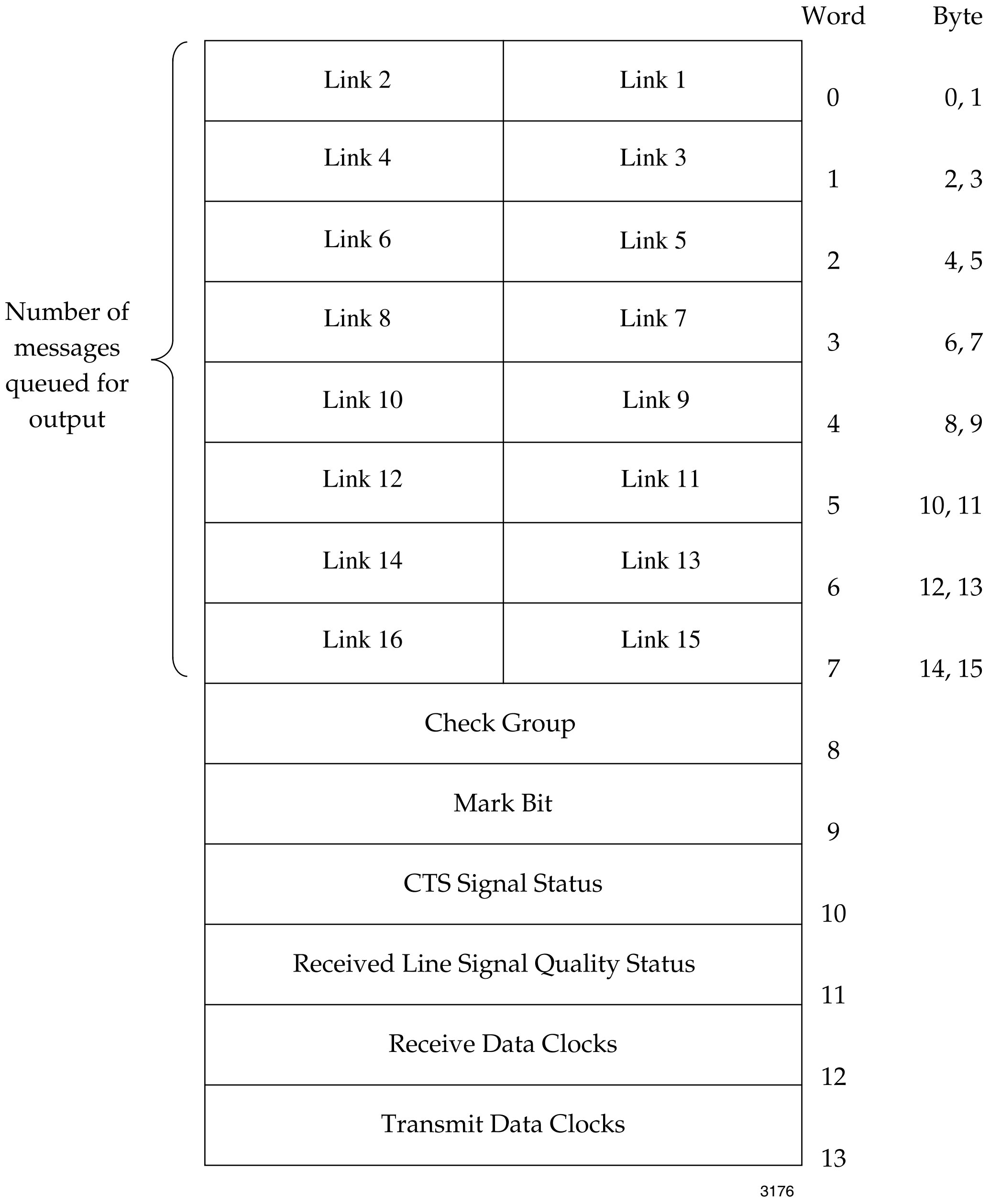


Figure 4–5: Input Data Block



Number of messages queued for output
3176

		Word	Byte
Link 2	Link 1	0	0, 1
Link 4	Link 3	1	2, 3
Link 6	Link 5	2	4, 5
Link 8	Link 7	3	6, 7
Link 10	Link 9	4	8, 9
Link 12	Link 11	5	10, 11
Link 14	Link 13	6	12, 13
Link 16	Link 15	7	14, 15
Check Group		8	
Mark Bit		9	
CTS Signal Status		10	
Received Line Signal Quality Status		11	
Receive Data Clocks		12	
Transmit Data Clocks		13	

Figure 4–6: System Parameters Area

4.3.14.1 Segmentation Header

The segmentation header format is shown in Figure 4–1 on page 51. Only the function code field and data size field are used. The data size field in the segmentation header is set to the total number of bytes in the data area (i.e., the total length of the embedded individual Input Data messages).

4.3.14.2 System Parameters Area

The System Parameters immediately follow the segmentation header for the input data block. These parameters report the status of the communication links on the ICP. Figure 4–6 on page 83 shows the structure of the system parameters area. The number of messages queued for output on each link is reported in byte format with a range in values of zero to 255. The following serial port signal status elements are reported using the bits in a word to identify the current status for each link:

- Clear to Send status
- Data Carrier Detect status
- Receive data clocking status
- Transmit data clocking status

These statuses are reported using bit zero to report link 1, bit 1 to report link 2, and so on. A status bit is set if the corresponding signal is off or missing. If modem signals are being monitored (i.e., a Set Signal Monitor Interval command has been issued with a non-zero interval), the modem signal status is the status last reported by a Link Status notification (or, if no changes have occurred, the initial status). If modem signals are not being monitored, the immediate status is reported. These conditions are reported for most protocols. Consult the individual protocol programmer’s guides.

4.3.14.3 Input Data Messages

The individual Input Data messages are stored in order of reception. The communication header format is shown in Figure 4–1 on page 51. Each Input Data message is composed of a communication header and data area. The link number field contains the number of the link that received the message. The error status and extended error status fields contain any error information pertaining to the associated protocol data.

The data size field contains the number of bytes in the data area, including the four bytes of time stamp; hence the data size value is four greater than the number of actual data bytes supplied for this message. For protocols with an odd number of bytes in the data area, a one-byte pad containing zero is added so that the next Input Data message an start on a word boundary; however, the data size field does not account for that pad.

