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Routing Products

Protocols Manual

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Headquarters
400 Providence Mine Rd
Nevada City, CA 95959
United States

15655 SW Greystone Ct.
Beaverton, OR 97006
United States

10 Presidential Way
Suite 300
Woburn, MA 01801
United States

Kapittelweg 10
4827 HG Breda
The Nederlands

7140 Baymeadows Way
Ste 101
Jacksonville, FL 32256
United States

2300 So. Decker Lake Blvd.
Salt Lake City, UT 84119
United States

Rue du Clos Courtel
CS 31719
35517 Cesson-Sevigné Cedex
France

1 rue de l'Hautil
Z.I. des Boutries BP 150
78702 Conflans-Sainte
Honorine Cedex
France

Technopole Brest-Iroise
Site de la Pointe du Diable
CS 73808
29238 Brest Cedex 3
France

40 Rue de Bray
2 Rue des Landelles
35510 Cesson Sevigné
France

Spinnereistrasse 5
CH-5300 Turgi
Switzerland

Brunnenweg 9
D-64331 Weiterstadt
Germany

Carl-Benz-Strasse 6-8
67105 Schifferstadt
Germany

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Chalfont, PA 18914
Ph: (215)997-4519
Fax: (215)997-3809

Accredited By:
ANAB

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Contacting Grass Valley

International Support Centers	**France 24 x 7**	+800 8080 2020 or +33 1 48 25 20 20	**United States/Canada 24 x 7**	+1 800 547 8949 or +1 530 478 4148
Local Support Centers (available during normal business hours)	**Asia**	**Hong Kong, Taiwan, Korea, Macau:** +852 2531 3058 **Indian Subcontinent:** +91 22 24933476 **Southeast Asia/Malaysia:** +603 7805 3884 **Southeast Asia/Singapore:** +65 6379 1313 **China:** +861 0660 159 450 **Japan:** +81 3 5484 6868		
	Australia and New Zealand: +61 1300 721 495		**Central/South America:** +55 11 5509 3443	
	Middle East: +971 4 299 64 40 **Near East and Africa:** +800 8080 2020 or +33 1 48 25 20 20			
	Europe	**Belarus, Russia, Tadzikistan, Ukraine, Uzbekistan:** +7 095 2580924 225 **Switzerland:** +41 1 487 80 02 **S. Europe/Italy-Roma:** +39 06 87 20 35 28 **-Milan:** +39 02 48 41 46 58 **S. Europe/Spain:** +34 91 512 03 50 **Benelux/Belgium:** +32 (0) 2 334 90 30 **Benelux/Netherlands:** +31 (0) 35 62 38 42 1 **N. Europe:** +45 45 96 88 70 **Germany, Austria, Eastern Europe:** +49 6150 104 444 **UK, Ireland, Israel:** +44 118 923 0499	

Grass Valley Web Site

The www.grassvalley.com web site offers the following:

Online User Documentation — Current versions of product catalogs, brochures, data sheets, ordering guides, planning guides, manuals, and release notes in .pdf format can be downloaded.

FAQ Database — Solutions to problems and troubleshooting efforts can be found by searching our Frequently Asked Questions (FAQ) database.

Software Downloads — Download software updates, drivers, and patches.

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END-OF-LIFE PRODUCT RECYCLING NOTICE

Grass Valley's innovation and excellence in product design also extends to the programs we've established to manage the recycling of our products. Grass Valley has developed a comprehensive end-of-life product take back program for recycle or disposal of end-of-life products. Our program meets the requirements of the European Union's WEEE Directive, the United States Environmental Protection Agency, and U.S. state and local agencies.

Grass Valley's end-of-life product take back program assures proper disposal by use of Best Available Technology. This program accepts any Grass Valley branded equipment. Upon request, a Certificate of Recycling or a Certificate of Destruction, depending on the ultimate disposition of the product, can be sent to the requester.

Grass Valley will be responsible for all costs associated with recycling and disposal, including freight. However, you are responsible for the removal of the equipment from your facility and packing the equipment to make it ready for pickup.

For further information on the Grass Valley product take back system please contact Grass Valley at + 800 80 80 20 20 or +33 1 48 25 20 20 from most other countries. In the U.S. and Canada please call 800-547-8949 or 530-478-4148, and ask to be connected to the EH&S Department. Additional information concerning the program can be found at: www.thomsongrassvalley.com/environment

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Contents

Preface

About This Manual

This document describes external protocols for Grass Valley Routing products. It assumes basic familiarity with routing equipment. For information on Grass Valley Routers refer to product manuals.

Section 1

Protocols Overview

Introduction

The Grass Valley Router System can be controlled by external devices, and can also control external devices. Several methods are employed to accomplish this control. This manual covers the following protocols that allow external control of part or all of a Grass Valley Router System:

- *Grass Valley Router Control Language* on page 17 (Encore Control System Protocol via RS-232, RS-422, SLIP, or Ethernet),
- *Series 7000 Native Protocol* on page 111 (Series 7000 Signal Management System Protocol via RS-232, RS-422, SLIP, or Ethernet), and
- *Serial Node Controller Protocol on page 165* (Pro-Bel Protocol via RS-485).

  Omnibus automation system control of a System 7000, using a variation of the Pro-Bel protocol.

Other control mechanisms listed below that involve protocols are described elsewhere:

- Encore Diagnostic (via VT-100 terminal or emulator),

  For reporting diagnostic information, and for issuing simple commands for diagnostics and service purposes. This interface is described in the *Encore Installation and Service Manual*.
- System Diagnostic Interface (Series 70000 via VT-100 terminal or emulator),

  For reporting diagnostic information, and for issuing simple commands for diagnostics, service, and installation purposes. This interface is described in the *Series 7000 Installation Manual*.
- Pro-Bel System 3 Interface, and

  System 7000 Control of a Pro-Bel System 3. This interface is described in the *Series 7000 Installation Manual*.
- Networked Series 7000 systems.

  Uses Native Protocol. Issues relating to networked control are described in the *Series 7000 Configuration Manual*.

General Interface Requirements

For successful control, all devices involved must be physically connected with the proper interface, have any required options installed, and be properly configured for the desired connection and protocol.

Requirements differ for different control mechanisms, and are described where appropriate.

Refer to the manufacturer's documentation of any external device being interfaced to a Grass Valley Router System for information on installation and configuration procedure for these systems

RCL NP Client Application

The RCL (Router Control Language) NP (Native Protocol) Client Application is a software application implementing the RCL/NP Protocol, it also doubles over as a test tool that talks to any Server implementing the RCL/NP protocol for the various operations that needs to be performed, such as; Takes, Queries, etc. It also provides the capability to interface and control routers, which implement either NP or RCL protocol. Contact Customer Service for more information about this application.

Section 2

Grass Valley Router Control Language

Introduction

The Grass Valley Router System can be controlled by an external, serial or ethernet connected communicating device such as a personal computer or an automation system. The Router Control Language (RCL) described is intended to facilitate control of the Grass Valley Router.

Commands and error responses are terse and character efficient to maximize throughput. All message bytes are from the ASCII character set (printable and control characters). This provides the ability to easily log information through the duplex control ports.

Message sizes can be tuned to match receive buffer sizes to maximize throughput.

RCL is implemented in Grass Valley Encore routing systems from Encore Software Version 1.6.5 onwards. SMS7000 and earlier Encore systems do not support RCL.

RCL protocol offers significant advantages over its predecessor Native protocol. The following features facilitate the client to control the routing system in a better way:

- *Synchronizing Requests and Responses* on page 32,
- *Multiple Area Support* on page 32,
- *Subscription Support* on page 32,
- *Exclusion Set Support* on page 34, and
- *Refreshing and Maintaining Protects* on page 34.

Command and Message Description Notation

For the command parameter descriptions in this section, lower case parameters must be replaced by user specified information, while upper case parameters must be literally supplied.

Upper case parameters fall into two categories: printable ASCII characters, where they are supplied as shown, and ASCII control characters, where the text shown translates into a hex equivalent.

Notation symbols used in the format descriptions in this section are shown in Table 1.

Table 1. Notation symbols

Symbol	Meaning
...	A continued sequence.
|	Or
[]	Optional parameters
< >	Choices, or ASCII control characters, or for clarity.
,	Comma designates horizontal tab <HT>, the data separator.

For the sake of readability, spaces may be shown in the descriptions where none exist in the protocol definition.

Interface Requirements

In order to control a Grass Valley Router system using RCL, both the Grass Valley Router and the external device must have RCL protocol implementation.

Communication with the Grass Valley Routing system can be achieved using either a RS-232, a RS-422, or an Ethernet interface.

RS-232 or 422 Communication

Pinouts and cable diagrams for creating RS-232 or 422 connections are available as part of the Installation instructions in Grass Valley product manuals.

Default communication settings are:

- 9600 Baud
- 8 Data Bits
- 1 Stop Bit
- No Parity

The external device controlling the Routing System must be equipped with an RS-232 or RS-422 Serial Port capable of supporting at least one of the following communication rates; 300 k, 600 k, 1.2 k, 2.4 k, 9.6 k, 19.2 k, 38.4 k, or 115.2 k Baud.

Ethernet Communication

Use of Ethernet is recommended. The network should be closed, for use only by the Grass Valley Router system. Configurations that are connected to larger, open networks, are not supported.

Each device on the network must be assigned a unique IP address and name. Review the instructions for Ethernet interface hardware in your computer manuals. It may be necessary to consult an expert in the field of Ethernet network installation.

To use the RCL Ethernet interface, user-supplied software must be created to send and receive RCL messages according to the protocol specifications in this document. The programmer writing software for this application must be skilled in the use of TCP/IP sockets. Knowledge of Ethernet networking and system administration is also required to install and configure software.

For Grass Valley Router systems which do not support Ethernet, external control using RCL control is accomplished via a RS-232 or RS-422 interface.

Basic RCL Description

The levels of the RCL Protocol are defined in Table 2:

Table 2. Protocol Levels

Level	Description
Level 1	Physical (e.g. RS-232, RS-422, Ethernet)
Level 2	Data Link (e.g. checksums, ACK/NAK)
Level 3	Supervisory (e.g. flow control, message buffering)
Level 4	Application

The following discussions assume that Levels 1, 2, 3, and 4 will be similarly implemented on each end of the communication link. Because of significant differences in all but level 4 messages, the RS-232/RS-422 and Ethernet descriptions are presented separately.

RS-232 and RS-422 Description

Level 1

- RS-232 or RS-422
- Baud rate - 300 k, 600 k, 1.2 k, 2.4 k, 9.6 k, 19.2 k, 38.4 k, or 115.2 k (Default = 9.6 k)
- 1 stop bit
- 8 data bits
- No parity

Level 2

Level 2 adds the <SOH> character and the protocol_id to the message byte stream. It calculates the message checksum and appends it to the message. It then adds the <EOT> character, and transmits the message.

The receiving end, buffers input, verifies the <SOH>, protocol_id, and <EOT> bytes, and verifies the checksum. If the message is successfully received, it notifies Level 3 of its availability.

Level 2 ACK/NAK

When a message is successfully received by the router, an ACK (0x06) message is returned to the client. The client also should send an ACK when it receives a complete message. ACKs are returned immediately, with no field delay. ACKs are not encapsulated in <SOH>, <checksum>, or <EOT>. If the sender does not receive an ACK within 500-1000 milliseconds after the message is sent, the message is re-transmitted for a total of ten (10) attempts. The Router end of the protocol will always attempt to transmit exactly ten (10) times. However, the external device may choose fewer attempts, or simply keep transmitting the same message until it is finally acknowledged.

If an error occurs during reception of a message, a NAK (0x15) followed by an error code descriptor is returned to the sender. NAKs are returned immediately, without any delay. NAKs and Level 2 error codes are not preceded by an <SOH> or verified with a <checksum>. However an <EOT> trails the NAK message, as follows:

```
<NAK> <ErrorCodeHI> <ErrorCodeLO> <EOT>
```

The error code is a two digit hex number, expressed in ASCII.

The sender can attempt to re-transmit. However, the sender should not attempt transmission of a new or repeated message until an ACK or NAK is received, or until an appropriate time-out occurs. If a NAK with an error

code indicating buffer not available is received, the sender should delay before attempting a re-transmission.

When the external device returns NAKs to the RCL Server, they must be in the format described above (with error code and EOT).

See *Level 2 (NAK) Error Code Descriptions* on page 30 for specific error information.

Level 3

Level 3 copies input messages from Level 2 buffers into its own buffers. By marking the Level 2 buffers as available, it effectively accomplishes flow control (assuming the sender delays long enough before attempting to re-transmit the message, and the receiver gets a buffer cleared out in time). Should buffers become full, Level 2 will return the required <NAK> <buffer not available error> <EOT>, for every message attempted while this buffer (or queue) full condition remains. Again, a delay between transmitted messages should be invoked when this error condition is reported to the sender.

Level 3 passes incoming data buffers up to the appropriate Level 4 protocol handler one at a time. Level 3 appends the RCL Server internal header to the front of the RCL message before delivering to Level 4.

Level 3 receives output messages from Level 4, one at a time, and buffers them for output to Level 2. Level 3 strips the RCL Server internal header from the message, only passing on to Level 2 the properly formatted RCL message. Messages are passed to Level 2 one at a time. Level 2 calculates the checksum and transmits.

Level 3 Error Recovery

Ten (10) consecutive transmit retries of a message will be attempted. Should the packet not be accepted by the receiving side within that count, an error will be sent. Appropriate action could be a switch over to the redundant Interface Card if redundant pairs are involved, or an Interface reset in stand-alone configurations.

In both transmit and receive cases, the retry count is reset to zero on receipt of the ACK.

See *Error Codes* on page 30 for specific error information.

Level 4

Level 4 of RCL parses the content of the messages, and accesses the Grass Valley Router to either return the information requested, or to perform the requested action.

See *RCL Message Categories* on page 36 for a detailed listing of all Level 4 messages.

Ethernet Description

Level 1 Description

- 10-Base2 Ethernet
- Closed network strongly recommended (dedicated to Grass Valley Router)

Levels 2, 3, and 4 Description

There are two widely used socket types, stream socket, and datagram socket. Each uses its own communications protocol. Datagram sockets use UDP (User Datagram Protocol), which is a message oriented protocol. Stream sockets use TCP (Transmission Control Protocol), which is a stream oriented protocol.

Datagram sockets have to read entire messages at once and carry sufficient information to be routed from the source device to the destination device. They do not rely on earlier exchanges between the source device, destination device, and the transporting network.

Stream sockets (sometimes referred to as Berkeley sockets) treat communications as a continuous stream of characters and are connection oriented. Therefore, a connection must be opened and maintained for the duration of the communications. Stream sockets are supported for many different host environments and operating systems.

A computer or other host device using RCL must initiate communication with a Grass Valley router. The computer is a client, and the Grass Valley router is the server.

RCL Session Sequence

A RCL client can establish connection to RCL Server and perform operations using the steps mentioned below.

1. Create a TCP/IP stream socket on the client.
2. Set linger on with a timeout of zero.
3. Connect the socket to the IP address of the desired RCL Server, on port 12345.
4. Perform RCL Connect (RC) sequence:
   a. Request RCL connect to the RCL Server

   ```
   RC
   ```

   b. Response

   ```
   RA,session_id
   ```

5. Do the necessary queries and operations on the router.
6. Once the client finishes the operations and no longer wants to communicate with the router it can disconnect by initiating the RCL disconnect (RD) as described in page 8.
7. Close the TCP socket that was created during the initiate communication phase.

Data Link and Supervisory Control

Unlike RCL via Serial, the TCP/IP communications layers used with Ethernet are responsible for the end-to-end error-free transport of messages. This means that messages sent and received via stream sockets are guaranteed to arrive in order and error-free, as long as the connection between the client and server is maintained.

In RCL via an Serial, Levels 2 and 3 are responsible for the error-free transport of messages. Since data transport is managed transparently for TCP/IP stream sockets, the Level 2 ACK/NAK protocol is not used for Ethernet communications. The user-supplied software must not generate or expect ACKs or NAKs for message transactions. Level 2 error messages will not be generated.

Since the TCP stream connection is error-free, message format and checksum errors are generally a result of a programming error and not a communications error. The user-supplied program should be able to prevent these errors.

Sending Messages

While connected, RCL Level 4 messages may be sent from the client by writing to the socket. Each message sent must be properly constructed as documented for RCL messages.

The requirements for each message are:

- The message must begin with a SOH,
- End with an EOT, and
- The transmitted checksum must be correct.

The user-supplied software must check for errors returned by the socket's write function call to ensure that the entire message was accepted and transmitted correctly.

All RCL Level 4 messages and responses are available to an Ethernet client. However, since the Level 2 ACK/NAK is not used, the `BK,2` command will be ignored (no response is generated).

One possible source of problems is in the checksum verification. Message checksums as defined for Level 2 must be calculated and included with all messages. The RCL Server interface will discard any message with a

checksum error, and a Level 2 error message will not be returned. Since TCP/IP guarantees an error-free message, the checksum cannot be corrupted during transmission. However, if the user-supplied software incorrectly calculates the checksum, the message will not be processed by the Server.

With stream sockets, the user-supplied software must correctly handle byte ordering and padding for multi-byte values. However, all RCL messages are comprised of single byte values (ASCII characters), so byte ordering is not a problem when the correct message format is followed.

Receiving Messages

RCL Level 4 responses are received by the client by reading from the connected stream socket. Each message is formatted as documented, beginning with a SOH character and ending with an EOT character.

When reading a TCP/IP stream socket, data is presented error-free and in the order sent. However, there is no built-in method for identifying the boundaries of messages. It is up to the user-supplied software to look for the beginning SOH and ending EOT. Be aware that most stream socket implementations may deliver message fragments when the read function call is made. The user-supplied software must be designed to buffer received messages until a complete message is received. Response messages will be received for all command messages sent to the server.

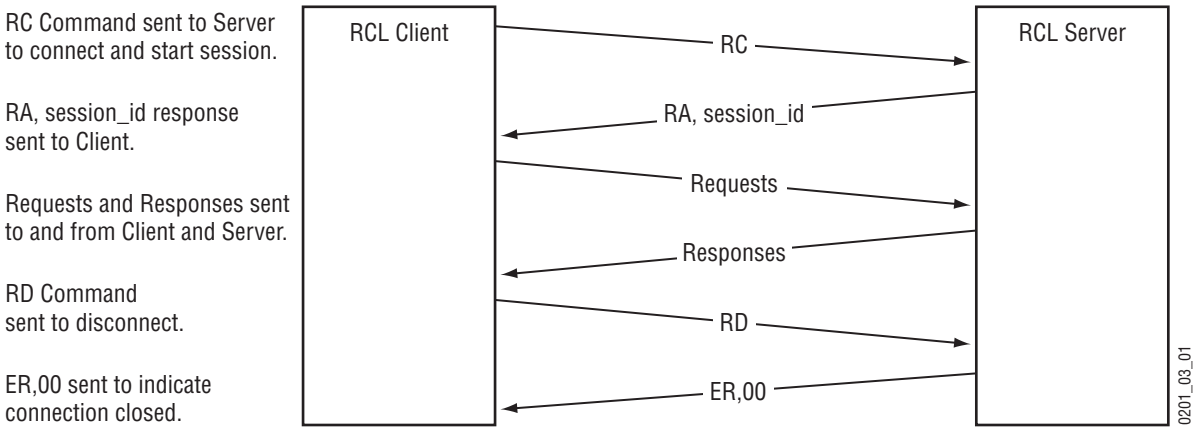
RCL Connection Management

RCL Connect

The TCP or serial connection mechanism is followed by an application level RCL connect mechanism, before the client can do any other transaction with the Grass Valley Router. The RCL connect sequence is.

1. The client will send a connect request command `RC` (described in *RC - RCL Connect* on page 72).
2. The server will respond back with RCL accept message `RA` (described in *RC - RCL Connect* on page 72). The server response `RA` will have an unique `session _id` for this connection.

Figure 1. RCL Client and Server Communication



RCL Disconnect

Either the client or server can initiate the RCL disconnect process by issuing the `RD` command (described in *RD - RCL Disconnect* on page 72). This is the application level disconnect which needs to be done before a socket closure. The end that receives disconnect request will respond back with an `ER, 00` and the connection will be closed gracefully.

This process is depicted in the diagram above. This shows the RCL connect and disconnect mechanism and the flow of commands and responses during this process.

RCL Announce

The RCL server during start up will send a command called RCL Announce (`RN`) to all the connected clients indicating that the server has just started up. The format of the command is: `RN`

RCL Message Format

Every RCL message has a fixed length header, a variable data field and a fixed length trailer.The size of the data field can be between 0 and 1007 bytes. The fields in the RCL message is case sensitive. RCL request and response message format is described below.

```
<SOH> <protocol_id> <session_id><message_id>
<seq_number><Reserved> <Data> <checksum> <EOT>
```

The significance and the valid values of the various fields in the message is shown in Table 3.

Table 3. RCL Message Format Fields

Field	Description
<SOH>	ASCII Start of Header character (Value = ASCII 01)
<protocol_id>	The protocol identifier (one ASCII character) (Value = 'R')
<session_id>	Two hex digits converted to its ASCII representation. The server at session initiation will give the session ID.
<message_id>	Four hex digits converted to ASCII representation. The unique ID of the message in this session.
<seq_number>	Four hex digits converted to ASCII representation. The most significant byte is sent first. This indicates the number of the message in its sequence. 0000 if it is the last message.
<Reserved>	Four hex digits reserved for future use. To be filled with value 0xFFFF.
<Data>	The request/response message. The parameter delimiter is <HT> Horizontal Tab (0x09) and precedes each parameter. (Note that in the examples, A comma is used to signify <HT>.).A trailing <HT> following the last datum is essential to facilitate parsing. The data is of variable length and depends on the command \ response. The maximum length of this field can be 1005 bytes. The trailing <HT> should not be specified for the some commands after the last datum. See Trailing <HT> (page 37)
<checksum>	Two-byte check sum value for error checking. Refer to the checksum calculation algorithm section below.
<EOT>	ASCII End of transmission (Value = ASCII 04).

Table 4 is an example showing how the various fields in the RCL message should be used. The `BK,D` command is used in the example below.

Table 4. Example of BK,D Command

Field	Byte	Byte in ASCII (as sent in message)	Length (in bytes)
SOH	SOH	01	1
protocol_id	R	52	1
session_id	4 5	34 35	2
message_id	1 2 3 4	31 32 33 34	4
seq_number	0 0 0 0	30 30 30 30	4
Reserved	F F F F	46 46 46 46	4
request_cmd	B K	42 4b	2
HT	HT	09	1
parameter	D	44	1
checksum 0	TBD	TBD	1
checksum 1	TBD	TBD	1
EOT	EOT	04	1

Checksum Calculation Algorithm

The checksum is calculated on those items following SOH and before the inserted checksum value. All the values between SOH and the checksum field are summed up and mod 0x100 on this is calculated. This is then negated to arrive at the two byte checksum.

Please refer to *Appendix A-CheckSum Calculation Code Snippet* page 191 for the code snippet showing the checksum calculation for the BK,D example from Table 4.

Note The calculations below are all in Hex values.

52+34+35+31+32+33+34+30+30+30+30+46+46+46+46+42+4b+09+44=437

Mod 100 of 437 = 37

To negate that value: 100-37=C9

The checksum value is converted to two hex digits and inserted in the message as shown in Table 5

Table 5. Checksum Value Conversion to Byte

Field	Byte	Byte in Hex (as sent in message)	Length (in bytes)
SOH	SOH	01	1
protocol_id	R	52	1
session_id	4 5	34 35	2
message_id	1 2 3 4	31 32 33 34	4
seq_number	0 0 0 0	30 30 30 30	4
Reserved	F F F F	46 46 46 46	4
request_cmd	B K	42 4b	2
HT	HT	09	1
parameter	D	44	1
checksum 0	C	43	1
checksum 1	9	39	1
EOT	EOT	04	1

Responses and Errors

As soon as the RCL server receives the request from the client, it processes the request and sends a positive or negative response based on the status of the performed operation. The maximum time the client will have to wait for a response from the server is called the Latency Time. This Latency time is the timeout period for the client to retransmit requests if it did not get the response.

The default mode of operation would include response for all commands. The clients can enable/disable responses for operations in order to reduce

processing at the client end. The client can disable these responses by sending the RCL command `BK,E,OFF`.