The first 32-bit word in the data area of each message contains the time stamp of the message. This marks the time of arrival at the link of the first bits of the message. The remainder of the data area contains the message information received on the link. This is the client-format data, as distilled from the full bit-stream that conveyed the message on the link.

4.3.15 Link Status Notification [35]

The Link Status Notification is generated by the ICP when a notable protocol-specific event occurs for a link. The message header data size field contains 4. The first 16-bit word of the data area contains the code for the parameter being reported. The second word contains the value associated with that parameter. Table 4–10 on page 86 lists the parameters that may be reported. Modem signal changes are reported only if modem signals are being monitored (i.e., a Set Signal Monitor Interval command has been issued with a non-zero interval).

Link Status Notifications have three standard formats (called Type I, Type II, and Type III). Each Military/Government protocol uses a particular format, though several use variations not described here. Refer to the individual protocol programmer's guides for details.

Table 4–10: Link Status Notification

Parameter	Error or Status Change		
	Type I	**Type II**	**Type III**
1	Data Carrier Detect (DCD)	Idle Pattern Status	Receive Sync Status
2	Clear to Send (CTS)	Modem Signal	Modem Signal
3	Receive Clocking	Receive Clocking	Receive Clocking
4	Transmit Clocking	Transmit Clocking	Transmit Clocking
5	Receive Data Loss	Receive Data Loss	Receive Data Loss
6 7 8 9	Parameters 6 through 9 are used only in custom formats not described here.		
10	Over Speed Clocks		

Parameters 1 through 5 and their associated values are identical to the Link Status Report parameter/value pairs listed in Table 4–6 on page 78, Table 4–7 on page 78, and Table 4–8 on page 79.

Parameter 10, Over Speed Clocks, has two values. A value of one indicates that the ICP is detected clock signals in excess of the configured data rate. A value of zero indicates that the ICP is not detecting the excessive clock signals. The client may wish to avoid sending Output Data Blocks to the ICP while the over speed clocking condition persists, as the ICP may be unable to reliably transmit. This Link Status Notification response is received only from links which are assigned protocols that define the Over Speed Clock Retry Interval parameter, and which have that parameter configured.

4.3.16 Set Time Stamp Value Response [36]

The Set Time Stamp Value response signifies that the Set Time Stamp Value command (Section 4.2.16 on page 69) was processed successfully. The message header data size field contains 4. The data area contains the value specified in the Set Time Stamp Value command.

4.3.17 Protocol-specific ICP Response [37]

The protocol-specific ICP response (function code 37) signifies that the protocol-specific command 16 (Section 4.2.17 on page 71) was processed successfully. It is described in the programmer's guides for those Military/Government Protocols that use it.

4.3.18 (reserved) [38]

This ICP response/notification code is reserved.

4.3.19 Transmit Acknowledgment [39]

The Transmit Acknowledgment notification provides a flow control feedback mechanism for messages sent from the client to the ICP for transmission on the links (Section 4.2.15 on page 69). The message header data size field contains 2. Word zero of the data area contains the number of messages being acknowledged.

A Transmit Acknowledgment Threshold configuration option is provided for each link. When it is enabled, the ICP maintains a count of messages transmitted to the link but not yet acknowledged to the client. A Transmit Acknowledgement notification is sent to the client when:

- the count of completed transmissions reaches the value of the configuration option

- a transmission is negatively acknowledged (due to transmit expiration or some other unrecoverable error)
- a Disable Link command is received from the client and any transmit completions have accumulated (sent prior to the Disable Link response)

Negative acknowledgements are indicated by the Transmit NAK flag of the message header Error Status byte (Section 4.1.1.4 on page 52), in which case the data value *N* acknowledges the first *N*-1 transmissions and negatively acknowledges the *N*th one.

4.3.20 Version Report [40]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The Version Report is the response to the Version Report Request (Section 4.2.18 on page 71). It combines the protocol mask and version string as described in Figure 4–7 on page 94 and under the ICP Configuration Report's Fixed Data on page 90. The message header data size field contains 38 (accounting for 4 bytes of mask, 33 bytes of string, and a null terminator for the string).

4.3.21 ICP Links Report [41]

Note

This response is obsolete (but still supported), because the corresponding client command is obsolete.

The ICP Links Report is the response to the ICP Links Report request (Section 4.2.19 on page 71). The message header data size field contains 2. Word zero of the data area contains the number of serial ports on the ICP.

4.3.22 Buffer Status Report [42]

The Buffer Status Report is the response to the Buffer Status Report request (Section 4.2.20 on page 72). The report format is shown in Table 4–11 on page 89. The message header data size field is variable, depending on the number of ICP queues being described. Words 0 and 1 of the data area give the current Buffer Status report period and threshold. Words 2–5 describe the pool of communications buffers, and words 6–9 describe the pool of segmentation buffers. Word 10 gives the number ICP queues described in Words 11–*n*, where *n* is the final word index of the report.

Table 4–11: Buffer Status Report

Word	Description
0	Buffer Status Report period (in seconds)
1	Buffer Status Report threshold (in percent)
2	Communication buffer size
3	Total number of communication buffers
4	Number of communication buffers in use
5	Percentage of communication buffers in use
6	Segmentation buffer size
7	Total number of segmentation buffers
8	Number of segmentation buffers in use
9	Percentage of segmentation buffers in use
10	Number of ICP queues listed
11	Queue #1 buffer count
12	Queue #2 buffer count
…	
10 + *n*	Queue #*n* buffer count

The Buffer Status report is generated under three conditions:

- A *direct-response report* is generated when any Buffer Status request is received from the client.
- A *periodic report* is generated when the defined Buffer Status report interval (if any) has elapsed since the issuance of the previous Buffer Status report.
- An *unsolicited report* is generated when the communication or segmentation buffer usage rises above or falls below the defined Buffer Status report threshold (if any).

Direct-response reports are sent via the session used by the request (normally the General Session). Periodic and unsolicited reports are sent through the General Session.

4.3.23 ICP Configuration Report [43]

The ICP Configuration Report is the response to the Configure ICP command (Section 4.2.1 on page 55). The report has a length of 128 bytes. The message header data size field contains 128.

The ICP Configuration Report format is shown in Figure 4–7 on page 94. Due to its length and detail, it is economically depicted as a "C" language structure. The report is divided into four natural sections (Fixed Configuration, Timing, Buffering, and Links), with additional bytes reserved for future use.

<u>Fixed Data</u>

This information consists of 48 bytes concerning the ICP hardware and downloaded ICP software, which by definition cannot be modified by the client:

- A 32-bit mask with a bit set for each protocol that is included in the downloaded software. Protocols are numbered 0-31. Bit *i* represents the protocol numbered *i*. (The number for a given protocol is defined in Chapter 3 of the Programmer's Guide for that protocol.)

- A 33-byte string showing the product number, product designator, product revison level, and product date--followed by a null character for string-termination purposes in a 34th byte.
- The ICP board type, as given in Table 4–12.

Table 4–12: ICP Board Types

Type	Board
1	ICP3222
2	ICP6000A
3	ICP6000B
4	ICP2424
5	ICP2432
6	ICP2432B

- The number of links on the ICP.
- The number of megabytes of RAM on the ICP (e.g., 32).
- A flag that indicates whether the ICP performs byte-reordering within 16-bit and 32-bit entities, due to having the opposite “Endian” memory organization from the client system (1=opposite, 0=same).
- A flag that indicates whether the ICP uses the standard API node interface to the client application, or obsolete non-API nodes (1=API, 0=non-API).

Timing Data

This information consists of 16 bytes concerning ICP timing:

- The timing type for timestamping: Internal (not running), Internal (running), or Host. The downloaded default is Internal (not running).

- The signal monitor interval, in seconds. The downloaded default is 0, meaning no signal monitoring.
- The received data blocking interval (applied to all sessions, meaning that this value overrides any blocking intervals that have already been established by Configure Link commands). The downloaded default is 10000 milliseconds.

Buffering Data

This information consists of 16 bytes concerning ICP buffering:

- The segmentation buffer data area size. The downloaded default is 2048 bytes, but reducing this to 512 bytes is recommended for purposes of having many more buffers available.
- The number of segmentation buffers. This is not configured directly, but is a consequence of sizing the segmentation buffers.
- The communication buffer data area size. The downloaded default is 32 bytes, unless any resident protocols require more than this, in which case the largest such requirement becomes the default.
- The number of communication buffers. This is not configured directly, but is a consequence of sizing the communication buffers.
- The interval for periodic ICP Buffer Reports. The downloaded default is 0, meaning no periodic ICP Buffer Reports.
- The threshold for unsolicited ICP Buffer Reports. The downloaded default is 0, meaning no unsolicited ICP Buffer Reports

Links Data

This information consists of 16 bytes concerning the links:

- A 16-bit mask with a bit set for each link with an attached Link Session. Bit *i* represents Link *i*.
- A 16-bit mask with a bit set for each link that is enabled. Bit *i* represents Link *i*.
- An array of protocol numbers. Array element *i* represents Link *i*-1 and contains the number (0-31) of the protocol, if any, assigned to the corresponding link. Elements for links not assigned a protocol contain -1. (The number for a given protocol is defined in Chapter 3 of the Programmer's Guide for that protocol.)

The default ICP configuration (for both fixed and non-fixed portions), as assigned upon download of the ICP, is displayed at the ICP console upon ICP startup. Whenever an ICP Configuration Report is sent to the client, all the non-fixed portions of it are displayed at the ICP console (unless there has been no change to any of them since the most recently displayed version).

```
/* ICP Configuration Report */
typedef struct
{
   /* Fixed configuration information */
   struct {
      unsigned int  protocol_mask;      /* mask of protocols on ICP */
      unsigned char version [33];       /* version string */
      unsigned char null_term;          /* null-termination of string */
      unsigned char board_type;         /* ICP type (e.g., ICP2432B is 7) */
      unsigned char num_links;          /* # of links on ICP */
      unsigned char ram_size;           /* # of megabytes of RAM on ICP */
      unsigned char swapping;           /* “Endian” swapping? T=1, F=0 */
      unsigned char api;                /* host uses API? T=1, F=0 */
      unsigned char filler_to_48[5];    /* round up to 48 bytes */
   } fixed;                             /* sizeof = 48 */

   /* Timing information */
   struct {
      signed   short type;              /* timing type (Internal or Host) */
      unsigned short monitor;           /* monitor interval (sec) */
      unsigned short blocking;          /* blocking interval */
      unsigned short filler_to_16[5];   /* round up to 16 bytes */
   } timing;                            /* sizeof = 16 */

   /* Buffer report information */
   struct {
      unsigned short seg_size;          /* segmentation buffer size */
      unsigned short seg_total;         /* segmentation buffer count */
      unsigned short comm_size;         /* communication buffer size */
      unsigned short comm_total;        /* communication buffer count */
      unsigned short rpt_interval;      /* periodic buffer report interval */
      unsigned short rpt_threshold;     /* threshold buffer report level */
      unsigned short filler_to_16[2];   /* round up to 16 bytes */
   } bufrpt;                            /* sizeof = 16 */

   /* Link information */
   struct {
      unsigned short attached_mask;     /* link session attached? T=1, F=0 */
      unsigned short enabled_mask;      /* link enabled? T=1, F=0 */
      unsigned char  protocol[8];       /* protocol assigned to link-1 */
      unsigned char  filler_to_16[4];   /* round up to 16 bytes */
   } links;                             /* sizeof = 16 */

   /* Leave room for future material */
   unsigned char filler_to_128[32];     /* round up to 128 bytes total */

} ICPRPT;                               /* sizeof = 128 */
```

Figure 4–7: ICP Configuration Report Structure

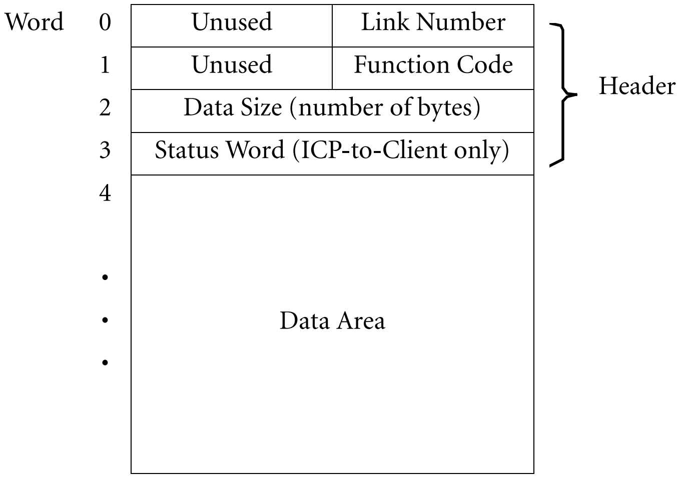
Chapter

5

Asynchronous Protocol Messages

5.1 Asynchronous Protocol Message Formats

Figure 5–1 shows the asynchronous protocol message format. The message headers for asynchronous protocols have the same basic format as those for synchronous protocols (four 8-bit fields followed by two 16-bit fields) as described in Chapter 4.