In case of operations like take, protect, unprotect and salvo, positive response only indicates that the operation request has been passed onto the lower layers in the system. It does not indicate successful completion of the operation. The only way to find out if the operation has been successfully carried out is to query the status back on the specific entity on which the operation was performed. In case of clients who have subscribed for status changes on the entity, the change will be asynchronously notified.

Level 4 Error

The RCL level 4 error message is an RCL message with the following data. The header and trailer information is the same as any other RCL message.

```
<SOH><protocol_id><session_id><message_id><seq_number>
<Reserved><Data><checksum><EOT>
```

Where `<Data>` is of the form `ER<,error_code><,request_cmd>`

`ER`	The two ASCII characters 'ER'
`<,error_code>`	Two digit ASCII code defining the error detected at Level 4. Level 4 error codes are two digit hex numbers, and are transmitted as two ASCII bytes, most significant byte first. "ER,00" signifies that the request was successfully executed and is not an error.
`<,request_cmd>`	The two-letter request command which this message corresponds to.
`[,data]`	Optional printable ASCII character providing additional information about the error. In many cases, this data will be one of the parameters of the failed command (e.g., the incorrect dest_name). The datum delimiter is <HT> Horizontal Tab (0x09), and precedes each datum, including the first. (Examples show <HT> as comma.) A trailing <HT> following the last datum is sent to facilitate parsing by the client. Incoming control messages are buffered to maximize throughput.

Message Size and Sequence

Message size can grow quite large, both for commands and responses. For example, the `TA` (Request Take) command could grow large, depending on

the number of sources and levels specified. Long commands and responses may need to be segmented and sent in a sequence of messages rather than in one large message.

The seq_number indicates the sequence of this packet in the context of the whole message.

If <seq_flag = ASCII '0000'>, this is the last segment.

Many messages fit in a single packet. For these messages also, the sequence number is set to '0000'.

Messages are sent with entries intact, so each message makes complete sense on its own. Messages are not arbitrarily broken up without regard to data boundaries.

Level Bitmap

A level_bitmap is a 32 bit quantity where each bit represents the presence (=1) or absence (=0) of a particular level for that command or response. The least significant bit (right-most) represents Level #0. The most significant bit (left-most) represents Level #31. The QN,L command allows the user to find out the Level Names configured in the system.

The following example shows how level bitmap is constructed for a given set of levels.

Assume that a particular operation is to be performed on levels 0, 2, 3, 4, 5, 6, and 10. This information is rendered onto a 32 bit quantity as shown below.

Level Bitmap = 0000 0000 0000 0000 0000 0100 0111 1101 (Binary)

The equivalent hex message is shown below

Level Bitmap (Hex) = 0x 0000047D

These 8 hex digits are then converted to ASCII (='0',...'9', 'A',...'F') and sent with the most significant byte first. The hex digits 'A'...'F' can be sent as upper or lower case ('a'...'f').

Level Bitmap (Sent in ASCII) = 30 30 30 30 30 34 37 44

Area Bitmap

An area_bitmap is a 64 bit quantity where each bit represents the presence (=1) or absence (=0) of a particular area for that command or response. The least significant bit (right-most) represents area index #0; the most significant bit (left-most) represents area index #63. The QN,A command allows the user to find out the Area Names configured in the system.

The following example shows how an area bitmap is constructed for a given set of areas.

Assume that a particular operation is to be performed on areas 8, 13, 19, 24, 25, 28, and 32. This information is rendered onto a 64 bit quantity as shown:

Area Bitmap = `0000 0000 0000 0000 0000 0000 0000 0001` (Bits 63-32)

(Binary) `0001 0011 0000 1000 0010 0001 0000 0000` (Bits 31-0)

The equivalent hex message is:

Area Bitmap = `0x 00000001 13082100`
(Hex)

These 8 hex digits are then converted to ASCII (='0',...'9', 'A',...'F') and sent with the most significant byte first. The hex digits 'A'...'F' can be sent as upper or lower case ('a'...'f').

Area Bitmap = `30 30 30 30 30 30 30 31 31 33 30 38 32 31 30 30`
(Sent in ASCII)

Error Codes

RCL server may return Level 2 NAK errors or Level 4 errors in case of request failures.

Level 2 NAK Errors

Negative Acknowledgement (NAK) is generated due to communication related failures to a serial (RS-232 or RS-422 interface) client. These errors are not present for the Ethernet RCL interface.

An example of a Level 2 error is a Time Out Error. Time out interval begins upon reception of an `SOH` and is halted at the reception of an `EOT`. Time out interval is one (1) second for data rates from 2400 to 38.4k Baud.

For slower rates, time out is calculated as:

Time out (in seconds) = 2400/data rate.

For example, at 300 Baud, time out = 8 seconds (2400/300 = 8).

Level 2 (NAK) Error Code Descriptions

The following codes are sent with NAKs from the Router to the RCL client. The client is also responsible for sending NAKs to the Router when appro-

priate. However, if specific errors are reported with an external device's NAK, they should be defined as:

<NAK> <error_code> <EOT>

<error code> is defined as a Hexadecimal number 71 - 79 (Table 6).

Table 6. RCL Protocol Level 2 NAK Error Codes

Decimal Value	Hexadecimal Value	Meaning	Description
113	71	Buffer Size Exceeded	The number of characters received since the last detected SOH is greater than the maximum RCL message length.
114	72	Buffer Not Available	Input buffer full.
115	73	Reserved	
116	74	Chip Level Error	Error detected by UART such as parity error.
117	75	Checksum Error	Packet had a bad checksum. Low Level errors such as framing, overrun, etc., are reported as checksum errors.
118	76	Time Out Error	Time out interval is begun upon the reception of an SOH, and is halted at the reception of an EOT. Time out interval is one (1) second for data rates from 2400 to 38.4k Baud. For slower rates, time out is equal to 2400/data rate = time out in seconds. For example, at 300 Baud, time out = 8 seconds (2400/300 = 8).
119	77	Missing SOH	EOT is detected without a preceding SOH.
120	78	Missing EOT	No EOT detected in message.
121	79	Reserved	

Level 4 Errors

RCL Level 4 Errors occur when the commands are parsed and processed. Refer to page 195 for a list of Level 4 Error Codes.

A client can retrieve an explanation of the numeric error code at run time by using either the All Level 4 Errors or the Specific Level 4 Errors retrieval method.

All Level 4 Errors Retrieval

The client can request a list of all Level 4 error codes and definitions using the command QE.

The Router will respond with separate messages, each containing an error code and a description. Copy or print the error listing so that the explanations are at hand when error codes are received.

Specific Level 4 Errors Retrieval

Use the QE command with specific error code parameters.

RCL Features

Synchronizing Requests and Responses

Message and session IDs are provided to facilitate the clients, to match RCL requests with the responses that are obtained from the server.

The client has to generate a message ID for every request it sends to the server. The client can use the message ID to match the response with request in a particular session. The RCL server copies the message ID (received as part of the request) onto the response. This mechanism makes it possible to associate the responses with the requests that triggered them, even in case of multiple responses. It must be noted here that message ID's may wraparound in a session. Message IDs can range from 1 - to - 65535. This large range ensures that there will be no ambiguity in the response matching due to wraparound of message IDs. Message ID with value 0 is reserved for server use. The server will use this when it has to send error response and has not been able to extract a valid message ID. Notifications sent as part of subscription response will have its own sequence of message IDs with respect to a session.

Each RCL session is identified uniquely by a session ID. This session ID will be provided by the RCL server during the session initialization phase as described in the RCL connect mechanism. The client will have to use this session ID for any further request to the server. The server will copy the same as part of the response. Session ID value 0 is reserved. The RCL client will use this when it issues a RC. Since the session ID is given back to the client as part of response to RC, the client will need to use this default value for RC command.

Multiple Area Support

Areas create hierarchies within the control system and make it easier to group sources and destinations in a large system. Once an area is defined the sources and destinations in the area are identified using fully qualified names and indices. A source or destination name is said to be fully qualified if it is prefixed by "area name:". Similarly source or destination indices need to be prefixed with "area index:" to make them fully qualified. Some RCL commands also take an optional parameter called Area Bitmap to specify a set of areas on which a particular request is intended for. Please refer to the *Area Bitmap* on page 29.

Subscription Support

Subscription is a mechanism through which RCL clients can register for notifications regarding configuration and status information. Whenever

these parameters change, the client is notified asynchronously by the RCL server. RCL facilities for subscription can be described in terms of the following categories.

- Status change subscriptions
- Configuration change subscriptions

The subscription sequence and the commands used for this are introduced below. The command syntax and response is described in *Client Subscription Message Descriptions* on page 81. The way these commands (and their parameters) are used is explained in *Subscription Commands Usage* on page 83.

- The client after establishing connection with the server can subscribe for any of the information. The Subscribe (`SB`) command should be used for this support and is described in *SB – Subscribe* on page 81. Once the subscription request is received, the server confirms the subscription registration by issuing an `ER,00` command. If the subscription request fails, an appropriate `ER,nn` message is generated. (Where nn is the two-digit error code sent back by the server identifying the cause of this failure.)
- The client can at any point decide to unsubscribe for a particular request that it had subscribed earlier. The Unsubscribe (`UB`) command should be used for this and is described in *UB – Unsubscribe Request* on page 81. When an unsubscribe request is received the server confirms the un-subscription by issuing an `ER,00` command. If the unsubscribe request fails, an appropriate `ER,nn` message is generated. (Where nn is the two-digit error code sent back by the server identifying the cause of this failure.)
- The server sends an asynchronous notification (`NY`) to the client whenever the subscribed status/configuration information changes are reported in the system.

The RCL server retains the subscriptions for each client till the client is connected. However, if a refresh rate is configured for the RCL client through the RCL Client Configuration screen of the OUI, then the subscriptions are retained only as long as the RCL Client refreshes the connection within the refresh timeout period specified. A refresh rate of zero means that the subscriptions are retained as long as the client remains connected. The subscriptions for all the clients are dropped in case of server reboot. In this case, RCL server will send a command called RCL Announce (`RN`) to the connected clients indicating that the client should resend the subscriptions to continue receiving the notifications.

Exclusion Set Support

The mechanism of exclusion sets (area, destination and level exclusion sets) can be applied to RCL clients. The exclusion sets to be used by any RCL client is configured at the system level (outside the scope of RCL). Any destination, area or level that is excluded for a particular RCL client is not visible to it through any operation. For example, when a client queries for the list of destinations, those destinations that are excluded are not returned.

Whenever the exclusion set changes, if the client has subscribed for notification, the client is informed about the change and needs to reinitialize its operational set of sources and destinations. These are intimated as configuration change notification. The `BK,F` flags described in Table 12 will also be set to reflect the changes in the configured names applicable to the client due to changed exclusion sets. The clients can choose to poll it at any point to know what has changed and get the information accordingly.

Refreshing and Maintaining Protects

If an automation client protects particular destinations on the Router, the client is responsible for refreshing those protects periodically or the protects will be dropped by the RCL Server.

The refresh interval can be disabled (= 0), or set ≤ 255 seconds. If any Level 4 command is not received within this periodicity, the RCL Server decides that the external device is no longer active and sends a device-delete message to the system. As a result, all protects (and Subscriptions) currently held by this automation client are dropped.

The refresh interval can be set from the client config screen of the OUI. The `BK`, with no parameters, has no side effects and can be used to keep protects refreshed in the absence of other Level 4 command activity. Level 2 ACKs from the external automation clients do not refresh the protects.

Protects issued by a client are also dropped when the RCL Server loses the connection with the client. In case of serial clients, if the connection is not closed gracefully (using `RD` command) protects remain till the next connect request from the same client. These are cleared during the next RCL connect (using `RC` command) from the client.

The configuration flags on the user interface with respect to protect function are:

Maintain protect persistence	When this flag is set, any protects performed by the client will be maintained across sessions of the same client. If this is not set, protects that a client has issued will be dropped when connection is lost with the client or when the client fails to refresh the protects within the configured time interval.
Protect Override	When this flag is set for a client, the client can override the protect that had been performed on a destination by a different control point and modify the destination status. For example if client A has protected destination Mydest, another client B with the protect override set can perform a take onto the same destination.

RCL Message Categories

Client Originated Messages

The RCL Protocol messages originating from a client are in Table 7.

Table 7. Client Originated Messages

Command	Description	Expected Server Response
AS - Assign Source (page 39)	Assign a source to destination	ER, 00
BK - Background Activities (page 40)	Query system configuration and flags	KB
CA - Change Alias (page 42)	Change the source or destination alias name	ER, 00
CH - Request Chop (page 43)	Initiates chopping between specified sources.	ER, 00
CM - Commit Alias Changes (page 44)	Commit the source or destination alias changes to network	ER, 00
DA - De-Assign Source (page 45)	De-assign a source from a destination	ER, 00
GA - Get Alias Name (page 45)	Get the source or destination alias name with configuration information	AG
GT – Get Current VITC Time (page 46)	Get the current VITC time from the server in HHMMSSFF format as ASCII characters.	TG
PI - Protect by Index (page 47)	Protects a specified destination index.	ER,00
PR - Protect (page 47)	Protects a specific destination from other control points	ER, 00
QA- Query Machine Assignment Status (page 48)	Query machine assignment status	AQ
QB - Query Alarm Definitions (page 48)	Query the list of supported alarms.	BQ
QC - Query Combined Destination Status (page 50)	Queries source status on combined levels of the destination. The combined levels are interpreted with respect to the first level on which the destination is present. The status returned back will have the source taken to the destination on the first level on which the destination is present. This will also specify the other levels on this source has been taken to.	CQ
QD - Query Destination Status (page 51)	Queries sources assigned to destinations by destination name.	DQ
QE - Query Error Definition (page 53)	Queries text describing a particular error code.	EQ
QH - Query Alarm Status (page 53)	Query the alarm status	HQ
QI - Query Destination Status on a Specific Level by Index (page 55)	Queries sources assigned to destinations by Destination index and Level Index.	IQ
QJ - Query Destination Status by Index (page 55)	Queries sources assigned to destinations by Destination Index for all levels.	JQ
QK - Query Destination Status by Index with Tie Lines Used (page 57)	Query the destination status by destination index for all levels with tie line information	KQ
QM - Query Monitor Status (page 58)	Query monitor status for specified monitor	MQ
Qm- Query Monitors Status with Level Information (page 59)	Query monitor status along with level information	mQ
QN - Query Names (page 64)	Checks names associated with Sources, Destinations, Levels, Salvos, Areas or TieLines.	NQ
QP - Query Salvo Details along with Protect information (page 59)	Query salvo details along with protect information	PQ
QR - Query Room Details (page 60)	Query the included destinations, assigned tie lines and linked rooms for specified room	RQ
Qs - Query Salvo Element with Operation Type (page 61)	Query salvo elements information with operation type.	sQ
QT - Query Date & Time (page 62)	Query system date and time information	ST
QU - Query Audio Attributes (page 62)	Query the audio attributes of a destination on audio levels.	UQ

Table 7. Client Originated Messages - (continued)

Command	Description	Expected Server Response
QV - Query Salvo Elements (page 70)	Queries sources, destinations, and levels associated with a specified Salvo.	VQ
QX- Query Cached Destination Status by Index (page 71)	Queries cached destination status by index	XQ
QY - Query Cached Destination Status (page 71)	Queries cached destination status by name	YQ
RC - RCL Connect (page 72)	Request RCL connect to the server.	RA
RD - RCL Disconnect (page 72)	Request RCL Disconnect.	ER, 00
SA - Set Audio Attributes (page 73)	Set audio attributes to a destination on specified levels	ER,00
TA – Take (Breakaway) (page 75)	Takes Sources (on specified levels) to specified destination, by name.	ER, 00
TD - Take (Single Source) (page 76)	Takes a single source to all or specified levels.	ER, 00
TI - Take by Level Index (page 77)	Takes same source (on all or specified level) to specified destination, by index.	ER, 00
TJ - Take by Level Bitmap (page 77)	Takes Sources (on specified levels) to specified destination by level bit map. Allows Breakaways. More than one source can be specified to be taken on to the destination on different levels.	ER, 00
TM - Take Monitor (page 78)	Takes Destination (on specified levels) to the Monitor.	ER, 00
TS - Take Salvo (page 79)	Executes the specified Salvo.	ER, 00
UI - Unprotect by Index (page 80)	Removes previously applied protect from specified destination index.	ER,00
UP - Request Unprotect (page 80)	Removes previously applied Protect from specified Destination.	ER, 00

Trailing <HT>

The following commands are supported with or without the trailing <HT> after the last datum/parameter. That means the trailing<HT> is optional for these commands.

AS, BK, DA, GT, PR, UP, QA, QC, QD, QE, QI, QJ, QK, QM, QN, QP, QR, QV, QX, QY, RC, RD, TD, TA, TI, TJ, TS

Example

To query the all destinations status by name, the client can use either of following syntax:

`QD` or `QD,` (i.e. QD<HT>)

Client Subscription Messages

The Subscription messages originated from the client are in Table 8.

Table 8. Client Subscription Messages

Command	Description	Expected Server Response
SB – Subscribe (page 81)	Subscribe for status/configuration changes.	ER, 00
UB – Unsubscribe Request (page 81)	Unsubscribe for already subscribed status/configuration information	ER, 00

Server Originated Messages

The RCL Protocol messages originated from the server are in Table 9.

Table 9. Server Originated Messages

Command	Description	Expected Client Response
NY – Notification (page 82)	An asynchronous Notification sent whenever the subscribed status/configuration information changes	ER, 00
RD - RCL Disconnect (page 83)	Request RCL Disconnect.	ER, 00
RN - RCL Announce (page 83)	Server announce at start up to facilitate clients to refresh subscription requests.	None.

RCL Message Specifications

The following specifications apply to all the RCL message commands.

Note Leading zeros are used if necessary so as to keep the area index length to 2 digits and destination/source index length to four digits.

`fullqual_dest_name` Specifies the fully qualified destination name. This is of the form `area_name:destination_name`.

Example, for a destination called `GRAFIX` in area `NEWS`, the fullqual_dest_name is `NEWS:GRAFIX`.

`fullqual_src_name` Specifies the fully qualified source name. This is of the form `area_name:source_name`.

Example, for a source called `VTR2` in area `SPORTS`, the fullqual_src_name is `SPORTS:VTR2`.

`fullqual_dest_index` Specifies the fully qualified destination index. This is of the form `area_index:destination_index`.

Example, for a destination with index 127 in area with index 2, the fullqual_dest_index is `02:007F`. (Use the hexadecimal values for index 127 which is 00F7 and index 2 which is 02.)

`fullqual_src_index` Specifies the fully qualified source index. This is of the form `area_index:source_index`.

Example, for a source with index 64 in area with index 1, the fullqual_dest_index is `01:0040`. (Use the hexadecimal values for index 64 which is 0040 and index1 which is 01.)

Every RCL Client may configure a default area through the client configuration screen of the OUI. If the field `'area_name:'/ 'area_index:'` is omitted in the fully qualified name, then the default configured area is used by the RCL Server to qualify the Source/Destination name/index.

time_stamp – VITC Time stamp to be provided by the clients for deterministic operations. The time stamp is specified as part of the commands in `HHMMSSFF` format.

In case of non time stamped operations this field can be left blank. The time stamp field is used to specify the VITC time at which the operation (take, chop or protect) should be performed on the router. The operation will be carried out exactly on the specified frame. This time should at least be 6 frames more than the time at which the command is received by the RCL Server. Thus the client should take into account the transit time (Via Ethernet or serial medium) while setting this time stamp value. There is also an upper limit on the time that can be specified by the client. The time specified should not be more than 100 frames from the time at which the RCL Server receives the request.

Client Originated Message Descriptions

AS - Assign Source

The AS command facilitates to assign one or more sources to a specific destination. The command shall accept sources and destinations from the same area only.

Command

```
AS,fullqual_dest_name,nbr_srcs[,fullqual_src_name1…
fullqual_src_nameN]
```

Response

The AS Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

BK - Background Activities

The BK command can be sent to query system configuration and flags

Command

```
BK[,parameter [,mask]]
```

One parameter can be specified per BK call. Each parameter consists of a single, case sensitive character, defined in Table 10.

Table 10. BK Command Parameters

Parameter	Description
A	Clears the flags associated with the QA command. After BK,A is sent, the next QA command will result in the server sending the assignment status for all the destinations.
N	Return device name.
R	Return software revision number.
T	Return software title with version.
t	Return protocol title with version.
F	Queries the configuration flags. Refer to Table 12 for the meaning of these flags.
f	Clears the configuration flags specified in the mask. Refer to Table 12 for bit definition of the mask.
D	Clears the flags associated with the QD command. After BK,D is sent, the next QD command will result in the server sending all destination statuses.
P	Queries the client specific configuration parameters specified on the graphical user interface.
E	Returns whether to send the positive responses for operations. The client can also use this command to set/stop the positive responses for operations by sending BK,E,ON or BK,E,OFF respectively.
d	Returns the name of the client specified on the graphical user interface.
2	This command is used by the serial client to ensure that the RCL server is running. The server will respond back with a level 2 acknowledgement. This command is for the serial interface only.
U	Clears the flags associated with the QU command. After BK,U is sent, the next QU command will result in the server sending all destinations attributes statuses.
H	Clears the flags associated with the QH command. After BK,H is sent, the next QH command will result in the server sending all alarms status.
	No parameter, no side effects. Can be used to refresh Protects and Subscriptions

Response

For the **BK** command the response is dependent on the parameter specified. For some parameters the response will be an `ER,00` to signify that the request has been executed successfully.

For other parameters response with returned data is of form:

`KB,parameter,data`

Parameter consists of a single, case sensitive character, defined in Table 11.

Table 11. KB Response Parameters

Parameter	Data
N	Device name string.
T	Software title with version string.
R	Software revision string.
t	Protocol title with version string.
E	Echo = ON | OFF. A value will be returned for both set and query requests.
d	Client Name.
P	QueryOnly =<ON|OFF>[a], ChopLck=<ON|OFF>, SalvoLock=<ON|OFF>, ProtectOverride=<ON|OFF>, MonitorControl=<ON|OFF>, ControllableLevels=lvlBitMap
D	This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.
2	No level 4 response for this command.
F	Four ASCII characters representing four HEX digits (16 bits). These bits indicate changes of corresponding parameters since last cleared by `BK,f` command. Refer to Table 12 to associate the bits with configuration parameter. If the parameter has changed the bit is set. Most significant hex digit is sent first (that is, b15...b12). Area bitmap information will be returned indicating the areas in which source and destination name changes have occurred. This facilitates the router to reload the names only in those areas which have changed. The area bitmap is a 64 bit quantity coded as 16 Hex bytes to indicate the area 1-64. Thus the response for this parameter will be `KB, F, mask, Name change area bitmap`.
U	This will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.
H	This will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.
	No parameter will return an `ER,00`

[a] When a client is set as a query only device, it cannot perform any operation (Take, Protect, etc.,). It can query status and configuration information.

For F response with the returned data is of form:

`KB, F`

For a `KB, F` response, the data is defined in Table 12.

Table 12. KB, F Command Response Bits

Bit #	Meaning
0 (lsb)	Reserved
1	Any protect initiated by this client was dropped.
2	Destination changes
3	Reserved
4	Source changes
5	Level changes
6	Salvo changes

Table 12. KB, F Command Response Bits - (continued)

Bit #	Meaning
7	Reserved
8	Area changes
9	Client Name changes
10 - 14	Reserved
15	Reserved
f, mask	This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example of the Use of Flag Bits

The user queries RCL using `BK,F`. They receive a reply with parameter bit #4 set to indicate that there has been a change (addition, or modification, or deletion) to the system source name table. The server will also send the source change area bit map (as part of the `KB,F` response) indicating the areas on which the source information has changed. The client should now issue a `QN,S, source_area_bitmap` command to get the new source information. The source change area bit map returned with `KB,F` can be used by the client as part of the `QN,S` command. The client next uses the `BK,f,` mask (where mask bit #4 = 1) command to clear bit #4 from the mask. The client again queries using `BK,F`. The reply shows that bit #4 = 0, indicating that the source name list just downloaded is current.

Do not confuse the flags discussed with the `f` & `F` options with those discussed with the `D` option. The `QD` command allows the user to download incremental changes in the Destination Status tables. The `D` option of the `BK` command clears the bit arrays that keep track of these incremental changes. This re-synchronizes the router data base (for Destination Status) if the external device resets.