Word			
0	Unused	Link Number	Header
1	Unused	Function Code	
2	Data Size (number of bytes)		
3	Status Word (ICP-to-Client only)		
4 • • •	Data Area		

Figure 5–1: Client Asynchronous Protocol Message Format

Note

In Figure 5–1, the lower byte addresses are depicted on the right, and the higher byte addresses on the left.

However there are several differences from the case of synchronous protocol headers:

- The Station Number byte field (Byte 1) is not used.
- The Error Status byte field (Byte 3) is not used.
- The Extended Error Status word field (Word 3) is called the Status word field and is used for all status information.

Table 5–1 lists the Status word bits and their meanings. These bits are numbered from zero to 15. The Status word is used only with the ICP-to-client messages.

Table 5–1: Status Word Field Description (ICP-to-Client Message)

Bit Number	Description
0	(reserved)
1	Framing error
2	Parity error
3	Receive overrun error
4	End-of-message framed
5	Buffer full
6	Receive timeout
7	Loss of DCD
8	Broken message
9	Secure Mode violation
10	CTS timeout
11-14	protocol-specific meanings
15	Rejected message

5.2 Overview of Requests using Raw dlWrite

The following sections describe the link-related commands the client application can send to the ICP for asynchronous protocols. See Table 5–2. As noted there, many of these commands have corresponding synchronous protocol function codes (the asynchronous codes having been retained for historical reasons when the asynchronous protocols were merged into the Military/Government Protocols set). Asynchronous protocols may use either such code to accomplish the same action.

Table 5–2: Asynchronous-Protocol Function Codes Originating in the Client

Async Code	Sync Code	Usage	Reference
51	14	Output Data Block	Section 5.2.1 on page 97
52	8	Configure Link	Section 5.2.2 on page 97
53	9	Enable Link	Section 5.2.3 on page 98
54	10	Disable Link	Section 5.2.4 on page 98
55	n/a	Set/Clear Modem Signals	Section 5.2.5 on page 98
56		(reserved)	n/a
57		(reserved)	n/a
58	n/a	Request Modem Status	Section 5.2.8 on page 99

5.2.1 Output Data Block [51 (Async)] or [14 (Sync)]

Command 51 is identical to command 14 in Section 4.2.15 on page 69.

5.2.2 Configure Link [52 (Async)] or [8 (Sync)]

Command 8 is similar but not identical to command 8 in Section 4.2.9 on page 65. The difference is in the format of the configuration option/value data pairs. In the asynchronous protocol case, the option code is a 16-bit word, as with the synchronous case; but the option value is a 32-bit word, instead of 16 bits. A configuration option code of zero ends the transmission of data, as with the synchronous case.

Figure 5–2 gives an example of the Configure Link command for an asynchronous protocol (whether using function code 52 or 8), using two options. Refer to the individual protocol programmer's guide for configuration option descriptions.

Unused	Link = 1	0
Unused	Function = 52	2
Data Size = 14		4
Reserved for ICP Status		6
Configuration Option		8
Configuration Value (longword)		10
Configuration Option		14
Configuration Value (longword)		16
0		20

Figure 5–2: Link Configuration Block with Two Options

5.2.3 Enable Link [53 (Async)] or [9 (Sync)]

Command 53 is identical to command 9 in Section 4.2.10 on page 67.

5.2.4 Disable Link [54 (Async)] or [10 (Sync)]

Command 54 is identical to command 10 in Section 4.2.11 on page 67.

5.2.5 Set /Clear Modem Signals [55]

The Set/Clear Modem Signals command asserts or deasserts the Data Terminal Ready and Request To Send modem signals. The data field is set with a 16-bit word describing the action or actions to be taken. Set the appropriate bits in the lower byte of the command word to assert the DTR and/or RTS signals. Set the corresponding bits in the upper byte of the command word to deassert them.

Within each byte, DTR is represented by bit one and RTS by bit four. In the 16-bit data word, turn on DTR by setting bit 1, and turn on RTS by setting bit 4. Turn off DTR by setting bit 9, and turn off RTS by setting bit 12.

5.2.6 (reserved) [56]

Command 56 is reserved.

5.2.7 (reserved) [57]

Command 57 is reserved.

5.2.8 Request Modem Status [58]

This message requests a report of the status of the link’s DCD and CTS modem signals. Section 5.3.5 on page 101 describes the ICP response.

5.3 Overview of Responses using Raw dlRead

The following sections describe the link-related messages that the ICP can send to the client for asynchronous protocols. See Table 5–3.

As noted in Table 5–3, most of these messages have corresponding synchronous protocol function codes (the asynchronous codes having been retained for historical reasons when the asynchronous protocols were merged into the Military/Government Protocols set). Section 4.3 on page 73. Asynchronous protocols may use either code; for example, for a duplicated ICP response message.

Table 5–3: Asynchronous-Protocol Function Codes Originating in the ICP

Async Code	Sync Code	Description	Reference
71	39	Transmit Acknowledgment	Section 5.3.1 on page 100
72	28	Configure Link Response	Section 5.3.2 on page 101
73	29	Enable Link Response	Section 5.3.3 on page 101
74	30	Disable Link Response	Section 5.3.4 on page 101
75-77		(reserved)	n/a
78	n/a	Modem Status Report	Section 5.3.5 on page 101
79	n/a	Data Lost Notification	Section 5.3.6 on page 102
80	34	Input Data Block	Section 5.3.7 on page 102
81	n/a	Transmit Negative Acknowledgment	Section 5.3.8 on page 102
82	n/a	Protocol-specific Notification	Section 5.3.9 on page 102

5.3.1 Transmit Acknowledgment [71 (Async)] or [39 (Sync)]

Command 71 is similar but not identical to command 39 in Section 4.3.19 on page 87. The difference is that in the asynchronous protocol case, only one transmission at a time is implicitly acknowledged and the message header data size field contains 0.