CA - Change Alias

Change the source or destination aliases. Changing the source \ destination alias name is a two-step process. The RCL client can send the request to change the source \ destination alias of multiple sources \ destinations using the command CA. However these changes are not committed and broadcast to the network immediately. The client needs to send the RCL command CM to commit and broadcast the alias name changes.

Table 13. CA Parameters

Parameter	Meaning
SA	Source Alias
DA	Destination Alias

Command

```
CA,SA,nbr_sources,[src_alias_name_entry1,
…src_alias_name_entryn,]
```

Src_alias_name_entry is defined as:

```
fullqual_src_index,new_fullqual_src_alias
```

This command facilitates to change the source alias names. These changes are broadcasted to network once the client sends a CM,SA command.

Response

The CA,SA Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Command

```
CA,DA,nbr_destns,[dest_alias_name_entry1,
…dest_alias_name_entryn,]
```

dest_alias_name_entry is defined as:

```
fullqual_dest_index,new_fullqual_dest_alias
```

This command facilitates to change the destination alias names. These changes are broadcasted to network once the client sends a CM,DA command.

Response

The CA,DA Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

CH - Request Chop

Chop command allows chop operations to be performed on a specified destination on the router. The command allows chop source to be specified on a level by level basis allowing more than one source to be specified on different levels.

Command

```
CH, fullqual_dest_name,nbr_sources,src_name_entry1
[,..., src_name_entryn]
```

(<seq_flag='0000'> for the last sequence sent.)

However, the specified source names to be taken to the destination specify the chop source names and levels. The other source for the chop operation is the already taken source on the destination. To stop chopping, issue a take on the required levels.

To specify a chop operation, first Take sources on levels to the destination, then Chop to the same destination with the chop sources on the required levels.

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure, indicating the reason of failure.

`dest_name`	Destination to be taken to.
`nbr_sources`	Number of following entries (must be at least one).

`src_name_entryn` is defined as:

```
fullqual_src_name,level_bitmap
```

Example

The following command will chop a source named `VTR_W_2` in area `NEWS` on levels with indices 2 and 3 and source `VTR_M_2` in area `NEWS` on level index 1 to the destination `VTR_B_1` in area `NEWS`.

```
CH,NEWS: VTR_B_1,2,NEWS: VTR_W_2,0000000C,
NEWS: VTR_M_2,00000002
```

CM - Commit Alias Changes

Commit the source or destination alias changes allowing the broadcast of alias changes onto the network.

Table 14. CM Parameters

Parameter	Meaning
SA	Source Alias
DA	Destination Alias

Command

`CM,SA`

Commit the source alias changes and broadcast the same onto the network.

Response

The CM,SA Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Command

`CM,DA`

Commit the destination alias changes and broadcast the same onto the network.

Response

The CM,DA Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

DA - De-Assign Source

The DA command facilitates to de-assign one or more sources from a specific destination. The command shall accept sources and destinations from the same area only.

Command

`DA,fullqual_dest_name,nbr_srcs[,fullqual_src_name1… fullqual_src_nameN]`

Response

The DA Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

GA - Get Alias Name

This command shall return the alias name for source or destination based on parameter along with source or destination configuration information.

Table 15. GA Parameters

Parameter	Meaning
SN	Source Name
SI	Source Index
DN	Destination Name
DI	Destination Index

Command

`GA,SN,fullqual_source_name`

This command shall return the source alias name along with source information for the specified source (by Name).

Response

```
AG,SN,fullqual_src_name,fullqual_src_index,
TieLine_Type,Level_Bitmap ,fullqual_src_alias
```

Command

```
GA,SI,fullqual_source_index
```

This command shall return the source alias name along with source information for the specified source (by Index).

Response

```
AG,SI,fullqual_src_name,fullqual_src_index,
TieLine_Type,Level_Bitmap ,fullqual_src_alias
```

Command

```
GA,DN,fullqual_dest_name
```

This command shall return the destination alias name along with destination information for the specified destination (by Name).

Response

```
AG,DN,fullqual_dest_name,fullqual_dest_index,
TieLine_Type,Level_Bitm  ap,fullqual_dest_alias
```

Command

```
GA,DI,fullqual_dest_index
```

This command shall return the destination alias name along with destination information for the specified destination (by Index).

Response

```
AG,DI,fullqual_dest_name,fullqual_dest_index,
TieLine_Type,Level_Bitmap,fullqual_dest_alias
```

GT – Get Current VITC Time

Get the current VITC time from the server in `HHMMSSFF` format as ASCII characters

Command

```
GT
```

Response

```
TG, HHMMSSFF
```

HH = Hours 00 … 23

MM = Minutes 00 … 59

SS = Seconds 00 … 59

FF = Frames 00 … 30 for NTSC
00 … 25 for PAL

PI - Protect by Index

Protect command allows the specified destination index to be protected from any source changes on the specified level. The level bitmap is an optional parameter which if not specified results in an all level protect.

Command

```
PI,fullqual_dest_index[,level_bitmap]
```

Response

This will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To protect a destination at index 0x0000 in area index 0x02 on the fourth and fifth levels only, the command is as shown below:

```
PI,02:0000 ,00000018
```

PR - Protect

Protect command allows the specified destination to be protected from any source changes on the specified level. The command requires a level_bitmap to be specified on which protect should be performed.

Command

```
PR,fullqual_dest_name,level_bitmap
```

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To protect a destination named `PDR2` in area `POSTPRD` on levels with indices 3 and 4 the client should issue the following command

```
PR,POSTPRD:PDR2,00000018
```

QA- Query Machine Assignment Status

Query the current assignments on a specific destination or for all the destinations configured in system.

Command

```
QA
```

The assignment status is returned for all the destinations for which assignment have changed since the last time status was sent. The BK,A command can be sent before this request to force return of all destination assignment status.

Command

```
QA,fullqual_dest_name
```

The assignment status will be returned only for the requested Destination.

QB - Query Alarm Definitions

The command allows a client to query the supported alarm definitions. Alarm definitions are not the same for all devices. For example, some hardware devices support AC power alarm and some will not.

The QB command can have different command syntaxes.

Command

```
QB
```

The definitions for all supported alarms are returned. The response can result in a sequence of messages for each of many alarms.

Command

```
QB[,<alarm ID>]
```

The definition for the specified alarm ID is returned. If the alarm ID is invalid or not present, for all supported alarms definitions are returns.

Response

`BQ,<alarm ID>,<max alarms>,<alarm description string>`

`Alarm ID`	A 4 digit hexadecimal number representing the alarm.
`Max alarms`	A two digit hexadecimal number representing the maximum number of alarms.
`Alarm description string`	A string describing the alarm

Table 16 lists all supported Alarm IDs.

Table 16. Alarm IDs

Alarm ID	Alarm Name
0x0101	Frame Fan
0x0102	Power-supply AC
0x0103	Power-supply DC
0x0104	Power-supply Fan
0x0105	Power-supply
0x0106	Reference Signal
0x0107	Temperature out of bound
0x0110	Fault LED state
0x0111	Error LED state
0x0112	SIO board state
0x0113	GSC Board State
0x0114	XPT board state
0x0115	Network Interface card 1 state
0x0116	Network Interface card 2state
0x0118	File system cleanup state
0x0119	File system lockout state
0x0120	RF1 Sync state
0x0121	RF2 Sync state
0x0122	Time Code state
0x0123	Serial Client state
0x0124	Ethernet Client state
0x0125	Panel Communication state
0x0126	Mirror Panel server state
0x0127	CPL Matrix state
0x0128	Mirror Router Controller state

Table 16. Alarm IDs

Alarm ID	Alarm Name
0x0129	Router Engine state
0x0130	Watchdog Action

QC - Query Combined Destination Status

Query the status on combined levels of the destination. The combined levels is interpreted with respect to the first level on which the destination is present. The status returned back will have the source taken to the destination on the first level on which the destination is present. This will also specify information of the other levels on which this source has been taken to.

Command

The `QC` command can have different command syntaxes.

`QC`	In this case, destination status is returned for all destinations for which status has changed since the last time status was sent. Destination status is returned for all levels (for the changed as well as unchanged levels) which have status. The `BK,D` command can be sent before this request to force return of all destination status.
`QC[,area_bitmap:]`	In this case the destination status is returned for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.
`QC[,fullqual_dest_name]`	In this case the status for the requested destination will be returned

Response

```
CQ,fullqual_dest_name,dst_level_bitmap
[,src_name_entry1]
```

(<seq_flag='0000'> for the last sequence sent.)

`dst_level_bitmap` Describes the levels configured for destination.

`src_name_entry1` is defined as:

```
<'N'|'P'>,<'N'|'C'>, fullqual_src_name,level_bitmap,
[prot_device_name], [fullqual_chop_src_name]
```

Parameters for this response are in Table 17.

Table 17. QC Response Parameters

Parameter	Meaning
'N' |'P'	Not-protected or Protected
'N'	'C'	Not-chopping or Chopping
fullqual_src_name	The source currently taken to the destination on the first level on which the destination is present.
level_bitmap	Describes the levels of that destination which the source is on
prot_device_name	The device currently holding the protect. If the destination is not protected, or the device name is unknown, the field is left blank.
fullqual_chop_src_name	The name of the source chopping to this destination. The fully qualified chop source name will be returned as "Chopping".

If there is no source currently on the first level defined for the destination, the `fullqual_src_name` part of the `src_name_entry` will be blank in the response.

If the query is made for all the areas or all the destinations in a given area, the response will contain only those destination whose status has changed since the last query. If there are no destination status changes since the last query, the response will be a blank `CQ`. That is, no destination status will accompany the `CQ`.

`QC` (with no `dest_name` specified) is one of several commands whose response can be more than one message sequence. `QC` with no parameter can result in a sequence of messages for each of many destinations.

Example

To query the combined status of the destination `PDR2` in area `POSTPRD` the following command syntax should be used.

```
QC,POSTPRD:PDR2
```

QD - Query Destination Status

Query the destination status. This query returns status of the requested destination including the sources that have been taken to the destination along with the associated levels for the sources.

Command

QD can have different command syntaxes.

`QD`	In this case, destination status is returned for all destinations for which status has changed since the last time status was sent. Destination status is returned for all levels (for the changed as well as unchanged levels), which have status. The `BK,D` command can be sent before this request to force return of all destination status.
`QD[,fullqual_dest_name]`	In this case the status for the requested destination will be returned
`QD[,area_bitmap:]`	In this case the destination status information is returned for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.

Response

```
DQ, fullqual_dest_name,nbr_sources
[,src_name_entry1,...,src_name_entryn]
```

(<seq_flag='0000'> for the last sequence sent.)

`nbr_sources`	Number of sources on that destination which are being reported in this message sequence. If there are no sources on this destination at any of its levels, `nbr_sources = 0` will be returned.

`src_name_entryn` is defined as:

```
<'N'|'P'>,<'N'|'C'>, fullqual_src_name,level_bitmap,
[prot_device_name], [fullqual_chop_src_name]
```

Data for this response is identical to the `QC` command response described previously.

The fully qualified chop source name will be returned as "Chopping

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

If the query is made for all the areas or all the destinations in a given area, the response will contain only those destination whose status has changed

since the last query. If there are no destination status changes since the last query, the response will be a blank `DQ`. That is, no destinations status will accompany the `DQ`.

`QD` (with no `dest_name` specified) is one of several commands whose response can be more than one message sequence. QD with no parameter can result in a sequence of messages for each of many destinations.

Example

Suppose the index of area INGEST is 1 and index of POSTPROD is 5, then the corresponding area bitmap will be 0x0000000000000022

To query the status of all the destinations in areas INGEST and POSTPROD, the following command syntax should be used.

```
QD, 0000000000000022:
```

QE - Query Error Definition

Error messages returned by the server are identified by a two byte code. The `QE` command allows the user to retrieve the text describing Level 4 error codes. Level 2 error codes (associated with NAKs) are described in *Level 2 (NAK) Error Code Descriptions* on page 30.

Command

```
QE,[error_code]
```

`error_code` A 2 hex digit error code (to be sent in ASCII format)

Response

If the `error_code` is specified along the query, the description for that `error_code` is returned. Else, the description for all the error codes are returned.

```
EQ,error_code,error_definition_string
```

(<seq_flag='0000'> for the last sequence sent.)

QH - Query Alarm Status

The QH command queries for the alarm status.

Command

```
QH
```

The alarm status is returned for all alarms for which status has changed since the last time status was sent. The alarm status contains the faulty and active status. The BK, H command can be sent before this query to force a return of all the alarm status.

Response

```
HQ, Nbr_entries,alarm_entry1,….alarm_entryN.
```

Nbr_entries indicates the number of alarm entries present in response.

Alarm_entry is defined as:
AlarmID, AlarmStateID, AlarmParameter

where

Alarm ID is a 4 digit hexadecimal number representing the alarm

AlarmStateID is a single digit value.1 represents a faulty state and 0 represents no faulty state.

AlarmParameter is a string representing the module generating the alarm

Example

If the first fan in the frame is faulty, the response will be as shown below

HQ,01, 0101 ,1,1

Command

```
QH,AC
```

Query active alarm status for faults only.

Response

```
HQ,AC,Nbr_entries,alarm_entry1,….alarm_entryN.
```

Nbr_entries indicates the number of alarm entries present in the response.

Alarm_entry is defined as:
AlarmID, AlarmStateID, AlarmParameter

Alarm ID is a 4 digit hexadecimal number representing the alarm

AlarmStateID is a single digit value.1 represents a faulty state and 0 represents no faulty state.

AlarmParameter is a string representing the module generating the alarm

Example

If the first fan is faulty and the second power supply is faulty, the response will be as shown below:

```
HQ,AC,02,0101,0,1,0102,1,1
```

QI - Query Destination Status on a Specific Level by Index

Query the destination status on a specific level using the destination index. This query returns the source that has been taken to the destination on the specified level. Both the destination and level are specified using indices.

Command

```
QI, fullqual_dest_index,lvlIndex
```

Response

```
IQ, fullqual_dest_index,lvlIndex,<'N'|'P'>,<'N'|'C'>,
fullqual_src_index, [fullqual_chop-SrcIndex]
```

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number, all indexes refer to configured entities. Valid indexes and their association with specific names can be determined using the commands: `QN, ID`; `QN, IS`; `QN, L`; `QN, IA`.

The source index contains specific values for the "Undef","No_xpt", "Parked" and "No_Mtrx". Refer the table Table 19 on page 57.

The fully qualified chop source index will be returned as "0xFFFA".

Example

Suppose the index of POSTPROD is 3, and the index of PROFILE1 is 399. Then the corresponding fullqual_dest_index is `03:018F`. Suppose the level index of video is 0.

To query the status of destination PROFILE1 in area POSTPROD, on video level the following command syntax should be used.

```
QI,03:018F,00
```

QJ - Query Destination Status by Index

Query the destination status by index. This query returns the sources that have been taken to the destination along with the levels on which the source is associated. This command is the index equivalent `QD`.

Command

QJ can have different command syntaxes.

QJ	In this case, destination status is returned for all destinations for which status has changed since the last time status was sent. Destination status is returned for all levels (for the changed as well as unchanged levels), which have status. The BK,D command can be sent before this request to force return of all destination status.
QJ[,fullqual_dest_index]	In this case the status for the requested destination will be returned
QJ[,area_bitmap:]	In this case the destination status is returned for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.

Response

```
JQ, fullqual_dest_index,nbr_sources
[,src_name_entry1,..., src_name_entryn]
```

(<seq_flag='0000'> for the last sequence sent for a particular destination status.)

nbr_sources	Number of sources on that destination which are being reported in this message sequence. If there are no sources on this destination at any of its levels, nbr_sources = 0 will be returned.

src_name_entryn is defined as:

```
<'N'|'P'>,<'N'|'C'>,fullqual_src_index,
level_bitmap,[prot_device_name],
[fullqual_chop_src_index]
```

Parameters for this response are in Table 18.

Table 18. QJ Command Response Parameters

Parameter	Meaning
'N' |'P'	Not-protected or Protected
'N' | 'C'	Not-chopping or Chopping

Table 18. QJ Command Response Parameters - (continued)

Parameter	Meaning
fullqual_src_index	The source (in the area specified by area index :) currently taken to the destination. Refer the Table Table 19 for specific source indices for "Undef","No_xpt" ,"Parked" and "No_Mtrx"
level_bitmap	Describes the levels of that destination for which the source is on.
prot_device_name	The device currently holding the protect. If the destination is not protected, or the device name is unknown, the field is left blank.
fullqual_chop_src_index	The index of the source (along with the source area) chopping to this destination. The fully qualified chop source index will be returned as "0xFFFA".

Table 19. Source Indices

Source Index	Meaning
0XFFFE	Undef
0XFFFD	No_Xpt
0XFFFC	Parked
0XFFFB	No_Mtrx

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number, all indexes refer to configured entities. Valid indexes and their association with specific names can be determined using the commands: `QN, ID`; `QN, IS`; `QN, L`; `QN, IA`.

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

If the query is made for all the areas or all the destinations in a given area, the response will contain only those destination whose status has changed since the last query. If there are no destination status changes since the last query, the response will be a blank `JQ`. That is, no destinations status will accompany the `JQ`.

Example

To query the status of all the destinations in all the areas, the following command syntax should be used.

```
QJ
```

QK - Query Destination Status by Index with Tie Lines Used

Query the destination status along with the tie lines used. This query shall return the sources that have been taken to the destination along with the tie lines (if any) used and the levels on which the Source is associated.

QK can have the different command syntaxes.

Command

```
QK
```

The destination status along with the tie lines (if any) used is returned for all destinations for which status has changed since the last time status was sent. Destination status is returned for all levels (for the changed as well as unchanged levels) which have status. The BK,D command can be sent before this request to force return of all destinations status.

Command

```
QK,area_bitmap:
```

The destination status along with the tie lines (if any) used is returned for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.

Command

```
QK,Fullqual_dest_index
```

The status for the requested destination status along with the tie lines (if any) used will be returned.

Response

KQ,fullqual_dest_index,nbr_sources[,src_index_entry1…,src_index_entryN]

src_index_entryn is defined as:

```
<'N'|'P'>,<'N'|'C'>,nbr_tielines,fullqual_src_index,
level_bitmap,[device_name],[fullqual_chop_src_index]
[,tie_line_name1…,tie_line_nameN]
```

The source index contains specific values for the "Undef","No_xpt", "Parked" and "No_Mtrx" Refer the table Table 19 on page 57.

The fully qualified chop source index will be returned as "0xFFFA".

QM - Query Monitor Status

Query the destination that has been taken to a specific monitor (by name).

Command

```
QM,fullqual_mon_name
```

fullqual_mon_name: The fully qualified monitor name of the form area_name:monitor_name.

Response

```
MQ,fullqual_mon_name,mon_type,fullqual_type_name
```

Where

fullqual_mon_name: The Name of the configured monitor.

mon_type : 'S' = Source, 'D' = Destination.

fullqual_type_name: The fully qualified Source or Destination Name of the form area_name:dest_name (or area_name:src_name) that has been taken to the monitor. This parameter shall be interpreted as source or destination name based on the mon_type parameter.

Qm- Query Monitors Status with Level Information

Command

```
Qm,Fullqual_Monitor_Name
```

Response

```
mQ,fullqual_mon_name,mon_type,Number_of__Entries,
[,type_name_Entry1…  type_name_EntryN]
```

`fullqual_mon_name`	A configured monitor name.
`mon_type`	The type of monitor: ('S' Source or 'D' Destination)
`Number_of_Entries`	The number of entries in the response.
`Type_name_Entry`	Defined as: `fully_qualified_type_name, level_bitmap`
`Fully_qualified_ type_name`	The fully qualified source or destination name.

QP - Query Salvo Details along with Protect information

Query the salvo details along with the protect information.

Command

```
QP,SalvoName
```

Response

```
PQ,SalvoName,Version,Creator,<'U'|'N'>,<'L'|'N'>,
LockText,nbr_entries [,entry1…,entryN]
```

Table 20. Definitions

SalvoName	Name of the salvo whose details are sent back.
Version	Salvo version. Maximum can be 8 Hex digits
Creator	IP address of the salvo creator of the form "10.255.104.87:.
'U'|'N'	Pre-unlock option set or not set.
'L'|'N'	Post-lock option set or not set.
LockText	String indicating the text that will be used for locking the destinations.
Nbr_entries	Number of elements in the salvo.

EntryN is defined as follows:

```
fullqual_dest_name,fullqual_src_name,level_bitmap
```

QR - Query Room Details

Command

```
QR,[Parameter], room_name
```

This command shall return the room details based on parameter type.

Table 21. QR Parameters

Parameter	Meaning
D	Destination Names
T	Tie Line Names
L	Linked Room Names

Command

```
QR,D,room_name
```

This command shall return the list of destinations belongs to room_name.

Response

```
RQ,D,\room_name,nbr_destinations[,fullqual_dest_name1,
…fullqual_dest_nameN]
```

Command

```
QR,T,room_name
```

This command shall return the list of tie lines belongs to room_name.

Response

```
RQ,T,\room_name,nbr_tieLines[,tie_line_name1,
…tie_line_nameN]
```

Command

```
QR,L,room_name
```

This command shall return the list of linked rooms to room_name.

Response

```
RQ,L,\room_name,nbr_linked_rooms[,room_name1,
…troom_nameN]
```

Qs - Query Salvo Element with Operation Type

Command

```
Qs,N,SalvoName
```

This command allows the RCL client to query the salvo elements information along with the operation type.

Response

```
sQ,N,SalvoName,Version,Creator,
<'U'|'N'>,<'L'|'N'>,LockText,nbr_entries
[,salvo_element_entry1…,salvo_element_entryN]
```

`Salvo_element_entry` is defined as:

Type_of_Element,Fully_qualified_destination/
Fully_qualified_monitor_name,fully_quallified_source/
fully_qualified_destination_name/attribute_name,level_bitmap

Where:

Type_of_Element is 'DN' for destination, 'DM' for destination monitor, and 'AA' for Audio Attributes. The type will be blank if the type is unknown.

Attribute_name represents the audio attribute acronym for the attribute applied on the specified level bitmap. If more than one attribute is applied, all the attribute acronym names will be listed with the delimiter as a semicolon (";").

If the attributes Stereo, Mute, Invert left and, Invert right are applied, the attribute name will be ST; IL; IR; MT

The audio attribute acronym will be blank for all non applicable levels. (like for example a video level)

Table 22. Audio attributes Acronyms

Audio Attribute Name	Acronyms used by RCL Server to send clients
Stereo	ST
Sum	SM
Swap	SW
Left Only	LO
Right Only	RO
Invert Left	IL
Invert Right	IR
Mute	MT

QT - Query Date & Time

Command

```
QT
```

Response

```
ST,yyyymmddhhmmss
```

hh is 00...23

QU - Query Audio Attributes

This command allows a client to query the audio attributes for destinations. The attribute status will be return for applicable levels (i.e. audio levels)

Table 23. QU Parameters

Parameter	Meaning
N	By Name
I	By Index

Command

```
QU,N
```

The audio attributes status for all destinations will be returned for which status has changed since the last status was sent to the client.

Command

```
QU,N,area_bitmap:
```

The audio attributes status will be returned for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.

Command

`QU,N,fqual_dst_name`

The audio attribute status for specified destination will be sent to client.

Response

`UQ,N, fqual_dst_name, nbr_entries,attribute_entry1,.. attribute_entryN`

nbr_entries:- Number of attribute parameters on this destination.

Attribute_entry is defined as: attribute_parameter, levelbitmap

Where:

attribute_parameter is a two digits hexadecimal value and the values are as mentioned in Table 28 on page 73.

The response for the `QU,N` and `QU,N,area_bitmap:` commands can result in multiple response messages to client.

Command

`QU,I`

The audio attributes status will return for all destinations for which status has changed since the last status was sent to the client

Command

`QU,I,area_bitmap:`

The destination audio attributes status will return for all destinations in the areas specified by the area bitmap for which status has changed since the last time status was sent to the client.

Command

`QU,I,fqual_dst_index`

The audio attribute status for specified destination will be sent to client.

Response

`UQ,I,fqual_dst_index, nbr_entries, attribute_entry1, attribute_entryN`

nbr_entries:- Number of attribute parameters on this destination.

Attribute_entry is defined as: attribute_paramter, levelbitmap

Where

Attribute_parameter is a two digits hexadecimal value and the values are as mentioned in Table 28 on page 73.

The response for the `QU,I` and `QU,I,area_bitmap:` commands can result in multiple response messages to client.

QN - Query Names

Query the various configuration names in the system. Typically the names configured in the system are queried by the client, at connect time and whenever the name gets changed. The configuration name change is indicated to the client, by setting the flags associated with `BK,F`. Also if the client has subscribed for name changes, the client will be notified asynchronously.

Command

```
QN,parameter[,area_bitmap]
```

One parameter can be specified per `QN` call. The parameters available, and their meaning, are in Table 24.

Table 24. QN Parameters

Parameter	Meaning
S	Source Names
D	Destination Names
L	Level Names
V	Salvo Names
R	Room Name
N	Monitor Names
SA	Source Alias Names
DA	Destination Alias Names
T	Tie line Names
IS	Sources Names with source indices
ID	Destinations Names with destination indices
A	Area Names
IA	Area Names with area indices.
XA	Area indices
XD	Destination indices
XL	Level indices
XS	Source indices
l (lower case "L")	Level names along with level format information
m	Monitor names along with level information

The optional area bitmap can be specified only for the parameters `S/IS` and `D/ID`. This area bitmap specifies the areas on which the client requests the names from the server. When the area bitmap parameter is not specified the source or destination names will be returned from all the areas that are present in the network. In case of large systems the number of areas may be significant and the client may be operating only on one or couple of areas. The area bitmap will specify the areas from where the names should be retrieved and returned to the client.

Response S

```
NQ,S,nbr_sources[,src_name_entry1,...,src_name_entryn]
```

`src_name_entryn` is defined as:

```
   fullqual_src_name,<'N'|'T'>,level_bitmap
```

`<'N'|'T'>` Indicates No-TieLine or Tieline related

Response D

```
NQ,D,nbr_destns
[,dest_name_entry1,...,dest_name_entryn]
```

`dest_name_entryn` is defined as:

```
   fullqual_dest_name,<'N'|'T'>,level_bitmap
```

`<'N'|'T'>` Indicates No-TieLine or Tieline related

Response L

```
NQ,L,nbr_levels[,lvl_name_entry1,...,lvl_name_entryn]
```

`lvl_name_entryn` is defined as:

```
   lvl_name,lvl_number,< 'R' | 'N' >
```

`lvl_number` A hex ASCII number from 00 to 1f (representing levels 00 to 31 decimal)

`'R' | 'N'` Indicates that the level is Restricted or Not Restricted with respect to assignments

Response V

```
NQ,V,nbr_salvos[,salvo_name1,...,salvo_namen]
```

Response IS

```
NQ,IS,nbr_sources
[,IS_src_name_entry1,...,IS_src_name_entryn]
```

`IS_src_name_entryn` is defined as:

```
fullqual_src_name,fullqual_src_index,<'N'|'T'>,
level_bitmap
```

`<'N'|'T'>` No-tieline or Tieline Related

Response ID

```
NQ,ID,nbr_destns
[,ID_dest_name_entry1,..., ID_dest_name_entryn]
```

`ID_dest_name_entryn` is defined as:

```
fullqual_dest_name,fullqual_dest_index,<'N'|'T'>,
level_bitmap
```

`<'N'|'T'>` No-tieline or Tieline Related

Response A

```
NQ,A,nbr_areas[,area_name1,...,area_namen]
```

Response IA

```
NQ,IA,nbr_areas
[,area_name_entry1,...,area_name_entryn]
```

`area_name_entryn` is defined as:

```
area_name, area_index
```

Command

```
QN, R,[room name]
```

This command shall return the list of available room names along with room type. When the room_name is specified, this command shall return the details only for the specific room.

Response R

```
NQ,R,nbr_rooms[,room_name_entry1,...room_name_entryN]
```

Where:

nbr_rooms: The number of rooms configured.

room_name_entry is defined as room_name,room_index,room_type.

room_type can be S/C/A. Where S - Studio, C - Cubicle, A - standalone.

Command

```
QN,N
```

This command shall return the list of monitor names.

Response N

```
NQ,N,nbr_monitors[,fullqual_mon_name1,
…fullqual_mon_nameN]
```

Where:

nbr_monitors: The number of monitors configured.

fullqual_mon_name: The Name of the configured monitor. The fullqual_mon_name will be of the form area_name:monitor_name.

Example: A monitor named Mon1 in area NewsRm will be returned as NewsRm:Mon1.

Command

```
QN,T[,tieline_name]
```

This command shall return the list of available tie line names along with type. When the tieline_name is specified, this command shall return the details only for the requested tie line as specified by the tieline_name.

Response

```
NQ,T,nbr_tielines[,tie_line_name_entry1,
…tie_line_name_entryN]
```

nbr_tielines: The number of tie lines configured in the system.

tie_line_name_entry is defined as tie_line_name, tie_line_type, tie_line_parameter

tie_line_type: can be F/R/X/A/M/U. Where F - Floating, R - Reserved, X - Fixed, A - Assignable, M-Room, U-Undefined

Depending on the tie line type the tie_line_parameter can be one of the following

Table 25.

Tie Line Type	Tile Line Parameter
Reserved(R)	Fully qualified destination name
Fixed(X)	Fully qualified source name
Room(M)	Room name
Floating(F),Assignable(A),Undefined(U)	Blank

Command

```
QN,SA
```

This query shall return source alias names.

Response SA

```
NQ,SA,nbr_sources[,SA_src_alias_name_entry1,…,
SA_src_alias_name_entryN]
```

SA_src_alias_name_entry is defined as

```
fullqual_src_name,fullqual_src_index,TieLine_Type,
Level_Bitmap ,fullqual_src_alias
```

Command

```
QN,DA
```

This query shall return destination alias names.

Response DA

```
NQ,DA,nbr_destns[,DA_dest_alias_name_entry1,…,
DA_dest_alias_name_entryN]
```

DA_dest_alias_name_entry is defined as:

```
fullqual_dest_name,fullqual_dest_index,TieLine_Type,
Level_Bitmap,fullqual_dest_alias
```

For all responses <seq_flag='0000'> for the last sequence sent.

Example

Suppose a client is interested in areas NEWSROOM and INGEST. The area index of NEWSROOM is 22 and that of INGEST is 2.

To query the source names (with indices) in the above areas the client needs to issue following command:

```
QN,IS,0000000000400004
```

To query the destinations in all the areas the client can issue the command:

```
QN,D
```

Response XA

```
NQ, XA, No_entries, areaIndex1,…,areaIndexN
```

`No_entries`	The numbers of available areas count.

Response XD

```
NQ, XD, No_entries, dest_index_entry1…
dest_index_entryN
```

`No_entries:` The numbers of available destinations count.

`Dest_index_entry`	`fquall_dest_index, Tie_flag, dest_levelbitmap`

Response XS

```
NQ,XS,No_entries,src_index_entry1….,src_index_entryN
```

`No_entries`	The numbers of available sources count.
`src_index_entry`	`fquall_src_index,Tie_flag, src_levelbitmap`

Response XL

```
NQ, XL, No_entries, levelIndex1,…,levelIndexN
```

`No_entries`	The numbers of available level.

Response l (small "L")

```
NQ,l,Number_of_entries,
level_name_entry1,…,level_name_entryN.
```

`Number_of_entries`	the number of levels in the system.
`Level_name_entry`	defined as: `level_name,level_index,level_medium_type,level_format_type`

`Level_medium_type` A 4 digital hexadecimal value.

`Level_format_type` A single character value. These variables can have values shown in Table 26.

Table 26. Level Format Type

Level Format Name	Level Medium Type Value (Hexadecimal)	Level Format Type
Digital Video	0001	D
Digital Audio	0004	G
Analog Audio Stereo	0004	S
Analog Audio Left	0002	A
Analog Audio Right	0002	B
Composite	0001	V
Component	0001	C
Timecode	0008	T
Data	0010	R
Assignable Data	0040	N
Embedded data (Video+Audio)	0005	E
Multi Data	0080	M
Unknown	0000	?
Any	0020	*
Others	0020	O

Response m

```
NQ,m,nbr_monitors[,Mon_name_Entry1,… Mon_name_EntryN],
```

`Nbr_monitors` The number of monitors present in system.

`Mon_name_Entry` Defined as:
`fquall_monitor_name,`
`fquall_monitor_index,level_bitmap.`

QV - Query Salvo Elements

Query the salvo elements which make up the salvo. The salvo is specified by name.

Command

```
QV,salvo_name
```

Response

`VQ,salvo_name,nbr_entries[,entry1,...,entryn]`

(<seq_flag='0000'> for the last sequence sent.)

`entryn` is defined as follows:

```
fullqual_dest_name, fullqual_src_name,level_bitmap
```

Example

To query the salvo elements that comprise a salvo named `RCLSVO1` the client needs to send

`QV,RCLSVO1`

QX- Query Cached Destination Status by Index

The Clients communicating to a Redundant Encore system can send a QX command to query the cached destination status changes by index that was stored during the redundancy switchover. By sending this request the clients can obtain the cached destination status by index for a specified window of time during which the switch over happened instead of querying all the destination status (using QJ) which is time and network intensive. The cached destination status is stored in Encore for 20 seconds assuming that the client connects to the mirroring partner with in that duration.

Response

Response token will be XQ and the rest of the packet structure shall remain the same as for the existing RCL response JQ

QY - Query Cached Destination Status

The Clients communicating to a Redundant Encore system can send a QY command to query the cached destination status changes that were stored during the redundancy switchover. By sending this request clients can obtain the cached destination status for a specified window of time during which the switch over happened instead of querying all the destination status (using QD) which is time and network intensive. The cached destination status is stored in Encore for 20 seconds assuming that the client connects to the mirror pair with in that duration.

Response

Response token will be YQ and the rest of the packet structure shall remain the same as for the existing RCL response DQ

RC - RCL Connect

Request RCL connect to the RCL server.

Command

`RC`

The RCL server on getting a `RC` request from a client will check the validity of the client and accept the client request. A unique session_id is generated for the connection. Then the server responds back intimating the connection acceptance by sending the following response.

Response

`RA, session_id`

`session_id` The unique session_id created for this connection by the server. 2 Hex digits with values from 0-0xFF.

If the client reissues a `RC`, the session will be reinitialized. All the subscriptions made so far and the state information will be lost.If the client is not configured in the user interface, the connection will be closed without any response.

RD - RCL Disconnect

Request RCL disconnect.

Command

`RD`

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

This specifies the RCL disconnect request for the current session. Either the client or the server can send this. The end that receives disconnect request will respond back with an `ER, 00` and terminate the session. The client will send this when it wants to close the session. For graceful disconnect the client should send `RD` before closing the socket or serial port.

SA - Set Audio Attributes

This command allows a client to apply the audio attributes on specified audio levels

The applied attributes will become the current attributes for that destination on specified levels. That means the set command always overrides the existing attributes for that destination on specified levels.

Table 27. SA Parameters

Parameter	Meaning
N	By Name
I	By Index

Command

```
SA, N, fqual_dst_name, nbr_entries, attribute_entry1,
attribute_entryN
```

`nbr_entries` Number of entries takes on to a destination

`Attribute entry` Defined as: `attribute_parameter,levelbitmap`

`Attribute_parameter` Atwo digits hexadecimal value as shown in Table 28

Table 28. Dynamic Audio Attribute Values

Attribute Type	Attribute Value (hexadecimal)
Stereo	01
Sum	02
Swap	03
Left only	04
Right only	05
Mute	08
Invert Left	10
Invert Right	20
Clear attribute	00

Specify the attribute value as Zero (0) to clear the set attributes and default back to Stereo.

Stereo, Sum, Swap, Left only and Right only are mutually exclusive attributes. That means, no two attributes in this list can coexist at the same time on a given destination. Applying a mutually exclusive attribute on top of

an existing mutually exclusive attribute will remove the previous attribute and retain only the current one.

Mute, Invert left, Invert Right are non-mutually exclusive attributes. That means, the attributes in this list can coexist at the same time on a given destination.

A given destination can have one mutually exclusive attribute and up to three non-mutually exclusive attributes at the same time.

The attribute parameter is used by the set attribute, get attribute and attribute change notification commands. This parameter will be referred as 'attribute_parameter' henceforth.

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To apply the attributes "Swap" ,"Invert Left" and "Mute" on the destination DST1 in area INGEST on the level indices 2, 3 and 4 the following syntax can be used:

```
SA,N, INGEST:DST1,01,1b,0000000e
```

Here the attribute parameter is 0x1b (3(swap)+8(mute)+16(invert left) = 27 = 0x1b)

Command

SA,I, fqual_dst_index, nbr_entries ,attribute_entry1,… attribute_entryN

`nbr_entries`	Number of entries takes on to a destination.
`Attribute entry`	defined as: `attribute_parameter, level bitmap`

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To apply the attributes "Sum" ,"Invert Left" and "Invert Right " on the destination index 0x0000 (DST1) in area index 2 (INGEST) on the level indices 2, 3 and 6, the following syntax can be used:

```
SA,N, 01:0000,01,32,00000026
```

Here the attribute parameter is 0x32 (2(sum) + 16(invert left) + 32(invert right) = 50 = 0x32).

TA – Take (Breakaway)

Take the sources on the specified levels to the destination by name. `TA` facilitates performing breakaway takes in a single request by name. The client can specify individual sources along with the levelbitmap information to take different sources on different levels. VITC time stamp can also be provided to perform deterministic switching.

Command

```
TA,time_stamp,fullqual_dest_name,nbr_sources,
src_name_entry1[,..., src_name_entryn]
```

(<seq_flag='0000'> for the last sequence sent.)

`time_stamp`	Time at which the take will be performed.
`fullqual_dest_name`	Destination to be taken to.
`nbr_sources`	Number of following entries (must be at least one).

`src_name_entry` is defined as:

```
fullqual_src_name,level_bitmap
```

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

The example shows how to perform a breakaway take of the following sources on the levels specified to destination MON1 in area MIXROOM.

Source - MAINCAM Level index – 3

Source - ANCCAM Level index - 2

Source – FEED Level index – 1

All the above sources are in area MIXROOM.

```
TA,, MIXROOM:MON1,3, MIXROOM:MAINCAM,00000008,
MIXROOM:ANCCAM,00000004, MIXROOM:FEED,00000002
```

The above take was non time stamped and thus the timestamp field is blank. However the separator needs to be sent as part of the message.

Note Separators are horizontal tabs ([HT]) represented by the comma (,) character. In the example, the comma after the TA, represents the horizontal tab for the blank time_stamp field. For more information on notation see *Command and Message Description Notation* on page 18.

TD - Take (Single Source)

Take the source on the specified levels to the destination by name. The level information can be omitted from this command thus allowing to perform an All Level take. VITC time stamp can also be provided to perform deterministic switching.

Command

```
TD,time_stamp, fullqual_dest_name,src_name_entry
```

`time_stamp`	Time at which the take will be performed.
`fullqual_dest_name`	Destination to be taken to

`src_name_entry` is defined as:

```
fullqual_src_name[,levelbitmap]
```

With no level bitmap specified, the source will be taken to all levels of the destination.

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To take the sources `FEED1` in area `INGEST` on the level indices 2,3and 4 to the destination `VW3` in area `POSTPROD` the following syntax is used:

```
TD,,POSTPROD:VW3,INGEST:FEED1,0000001C
```

The above take will need a tie-line to have been defined in the system between areas `INGEST` and `POSTPROD`.

TI - Take by Level Index

Take the source on the specified levels to the destination by index. The level information can be omitted from this command thus allowing to perform an all level Take. VITC time stamp can also be provided to perform deterministic switching. In this command the source, destination and level should be specified using their indexes.

Command

```
TI,time_stamp, fullqual_destIndex, fullqual_srcIndex
[,levelIndex]
```

`time_stamp` Time at which the take will be performed.

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number, all indexes refer to configured entities. Valid indexes and their association with specific names can be determined by using the commands: `QN,L`; `QN,ID`; `QN,IS`.

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To take the source FEED1 with index 3 in area INGEST whose index is 5 on all levels to the destination VW3 (index 1) in the same area the following syntax is used:

```
TI,,05:0001,05:0003
```

TJ - Take by Level Bitmap

Take the sources on the specified levels to the destination by index. `TJ` facilitates performing breakaway takes in a single request by index. The client can specify individual sources along with the levelbitmap information to take different sources on different levels. VITC time stamp can also be provided to perform deterministic switching.

Command

```
TJ,time_stamp, fullqual_dest_index,nbr_sources,
src_name_entry1[,..., src_name_entryn]
```

(<seq_flag='0000'> for the last sequence sent.)

`time_stamp`	Time at which the take will be performed.
`fullqual_dest_index`	Destination to be taken to
`nbr_sources`	Number of following entries (must be at least one)

`src_name_entryn` is defined as:

```
fullqual_src_index,level_bitmap
```

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number. All indexes refer to configured entities. Valid indexes and their association with specific names can be determined by using the commands: `QN,L`; `QN,ID`; `QN,IS`.

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To perform a timed take at 16 hours, 23 minutes, 10 seconds and 15 th frame of the source FEED1(index 3) in area INGEST (index 5) on the levels 0 and 1 to the destination VW3 (index 1) in the same area the following syntax is used:

```
TJ,16231015,1,05:0001,05:0003,00000003
```

TM - Take Monitor

Take the source or destination as specified by mon_type to monitor on specified levels.

The level bitmap is an optional parameter which if not specified results in an all level monitor take.

Command

```
TM, fullqual_type_name[,mon_type,
fullqual_mon_name[,level bitmap] ]
```

`Fullqual_type_name`	Defined as: `fullyqual_src_name` or `fullqual_dst_name`
`mon_type`	'S' is Source, 'D' is Destination
`Fullqual_mon_name`	Configured monitor name or default monitor name.

Response

The Command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To take the destination DST1 in area INGEST on 3rd and 5th levels of monitor MON1 (same area) the following syntax is used:

```
TM,INGEST:DST1,D,INGEST:MON1,00000014
```

TS - Take Salvo

Execute the salvo specified by the `salvo_name`. VITC time stamp can also be provided to perform deterministic switching.

Command

```
TS,time_stamp,salvo_name
```

`time_stamp`	Time at which the take will be performed.
`salvo_name`	Salvo name

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To perform a Salvo take of a salvo name `RCLSVO1` the following command syntax should be used:

```
TS,,RCLSVO1
```

10.Add the UI command description after "TS- Take Salvo " description in protocol manual (on page number 65 of revision number 071-0201-07.pdf)

UI - Unprotect by Index

Unprotect command allows the protect on the specified destination to be removed on the specified level. The levelbitmap is an optional parameter which if not provided will result in an unprotect on all levels.

Command

```
UI,fullqual_dest_index[,level_bitmap]
```

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

UP - Request Unprotect

Unprotect command allows the protect on the specified destination to be removed on the specified level. The command requires a `level_bitmap` to be specified on which unprotect should be performed. The format of the Unprotect command is shown below.

Command

```
UP,fullqual_dest_name,level_bitmap
```

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Example

To Unprotect a destination named `PDR2` in area `POSTPRD` on levels with indices 3 and 4 the client should issue the following command:

```
UP,POSTPRD:PDR2,00000018
```

Client Subscription Message Descriptions

SB – Subscribe

Subscribe request for status/configuration change information. The specific information for which the client subscribes is decided based on the subscription type and parameters sent as part of the `SB` command.

Command

```
SB[, subscription_type[,parameters]]
```

The subscription type specifies the status or particular configuration element. Refer to Table 29 for the list of available subscription type acronyms. If no subscription type is specified in the `SB` command, then a global subscription for all supported events is done. The parameters for any subscription command depend on the subscription type and are explained in the *Subscription Commands Usage* on page 83.

Note Using the SB command without any parameters is not recommended. Instead, use the "SB,SL" or "SB,SL,D" commands. Without parameters, more than one delete notification will be received by the RCL client. Though this should not cause problems, it may lead to additional processing by the client.

Response

Subscription request will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

UB – Unsubscribe Request

Unsubscribe request for already subscribed status/configuration change information. The specific information for which the client un-subscribes is decided based on the subscription type and parameters sent as part of the `UB` command.

Command

```
UB[, subscription_type[,parameters]]
```

The subscription type specifies the status or particular configuration element. Refer to Table 29 for the list of available subscription type acronyms. If no subscription type is specified in the `UB` command, then a global unsubscription for all subscribed events is done. The parameters for any unsubscribe command depend on the subscription type that needs to be unsubscribed and are explained in the *Subscription Commands Usage* on page 83.

Response

Unsubscribe request will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

Server Originated Message Descriptions

NY – Notification

An asynchronous Notification is sent to the client by the server whenever the subscribed status/configuration information changes.

Notification Format:

```
NY, subscription_type[,parameters]
```

Refer to Table 29 for the list of available subscription type acronyms. The parameters for the notification depend on the subscription type and are explained in the *Subscription Commands Usage* on page 83.

Table 29. Subscription Type Descriptions

Subscription Type	Meaning
AI	Destination audio attributes status change by index
AL	Alarm status change
AN	Destination audio attributes status change by name
AR	Area configuration change
AS	Destination assignment change
CN	Source or destination configuration change
DA	Destination alias change
DJ	Destination status change by index
DK	Destination status change with tie line information
DS	Destination status change
EV	Events (Take,Protect, Unprotect, Salvo) notification
LV	Level configuration change
MN	Monitor status change
mn	Monitor status change with level information
RL	Room linkage change
RM	Room configuration change
SA	Source alias change
SL	Salvo configuration change
SV	Salvo content change
TL	Tie line configuration change

RD - RCL Disconnect

Request RCL disconnect.

Command

`RD`

Response

This will get an `ER,00` response on success and an `ER,nn` (nn>0) on failure indicating the reason of failure.

This specifies the RCL disconnect request for the current session. Either the client or the server can send this. The end that receives disconnect request will respond back with an `ER, 00` and terminate the session. The client will send this when it wants to close the session. For graceful disconnect the client should send `RD` before closing the socket or serial port.

RN - RCL Announce

The RCL server during start up will send a command called RCL Announce (`RN`) to all the connected clients indicating that the server has just started up.

Command

`RN`

Response

None

Subscription Commands Usage

This section describes the usage of the subscribe (`SB`),unsubscribe (`UB`) and the notification (`NY`) commands. These commands are described with respect to the following types of subscription

- *Status Change Subscriptions* on page 84
- *Configuration Change Subscriptions* on page 88

Status Change Subscriptions

A RCL client can subscribe for destination status of one or a group of destinations. Whenever the status of a destination changes, all the clients that have subscribed for that destination status receive a notification.

Subscribe for Status Change

Subscribe command for destination status could be used in the following formats.

Command

```
SB, DS
```

The client receives notifications, whenever the status of any destination in any area changes.

Command

```
SB, DS, area index
```

The client receives notifications, whenever the status of any destination in the area specified by the area index changes.

Example

To subscribe for destination status changes in area POSTPRD (index 2) the client should issue the following command: `SB,DS,02`.

```
SB, DS, fullqual_dest_name
```

The client receives notification only if the status of the specified destination changes.

Unsubscribe for Status Change

Unsubscribe command for destination status could be used in the following formats.

Command

```
UB, DS
```

Unsubscribe destination status change notifications for all destinations in all areas

Command

```
UB, DS, area index
```

Unsubscribe destination status change notifications in the area specified by the area index

Command

`UB, DS, fullqual_dest_name`

Unsubscribe the specified destination change notification.

Example

To unsubscribe for destination status changes for destination `VW3` in area `POSTPRD`, the client should issue the following command:
`UB,DS,POSTPRD:VW3`

Illegal Subscribe and Unsubscribe Combinations

Do not use these subscribe and unsubscribe combinations:

```
SB,DS and UB,DS, fullqual_dest_name
or
SB,DS, area bitmap and UB,DS, fullqual_dest_name
```

In these cases an appropriate error will be sent back to the client.

Notification for Status Change

Whenever the status for a destination changes, all RCL clients that have subscribed for that destination's status receive notifications in the following format.

```
NY, DS, fullqual_dest_name, nbr_sources
[,src_name_entry1,..., src_name_entryn]
```

`src_name_entryN` is defined as

```
<'N'|'P'>,<'N'|'C'>, fullqual_src_name,level_bitmap,
[prot_device_name], [fullqual_chopsrc_name]
```

The fully qualified chop source name will be returned as "Chopping".

Note The notification format is similar to the `DQ` response.

Destination Status Change By Index

A RCL client can subscribe for destination status change of one or a group of destinations. Whenever the status of destination changes, all the clients that have subscribed for that destination status change receives a notification.

Subscribe for Status Change

Subscribe command for destination status change can be used in the following formats.