5.3.2 Configure Link Response [72 (Async)] or [28 (Sync)]

Command 72 is similar to command 28 in Section 4.3.8 on page 76. There are two differences. The first is in the format of the Link Configuration Report in the data area. For asynchronous protocols, this report has the format shown in Figure 5–2 (but with all configuration items for the assigned protocol).

The second difference from the synchronous Configure Link response is that it is optional. It is sent only if the link has been configured by the client for the generation of these responses (refer to the individual protocol programmer's guides). Unless stated otherwise in that document, the default is to *not* send acknowledgments, so that previously existing client applications can run without change.

5.3.3 Enable Link Response [73 (Async)] or [29 (Sync)]

Command 73 is identical to command 29 in Section 4.3.9 on page 77.

5.3.4 Disable Link Response [74 (Async)] or [30 (Sync)]

Command 74 is identical to command 30 in Section 4.3.10 on page 77.

5.3.5 Modem Signal Report [78]

This message is a response to the Request Modem Status command (Section 5.2.8 on page 99). It reports the link's DCD and CTS modem signals. See Figure 5–3. The message header data size field contains 1. Word 0 contains the report in the first byte.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		DCD	CTS				

0 = signal absent
1 = signal present

Figure 5–3: Modem Signal Report

5.3.6 Data Lost Notification [79]

This message informs the client that incoming link data has been discarded for lack of available buffers. When there are no communication buffers left on the ICP to assign to the reception of the next message on a link, the ICP discards all messages received on that link until a buffer becomes available. This condition is caused by the client failing to read messages from the ICP at a rate compatible with the incoming data stream. The message header data size field contains zero.

5.3.7 Input Data Block [80 (Async)] or [34 (Sync)]

Command 80 is identical to command 34 in Section 4.3.14 on page 81. Function code 80 is generated when the link was enabled with function code 73. Function code 34 is generated when the link was enabled with function code 9.

5.3.8 Transmit Negative Acknowledgment [81]

The Transmit Negative Acknowledgment notification signifies that the asynchronous transmission was aborted or refused. The reason for aborting is loss of CTS. The reason for refusal is a Secure-Mode violation. Each is specified by a bit in the message header Status field (Table 5–1). The message header data size field contains 2. For loss of CTS, word 0 of the data area contains the number of characters (possibly zero) sent out before the transmission was aborted for loss of CTS. For a Secure-Mode Violation, word 0 does not contain a defined value.

5.3.9 Protocol-specific Notification [82]

This is a protocol-specific ICP notification. For any protocols to which is pertains, it is described in the associated programmer's guide.

Appendix

A Military/Government Protocols Loopback Test Program

Note

The term “Freeway” can mean either a Freeway server or an embedded ICP. For the embedded ICP, also refer to the user’s guide for your ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*).

This appendix describes the Military/Government Protocols loopback test procedure, including the following:

- an overview of the test
- a description of how to install the hardware needed for the test
- instructions on how to run the test
- sample screen display from the test

Note

Before running the loopback test, you must install the Freeway software and boot Freeway to download the software as described in the *Freeway User Guide* (for a Freeway server) or the user’s guide for your embedded ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*).

Note

When the loopback test is run under VMS, Protogate recommends a minimum Buffered I/O Byte Count process quota of 30,000 bytes. The AST Limit and Open File Limit process quotas must provide a unit for each session that will be opened. The number of sessions is equal to the number of selected ports, plus one.

A.1 Overview of the Test Program

The loopback test uses the data link interface (DLI) available with Freeway. The DLI library is in the freeway/client/*op-sys*/lib directory (where *op-sys* is the identifier for the operating system you are using) and can be used with any data link protocol on Freeway.

The loopback test program is placed in the freeway/client/*op-sys*/bin directory during the installation procedures.

Note

Earlier Freeway terminology used the term “synchronous” for blocking I/O and “asynchronous” for non-blocking I/O. Some parameter names reflect the previous terminology.

One high-level test program written in C is supplied with the Military/Government Protocols: milalp, which uses non-blocking I/O, meaning that the asyncIO DLI configuration parameter (described in the *Freeway Data Link Interface Reference Guide*) must be set to “yes” (the default is “no” for blocking I/O). The test is interactive; it prompts you for all the information needed to run the test.

The loopback test performs the following functions:

- Configures ICP buffer sizes

- Configures the link-level control parameters such as baud rates, clocking, and protocol
- Enables and disables links
- Initiates the transmission and reception of data on the serial lines
- Obtains link statistics from Freeway

You can use the loopback test as a template for designing client applications that interface with the DLI layer. You can also use it to verify that the installed Freeway devices and cables are functioning correctly.

A.2 Hardware Setup for the Test Program

The test program runs in loopback mode. Before running the test, perform the following procedure to install the loopback cabling:

Step 1: Provide a synchronous modem. Configure the modem to supply continuous clocking at a data rate between 50 and 19,200 bits per second. The Freeway ICPs are default configured for external clocking, and the modem supplies the clock signal for loopback testing.

Step 2: Select pairs of adjacent ports to loopback. Ports are looped back in the following pairs: (1,2), (3,4), (5,6), and so on. Install the special three-headed loopback cable between the ports you selected and the synchronous modem. For information on port numbering[1] and instructions on how to install the loopback cable, refer to the appropriate "Port Numbering and Cabling" information in your hardware installation guide.

[1] The "Port Numbering and Cabling" information in your hardware installation guide reflects the standard numbering convention of (0,1), (2,3), etc. The loopback test program uses (1,2), (3,4), and so on.

Note

The loopback cable is used only during testing, not during normal operation.

A.3 Running the Test Program

Caution

To run the test program successfully, you must have write privileges in the bin directory on the boot server.

Step 1: **To start the test program in a UNIX or Windows NT system**, change to the directory that contains the test program. For example, if you performed the default installation on a UNIX system, this directory is called /usr/local/freeway/client/*op-sys*/bin where *op-sys* is the identifier for the operating system you are using. On a Windows NT system the default directory is c:\freeway\client\op-sys\bin. Enter the following command at the prompt:

```
milalp
```

To start the test in a VMS system, change to the directory that contains the test program. If you performed the default installation, this directory is called SYS$SYSDEVICE:[FREEWAY.CLIENT.*OP-SYS*.BIN], where *OP-SYS* is the identifier for the hardware platform model and TCP/IP software you are using, for example AXP_TCPWARE. Enter the following command at the prompt:

```
RUN MILALP
```

The test may also be invoked with any combination of four options, using a bit-encoded value as a program argument:

bit 0: Suppress the user help query
bit 1: Allow for multiple ICPs in the test

bit 2: Assume all port clocking is internal

bit 3: Prompt user for ICP buffer sizing

Examples of program invocations are (hexadecimal values required):

milalp	(no options)
milalp 2	(multiple ICPs in test)
milalp 0xd	(no help screens, internal clocking, buffer sizing)

Other bit values in the argument are reserved for Protogate use. These uses are documented in the "Module Description" comments near the beginning of the freeway/client/test/mil/milalp.c source file.