Command

```
SB, DJ
```

The client receives notifications, whenever the status of any destination changes.

Command

```
SB,DJ,area_index:
```

The client receives notifications, whenever the destination status of any destination in the area specified by the area index changes.

Specifying a colon ':' after the area index is necessary.

Command

```
SB, DJ, fullqual_dest_Index
```

The client receives notification, whenever the destination status is changed for specified destination index.

Command

```
SB, DJ, Destination Range
```

`Destination Range`	Defined as: `fullqual_dest_index1, fullqual_dest_indexN`

The client will receive a notification, when the status is changed for any of the the destinations in the range of the fully qualified destination index 1 and fully qualified destination index N. The range must be from a single area and cannot span multiple areas. In addition, the range has to be in the ascending order of indices.

Response

This commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To subscribe for destination status change for destinations "0000" to "0008" in area index 0x02, the client should issue the following command

```
SB, DJ, 02:0000, 02:0008
```

The client receives notification, whenever the destination status is changed for the destination indices 0000, 0001, 0002,0003,0004,0005,0006,0007,0008

Notification for Destination Status Change

Whenever the destination status is changed all RCL clients that have subscribed for the same will receive notifications in the following format.

```
NY, DJ, fullqual_dest_index, nbr_sources,
src_name_entry1….src_name_entryN.
```

`Nbr_sources` Number of sources on that destination which are being reported in this message sequence.

`Src_name_entry` is defined as”

```
<'N'/'P'>,<'N'/'C'>,
fullqual_src_index,level_bitmap,
[protect_device_name],
[fullqual_chop_src_index]
```

The fully qualified chop source index will be returned as "0xFFFA".

This notification is similar to QJ response.

Unsubscribe for Status Change

Unsubscribe command for destination status change notifications can be used in the following formats.

Command

```
UB, DJ
```

Unsubscribe for destination status change notifications for all destinations.

Command

```
UB,DJ,area_index:
```

Unsubscribe for destination status change notifications for all destinations in the area specified by the area index.

A colon ":" at the end of the command is necessary.

Command

```
UB, DJ, fullqual_dest_index
```

Unsubscribe for status change notifications only for the specified destination.

Command

```
UB, DJ, fullqual_dest_index1, fullqual_dest_indexN
```

Unsubscribe for status change notifications for the specified destination range.

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To unsubscribe for status change notification for a destination range "0000" to "0008" on area index 0x02, the following command can be used:

```
UB, DJ, 02:0000,02:0008
```

Configuration Change Subscriptions

A RCL client can subscribe for changes in the configuration of the system. The configuration changes that can be subscribed for are described along with their command format in this section.

Subscribe for Configuration Change

Subscribe command for Configuration change could be used in the following formats.

Command

```
SB, CN [, area index]
```

Subscribe to get notified, when destination or source configuration changes in the router. When the optional area index is specified, the server will send notification for changes only in the specified area.

Command

```
SB, LV
```

Subscribe to get notified, when level configuration changes.

Command

```
SB, SL
```

Subscribe for salvo configuration changes.

Command

```
SB, AR
```

Subscribe for area configuration changes.

Command

```
SB, SV
```

Subscribe for content changes of any salvo.

Example

To Subscribe for source and destination configuration changes in areas POSTPRD (index 4) and EDITROOM (index 2), the client should issue the following commands:

```
SB,CN,04
SB,CN,02
```

Unsubscribe for Configuration Change

The previously subscribed configuration change subscriptions can be unsubscribed using the Unsubscribe command syntaxes shown below.

Command

```
UB, CN [, area index]
```

Unsubscribe the source and destination configuration change subscription. The client can choose to unsubscribe only in specific area by specifying the area index.

Command

```
UB, LV
```

Unsubscribe level configuration change subscription.

Command

```
UB, SL
```

Unsubscribe salvo configuration change subscription.

Command

```
UB, AR
```

Unsubscribe area configuration change subscription.

Command

```
SB, SV
```

Unsubscribe the previously subscribed salvo content change subscription.

Notification for Configuration Change

Whenever a configuration change occurs in the system, all the RCL clients that have subscribed for that configuration change receive a notification from the RCL server with the subscription type specifying the element which has changed. In case of source and destination name changes, the clients also receive additional area bitmaps specifying the areas in which the names have changed.

```
NY, subscription_type [, area index]
```

`subscription_type`	One of the subscription types specified in Table 29 (Except `DS` and `SV`).
`Area index`	Specified only if the subscription type is `CN`. The area index indicates the area on which the destination or source configuration has changed.

Upon receiving this notification, the client has to invoke specific commands to refresh the changed configuration.

Example

If the client receives a notification with the subscription_type as `SL`, then the client should issue a `QN, V` to reload the fresh salvo names from the system.

In case of salvo content change subscriptions, whenever the content of a salvo changes, the following notification is sent to all clients that have subscribed for that change.

Command

```
NY, SV, salvo name
```

When a client receives such a notification, the client has to send a salvo status query (`QV`) for the notified salvos to refresh their contents.

Assignment Change Subscription

A RCL client can subscribe for assignment changes of one or a group of destinations. When the assignments are changed in the system all the subscribed clients receive notification about the assignment change.

Subscribe for Assignment Status Change

Subscribe for assignment status change can be used in the following formats.

Command

```
SB,AS
```

The client receives notifications, whenever the assignment status of any destination in any area changes.

Command

```
SB,AS,area index
```

The client receives notifications, whenever the assignment status of any destination in the area specified by the area index changes.

Command

```
SB,AS,fullqual_dest_name
```

The client receives notifications, whenever the assignment status of the destination represented by fullqual_dest_name changes.

Example

To subscribe for assignment status changes (by index) in area POSTPRD (index 2) the client should issue the following command:

```
SB,AS,02
```

Response

The SB,AS command will get an ER,00 response on success and an ER,nn(nn>0) on failure indicating the reason of failure.

Notification for Assignment Change

Whenever the assignments for a destination changed, all RCL clients that have subscribed for the same receive notifications in the following format.

```
NY,AS,fullqual_dest_name,nbr_sources[,fullqual_src_nam
e1…fullqual_src_nameN]
```

Unsubscribe Assignment Status change

The Unsubscribe Assignment status change command can be used in the following formats.

Command

```
UB,AS
```

Unsubscribe assignment status change notifications for all destinations in all areas

Command

```
UB,AS,area index
```

Unsubscribe assignment status change notifications in the area specified by the area index

Command

```
UB,AS,fullqual_dest_name
```

Unsubscribe the assignment change notification for destination specified by fullqual_dest_name.

Example

To unsubscribe the assignment status changes for destination VTR1 in area POSTPRD, the client should issue the following command:

```
UB,AS,POSTPRD:VTR1
```

Response

The UB,AS Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Destination Status Change Subscription (by Index w/ Tie-line Info)

A RCL client can subscribe for destination status change by index along with tie line information for one or a group of destinations. This lets the client know of changes in tie line usage as well. When the destination status changes for a subscribed destination, the RCL Server shall notifies the subscribed clients with the information on the latest status for that destination.

Subscribe for Destination Status Change (By Index w/ Tie-line Info)

Subscribe for destination status change (By Index w/ Tie-line Info) can be used in the following formats.

Command

```
SB,DK
```

The client receives notifications, whenever the status of any destination in any area changes along with the tie line information.

Command

```
SB,DK,area index
```

The client receives notifications, whenever the status of any destination in the area specified by the area index changes along with the tie line information.

Command

`SB,DK,fullqual_dest_name`

The client receives notifications, whenever the status of the destination represented by fullqual_dest_name changes along with the tie line information.

Response

The SB,DK Command will get an ER,00 response on success and an ER,nn(nn>0) on failure indicating the reason of failure.

Notification for Destination Status Change by Index w/ Tie-line Info

Whenever the destination status changes, all RCL clients that have subscribed for the same receive notifications in the following format.

```
NY,DK,fullqual_dest_index,nbr_sources[,lsrc_index_entr
y1…,src_index_entryN]
```

src_index_entryn is defined as:

```
<'N'|'P'>,<'N'|'C'>,nbr_tielines,fullqual_src_index,
level_bitmap,[device_name],[fullqual_chop_src_index]
[,tie_line_name1…,tie_line_nameN]
```

Whenever the destination status changes, all RCL clients that have subscribed for the same receive notifications in the following format.

```
NY,DK,fullqual_dest_index,nbr_sources
[,lsrc_index_entry1…,src_index_entryN]
```

src_index_entryn is defined as:

<'N'|'P'>,<'N'|'C'>,nbr_tielines,fullqual_src_index,level_bitmap, [device_name],[fullqual_chop_src_index][,tie_line_name1…, tie_line_nameN]

The source index contains specific values for the "Undef","No_xpt", "Parked" and "No_Mtrx" Refer the table Table 19 on page 57.

The fully qualified chop source index will be returned as "0xFFFA".

Un-Subscribe Destination Status Change by Index w/ Tie-line Info

Unsubscribe for destination status change (By Index w/ Tie-line Info) can be used in the following formats.

Command

```
UB,DK
```

Unsubscribe status change notifications by index along with the tie line information for all destinations in all areas.

Command

```
UB,DK,area index
```

Unsubscribe status change notifications by index along with the tie line information in the area specified by the area index.

Command

```
UB,DK,fullqual_dest_name
```

Unsubscribe the specific status change notification by index along with the tie line information for destination fullqual_dest_name.

Response

The UB,DK Command will get an ER,00 response on success and an ER,nn(nn>0) on failure indicating the reason of failure.

Monitor Status Change Subscription

A RCL client can subscribe for monitor status change. Whenever the monitor status is changed all the clients that have subscribed for that receive a notification

Subscribe for Monitor Status Change

Subscribe for monitor status change notification can have the following formats

Command

```
SB,MN
```

The client receives notifications, whenever the status of any monitor in any area changes.

Command

```
SB,MN,area index
```

The client receives notifications, whenever the status of any monitor in the area specified by the area index changes.

Command

```
SB,MN,fullqual_mon_name
```

The client receives notifications, whenever the status of the monitor represented by fullqual_mon_name changes.

Example

To subscribe for monitor status changes in area POSTPRD (index 2) the client should issue the following command: SB,MN,02.

Response

SB,MN Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Monitor Status Change

Whenever the status for a monitor changed, all RCL clients that have subscribed for that monitor's status receives notifications in the following format.

```
NY,MN,fullqual_mon_name,mon_type,fullqual_type_name
```

Unsubscribe Monitor Status Change

Unsubscribe for monitor status change notification can have the following formats

Command

```
UB,MN
```

Unsubscribe monitor status change notifications for all monitors in all areas

Command

```
UB,MN,area index
```

Unsubscribe monitor status change notifications in the area specified by the area index

Command

```
UB,MN,fullqual_mon_name
```

Unsubscribe the specific monitor change notification for monitor with name fullqual_mon_name.

Example

To unsubscribe the monitor status changes for monitor Mon3 in area POSTPRD, the client should issue the following command:

```
UB,MN,POSTPRD:Mon3
```

Response

UB,MN Command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Monitor Status Change with Level Information

A RCL client can subscribe for monitor status change. Whenever the monitor status is changed all the clients that have subscribed for that receive a notification with level information.

Subscription for Monitor status Change with Levels

Command

```
SB,mn
```

The client receives notifications, whenever the status of any monitor in any area changes.

Response

This command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Monitor Status Change

Whenever the any monitor status is changed, all RCL clients that have subscribed for it to be notified of the change and notification will be in the following format.

```
NY,mn,fullqual_mon_name,mon_type,number_of_entries
[,type_name_entry1… type_name_entryN
```

`fullqual_mon_name`	configured monitor name.
`mon_type`	'S' is Source , 'D' is Destination.
`number_of_entries`	Defined as the number of entries in response.

`type_name_entry` is defined as:

`fully_qualified_type_name,level_bitmap`

`fully_qualified_type_name`	a fullyqualified source/destination name based on the mon_type.

Unsubscription for Monitor Status Change

Command

`UB,mn`

Unsubscribe for monitor status change notification for all monitor.

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Tie-line Configuration Change Subscription

A client can subscribe for tie line configuration changes. When the tie line configuration is changed in the system all the subscribed clients receive notification of the change.

Subscribe for Tie-line Configuration Change

Command

`SB,TL`

Response

SBB,TL will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Tie-Line Configuration Change

RCL Server shall provide notification as described below when the Tie line configuration change occurs

`NY,TM`

Unsubscribe Tie-Line Configuration Changes

Unsubscribe for tie line configuration change notifications.

Command

```
UB,TL
```

Response

UB,TL will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Source Alias Change Subscription

A RCL client can subscribe for source alias name change. Whenever the source alias name is changed all the clients that have subscribed for that alias change receive a notification.

Subscribe for Source Alias Change

Subscribe for source alias change notification can have the following formats.

Command

```
SB,SA
```

The client receives notifications, whenever any source alias in any area changes.

Command

```
SB,SA,area_index
```

The client receives notifications, whenever any source alias in the area specified by the area index changes.

Example

To subscribe for source alias changes in area POSTPRD (index 2) the client should issue the following command: SB,SA,02.

Response

The SB,SA will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Source Alias Change

Whenever the source alias is changed, all RCL clients that have subscribed to be notified of the change shall receive notifications in the following

```
NY,SA,area_index
```

area_index - Specifies the area (by index) where the source alias changes have been effected.

Unsubscribe Source Alias Change

Unsubscribe for source alias change notification can have the following formats.

Command

```
UB,SA
```

Unsubscribe alias change notification for all source alias in all areas.

Command

```
UB,SA,area_index
```

Unsubscribe alias change notifications for all source alias changes in the area specified by the area_index.

Example

To unsubscribe the notifications when the source alias changes for source alias change in area POSTPRD (index 03), the client should issue the following command: UB,SA,03.

Response

The UB,SA Command will get an ER,00 response on success and an ER,nn(nn>0) on failure indicating the reason of failure.

Destination Alias Change Subscription

A RCL client can subscribe for destination alias name change. Whenever the destination alias name is changed all the clients that have subscribed for that alias change receive a notification.

Subscribe for Destination Alias Change

Subscribe for destination alias change notification can have the following formats.

Command

```
SB,DA
```

The client receives notifications, whenever any destination alias in any area changes.

Command

```
SB,DA,area_index
```

The client receives notifications, whenever any destination alias in the area specified by the area index changes.

Example

To subscribe for destination alias changes in area POSTPRD (index 2) the client should issue the following command: SB,DA,02.

Response

The SB,DA command will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Destination Alias Change

Whenever the destination alias is changed, all RCL clients that have subscribed to be notified of the change shall receive notifications in the following

```
NY,DA,area_index
```

Where

area_index - Specifies the area (by index) where the destination alias changes have been effected.

Unsubscribe Destination Alias Change

Unsubscribe for destination alias change notification can have the following formats.

Command

```
UB,DA
```

Unsubscribe alias change notification for all destination alias in all areas.

Command

```
UB,DA,area_index
```

Unsubscribe alias change notifications for all destination alias changes in the area specified by the area_index.

Example

To unsubscribe the notifications when the destination alias changes for destination alias change in area POSTPRD (index 03), the client should issue the following command: UB,DA,03.

Response

The UB,DA Command will get an ER,00 response on success and an ER,nn(nn>0) on failure indicating the reason of failure.

Room Configuration Changes Subscription

A RCL client can subscribe for room configuration changes. When the room configuration in the system is changed all the subscribed clients receive notification about the change.

Subscribe for Room Configuration Change

Command

```
SB,RM
```

Response

SB,RM will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Room Configuration Changes

Whenever the room configuration is changed all RCL clients that have subscribed for the same receive notifications in the following format.

```
NY,RM
```

Unsubscribe Room Configuration Changes

Unsubscribe for room configuration change notifications.

Command

```
UB,RM
```

Response

UB,RM will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Room Linkage Changes Subscription

A client can subscribe for room linkage changes. When the room linkage in the system is changed all the subscribed clients receive notification about the change.

Subscribe for Room Linkage Change

Command

```
SB,RL.
```

Response

SB,RL will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Notification for Room Linkage Change

Whenever the room linkage changes all RCL clients that have subscribed for the same receive notifications in the following format.

```
NY,RL,stu_room_name,nbr_linked_cub_rooms
[,cub_room_name1,…tcub_room_nameN]
```

Table 30. Parameter Descriptions

stu_room_name	Name of the studio room whose linkage has changed.
nbr_cub_rooms	Number of cubicle rooms linked to the studio room named stu_room_name.
cub_room_nameN	Name of the N th cubicle room linked to studio.

Unsubscribe Room Linkage Changes

Unsubscribe for room linkage change notifications.

Command

```
UB,RL
```

Response

UB,RL will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Attribute Status Change Subscription by Index

A RCL client can subscribe for attribute status change by index for one or a group of destinations. Whenever the destination attribute status changes, all the clients that have subscribed for this destination status receive a notification.

Subscribe for Attribute Status Change

Subscribe for destination attribute status change notification can have the following formats.

Command

```
SB,AI
```

The client receives notifications, whenever any audio attribute changes for any destination.

Command

```
SB,AI,area_index:
```

The client receives notifications, whenever any audio attribute changes for destination in the area specified by the area index changes.

A colon ":" at the end of the command is necessary.

Command

```
SB,AI,fqual_dst_index
```

The client receives notifications, whenever any audio attribute changes for specified destination.

Response

These commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To subscribe for audio attributes changes in area POSTPRD (index 2) the client should issue the following

```
SB,AI,02
```

Notification for Attribute Change by Index

Whenever the attributes changes for a destination, all RCL clients that have subscribed for that receive attribute change notification in the following format . The notification contains attributes status on all applicable levels.

```
NY,AI, fqual_dst_index, nbr_entries,attribute_entry1,..
attribute_entryN
```

`nbr_entries`	Number of attribute parameters on this destination.
`Attribute_entry`	Defined as: attribute_paramter, levelbitmap

Unsubscribe for Attribute Status Change

Unsubscribe command for destination attribute change could be used in the following formats.

Command

```
UB,AI
```

The client receives notifications, whenever any audio attribute changes for destinations in any area.

Command

```
UB,AI,area_index:
```

The client receives notifications, whenever any audio attribute changes for destination in the area specified by the area index changes.

A colon ":" at the end of the command is necessary.

Command

```
UB,AI,fqual_dst_index
```

The client receives notifications, whenever any audio attribute changes for specified destination.

Response

This commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To subscribe for audio attributes changes in area POSTPRD (index 2) the client should issue the following command

```
UB,AI,02.
```

Attribute Status Change Subscription by Name

A RCL client can subscribe for attribute status change by name for one or a group of destinations. Whenever the destination attribute status changes, all the clients that have subscribed for this destination status receive a notification.

Subscribe for Attribute Status Change

The subscribe command for destination attribute status change has the following formats.

Command

`SB,AN`

The client receives notifications, whenever audio attribute changes for any destination.

Command

`SB,AN,area_index:`

The client receives notifications, whenever any audio attribute changes for destination in the area specified by the area index.

A colon ":" at the end of the command is necessary.

Command

`SB,AN,fqual_dst_name`

The client receives notifications, whenever any audio attribute changes for specified destination.

Response

This commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To subscribe for audio attributes changes in area POSTPRD (index 2) the client should issue the following command:

`SB,AN,02`

Notification for Attribute Change by Name

Whenever the attributes changes for a destination, all RCL clients that have subscribed for that receive attribute change notification in the following format. The notification contains attributes status on all applicable levels.

```
NY,AN, fqual_dst_name, nbr_entries,attribute_entry1,..
attribute_entryN
```

`nbr_entries`	Number of attribute parameters on this destination.
`Attribute_entry`	Defined as attribute_paramter, levelbitmap

Unsubscribe for Attribute Status Change

Unsubscribe command for destination attribute change could be used in the following formats.

Command

```
UB,AN
```

Unsubscribe attribute change notification for all destinations.

Command

```
UB,AN,area_index:
```

Unsubscribe attribute change notifications for destinations in the area specified by the area index.

A colon ":" at the end of the command is necessary.

Command

```
UB,AN,fqual_dst_name
```

Unsubscribe attribute change notification for destination specified by destination index.

Response

This commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To unsubscribe the notifications when the attribute changes for destinations in area POSTPRD (index 03), the client should issue the following command:

```
UB,AN,03
```

Alarm Status Change

A RCL client can subscribe for alarm status changes of one or group of alarms. Whenever the alarm status changes in the system all the subscribed clients receive notification about the alarm status change.

Subscribe for Alarm Status Change

Subscribe for alarm status change can be used in the following formats.

Command

```
SB,AL
```

The client receives notification, whenever the alarm status of any alarm changes.

Command

```
SB, AL,AlarmID
```

The client receives notification only when the status of the specified alarm changes.

Command

```
SB, AL,AlarmIDX, AlarmIDY
```

The client receives notification, when the status of the specified alarm changes between `AlarmIDX` to `AlarmIDY` status. Here the range should be specified in ascending order of indices only.

Note If the one or more alarm indices are out of range in specified alarm range, the RCL Server will return an appropriate error instead of performing the subscription for the valid once.

Response

This commands will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To subscribe for alarm status change for alarm id from 0x0101 to 0x0107, the client should issue the following command:

```
SB,AL,0101,0107
```

Notification for Alarm Status Change

Whenever the status changes for an alarm, all NP clients that have subscribed for the same will receive notifications in the following format.

```
NY, AL, Nbr_entries, alarm_entry1,…..,alarm_entryN.
```

`Nbr_entries`	Number of alarms
`Alarm_entry`	Defined as: `alarmID, alarmStateID, alarm Parameter`

Unsubscribe for Alarm Status Change

Unsubscribe for alarm status change can be used in the following formats.

Command

```
UB,AL
```

Unsubscribe for alarm status change notification for all alarms.

Command

```
UB, AL,AlarmID
```

Unsubscribe for specified alarms status change notification.

Command

```
UB, AL,AlarmID1, AlarmIDN
```

Unsubscribe for range of alarms status change notification. Here the range should be specified in ascending order of indices only

Response

This commands will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure

Subscription for Events

A RCL client can subscribe for the Take, Salvo, Protect and Unprotect operations. Whenever the Take/Salvo/Protect/Unprotect operation is performed all RCL clients that have subscribed for the same will receive notification.

Command

```
SB,EV
```

The client receives notifications, whenever the Take/Salvo/Protect/ Unprotect happens.

Notification for Events

Whenever the Take/Salvo/Protect/Unprotect operations are performed all RCL/NP clients that have subscribed for the same will receive notifications in the following format:

```
NY,EV,timestamp, name of the initiating control device,
operation_type, operation_parameters
```

`Timestamp`	Operation requested time. The time format is: DDMONYYYY HH:MM: SS.FF (example: 16Jan2005 21:21:18.02). If the client connected to WIN32 CPS system the "FF" filed shows as "00" always.
`Name of the initiating control device`	The name of the device initiating the operation. In case, the device does not have name the IP address of the device will be used. The IP address will be sent as a string in dot notation.

`Operation_type`	The operation types can be "Take" or "Salvo" or "Protect" or "Unprotect"
`Operation_parameters`	This parameter will have different arguments based on the event. For example: Take operation parameters are: destination index ,source index and level bitmap. (The level bitmap will be shown as 0xFFFFFFFF if the take happened on all the configured levels of the destination.) The salvo operation parameter is: name of the salvo. The protect/unprotect operation parameters are: destination index and level bitmap.

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Unsubscribe for Events

Command

`UB,EV`

Unsubscribe for Events Notifications

Response

This command will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Section 3

Series 7000 Native Protocol

Introduction

The Series 7000 Routing System can be controlled by an external, serially communicating device such as a personal computer or an automation system. The Native Protocol described is intended to facilitate computer control of the Series 7000. A dumb terminal is not a practical Series 7000 controller.

Commands and error responses are terse and character efficient to maximize throughput. All message bytes are from the ASCII character set (printable and control characters). This provides the ability to easily log information traveling through the duplex control ports.

Command and Message Description Notation

For the command parameter descriptions in this section, lower case parameters must be replaced by user specified information, while upper case parameters must be literally supplied.

Upper case parameters fall into two categories: printable ASCII characters, where they are supplied as shown, and ASCII control characters, where the text shown translates into a hex equivalent.

Notation symbols used in the format descriptions are shown in Table 31.

Table 31. Notation symbols

Symbol	Meaning
...	A continued sequence.
|	Or
[]	Optional parameters
< >	Choices, or ASCII control characters, or for clarity.
,	Comma designates horizontal tab <HT>, the data separator.