Step 2: The following prompts are displayed. Defaults are shown in parentheses:

Select ICP device number (range [0,5]; default 0):

Enter the number of the ICP to be tested. This is the ICP that you cabled for testing in Step 2 on page 105.

Select ICP <i> Link <j> protocol (range [-1,2]; default 1):

Specify which protocol is to be tested on the given link.

Select ICP <i> Link <j> baud-rate [default=2400] (range [1,16]; default 1):

Specify which baud rate is to be used on the given link.

Select ICP <i> Segmentation buffer data area size (range [512,2048]; default 512):

Enter the ICP segmentation buffer data area size, in bytes.

Select ICP <i> Communication buffer data area size (range [<m>,<n>]; default <k>):

Enter the ICP communication buffer data area size, in bytes (minimum is dependent on protocols selected; maximum is dependent on selected segmentation buffer size).

Select ICP <i> transmit window size (range [1,<n>]; default 1):

Enter the ICP transmit acknowledge configuration parameter (maximum is dependent on the specified buffer sizes).

Select test length in minutes (range [1,100000]; default 1):

Enter the number of minutes you want the test to run.

Step 3: After you answer the last prompt, data transfer starts. The test displays a series of numbers, greater than (>) symbols, and less than (<) symbols to indicate that it is running. Numbers represent the links, greater than symbols appended to numbers represent data sent, and less than symbols prepended to numbers represent data received. A link number and its symbol are displayed upon the accumulation of a number of messages equal to three times the window size.

Step 4: Remove the loopback cable and configure the cables for normal operation as described in the appropriate "Port Numbering and Cabling" appendix in your hardware installation guide. Your Freeway is now configured to communicate with its clients.

A.4 Sample Output from Test Program

Figure A–1 shows the screen display from a sample Military/Government Protocols non-blocking loopback test program. Output displayed by the program is shown in typewriter type and your responses are shown in **bold type**. Each entry is followed by a carriage return.

```
% milalp 0xd

NO HELP selected
INTERNAL CLOCKING selected
SPECIFY BUFFER SIZES selected

PROTOGATE MILITARY/GOVERNMENT PROTOCOLS CLIENT TEST PROGRAM 5.0-0 09-FEB-00

Select ICP device number (range [0,5]; default 0): 1

ICP selected: 1

Session icp1general opened

ICP Protocol Software Version: Protogate MIL/GOV  7.5-4  07-JAN-00
Number of Links on ICP 1: 4

AVAILABLE PROTOCOLS FOR ICP 1:
  ( 0  ==> Omit this link from test)
  (-1  ==> Omit remaining links from test)
    1. PROT-A
    2. PROT-B

Select ICP 1 Link 1 protocol (range [-1,2]; default 1): 1
Select ICP 1 Link 2 protocol (range [-1,2]; default 1): 1
Select ICP 1 Link 3 protocol (range [-1,2]; default 1): 2
Select ICP 1 Link 4 protocol (range [-1,2]; default 1): 2
```

Figure A–1: Sample Output from Loopback Program

```
      BAUD     INTERNAL
      RATE     CLOCKING
     Default       1
     50 Baud (a)   2
   56.8 Baud (a)   3
   74.2 Baud (a)   4
    300 Baud       5
    600 Baud (s)   6
   1050 Baud (a)   7
   1200 Baud       8
   2400 Baud       9
   4800 Baud      10
   9600 Baud      11
  19200 Baud      12
  38400 Baud      13
 (a) = Asynchronous protocols
  (s) = Synchronous protocols

Select ICP 1 Link 1 baud-rate [default=2400] (range [1,16]; default 1): 1
Select ICP 1 Link 2 baud-rate [default=2400] (range [1,16]; default 1): 1
Select ICP 1 Link 3 baud-rate [default=2400] (range [1,16]; default 1): 1
Select ICP 1 Link 4 baud-rate [default=2400] (range [1,16]; default 1): 1

Select ICP 1 Segmentation buffer data area size (range [512,2048]; default 512): 512
Select ICP 1 Communication buffer data area size (range [38,500]; default 38): 38

Size   of ICP 1 segmentation  buffers:   512
Size   of ICP 1 communication buffers:    38
Number of ICP 1 segmentation  buffers:  1734
Number of ICP 1 communication buffers:  10627
```

Figure A–1: Sample Output from Loopback Program *(Cont'd)*

```
Select ICP 1 transmit window size (range [1,11]; default 1): 10

Opening sessions for selected links....

Session icp1port0 opened
Session icp1port1 opened
Session icp1port2 opened
Session icp1port3 opened

Configuring selected links....

Selected links configured

Enabling selected links....

Selected links enabled

Select test length in minutes (range [1,100000]; default 1): 1

Starting data transfer

1>2>3>4>1>2>3>4><2<11>2><4<3<1<21>2>3>4><1<21>2><3<4<2<11>3>2>4><3<4<2<11>2><2<
13>4>1>2><4<2<3<11>2>3>4><1<2<3<41>2><13>1>4><1<4<3<2<22>1><23>4>2>1><2<3<4<12>
1><23>4><4<1<32>1><2<12>3>4>1><1<4<2<31>2><13>4><2<41>2><3<1<22>1>3>4><1<21>2><
4<3<1<22>3>1>4><3<4<1<22>1><1<24>2>1><4<1<23><32>1><1<24>2>1><1<3<23><11>2><44>
<2<32>1><23>4><11>2><2<4<3<13>2>1><2<44><3<12>1>3><1<24>1>2><4<1<3<22>1>3><4<14
><3<21>2><1<23>2>1><1<44><2<32>1><13><22>4>1><1<2<4<31>2>3><1<2<44>1>2><3<1<23>
1>2><14><2<42>1><1<3<23><41>2>4><3<2<11>2><23>4><1<42>1><2<3<13><42>1>4><1<22>1
><33><1<21>2><44><3<1<22>1>3><14><22>1><4<1<3<23>2>1><44><1<2<31>2><1<23>2>4>1>
<1<4<2<32>1>3><1<2<44><32>1><1<23>2>1><1<24><4<32>1><23><4<14>2>1><2<1<31>2><23
>4><4<11>2><33><22>4><4<22><3<1<11>3>1><1<44>2><2<3<11>2>3><2<11>4><42><2

Shutting down selected links....

<3<1
```

Figure A–1: Sample Output from Loopback Program *(Cont'd)*

```
Host Statistics for ICP 1
-------------------------
Data Rate          2400   2400   2400   2400
Link ID number        1      2      3      4
RCV % efficient      61     61     87     85
XMT % efficient      62     62     87     88
RCV data packets   1837   1850   1122   1100
XMT data packets   1870   1860   1120   1140
XMT data unacked     20     19     20     16
XMT data NAKed        0      0      0      0
            73      Average percent efficiency (receive)
            74      Average percent efficiency (transmit)
            252     Data Segmentation Buffers received
            599     Data Segmentation Buffers sent

ICP 1 Synchronous Protocol Statistics
-------------------------------------
Protocol         PROT-A PROT-A PROT-B PROT-B
Link ID number        1      2      3      4
Data Rate          2400   2400   2400   2400
Msgs received      1837   1850   1122   1100
Mark/Parity errs      0      0      0      0
Chkgrp/CRC errs       0      0      0      0
Rcv overruns          0      0      0      0
Xmt underruns         0      0      0      0
Megs recd wo err   1837   1850   1122   1100
Msgs recd w errs      0      0      0      0
EOM errs              0      0      0      0
Messages sent      1850   1841   1100   1124
Lost messages         0      0      0      0

Selected links shut down

Session icp1general closed
Session icp1port0 closed
Session icp1port1 closed
Session icp1port2 closed
Session icp1port3 closed

Loopback test complete
```

Figure A–1: Sample Output from Loopback Program *(Cont'd)*

Appendix

B DLI and TSI Configuration Process

Note

The term "Freeway" can mean either a Freeway server or an embedded ICP. For the embedded ICP, also refer to the user's guide for your ICP and operating system (for example, the *ICP2432 User Guide for Windows NT*).

This appendix summarizes the process for configuring DLI sessions and TSI connections. DLI and TSI text configuration files are used as input to the dlicfg and tsicfg preprocessor programs to produce binary configuration files which are used by the dlInit and dlOpen functions. For embedded ICPs, only a DLI configuration file is used (not a TSI configuration file).

During your client application development and testing, you might need to perform DLI configuration repeatedly (as well as TSI configuration for a Freeway server).

Note

Some of the specifics regarding Military/Government Protocols DLI session configuration were described earlier in Section 2.2.1 on page 36.

You should be familiar with the protocol-independent configuration procedures described in the *Freeway Data Link Interface Reference Guide* and the *Freeway Transport Subsystem Interface Reference Guide*.

The DLI and TSI configuration files provided with the product are listed in Table B–1.

Table B–1: Configuration File Names

	Freeway Server	Embedded ICP
DLI:	mildcfg	milembcfg
TSI:	miltcfg	TSI not applicable for embedded ICP

The DLI and TSI configuration procedures are summarized as follows. Keep in mind that TSI configuration does not apply to an embedded ICP environment.

1. For a Freeway server, create or modify a TSI text configuration file specifying the configuration of the TSI connections (for example, miltcfg in the freeway/client/test/mil directory).

2. Create or modify a DLI text configuration file specifying the DLI session configuration for all ICPs and serial communication links in your system (for example, mildcfg in the freeway/client/test/mil directory).

3. If you have a UNIX or Windows NT system, skip this step. If you have a VMS system, run the makefc.com command file from the [FREEWAY.CLIENT.TEST.MIL] directory to create the foreign commands used for dlicfg and tsicfg.

   @MAKEFC <*tcp-sys*>

   where <*tcp-sys*> is your TCP/IP package:

MULTINET	(for a Multinet system)
TCPWARE	(for TCPware system)
UCX	(for a UCX system)

   VMS example: @MAKEFC UCX

4. For a Freeway server, go to the freeway/client/test/mil directory and execute tsicfg with the text file from Step 1 as input. This creates the TSI binary configuration

file in the same directory as the location of the text file (unless a different path is supplied with the optional filename). If the optional filename is not supplied, the binary file is given the same name as your TSI text configuration file plus a .bin extension.

tsicfg *TSI-text-configuration-filename [TSI-binary-configuration-filename]*

VMS example:	tsicfg miltcfg
UNIX example:	freeway/client/*op-sys*/bin/tsicfg miltcfg
NT example:	freeway\client\op-sys\bin\tsicfg miltcfg

5. From the freeway/client/test/mil directory, execute dlicfg with the text file from Step 2 as input. This creates the DLI binary configuration file in the same directory as the location of the text file (unless a different path is supplied with the optional filename). If the optional filename is not supplied, the binary file is given the same name as your DLI text configuration file plus a .bin extension.

dlicfg *DLI-text-configuration-filename [DLI-binary-configuration-filename]*

VMS example:	dlicfg mildcfg
UNIX example:	freeway/client/*op-sys*/bin/dlicfg mildcfg
NT example:	freeway\client\op-sys\bin\dlicfg mildcfg

Note

You must rerun dlicfg or tsicfg whenever you modify the text configuration file so that the DLI or TSI functions can apply the changes. On all but VMS systems, if a binary file already exists with the same name in the directory, the existing file is renamed by appending the .BAK extension. If the renamed file duplicates an existing file in the directory, the existing file is removed by the configuration preprocessor program.

6. If you have a UNIX system, move the binary configuration files that you created in Step 4 and Step 5 into the appropriate freeway/client/*op-sys*/bin directory where *op-sys* indicates the operating system: dec, hpux, sgi, solaris, or sunos.

   UNIX example: mv mildcfg.bin /usr/local/freeway/client/hpux/bin
   mv miltcfg.bin /usr/local/freeway/client/hpux/bin

7. If you have a VMS system, run the move.com command file from the [FREEWAY.CLIENT.TEST.MIL] directory. This moves the binary configuration files you created in Step 4 and Step 5 into the bin directory for your particular TCP/IP package.