For the sake of readability, spaces may be shown in the descriptions where none exist in the protocol definition.

Interface Requirements

In order to control a Series 7000 system using Native Protocol, both the Series 7000 and the external device must be properly equipped.

Communication with the Series 7000 system is via either an RS-232 or RS-422 interface, or via an Ethernet interface.

RS-232 or 422 Communication

Series 7000 systems with a stand alone control frame must be equipped with a Communications Interface (CIF) module and an RS-232/422 Interface board.

Series 7000 compact frames require an Asynchronous Mezzanine (Amezi) in the upper mezzanine position. The use of Native Protocol via a SLIP connection to a compact router is not recommended or supported. While it is possible, the slow SLIP communications link is likely to cause problems with the client application. Performance would be degraded even further if either the GUI or VSD were operated concurrently. These programs would probably fail because of communications timeouts.

Default Series 7000 communication settings are:

- RS-232 Protocol
- 9600 Baud
- 8 Data Bits
- 1 Stop Bit
- No Parity

The external device controlling the Series 7000 must be equipped with an RS-232 or RS-422 Serial Port capable of 300, 600, 1.2k, 2.4k, 9.6k, 19.2k, or 38.4k Baud communication rates.

Pinouts and cable diagrams for creating RS-232 or RS-422 connections are available as part of the Installation instructions in Grass Valley Series 7000 product manuals.

Ethernet Communication

Each Series 7000 stand alone control frame is equipped with an Ethernet port. Use of 10base2 Ethernet, 50 Ohm coax, tees, and terminations is recommended. The network should be closed, for use only by the Series 7000 system. Configurations that are connected to larger, open networks, are not supported.

Each device on the network must be assigned a unique IP address and name. This includes each Series 7000 MCPU, both primary and backup, plus each PC or other computer. Refer to the Grass Valley Series 7000 product manuals for a discussion on interconnection and addressing using Ethernet. Also review the instructions for Ethernet interface hardware in your computer manuals. It may be necessary to consult an expert in the field of Ethernet network installation.

To use the Native Protocol Ethernet interface, user-supplied software must be created to send and receive Native Protocol messages according to the protocol specifications in this document. The programmer writing software for this application must be skilled in the use of serial communications protocols, and the use of TCP/IP stream sockets. Knowledge of Ethernet networking and system administration is also required to install and configure software.

Series 7000 compact systems do not support Ethernet. External control using Native Protocol control is accomplished via an RS-232 or RS-422 interface.

Basic Native Protocol Description

The levels of the Series 7000 Native Protocol are defined in Table 32:

Table 32. Protocol Levels

Level	Description
Level 1	Physical (e.g. RS-232, RS-422, Ethernet)
Level 2	Data Link (e.g. checksums, ACK/NAK)
Level 3	Supervisory (e.g. flow control, message buffering)
Level 4	Application

The following discussions assume that Levels 1, 2, 3, and 4 will be similarly implemented on each end of the communication link.

Because of significant differences in all but level 4 messages, the RS-232/RS-422 and Ethernet descriptions are presented separately.

RS-232 and RS-422 Description

Level 1

- RS-232 or RS-422 (Default = RS-232).
- Baud rate - 300, 600, 1.2k, 2.4k, 9.6k, 19.2k, or 38.4k (Default = 9.6k)

Level 2

- 1 stop bit
- 8 data bits
- No parity

Level 2 adds the <SOH> character and the protocol_id to the message byte stream. It calculates the message checksum and appends it to the message. It then adds the <EOT> character, and transmits the message. Level 2 double buffers output.

The receiving end buffers input, verifies the <SOH>, protocol_id, and <EOT> bytes, and verifies the checksum. If the message is successfully received, it notifies Level 3 of its availability.

Level 2 ACK/NAK

When a message is successfully received, an ACK (0x06) message is returned to the sender. ACKs are returned immediately, with no field delay. ACKs are not encapsulated in <SOH>,<checksum>, or <EOT>. "If the sender does not receive an ACK within 500-1000 milliseconds after the message is sent, the message is re-transmitted for a total of thirty (30) attempts. The Router end of the protocol will always attempt to transmit exactly thirty (30) times. However, the external device may choose fewer attempts, or simply keep transmitting the same message until it is finally acknowledged."

If an error occurs during reception of a message, a NAK (0x15) followed by an error code descriptor is returned to the sender. NAKs are returned immediately, with no field delay. NAKs and Level 2 error codes are not preceded by an <SOH> or verified with a <checksum>. However an <EOT> trails the NAK message, as follows:

```
<NAK> <ErrorCodeHI> <ErrorCodeLO> <EOT>
```

The error code is a two digit hex number, expressed in ASCII.

The sender can attempt to re-transmit. However, the sender should not attempt transmission of a new or repeated message until an ACK or NAK is received, or until an appropriate time-out occurs. If a NAK with an error code indicating buffer not available is received, the sender should delay before attempting a re-transmission.

When the external device returns NAKs to the Series 7000, they must be in the format described above (with error code and EOT).

See *Level 2 (NAK) Error Code Descriptions* on page 128 for specific error information.

Level 3

Level 3 copies input messages from Level 2 buffers into its own buffers (up to "n" buffers). By marking the Level 2 buffers as available, it effectively accomplishes flow control (assuming the sender delays long enough before attempting to re-transmit the message, and the receiver gets a buffer cleared out in time). Should buffers become full, Level 2 will return the required <NAK> <buffer not available error> <EOT>, for every message attempted while this buffer (or queue) full condition remains. Again, a delay between transmitted messages should be invoked when this error condition is reported to the sender.

Level 3 passes incoming data buffers up to the appropriate Level 4 protocol handler one at a time. Level 3 appends the Series 7000 internal header to the front of the Native Protocol message before delivering to Level 4.

Level 3 receives output messages from Level 4, one at a time, and buffers them for output to Level 2. Level 3 strips the Series 7000 internal header from the message, only passing on to Level 2 the properly formatted Native Protocol message. Messages are passed to Level 2 one at a time. Level 2 calculates the checksum and transmits.

Level 3 Error Recovery

Thirty (30) consecutive transmit retries of a message will be attempted. Should the packet not be accepted by the receiving side within that count, an error will be sent by the sending side to the MCPU resident Redundancy Task for appropriate action. Appropriate action could be a switch over to the redundant Interface Card if redundant pairs are involved, or an Interface reset in stand-alone configurations.

In both transmit and receive cases, the retry count is reset to zero on any respective ACK.

See *Error Codes* on page 127 for specific error information.

Level 4

Level 4 of Native Protocol parses the content of the messages, and accesses the Series 7000 to either return the information requested, or to perform the requested action.

See *Native Protocol Messages* on page 131 for a detailed listing of all Level 4 messages.

Ethernet Description

Level 1 Description

- 10 Base 2 Ethernet
- Closed network strongly recommended (dedicated to Series 7000)

Levels 2, 3, and 4 Description

Stream sockets use TCP (Transmission Control Protocol), which is a stream oriented protocol. These sockets (sometimes referred to as Berkeley sockets) treat communications as a continuous stream of characters and are connection oriented. Therefore, a connection must be opened and maintained for the duration of the communications. Stream sockets are supported for many different host environments and operating systems.

To Initiate Communications:

A computer or other host device using Native Protocol must originate communications with the MCPU. The computer is a client, and the MCPU is the server.

1. Create a stream socket on the client.

   Linger options should be set as required for the application. Linger on with a timeout of zero is a good starting point.

2. Connect the socket to the IP address of the desired MCPU, on port 12345.

   When the connect succeeds, the MCPU will report an `NPi device added` on the system diagnostic console (if device event logging is enabled).

Note If there are redundant MCPUs, each MCPU must have its own unique IP address and name. However, only the active (primary) MCPU can communicate; it does not connect to the backup MCPU. If an MCPU switchover occurs, communications will be lost with the previously active MCPU, and it will be necessary to reconnect with the newly active MCPU. One approach is to create two sockets and attempt to connect to both MCPUs; the active (primary) connections will succeed, and the backup will not.

3. End the connection from the client by closing the socket.

   This will be detected by the MCPU, which will report the `NPi device deleted` on the system diagnostic console (if device event logging is enabled).

The user-supplied software should be designed to be able to recognize the SIGPIPE (broken pipe) interrupt or its equivalent. This will allow detection

if the connection is terminated by the MCPU. Otherwise, systems may not detect termination until a message is sent.

At the MCPU system diagnostic console, Native Protocol devices which are connected via Ethernet are referred to as NPi devices (Native Protocol/Internet). System diagnostic commands in Table 33 may be used:

Table 33. System Diagnostic Commands

Command	Meaning
ls anpi	lists Active NPi devices
pr cnpi "NPI1"	displays NPI configuration
ls inet	lists active NPi and RNC devices

By default, an NPi device name is constructed for listing purposes which consists of the last two IP address digits. For NPi devices to have names, the HOSTS table in the MCPU flash file system must contain the correct name/IP address relationships. (Refer to the configuration instructions in Grass Valley product manuals for more information on the HOSTS file).

Data Link and Supervisory Control

Unlike Native Protocol via Amezi, the TCP/IP communications layers used with Ethernet are responsible for the end-to-end error-free transport of messages. This means that messages sent and received via stream sockets are guaranteed to arrive in order and error-free, as long as the connection between the client and server is maintained.

In Native Protocol via an Amezi, Levels 2 and 3 are responsible for the error-free transport of messages. Since data transport is managed transparently for TCP/IP stream sockets, the `ACK/NAK` protocol is not used for Ethernet communications. The user-supplied software must not generate or expect `ACK`s or `NAK`s for message transactions. Level 2 error messages will not be generated.

Since the TCP stream connection is error-free, message format and checksum errors are generally a result of a programming error and not a communications error. The user-supplied program should be able to prevent these errors.

Sending Messages

While connected, Native Protocol Level 4 messages may be sent from the client by writing to the stream socket. Each message sent must be properly constructed as documented for Native Protocol messages; each message must begin with a `SOH`, end with an `EOT`, and the transmitted checksum must be correct. The user-supplied software must check for errors returned by the socket's write function call to ensure that the entire message was accepted and transmitted correctly.

All Native Protocol Level 4 messages and responses are available to an Ethernet client. However, since the Level 2 ACK/NAK is not used the BK,2 command will be ignored (no response is generated).

If a message is not sent for a period of time which exceeds the timeout configured or set for this connection, then the server (MCPU) will close the connection, and communications will be terminated. If a nonzero timeout is set, the user-supplied software must ensure that a message (any message) is sent periodically. The timeout value may be set by the user-supplied software program by transmitting a BK,I command. If the timeout is not set with a BK,I command, then the default value configured in the **CFGD NATIVE PROTOCOL INET** dialog box **REFRESH RATE** in the GUI will be used.

The rate at which messages are sent to the MCPU should be regulated to prevent overrunning the Native Protocol processing task in the MCPU application. If too many messages are sent too quickly the message buffers in the MCPU will fill, which will block the call to the socket's write function. To avoid this, wait until a Level 4 response is received from a previous command message before sending another. This ensures that the MCPU processing task has time to service all devices. Turn on the command echo option, either as the default in the **CFGD NATIVE PROTOCOL INET** dialog box in the GUI, or by using the BK,E,ON command message.

One possible source of problems is in the checksum verification. Message checksums as defined for Level 2 must be calculated and included with all messages. The MCPU server interface will discard any message with a checksum error, and a Level 2 error message will not be returned. Since TCP/IP guarantees an error-free message, the checksum cannot be corrupted during transmission. However, if the user-supplied software incorrectly calculates the checksum, the message will not be processed by the MCPU.

With stream sockets, it is the responsibility of the user-supplied software to correctly handle byte ordering and padding for multi-byte values. However, since all Native Protocol messages comprise single byte values (ASCII characters), byte ordering is not a problem as long as the correct message format is followed.

Receiving Messages

Native Protocol Level 4 responses are received by the client by reading from the connected stream socket. Each message is formatted as documented, beginning with a SOH character and ending with an EOT character.

When reading a TCP/IP stream socket, data is presented error-free and in the order sent. However, there is no built-in method for identifying the boundaries of messages; it is up to the user-supplied software to look for the beginning SOH and ending EOT. Be aware that most stream socket implementations may deliver message fragments when the read function call is made. The user-supplied software must be designed to buffer received messages until a complete message is received.

Response messages will be received for all command messages sent which specify that return information. A Level 4 acknowledgment response may optionally be returned for messages which do not automatically return a response. Refer to the **CmdEcho** option in the **Cfgd Native Protocol Inet** dialog box in the GUI, or the `BK,E,ON` command message.

Note The default CmdEcho option setting in the GUI applies to all Ethernet Native Protocol devices, but the `BK,E` command applies to each device independently.

Message Formats

Commands received by the 7000 through any control port configured for Native Protocol are formatted as follows.

Request Command Message Format

```
<SOH> <protocol_id> <seq_flag> <request_cmd>
[,parameter(s)] <checksum> <EOT>
```

`<SOH>`	ASCII Start of Header character (0x01)
`<protocol_id>`	One printable ASCII character. 'N' identifies the Native Protocol.
`<seq_flag>`	ASCII '0' if this is the last (or only) message in this sequence. Any other ASCII character indicates that there are more messages coming to complete the data portion of the <request_cmd>.
`<request_cmd>`	Two printable ASCII characters.
`[,parameter(s)]`	Optional parameters (printable ASCII characters) (max 108 bytes). The parameter delimiter is <HT> Horizontal Tab (0x09), and precedes each parameter, including the first. (Note that in the examples a comma is used to signify <HT>.) A trailing <HT> following the last parameter is optional for messages sent to the 7000 by the external device. The trailing <HT> should not be specified for some commands after the last datum. See *Trailing <HT>* on page 132

<checksum>	Negative sum mod 256 of all previous byte values (not including <SOH>). The one byte checksum is broken into two hex digits, converted to ASCII representation of those two digits, and sent as two ASCII characters. The most significant hex digit is sent first.
<EOT>	ASCII End of Transmission (0x04)

Response Command Message Format

For RS-232/RS-422 interfaces, all received commands are acknowledged with an ACK or NAK by Level 2. These do not exist with the Ethernet internace. In both interfaces some commands have a Level 4 response, described below.

```
<SOH> <protocol_id> <seq_flag> <response_cmd> <,data>
<checksum> <EOT>
```

<SOH>	ASCII Start of Header character (0x01)
<protocol_id>	One printable ASCII character. “N” identifies Native Protocol.
<seq_flag>	ASCII ‘0’ if this is the last (or only) message in this sequence. Any other ASCII character indicates that there are more messages coming to complete the data portion of the <response_cmd>.
<response_cmd>	Two printable ASCII characters, different from the “request_cmd”. This difference identifies bus directionality, resolving any ambiguities about the meaning of the data (or parameters) within the command.
<,data>	The requested information in printable ASCII (max 108 bytes). The datum delimiter is <HT> Horizontal Tab (0x09), and precedes each datum, including the first. (Examples show <HT> as comma.) A trailing <HT> following the last datum is always sent to facilitate message parsing by the external device.
<checksum>	Negative sum mod 256 of all previous byte values (not including <SOH>). The one byte checksum is broken into two hex digits, converted to ASCII representation, and sent as two ASCII characters. The most significant hex digit is sent first.

<EOT>	ASCII End of Transmission (0x04)

Level 4 responses occur as soon as the incoming command is processed, with no field delay.

Level 4 Response Message (ACK Level 4) Format

Some applications may require that control operations be successfully completed before another command is sent. This requires an acknowledgment from Level 4. This acknowledgment assures the external controller that the command has been sent on to the MCPU, but not that the MCPU has completed execution of the command. The acknowledgment will be one of three possible responses:

- Expected response containing data.
- An error response. See *Error Codes* on page 127 for specific information.
- If neither of the above occurs, Level 4 will return an error response with error number = ØØ (i.e., "no error occurred.")

```
<SOH> <protocol_id> <seq_flag> <ER,00> <,request_cmd,>
<checksum> <EOT>
```

<SOH>	ASCII Start of Header character (0x01)
<protocol_id>	One printable ASCII character. "N" identifies Native Protocol.
<seq_flag>	ASCII '0' if this is the last (or only) message in this sequence. Any other ASCII character indicates that there are more messages coming to complete the data portion of the <response_cmd>.
<ER,00>	ASCII Error 00
<,request_cmd,>	The two-letter designation of the offending command. If the error response originates from the RS-232/422 Interface card, this will be exactly the command sent by the external device. However, if the error response originates at the MCPU, there is no way to correlate the response with the requesting command — in this case the returned <request_cmd> = MC.

<checksum>	Negative sum mod 256 of all previous byte values (not including <SOH>). The one byte checksum is broken into two hex digits, converted to ASCII representation, and sent as two ASCII characters. The most significant hex digit is sent first.
<EOT>	ASCII End of Transmission (0x04)

These responses occur as soon as the incoming command is processed, with no field delay. Level 4 error response can be enabled or disabled from the Graphic User Interface, or by using the KB,E command.

Level 4 Error Message Format

The format for error messages originating at Level 4 returned to controlling devices through any control port configured for Native Protocol is as follows.

```
<SOH> <protocol_id> <seq_flag='0'> <ER> <,error_code>
<,request_cmd> [,data] <checksum> <EOT>
```

<SOH>	ASCII Start of Header character (0x01)
<protocol_id>	One printable ASCII character. "N" identifies Native Protocol.
<ER>	The two ASCII characters 'ER'
<,error_code>	Unique two digit ASCII code defining the error detected at Level 4. Level 4 error codes are two digit hex numbers, and are transmitted as two ASCII bytes, most significant first. Leading 0's are sent. "ER,00" is reserved for Level 4 Acknowledgment Format, and is not really an error.
<,request_cmd>	The two-letter designation of the offending command. If the error response originates from the RS-232/422 Interface card, this will be exactly the command sent by the external device. However, if the error response originates at the MCPU, there is no way to correlate the response with the requesting command — in this case the returned <request_cmd> = MC.

`[,data]`	Optional printable ASCII information providing additional information about the error. In many cases, this data will be one of the parameters of the failed command (e.g., the incorrect dest_name). The datum delimiter is <HT> Horizontal Tab (0x09), and precedes each datum, including the first. (Examples show <HT> as comma.) A trailing <HT> following the last datum is sent to facilitate parsing by the external device. Incoming control messages are buffered to maximize throughput. If Level 4 Acknowledgment is not active, error messages may not be synchronous with control messages, i.e., an error message may relate to a command sent several commands back. By providing the name of the offending command, along with the offending parameter, the error should be identifiable.
`<checksum>`	Negative sum mod 256 of all previous byte values (not including <SOH>). The one byte checksum is broken into two hex digits, converted to ASCII representation of those two digits, and sent as two ASCII characters. The leftmost hex digit is sent first.
`<EOT>`	ASCII End of Transmission (0x04)

These responses occur as soon as the incoming command is processed, with no field delay.

Message Sizes and Sequences

Message sizes can grow quite large, both for commands and responses. For example, the `TA` (Request Take) command could grow large, depending on the number of sources and levels specified. Long commands and responses may need to be segmented and sent in a sequence of messages rather than in one large message. For this reason, `seq_flag` was added to the Level 4 protocol.

- If a message is received with `<seq_flag` = any ASCII printable character not equal to '0'>, there are more segments to come.
- If `<seq_flag` = ASCII '0'>, this is the last (or only) segment.

Some messages are not candidates for sequencing. These messages have their sequence flags set = to ASCII '0' (`<seq_flag` = '0'>). Messages that are sequencing candidates are not necessarily sent sequenced. Message sequencing occurs only if the size of the message exceeds the buffer size specified by the Native Protocol (see *Message Buffer Sizes* below). For

example, the TA command specifies the nbr_sources in the data portion of the message. If the total number of sources = 1, only one sequence will be sent. However, if the total number of sources = 10 it may be necessary to split up the total message into several messages. Each of the sequenced messages has nbr_sources set such that the byte count is smaller than the buffer size. For example, four sequences may have to be sent in order to describe all 10 sources, with nbr_sources = 4, 2, 3, and 1.

Messages are sent with entries intact, so each message makes complete sense on its own. Messages are not arbitrarily broken up without regard to data boundaries.

In the command and response descriptions in this section, <sec_flag> is only indicated when it can be a value other than '0'.

Message Buffer Sizes

Every message has a fixed length header, a variable length body, and a fixed length trailer. The message format and number of bytes in each element is shown in Table 34.

Table 34. Message Element Sizes

	Header (fixed size = 5)				(variable size)	Trailer (fixed size = 3)	
Element	<SOH>	<protocol_id>	<seq_flag>	<req_cmd | resp_cmd>	<body>	<checksum>	<EOT>
Size	1	1	1	2	<108 max>	2	1

The maximum message buffer size is 116 (decimal) bytes, including header and trailer. The total number of header + trailer bytes = 8. Max <body> size = 108 bytes. The number of bytes in the message body varies from command (or response) to command (or response). For a given command or response, some are always the same number of bytes and others contain a variable amount of information.

Checksum Calculation Algorithm

The BK,I command is used in the example below:

Table 35. Checksum Calculation Table

Byte Description	Byte	Byte in Hex (as sent in message)
SOH	SOH	01
ProtId	N	4e
SeqNbr	0	30
ReqCmd	B, K	42, 4b
HT	HT	09

Table 35. Checksum Calculation Table

Byte Description	Byte	Byte in Hex (as sent in message)
Param	I	49
Cksum 0	TBD	TBD
Cksum1	TBD	TBD
EOT	EOT	04

The checksum is calculated on those items following `SOH` and before the inserted checksum value. The calculation is the negative sum mod 0x100 of those values.

Note The calculations below are all in Hex values.

4e+30+42+4b+09+49=15d

Mod 100 of 15d = 5d

To negate that value: 100-5d=A3

The `A3` checksum value is converted to two hex digits and inserted in the message as shown in Table 36.

Table 36. Checksum Value Conversion to Byte

Byte Description	Byte	Byte in Hex
SOH	SOH	01
ProtID	N	4e
SeqNbr	0	30
ReqCmd	B, K	42, fb
HT	HT	09
Param	I	49
Chksum0	A	41
Chksum1	3	33
EOT	EOT	04

Naming Conventions (_name)

Names of devices appear in the command descriptions (examples include `src_name, dest_name`). The following conventions apply to device names:

- Names must be from 1 to 8 printable ASCII characters.

  ASCII characters ? and * are excluded, and must not be used. The Series 7000 does not truncate a name longer than eight characters, but declares it an invalid name in its error response.

- Names are case sensitive.

  If all upper case letters are used in a in a name, NODE_CON for example, the system will acknowledge the name, Node_Con, as invalid or as a different object because the case of the letters do not match.

- Spaces in names are discouraged.

  Use an underscore instead of a space, to avoid confusion and keep all characters visible. For example, use VTR_17 rather than VTR 17.

Parameter Quantity (nbr_)

Various parameters describing quantities appear in the command descriptions (examples include `nbr_entries`, `nbr_sources`). These are the ASCII representation of hex quantities, transmitted with the most significant digit first. Normally, only the number of characters necessary to express the size of the number are sent. These are not fixed size fields.

Level Bitmap

In the descriptions, `level_bitmap` appears frequently. A level_bitmap is a 32 bit quantity where each bit represents the presence (=1) or absence (=0) of a particular level for that command or response. The least significant bit (right-most) represents Level #0; the most significant bit (left-most) represents Level #31. The `QN,L` command allows the user to find out the Level Names for each of the bits. We are using `level_bitmap` instead of `level_names` in our commands and responses because it significantly reduces the message buffer sizes needed for the protocol. A 32-bit `level_bitmap` is translated into an equivalent representation of 8 hex digits (= 0,...9,A,...F). These 8 hex digits are then converted to ASCII (='0',...'9', 'A',...'F') and sent with the most significant byte first. The hex digits 'A'...'F' can be sent as upper or lower case ('a'...'f').

For example, the 8-character ASCII message `0000047d` translates into the following bitmap rendering:

```
0000 0000 0000 0000 0000 0100 0111 1101
```

Checking for level presence or absence from 0 through 31 (right to left), this bit map indicates that levels 0, 2, 3, 4, 5, 6, and 10 are present in this command or response.

Refreshing Protects

If a native protocol control port protects particular destinations on the Series 7000, the port is responsible for refreshing those protects periodically or the protects will be dropped by the Series 7000.