   @MOVE *filename* <*tcp-sys*>

   where *filename* is the name of the binary configuration file and <*tcp-sys*> is the TCP/IP package:

MULTINET	(for a Multinet system)
TCPWARE	(for TCPware system)
UCX	(for a UCX system)

   VMS example: @MOVE MILDCFG.BIN UCX

8. If you have a Windows NT system, move the binary configuration files that you created in Step 4 and Step 5 into the appropriate freeway\client\op-sys\bin directory where *op-sys* indicates the operating system: axp_nt or int_nt (for Freeway server); axp_nt_emb or int_nt_emb (for an embedded ICP).

   NT example: copy mildcfg.bin \freeway\client\axp_nt\bin
   copy miltcfg.bin \freeway\client\axp_nt\bin

When your application calls the dlInit function, the DLI and TSI binary configuration files generated in Step 4 and Step 5 are used to configure the DLI sessions and TSI connections. Figure B–1 shows the configuration process.

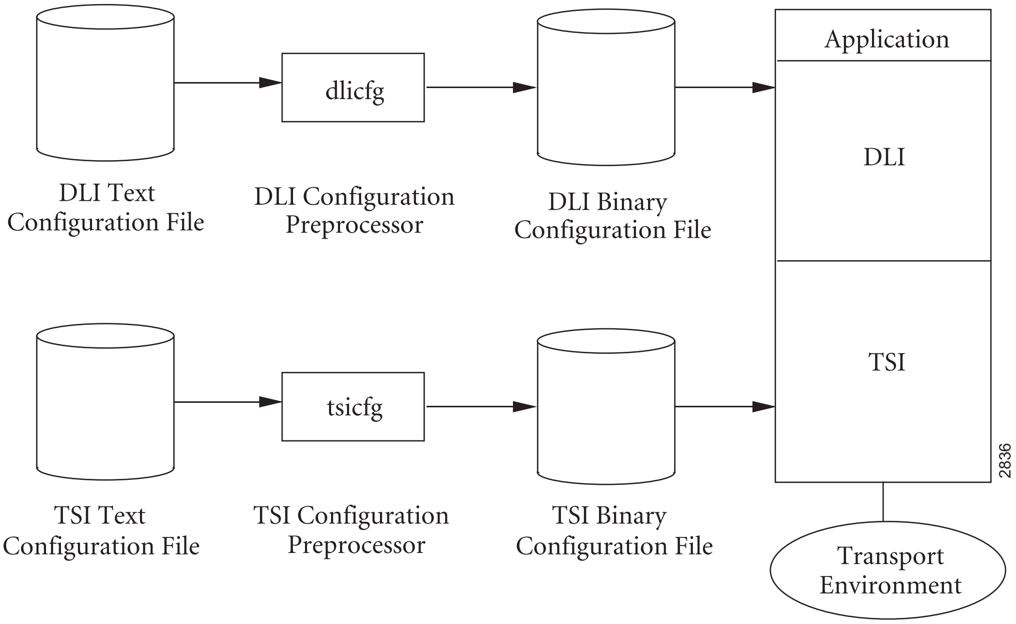

dlicfg
DLI Text Configuration File
DLI Configuration Preprocessor
DLI Binary Configuration File
Application
DLI
TSI
tsicfg
TSI Text Configuration File
TSI Configuration Preprocessor
TSI Binary Configuration File
Transport Environment
2836

Figure B–1: DLI and TSI Configuration Process

Appendix

C

Military/Government Protocols Input Data Time Stamping

C.1 The Concept of Time Stamping

Protogate's Military/Government Protocols include a 32-bit time stamp with each input data message that is received from a link and sent to the client. This value is inserted as the first four bytes following the individual Input Data message header and preceding the protocol message data itself. The time-stamp value represents some number of milliseconds. To the ICP, this is an arbitrary number. To the client program, it is an offset from a base time determined by the client program.

The time stamp for a given input data message is assigned upon the arrival of the first bit of the message data at the serial link. It is taken from a 32-bit time-stamp word maintained by the OS/Protogate operating system. The value is set to zero when the ICP is downloaded, and is then incremented once per millisecond. Two commands that alter this default activity are available to the client: Set Time Stamping and Set Time Stamp Value.

The Set Time Stamping command may specify either of two kinds of time-stamp activity: Internal timing (the default at startup) and PCI Host timing. The Set Time Stamp Value command applies only when Internal timing is active.

C.2 Internal Timing

When doing Internal timing, the ICP simply updates its 32-bit time-stamp value once per millisecond. This is the only process of maintaining the time-stamp value, apart from interventions by the Set Time Stamp Value command. This command enables the client program to periodically correct any timing drift that may be occurring on the ICP with respect to client-system timekeeping, by specifying a replacement value for the current time-stamp contents. Other than obeying this client command, the ICP does not instigate any timing correction on its own. The only wraparound to 0 with Internal timing is when 32-bit overflow occurs.

C.3 PCI Host Timing

When doing PCI Host timing, the ICP regularly updates its time-stamp contents via PCIbus transactions with the ICP driver that resides in whatever system hosts the ICP. PCI Host timing can be specified only when the ICP driver has the PCI Host timing capability. Freeway servers with the FreeBSD operating system support PCI Host timing. ICP drivers in systems with the ICPs embedded in the host PCIbus may or may not support PCI Host timing, depending on the host system and the driver release level.

As a 32-bit count of milliseconds, the PCI Host timing time-stamp represents an offset from the most recent midnight. It wraps around to zero at the next midnight (86,400,000 milliseconds). PCI Host timing values are kept to within a millisecond of the host system time via PCIbus transactions. Note that with Freeway servers or client systems that tune their system times according to external time sources (such as Network Time Protocol), the PCI Host timing thereby reflects that external source.

PCI Host timing is selected by the Set Time Stamping client command. This command selects PCI Host timing by specifying a 16-bit data value of -2.

A data value of 0 or greater selects Internal timing, if the client system ever needs to return to that timing mode. Any other negative value is rejected by the ICP. Two explanatory notes: (1) the value -2 instead of -1 is used by this command because -1 was used for a timing mode that pertained only to VMEbus ICPs; and (2) all non-negative values are permitted for establishing Internal timing (not just 0) in order to retain compatibility with the time-stamping methods used by pre-OS/Protogate client programs, which thereby may continue to run unchanged on ICPs with OS/Protogate.

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