The refresh interval can be disabled (=0), or set ≤ 255 seconds. If a Level 4 command (any Level 4 command) is not received with at least this periodicity, the native protocol port decides that the external device is no longer active and sends a device-delete message to the system. As a result, all protects currently held by this native protocol port are dropped.

Refer to the `BK,I` command description which allows the device to query and set the refresh interval. This can also be set from the Graphic User Interface. The `BK`, with no parameters, has no side effects and can be used to keep protects refreshed in the absence of other Level 4 command activity.

Level 2 `ACK`s from the external native protocol device do not reset the timeout counter.

Error Codes

Three sources of error codes may be returned to the external device as a result of a command transmitted to the Series 7000 System:

- Level 2 NAK errors
- Level 4 Errors
- Level 4 MCPU Errors.

Level 2 NAK Errors

Negative Acknowledgement (`NAK`) related error codes are generated by Native Protocol Level 2 using the RS-232,RS-422 interface. These errors are not present for the Ethernet Native Protocol interface.

An example of a Level 2 error is a Time Out Error. Time out interval begins upon reception of an `SOH` and is halted at the reception of an `EOT`. Time out interval is one (1) second for data rates from 2400 to 38.4k Baud. For slower rates, time out is equal to 2400/data rate = time out in seconds. For example, at 300 Baud, time out = 8 seconds (2400/300 = 8).

Level 2 (NAK) Error Code Descriptions

The following codes are sent with NAK's from the 7000 to the external device. The external device is also responsible for NAKing the 7000 when appropriate, but does not have to rigidly adhere to sending these error codes. However, if specific errors are reported with an external device's NAK, they should be defined as:

<NAK> <error_code> <EOT>

<error code> is defined as a Hexadecimal number 71 - 79 (Table 37).

Table 37. Native Protocol Level 2 NAK Error Codes

Decimal Value	Hex Value	Meaning	Description
113	71	Buffer Size Exceeded	The number of characters received since the last detected SOH is greater than the maximum Native Protocol message length.
114	72	Buffer Not Available	No buffer within the input queue was empty and able to store the incoming message. Buffer not available is only reported after an otherwise good message is received.
115	73	Undefined	Undefined
116	74	Chip Level Error	Parity, overrun, etc. Error detected by UART. This error is currently not sent by the 7000. However, the external device may use this code to report a NAK to the 7000.
117	75	Checksum Error	Packet had a bad checksum. Low Level errors such as framing, overrun, etc., are reported as checksum errors.
118	76	Time Out Error	Time out interval is begun upon the reception of an SOH, and is halted at the reception of an EOT. Time out interval is one 1) second for data rates from 2400 to 38.4k Baud. For slower rates, time out is equal to 2400/data rate = time out in seconds. For example, at 300 Baud, time out = 8 seconds (2400/300 = 8).
119	77	Missing SOH	No SOH detected in message. Results when EOT is detected without a preceding SOH.
120	78	Missing EOT	No EOT detected in message. Results when two SOHs are detected without an EOT between. For this to occur, the receiver would have to miss the EOT of the first message and the sender would have to send the second message either without receiving a proper acknowledgment for the first packet, or receiving an erroneous ACKnowledge for the packet whose EOT went undetected. This is an unlikely error. Most probably, when an EOT is missed by a receiver, a time out will occur within the receiver while it is waiting for the rest of the packet (and therefore, the missed EOT).
121	79	Amezi On Hold	The Amezi that is processing Native Protocol requests has been placed on hold, and is not currently accepting any messages. This is usually only encountered in a system configured for redundant Amezis with dedicated data lines to each, and is a signal to the external controller to attempt to re-send a message to the other Amezi.

Native Protocol Level 4 Errors

Native Protocol Level 4 Errors can occur when the command is parsed. Examples of error are: unknown command, unknown destination name. Errors of this type are returned to the external device in ER,nn responses, described elsewhere in this document.

Error codes of this type are documented in the responses to the QE command. They can also be interpreted from the System Diagnostic terminal with the command: npPrintErrRec 0xhh, where hh is the hex error code. See *Appendix B-Router Control Language Error Codes*.

Retrieve an explanation of the numeric error code in one of the following three ways:

Level 4 Error Explanation Retrieval Method 1

Program the controller to request a list of all Level 4 error codes and definitions using the command string:

`<SOH> N Ø Q E E C <EOT>`

The 7000 will respond with separate messages, each containing an error code and a description. Each message must be acknowledged before the next message will be transmitted. To acknowledge a message enter `<ACK>`.

Copy or print the error listing so that the explanations are at hand when error codes are received.

Level 4 Error Explanation Retrieval Method 2

Use the `QE` command with specific error code parameters.

Level 4 Error Explanation Retrieval Method 3

From the Series 7000 System Diagnostic Terminal, type:

`npPrintErrRec ØXhh`

(replace `hh` with the hex error code you are inquiring about)

For more information on using the Diagnostic Terminal to examine error messages, refer to the Grass Valley Series 7000 product manuals.

If the system is reporting Level 4 error messages resulting from take commands, check the **Cfgd Native Protocol Inet** menu item in the GUI. If the system is trying to control a level that is not enabled in the list of Controllable Levels, an error message will be generated.

MCPU Level 4 Directed Response Error Messages

Certain Native Protocol commands (for example, `TA` Request Take) are reformatted by Level 4 and passed on to the MCPU for execution. Errors may be generated at this level by the MCPU. Error messages are generated within the MCPU, and returned to the device. When an error occurs, it is sent from the MCPU to Native Protocol level, where it is reformatted into an `ER,01` response to the external device. These messages are identified by unique numbers different from those used by Amezi Level 4 error messages.

The error codes returned with these errors are identified by the `MC` command, as described in *Level 4 Error Message Format* on page 122. Error messages generated by the MCPU are sent to the Amezi via a Directed Response Message. Such messages will be passed on to the external device, as described below. Hex value 01 is the Level 4 error code allocated to Directed Response errors. Associated with each Directed Response

message is a secondary code, which defines the error detected by the MCPU, and which defines the content of the rest of the message. This code and its associated data are passed on to the external device.

The format of this message to the external device is as follows (actual text may differ from that shown):

```
<response_cmd="ER">
<error_code=0x01>
<request_cmd="MC">
<data_1=secondary_code_text_descr>
```

The secondary code is prefixed with a two-digit decimal number that facilitates rapid parsing by the external device (Table 38).

Table 38. Secondary Code

Secondary_Code	Additional Parameters Returned
10 bus_protect	dst_name, level_bitmap
20 src_exclusion	src_name, dst_name
21 prot_denied	dst_name, level_bitmap
22 unprot_denied	dst_name, level_bitmap
23 prot_status	dst_name, level_bitmap
25 salvo_exclusion	TBD
39 no_xpt	src_name, dst_name, level_bitmap
31 no_levels	src_name, dst_name
33 no_assign	none
32 tieline_busy	none
40 other_error	TBD

Native Protocol Messages

Available Two Letter Commands

Native Protocol two letter interface commands with brief descriptions are shown in Table 39.

Table 39. Two Letter Interface Commands

Command	Meaning	Description
AS	Machine Assign	Assigns a machine (router input) to control by a specified destination.
BK	Background Activities	Used without parameters to synchronize communications. Used to periodically refresh Protects. Used as a diagnostic tool.
CH	Request Chop	Initiates chopping between specified sources.
CT	Request Clear Destination Tielines	Removes Tieline in Use status if the specified destination is being fed by a tieline.
DA	Machine De–Assign	Removes a machine (router input) from control by a specified destination.
PI	Protect by index	Protects a specified destination index from other control points.
PR	Request Protect	Protects a specific destination from having its source changed.
QA	Query Machine Assignment Status	Checks machine assignment status changes.
QB	Query Alarm Definitions	Lists supported alarms information.
QC	Query Combined Destination Status	Returns source status on combined levels of the destination.
QD & Qd	Query Destination Status	Checks sources assigned to destinations by destination name.
QE	Query Error Definition	Retrieves text describing a particular error code.
QH	Query Alarm Status	Returns alarms status.
QI & Qi	Query Destination Status by Index (Response Type 1)	Checks sources assigned to destinations by specific Destination and Level Index.
QJ & Qj	Query Destination Status by Index (Response Type 2)	Checks sources assigned to destinations by Destination Index for all levels.
QL & Ql	Query Destination Status with TieLine Info	Checks sources assigned to destinations by destination name, includes TieLine Information.
QN	Query Names	Checks names associated with Sources, Destinations, Levels, Salvos, Rooms, or TieLines.
QT	Query Date and Time	Checks system date and time information.
QV	Query Salvo Status	Checks sources, destinations, and levels associated with a specified Salvo (Timed Salvo info is not available).
ST	Request Set Date and Time	Sets system date and time information.
TA	Request Take	Takes Sources (on specified levels) to specified destination, by name rather than index.
TD	Request Take Destination	Takes same source to all or specified levels.
TI	Request Take Index with Level Index	Takes Source (on specified level) to specified destination, by index rather than name.
TJ	Request Take Index with Level Bit Map	Takes Sources (on specified levels) to specified destination by index rather than name. Allows Breakaways.
TM	Request Take Monitor Destination	Takes Sources (on specified levels) to the Monitor Destination.
TS	Request Take Salvo	Executes the specified Salvo.
UI	Unprotect by index	Removes previously applied Protect from specified Destination index.
UP	Request UnProtect	Removes Protect from specified Destination.

Trailing <HT>

The following two letter commands are supported with or without the trailing <HT> after the last datum/parameter. This means the trailing<HT> is optional for these commands:

AS,BK,CT,DA,PR,QA,QC,QD,Qd,QE,QI,Qi,QJ,Qj,QN,QT,QV,TD,TI,TA,TJ, TS,UP

Example

To query the all destinations status by index, the client can use either of the following syntax:

`QJ` or `QJ,` (i.e. QJ<HT>)

Client Subscription Messages

Subscription messages originated from the client are shown in Table 40.

Table 40. Client Subscription Messages

Command	Description	Expected Server Response
SB- Subscription	Subscribe for status changes	ER,00
UB- Unsubscription	Unsubscribe for already subscribed status information	ER,00

Server Originated Messages

NP Protocol messages originated from the server are shown in Table 41.

Table 41. Server Originated Messages

Command	Description	Expected Client Response
NY-Notification	An asynchronous notification sent whenever the subscribed status changes	None

AS - Machine Assign

Command

```
AS,dest_name,src_name
```

Response

(None)

BK - Background Activities

The BK command can be used to synchronize communications between the external controller and the control port. The external controller sends BK messages (with no parameters) until it receives an ACK from the control port. At this point, communications are synchronized. Any native protocol command can be sent to accomplish synchronization. However, the BK command with no parameters has no side effects.

The BK command can also be used to periodically refresh protects.

The BK command also has diagnostic uses. When the BK command is sent with optional parameters, information described below is returned to the external device.

Command

```
BK [,parameter [,mask]]
```

A maximum of one parameter can be specified per BK call. Each parameter consists of a single, case sensitive letter, defined below.

Table 42. BK Command Parameters

Parameter	Description
N	Return device name.
R	Return software revision number.
T	Return software title with version.
t	Return protocol title with version.
F	Return set of flags defining reset occurrences, protects dropped, name/ID table updates, etc. (bit flag = 1 if defined change occurred — see below for change definitions)
f	Mask clear change flags defined in 'mask' (see below for mask definition). mask bits = 1 indicate flags to be cleared.
D	Clears the flags associated with the QD,no_parameter command. After BK,D is sent, the next QD,no_parameter command will result in destination statuses for all destinations being returned.
A	Clears the flags associated with the QA,no_parameter command. After BK,A is sent, the next QA,no_parameter command will result in all assignment statuses being returned.
P	Returns port configuration parameters fixed by Graphic User Interface configuration, and which cannot be modified by the native protocol device.
I	[, < RefreshIntervalInSecs | OFF=0 >} Sets or returns Refresh Interval. If no interval is specified, this is interpreted as a request to simply return the existing value. Refresh Interval is specified to be <= FF hex.
E	[, < ON | OFF >] Sets or returns status of Level 4 Echo (err = 00). If no parameter is specified, this is interpreted as a request to simply return the existing status.
d	Returns the name of this port or device.
2	Null command. This message is processed entirely by Level 2, and is not passed up to Level 4. If the message has the correct checksum, an ACK will be returned to the external controller. The intended use for this command is to allow an external controller to verify that a redundant, backup control port is alive, without side effects occurring in the Level 4 code. It can also be used on the active control port, but this is not its intended use.

Response

(No response if no returned data.)

Response with returned data is:

`KB,parameter,data`

`parameter` consists of a single, case sensitive letter, defined in Table 43:

Table 43. KB Response Parameters

Parameter	Data
N	Device name string.
R	Software revision string.
T	Software title with version string.
t	Protocol title with version string.
I	Refresh_Interval_in_Seconds. If = 0, refresh is not enabled. A value will be returned for both set and query requests (see `I` in Table 42).
E	Echo = ON | OFF. A value will be returned for both set and query requests (see `E` in Table 42).
d	Device_Name
P	PnlLck=<ON|OFF>, ChopLck=<ON|OFF>, SlvLck=<ON|OFF>, ProtOvrd=<ON|OFF>, MonCtl=<ON|OFF>, CtlblLvls=lvlBitMap
D	none
A	none
2	none
F	Four ASCII characters representing four HEX digits (16 bits), with bits flagging changes since flags last cleared by `f` parameter. Most significant hex digit is sent first (that is, b15...b12). See Table 44.

KB, F Response

For a `KB, F` response, the `data` is defined in Table 44:

Table 44. KB Command Response Bits

Bit #	Meaning
0 (lsb)	Reset has occurred. When reset occurs, this bit is set =1; all other flag bits are also set = 1.
1	any protects initiated by this control port were dropped.
2	destination changes
3	tieline changes
4	source changes
5	level changes
6	salvo changes
7	room changes
8 - 14	(Reserved. Always returned = 1 unless user has cleared these bits.)
15	Redundant switchover event occurred.
f, mask	(none)

Here is an example of the use of BIT flags for parameters = `f` or `F`.

The user queries Native Protocol using `BK,F` — and receives a reply with parameter bit #4 set to indicate that there has been a change (addition, modification, deletion) to the system source name table. The user next uses the `BK,f,` mask (where mask bit #4 = 1) command to clear bit #4 from the mask. The next `QN,S` command results in all source names being downloaded to the user. The user again queries using `BK,F`. The reply shows that bit #4 = 0, indicating that the source name list just downloaded is current.

Do not confuse flags discussed with `f` & `F` options with those discussed with `D` & `A` options. The `QD` and `QA` commands allow the user to download incremental changes in Destination and Assignment Status tables. The `D` and `A` options of the `BK` command allow the bit arrays that keep track of these incremental changes to be cleared. This allows re-synchronizing with the 7000 data base (for Destination & Assignment Status) if, for some reason, the external device resets.

Using a server timeout value (configured Refresh Rate or `BK,I` command) of zero is not recommended. If a connection is broken or a client crashes, the MCPU may not close the socket for a long period of time.

CH - Request Chop

Command

The format of the Chop command is identical to that of the `TA` Request Take command.

```
CH,dest_name,nbr_sources,src_name_entry1,
[..., src_name_entryn]
```

However, the specified source names to be taken to the destination actually specify the chop source names and levels. This command results in chopping with the already established destination status.

To specify a chop operation, first Take sources and levels to a destination, then Chop to the same destination with the chop sources and levels.

Response

(none)

Command

(<seq_flag='0'> for the last sequence sent.)

`dest_name`	Destination to be taken to
`nbr_sources`	Number of following entries (must be at least one)

`src_name_entryn` is defined as:

```
src_name,level_bitmap
```

Response

(none)

CT - Clear Tielines

Command

```
CT,dest_name
```

Response

(none)

DA - Machine De-assign

Command

```
DA,dest_name,src_name
```

Response

(none)

PI - Protect by Index

Protect command allows the specified destination index to be protected from any source changes on the specified level from other control points. The levelbitmap is an optional parameter if not provided it protects on all levels.

Command

```
PI,dest_index[,level_bitmap]
```

Response

This will get an `ER,00` response on success and an `ER,nn (nn>0)` on failure indicating the reason of failure.

Example

To protect a destination index 0x0000 (ex:-PDR1) in area index 0x02 on fourth and fifth levels, the client should issue the following command (here it is assumed the client is configured in area index 2):

```
PI,0000,00000018
```

PR - Request Protect

Command

```
PR,dest_name,level_bitmap
```

Response

No direct response, but a successful PR command will return a `Directed Response Message = prot_status` from the MCPU, which in turn results in a message to the external device `ER`, `error_code = 01`, echoed command = `MC`.

QA - Query Machine Assignment Status

Command

```
QA[,dest_name]
```

`dest_name` This can be either:

-An ASCII name of up to 8 characters. In this case the assignment status for a single destination will be returned, or

-Blank. If so, assignment status is returned for all destinations for which assignment has changed since the last time information was sent. Destination assignment information is returned for all levels (for the changed as well as unchanged levels) to which a machine is assigned. The BK,A command can be used to force return of all destination assignments.

Response

```
AQ,dest_name,nbr_sources[,src_name1,...,src_namen]
```

(<seq_flag='0'> for the last sequence sent.)

`nbr_sources` Number of sources assigned to that destination which are being reported in this message sequence. If there are no sources assigned to this destination, `nbr_sources = 0` will be returned.

`QA` (with no dest_name specified) is one of several commands whose response can consist of more than one message sequence. `QA` with no parameter can result in a sequence of messages for each of many destinations. To help the external device determine that a particular message sequence is the very last such sequence, it will be followed by a Level 4 Echo (ER,ØØ), if that Port Configuration Feature is enabled. `QA` (with a dest_name specified) is not followed by a Level 4 Echo.

QB - Query Alarm Definitions

This command allows a client to query the supported alarm definitions. Alarm definitions are not the same for all devices. E.g. some hardware supports AC power alarm, some will not.

Command

The QB command can have different command syntaxes.

`QB`

The definitions for all supported alarms are return. The response can result in a sequence of messages for each of many alarms. To help the external device determine that a particular message sequence is the last sequence, it is followed by a Level 4 Echo (ER,ØØ).

`QB[,<alarm ID>]`

The definition for specified alarm is returned. If alarm ID is not present, for all supported alarms definitions are returns. In this case the end of response can be followed by a Level 4 Echo (ER,ØØ).

Response

`BQ,<alarm ID>,<max alarms>,<alarm description string>`

`Alarm ID` Alarm ID is 4 digit hexadecimal number.

`Max alarms` Maximum number of device alarms, it is two digit hexadecimal number

`Alarm description string` a string describing of the alarm

QC - Query Combined Destination Status

Query the status on combined levels of the destination. The combined levels is interpreted with respect to the first level on which the destination is present. The status returned will have the source taken to the destination on the first level on which the destination is present. This will also specify information of the other levels on which this source has been taken to.

Command

`QC[,dest_name]`

`dest_name` This can be either:
- An ASCII name of up to 8 characters. In this case the status information for a single destination will be returned, or
- Blank. If so, destination status information is returned for all destinations for which status has changed since the last time status information was sent. Destination status information is returned for all levels (for the changed as well as unchanged levels) which have status. The `BK,D` command can be used to force return of all destination status.

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

Response

`CQ,dst_name,dst_level_bitmap[,src_name_entry1]`

(<seq_flag='0'> for the last sequence sent.)

`dst_level_bitmap` Describes the levels configured for destination. For source connected to first level dst_level_bitmap=0 will be returned if no source is connected.

`src_name_entry1` is defined as:

```
<'N'|'P'>,<'N'|'C'>,srcm_name,level_bitmap,
[device_name], [chop_src_name]
```

Parameters for this response are explained in Table 45.

Table 45. QC Response Parameters

Parameter	Meaning
'N' |'P'	Not-protected or Protected
'N' | 'C'	Not-chopping or Chopping
src_name	One of the sources currently taken to the destination
level_bitmap	Describes the levels of that destination which the source is on
device_name	The device currently holding the protect. If the destination is not protected, or the device name is unknown, the field is left blank.
chop_src_name	The name of the source chopping to this destination. The chop source name will be returned as "Chopping".

QC (with no dest_name specified) is one of several commands whose response can be more than one message sequence. QC with no parameter can result in a sequence of messages for each of many destinations. To help the external device determine that a particular message sequence is the last sequence, it is followed by a Level 4 Echo (ER,ØØ), if that Port Configuration Feature is enabled. QC (with a specified dest_name) is not followed by a Level 4 echo.

QD - Query Destination Status

Command

```
QD[,dest_name]
```

`dest_name` This can be either:
- An ASCII name of up to 8 characters. In this case the status information for a single destination will be returned, or
- Blank. If so, destination status information is returned for all destinations for which status has changed since the last time status information was sent. Destination status information is returned for all levels (for the changed as well as unchanged levels) which have status. The BK,D command can be used to force return of all destination status.

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

Response

```
DQ,dest_name,nbr_sources[,src_name_entry1,...,
src_name_entryn]
```

(<seq_flag='0'> for the last sequence sent.)

`nbr_sources` Number of sources on that destination which are being reported in this message sequence. If there are no sources on this destination at any of its levels, nbr_sources = 0 will be returned.

`src_name_entryn` is defined as:

```
<'N'|'P'>,<'N'|'C'>,src_name,level_bitmap,
[device_name], [chop_src_name]
```

The chop source name will be returned as "Chopping".

Data for this response is identical to the `QC` command response described previously.

`QD` (with no dest_name specified) is one of several commands whose response can be more than one message sequence. `QD` with no parameter can result in a sequence of messages for each of many destinations. To help the external device determine that a particular message sequence is the last sequence, it is followed by a Level 4 Echo (ER,ØØ), if that Port Configuration Feature is enabled. `QD` (with a specified dest_name) is not followed by a Level 4 echo.

Qd - Query Destination Status

Command

The `Qd` command is the same format as the `QD` command:

```
Qd[,dest_name]
```

Response

The response to the `Qd` command is similar to that of the `QD` command, with the following differences:

- The response Command is `dQ`.
- The src_name returned will be `NO_XPT` if that condition applies to the particular set of crosspoints being reported.

QE - Query Error Definition

Error messages returned through the controller channels are terse and identified by a two byte code. This command allows the user to retrieve the text describing Level 4 error codes. Level 2 error codes (associated with NAKs) are documented elsewhere.

This facility was provided so that error code interpretation could be determined by the on-line controlling device, without having to look up codes in possibly outdated documentation. Error code definitions can always be determined in the latest software release.

Command

```
QE,error_code
```

error_code	This can be either: - Any 2 hex digit (represented by ASCII) error code received in an ER,nn message in response to a command sent to the Amezi, or - Blank. In this case, error definition information will be returned for all error codes.

Response

```
EQ,error_code,error_definition_string
```

(<seq_flag='0'> for the last sequence sent.)

QH - Query Alarm Status

The QH command facilitates to query the alarm status.

Command

```
QH
```

The alarms status is returned for all alarms for which status has changed since the last time status was sent. The alarm status contains the faulty and active status. The BK, H command can send before this request to force return of all alarm's status.

```
QH,AB
```

Query absent signals alarm status. The alarms status is returned for all alarms for which signal (input/output) alarm status is faulty.

```
QH,AC
```

Query active alarm status. The alarms status is returned for all alarms except signal alarms on which alarm status is faulty.

Response

`HQ,Nbr_entries,alarm_entry1,….,alarm_entryN`

Nbr_entries is indicates the number of alarm entries present in response.

Alarm_entry is defined as:

```
alarmID,alarmStateID,alarmParameter
```

In case of QH,AB command response the "alarm Parameter" shall contain the combination of level bitmap and connection number of input/output.

Example for QH,AB Response

The first and second sources are taken to the destination's fourth and fifth levels. If the input signal is removed on the first two connector numbers (on two levels) , the response is shown below:

```
<SOH>N1HQ,AB,04,0108,1,00000003:0000,0108,1,0000000
3:0001,0109,1,00000003:0003,0109,1,00000003:0004,CH
<EOT>
```

Example for QH,AC Response

If the first fan is faulty and second power supply is faulty, the response is shown below:

```
<SOH>N1HQ,AC,02,0101,1,0,0102,1,1,CH<EOT>
```

QI - Query Destination Status By Index

Command

`QI,destIndex,lvlIndex`

`destIndex` and `lvlIndex` are always required

Response

`IQ,destIndex,lvlIndex,<'N'|'P'>,<'N'|'C'>,srcIndex,[chop-SrcIndex]`

This command allows access to destination information by using the destination index vs. the destination name. Similarly, information is returned by index reference vs. name. The returned indexes will always be four ASCII hex characters with leading zeros as needed.

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number, all indexes refer to configured entities. Valid indexes and their

association with specific names can be determined using the commands: QN, ID; QN, IS; QN, L.

The chop source index will be returned as "0xFFFA".

Qi - Query Destination Status By Index

Command

The Qi command is the same format as the QI command.

```
Qi,destIndex,lvlIndex
```

Response

The response to the Qi command is similar to that of the QI command, with the following differences:

- The Response Command is iQ.
- The srcIndex returned will be 0xfffe if an error condition applies to the crosspoint being reported.

QJ - Query Destination Status By Index

Command

```
QJ[,dest_index]
```

The dest_index field may be left blank. If so, destination status is returned for all destinations for which status has changed since the last status information was sent. Destination status information is returned for all levels (changed or unchanged) which have status. The BK,D command can be used to force return of all destination status.

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

Response

```
JQ,dest_index,nbr_sources[,src_name_entry1,...,
src_name_entryn]
```

(<seq_flag='0'> for the last sequence sent for a particular destination status.)

`nbr_sources` Number of sources on that destination which are being reported in this message sequence. If there are no sources on this destination at any of its levels, nbr_sources = 0 will be returned.

`src_name_entryn` is defined as:

```
<'N'|'P'>,<'N'|'C'>,src_index,level_bitmap,
[device_name], [chop_src_index]
```

Parameters for this response are explained in Table 46.

Table 46. QJ Command Response Parameters

Parameter	Meaning
'N' |'P'	Not-protected or Protected
'N' | 'C'	Not-chopping or Chopping
src_index	One of the sources currently taken to the destination
level_bitmap	Describes the levels of that destination which the source is on
device_name	The device currently holding the protect. If the destination is not protected, or the device name is unknown, the field is left blank.
chop_src_name	The name of the source chopping to this destination
chop_src_index	The index of the source chopping to this destination. The chop source index will be indicated as "0xFFFA".

Returned indexes will always be four ASCII hex characters with leading zeroes as needed. All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero-based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port and index numbers are identical. There is no disconnect index number; all indexes refer to configured entities. Valid indexes and specific name associations can be determined using the commands: `QN, ID; QN,IS; QN,L.`

The response to `QJ` (with no dest_index specified) can be more than one message sequence. `QJ` with no parameter can result in a sequence of messages for each of many destinations. To help the external device determine that a particular message sequence is the last, it is followed by a Level 4 Echo (ER,ØØ), if that Port Configuration Feature is enabled. `QJ` (with a specified dest_index) is not followed by a Level 4 echo.

Qj - Query Destination Status By Index

Command

The Qj command is the same format as the QJ command.

```
Qj[,dest_index]
```

Response

The response to the Qj command is similar to that of the QJ command, with the following differences:

- The Response Command is jQ.
- The srcIndex returned will be 0xfffe if that condition applies to the particular set of crosspoints being reported.

QL - Query Destination Status With Tieline Info

Command

Allows access to destination information, with possible tie-line information attached. The format of the request is the same as for the QD command.

```
QL[,dest_name]
```

dest_name	This can be either: - An ASCII name of up to 8 characters. In this case the status information for a single destination will be returned (seq_flag = 0), or - Blank. If so, destination status information is returned for all destinations for which status has changed since the last time status was sent. Destination status information is returned for all levels (for changed as well as unchanged levels) which have status. The BK,D command can be used to force the return of all destination status.

If there are no sources currently on some of the levels defined for the destination, no information is reported for those levels.

Response

```
LQ,dest_name,nbr_sources[,src_name_entry1,...,
src_name_entryn]
```

(<seq_flag='0'> for the last particular destination status report.)

`nbr_sources` Number of sources on that destination which are being reported in this message sequence. If there are no sources on this destination at any of its levels, nbr_sources = 0 will be returned.

`src_name_entryn` is defined as:

```
<'N'|'P'>,<'N'|'C'>,<'N'|'S'>,<'N'|'C'>, src_name,
level_bitmap,[device_name],[chop_src_name],
[downstreamSrcName],[downstreamChopSrcName]
```

Data for this response is explained in Table 47.

Table 47. LQ src_name_entry1 Description

Parameter	Meaning
'N' | 'P'	Not-protected or Protected
'N' | 'C'	Not-chopping or Chopping
'N' | 'S'	No downstream source name or downstream source name exists
'N' | 'C'	No downstream chop source name or downstream chop source name exists
src_name	One of the sources currently taken to the destination
level_bitmap	Describes the levels of that destination which the source is on
device_name	The device currently holding the protect. If the destination is not protected, or the device name is unknown, the field is left blank.
chop_src_name	Name of the source chopping to this destination
downstreamSrcName	Name of the downstream source, if any
downstreamChopSrcName	Name of the downstream chopping source, if any

`QL` (with no `dest_name` specified) is one of several commands whose response can be more than one message sequence. `QL` with no parameter can result in a sequence of messages for each of many destinations. To help the external device determine that a particular message sequence is the very last such sequence, it will be followed by a Level 4 Echo (ER,ØØ), if that Port Configuration Feature is enabled. `QL` (with a specified dest_name) is not followed by a Level 4 echo.

Ql - Query Destination Status With Tieline Info

Command

The `Ql` command is the same format as the `QL` command.

```
Ql[,dest_name]
```

Response

The response to the `Ql` command is similar to that of the `QL` command, with the following differences:

- The Response Command is `lQ`.
- The `src_name` returned will be `NO_XPT` if that condition applies to the particular set of crosspoints being reported.

QN - Query Names

Command

`QN,parameter`

One parameter can be specified per `QN` call. The parameters available, and their meaning, are listed in Table 48.

Table 48. QN Parameters

Parameter	Meaning
S	Source
D	Destination
L	Level
V	Salvo
R	Room
T	Tie line
M	
Y	
IS	Sources with source indexes
ID	Destinations with destination indexes
XD	Destination indices
XL	Level indices
XS	Source indices

S Response

`NQ,S,nbr_sources[,src_name_entry1,...,src_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`src_name_entryn` is defined as:

`src_name,<'N'|'T'>,level_bitmap`

`<'N'|'T'>` Indicates No-TieLine or Tieline related

D Response

`NQ,D,nbr_destns[,dest_name_entry1,...,`
`dest_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`dest_name_entryn` is defined as:

```
dest_name,<'N'|'T'>,level_bitmap
```

`<'N'|'T'>` Indicates No-TieLine or Tieline related

L Response

`NQ,L,nbr_levels[,lvl_name_entry1,...,lvl_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`lvl_name_entryn` is defined as:

```
lvl_name,lvl_number,< 'R' | 'N' >
```

`lvl_number` A hex ASCII number from 00 to 1f (representing levels 00 to 31 decimal)

`'R' | 'N'` Specifies that this level is Restricted or Not with respect to assignments

V Response

`NQ,V,nbr_salvos[,salvo_name1,...,salvo_namen]`

(<seq_flag='0'> for the last sequence sent.)

R Response

```
NQ,R,roomName,<'1'|'2'|'3'>,nbrDestNames
[,destName1,...,  destNamen]
```

`<'1'|'2'|'3>` Indicates the Room Class Type

There is one message returned per room Name.

`nbrDestNames` Value is <= 8.

The information for each room Name fits within one message buffer.

(<seq_flag='0'> for the last sequence sent.)

T Response

`NQ,T,nbr_tieLines[,tieLine_entry1,...,tieLine_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`tieLine_entryn` is defined as:

```
tieLineName,<'N'|'R'>,beginDstName,
upstreamLvlName,endSrName, downstreamLvlName
```

`<'N'|'R'>` indicates Not-reserved or Reserved

M Response

`NQ,M,nbr_tieline_entries[,tieline_entry1,...,tieline_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`tieline_entry` is defined as:

```
tieline_Name,<'N'|'R'>,tlTypeName,beginDstName,
endSrcName
```

Y Response

`NQ,Y,nbr_tltype_entries[,tltype_entry1,...,tltype_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`tltype_entryn` is defined as:

```
tltype_name,lvlbitmap
```

lvlbitmap includes the EndLevels in this entry, and for each consecutive 1 in the EndLevels bitmap (least significant bit first), a `lvlbitmap` of the BeginLevels that feed this endLevel. If there are many EndLevels in the tieline type, it may take more than one `tltype_entry` to send them all.

IS Response

`NQ,S,nbr_sources[,src_name_entry1,...,src_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`src_name_entryn` is defined as:

```
src_name,src_index,<'N'|'T'>,level_bitmap
```

`<'N'|'T'>` No-tieline or Tieline Related

`src_index` Four digit ASCII hex # with leading Ø's

ID Response

`NQ,D,nbr_destns[,dest_name_entry1,...,dest_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

dest_name_entryn is defined as:

```
dest_name,dest_index,<'N'|'T'>,level_bitmap
```

<'N'|'T'>	No-tieline or Tieline Related
dest_index	Four digit ASCII hex # with leading Ø's

XD Response

```
NQ, XD, No_entries, dest_index_entry1…
dest_index_entryN
```

No_entrie	The numbers of available destinations count.
Dest_index_entry	dest_index, Tie_flag, dest_levelbitmap

XS Response

```
NQ, XS, No_entries, src_index_entry1…..,src_index_entryN
```

No_entries	The numbers of available sources count.
src_index_entry	src_index, Tie_flag, src_levelbitmap

XL Response

```
NQ, XL, No_entries, levelIndex1,…,levelIndexN
```

No_entrie	The numbers of available level.

QT - Query Date & Time

Command

```
QT
```

Response

```
ST,yyyymmddhhmmss
```

hh is 00...23

QV - Query Salvo Status

Command

`QV,salvo_name`

Timed salvos are not included in the `QV` command.

Response

`VQ,salvo_name,nbr_entries[,entry1,...,entryn]`

(<seq_flag='0'> for the last sequence sent.)

`entryn` is defined as follows:

```
dest_name,src_name,level_bitmap
```

ST - Request Set Date & Time

Command

`ST,yyyymmddhhmmss`

The parameters are in ASCII (Table 49).

Table 49. Date and Time Values

Parameter	Values
yyyy	1993...2999
mm	01...12
dd	01...31
hh	00...23
mm	00...59
ss	00...59

Response

(none)

TA - Request Take

Command

`TA,dest_name,nbr_sources,src_name_entry1,...,`
`src_name_entryn]`

(<seq_flag='0'> for the last sequence sent.)

`dest_name` Destination to be taken to

`nbr_sources` Number of following entries (must be at least one)

`src_name_entryn` is defined as:

```
src_name,level_bitmap
```

Response

(none)

TD - Request Take Destination

Command

`TD,dest_name,src_name_entry`

(<seq_flag='0'> for the last sequence sent.)

`dest_name` Destination to be taken to

`src_name_entryn` is defined as:

```
src_name[,levelbitmap]
```

With no level bitmap specified, the source will be taken to all levels of the destination.

Response

(none)

TI - Request Take Index With Level Index

Command

`TI,destIndex,srcIndex[,levelIndex]`

This command allows a Take Request to be specified using indexes vs. names. If no level Index is specified, then an all-level take occurs.

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port

numbers are identical to index numbers. There is no disconnect index number, all indexes refer to configured entities. Valid indexes and their association with specific names can be determined by using the commands: `QN, L; QN, ID; QN, IS`.

Response

(none)

TJ - Request Take Index With Level Bitmap

Command

```
TJ,dest_index,nbr_sources,src_name_entry1,...,
src_name_entryn]
```

(<seq_flag='0'> for the last sequence sent.)

`dest_index`	Destination to be taken to
`nbr_sources`	Number of following entries (must be at least one)

`src_name_entryn` is defined as:

```
src_index,level_bitmap
```

All indexes (`dstIndex`, `lvlIndex`, `srcIndex`) are zero–based hex numbers. These indexes refer to the logical index for each entity, not to the physical port number. However, the system can be configured so that port numbers are identical to index numbers. There is no disconnect index number. All indexes refer to configured entities. Valid indexes and their association with specific names can be determined by using the commands: `QN, L; QN, ID; QN, IS`.

Response

(none)

TM - Request Take Monitor Destination

Command

```
TM,dest_name
```

Response

(none)

TS - Request Take Salvo

Command

`TS,salvo_name`

`salvo_name` An untimed salvo

Response

(none)

UI - Unprotect by Index

Unprotect command allows the protect on the specified destination to be removed on the specified level. The levelbitmap is an optional parameter if not provided it unprotect on all levels.

Command

UI, dest_index[,level_bitmap]

Response

This will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

UP - Request Unprotect

Command

`UP,dest_name,level_bitmap`

Response

No direct response. However, a successful `UP` command will result in the return of a `Directed Response Message = prot_status` from the MCPU, which in turn results in a message to the external device `ER`, error_code = 01, echoed command = `MC`.

Client Subscription Message Descriptions

SB - Subscribe

Subscribe request for status change information. The specific information for which the client subscribes is decided based on the subscription type and parameters sent as part of SB command.

Command

```
SB, Subscription_type [, parameters]
```

Refer the Table 50 on page 158 for the list of available subscription type acronyms.

Response

Subscription request will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

UB – Unsubscribe Request

Unsubscribe request for already subscribed status change information.

The specific information for which the client un-subscribe is decided on the subscription

Type and parameters sent as part of the UB command.

Command

```
UB,subscription_type[,parameters]
```

Refer to Table 50 on page 158 for the list of available subscription type acronyms.

Response

Unsubscription request will get an ER,00 response on success and an ER,nn (nn>0) on failure indicating the reason of failure.

Server Originated Message Descriptions

NY – Notification

An asynchronous notification is sent to the client by the server whenever the subscribed status information changes.

Notification Format:

```
NY, subscription_type[,parameters]
```

Refer to Table 50 for the list of available subscription type acronyms.

Table 50. Subscription Type Descriptionss

Subscription Type	Meaning
AL	Subscription for alarm status change
DJ	Subscription for destination status change by index
DS	Subscription for destination status change by name
EV	Subscription for events (Take, Salvo, Protect, Unprotect)

Subscription/Unsubscription Commands Usage

Alarm Status Change

A NP client can subscribe for alarm status changes of one or group of alarms. Whenever the alarm status changes in the system all the subscribed clients receive notification about the alarm status change.

Subscribe for Alarm Status Change

Subscribe for alarm status change can be used in the following fomats.

Command

```
SB, AL
```

The client receives notification, whenever the alarm status of any alarm changes.

Command

```
SB, AL, AlarmID
```

The client receives notification only when the status of the specified alarm changes.

Command

```
SB, AL, AlarmIDX, AlarmIDY
```

The client receives notification, when the status of the specified alarm changes between `AlarmIDX` to `AlarmIDY` status.

Here the range should be specified in ascending order of indices only.

Notification for Alarm Status Change

Whenever the status changes for an alarm, all NP clients that have subscribed for the same shall receive notifications in the following format.

```
NY, AL, Nbr_entries, alarm_entry1,….,alarm_entryN.
```

`Nbr_entries`	number of alarms
`Alarm_entry`	alarmID, alarmStateID, alarm Parameter

Unsubscribe for Alarm Status Change

Unsubscribe for alarm status change can be used in the following formats.

Command

```
UB, AL
```

Unsubscribe for alarm status change notification for all alarms.

Command

```
UB, AL, AlarmID
```

Unsubscribe for specified alarms status change notification.

Command

```
UB, AL, AlarmID1, AlarmIDN
```

Unsubscribe for range of alarms status change notification.

Here the range should be specified in ascending order of indices only

Destination Status Change By Index

A NP client can subscribe for destination status change of one or a group of destinations. Whenever the status of a destination changes, all the clients that have subscribed for that Destination status receives a notification.

Subscribe for Status Change

Subscribe command for destination status change can be used in the following formats.

Command

```
SB, DJ
```

The client receives notifications, whenever the status of any destination changes.

Command

```
SB, DJ, dest_Index
```

The client receives notification, whenever the destination status is changed for specified destination.

Command

```
SB, DJ, dest_index1, dest_indexN
```

The client receives notification, whenever the destination status is changed for the destinations between the dest_index1 and dest_indexN.

Example

To subscribe for destination status change for destinations “0000” to “0008”, the client should issue the following command

```
SB, DJ, 0000, 0008
```

The client receives notification, whenever the destination status is changed for the destination indices 0000,0001,0002,0003,0004,0005,0006,0007,0008

Notification for Destination Status Change

Whenever the destination status is changed all NP clients that have subscribed for the same shall receive notifications in the following format.

```
NY, DJ, dest_index,nbr_sources,
src_name_entry1,…,src_name_entryN.
```

`Nbr_sources` Number of sources on that destination which are being reported in this message sequence.

Src_name_entry is defined as:

```
<'N'/'P'>,<'N'/'C'>,src_index,level_bitmap,
[device_name],[chop_src_index]
```

The chop source index will be returned as "0xFFFA".

Note This notification is similar to QJ response.

Unsubscribe for Status Change

Unsubscribe command for destination status change can be used in the following formats.

Command

```
UB, DJ
```

Unsubscribe for destination status change notification of any destination status change.

Command

```
UB, DJ, dest_index
```

Unsubscribe for destination status change notification for specified destination.

Command

```
UB, DJ, dest_index1,dest_indexN
```

Unsubscribe for destination status change notification for specified destination range.

Example

To unsubscribe for destination status change notification for a destination range “0000” to “0008” the client should issue the following command

```
UB, DJ, 0000, 0008
```

Destination Status Change By Name

A NP client can subscribe for destination status change of one or a group of destinations. Whenever the status of a destination changes, all the clients that have subscribed for that Destination status receives a notification.

Subscribe for Status Change

Subscribe command for destination status change can be used in the following formats.

Command

```
SB, DS
```

The client receives notifications, whenever the status of any destination changes.

Command

```
SB, DS, dest_name
```

The client receives notification, whenever the destination status is changed for specified destination.

Example

To subscribe for destination status change for a destination “Dest1” the client should issue the following command

```
SB, DS, Dest1
```

Notification for Destination Status Change

Whenever the destination status is changed all NP clients that have subscribed for the same shall receive notifications in the following format.

```
NY,DS,dest_name, nbr_sources,
src_name_entry1,…,src_name_entryN
```

`Nbr_sources` Number of sources on that destination which are being reported in this Message sequence.

Src_name_entry is defined as:

```
<’N’/’P’>,<’N’/’C’>,src_name, level_bitmap,
[device_name],[chop_src_name]
```

The chop source name will be returned as "Chopping".

Note This notification is similar to QD response

Unsubscribe for Status Change

Unsubscribe command for destination status change can be used in the following formats.

Command

```
UB, DS
```

Unsubscribe for destination status change notification of any destination status change.

Command

```
UB, DS, dest_name
```

Unsubscribe for destination status change notification for specified destination.

Example

To unsubscribe for destination status change notification for a destination “Dest1” the client should issue the following command

```
UB, DS, Dest1
```

Subscription for Events

A NP client can subscribe for the take,Salvo,Protect and Unprotect operations. Whenever the take/Salvo/Protect/Unprotect operation is performed all NP clients that have subscribed for the same shall receive notification.

Command

```
SB,EV
```

The client receives notifications, whenever the take/Salvo/Protect/Unprotect happens.

Notification for Events

Whenever the take/Salvo/Protect operation is performed all RCL/NP clients that have subscribed for the same shall receive notifications in the following format:

```
NY,EV,timestamp, name of the initiating control device,
operation_type, operation_parameters
```

`Timestamp`	Operation requested time. The time format is: DDMONYYYY HH:MM: SS.FF For example: 16Jan2005 21:21:18.02. If the client connected to WIN32 CPS system the "FF" field shows as "00" always.
`Name of the initiating control device`	The name of the device initiating the operation. In case, the device does not have name the IP address of the device shall be used. The IP address be sent as a string in dot notation.
`Operation_type`	The operation types can be “Take” or ”Salvo” or ”Protect” or “Unprotect”
`Operation_parameters`	Differ for each operation type.

The Take operation parameters are destination index ,source index and level bitmap. (The level bitmap shall be shown as 0xFFFFFFFF if the take happened on all the configured levels of the destination.)

The salvo operation parameter is name of the salvo.

The protect/unprotect operation parameter are destination index and level bitmap.

Unsubscribe for Events

Command

`UB,EV`

Unsubscribe for events notifications.

Section 4

Serial Node Controller Protocol

Introduction

This section describes the format of the Series 7000 Serial Node Controller (SNC) RS-485 Pro-Bel SW-P-02x (extended) protocol. Some additional information about the Pro-Bel SW-P-02 standard protocol is also included.

This protocol is designed to allow an Omnibus system to control a Series 7000 Node Controller directly, using the established Pro-Bel protocol and this extension to that protocol. The extension allows larger Series 7000 messages (in SSML protocol format) to be transferred to and from the Series 7000 Node Controller. Basic matrix control can be accomplished using the standard Pro-Bel 02 protocol, and so use of the Pro-Bel 02x protocol is not required but can add functionality.

SSML is a Grass Valley proprietary protocol used to communicate within the Series 7000 system via the Node Control Bus. Formatting and use of Series 7000 SSML messages communicated via Pro-Bel 02x are not discussed in this document. Contact Grass Valley Customer Service if you require this information.

Physical Layer

RS-485

The Serial Node Controller physical interface is RS-485. A serial cable is required to connect the Series 7000 Node Controller to the controlling device. Maximum cable length is determined by customer needs, limited only by the RS-485 standard and the customer site environmental noise.

Link layer

Format Types

Two link layer protocols are defined:

- Pro-Bel SW-P-02 as defined in Pro-Bel's *General Switcher Communications Protocol*, Issue 7 of May 5, 1992. This protocol type is referred to as Type 02, and
- A Pro-Bel SW-P-02x, an extension for communicating Series 7000 Node Controller message types requiring 8 bits. This protocol is referred to as Type 02x.

Link Characteristics

Communication is via a full-duplex RS-485 asynchronous link at:

- 8 data bits,
- 1 stop bit,
- No parity, and
- 38400 baud.

Protocol message types are sent and received in any order as needed. The two protocols are mixed on the link. It is up to the sender to choose the correct protocol type for a particular message, and up to the receiver to be able to correctly parse either message type.

Some messages transmitted to the Series 7000 Node Controller by the controlling device require responses. It is not necessary for the controlling device to wait for a response before transmitting further messages.

Packet Pacing

Pacing is required by the controlling device between packets transmitted to the Series 7000 Node Controller. The method of pacing is to be a delay between the last character of one packet and the first character of the succeeding packet. This value is to be selected at test, but the current best estimate is two character times (at 38400 baud = 500 µs).

Handshaking

There is no link layer handshaking. No acknowledgment or error response is generated by the receiver upon reception of an 02 or 02x packet at the link layer (e.g., ACK, NAK) . If the receiver detects any error (checksum, unexpected byte count, unrecognized command) then the message is ignored. If a SOM or SOMx is received in the middle of an incoming packet, all the proceeding bytes of the incoming packet are discarded and a new packet is begun.

Success or failure of packet transmission can only be accomplished at the Packet Layer, either by receiving the corresponding response for messages that have responses, or by querying the Series 7000 Node Controller for the information needed for a verification (such as a crosspoint query via an Interrogate command). Refer to each message definition to determine what responses, if any, are expected.

The 02 Protocol

02 Message Format

```
<SOM> <command> <message> <checksum>
```

<SOM>	(1 byte) Start of message = 0x0FF
<command>	(1 byte) Message type. Also defines message length.
<message>	(0-n bytes) Message body.
<checksum>	(1 byte) 7 bit, sum all message bytes, excluding SOM, Count and any Bit7ESCs. Then compliment the Sum and Increment the sum by value of 1. Apply mask 0x7F (or value with binary 01111111). The result is the message checksum.

Special 02 Protocol Characters

SOM (0x0FF)	Signals to the receiver the start of a Type 02 message. Any incoming message is completed when the number of bytes expected are received. Any message not completely received when a SOM (or SOMx) is received is simply discarded, and the new message signaled by the SOM(x) is received.

The 02x Protocol

02x Message Format:

```
<SOMx> <command> <message> <checksum>
```

<SOMx>	(1 byte) Start of message = 0x0FE
<count>	(1 byte) Message length in bytes. Only includes <message> field. Does not include <SOM>, <count>, or <checksum> fields. Also does not include any 7 bit escape (BIT7ESC == F1) bytes.
<message>	(0-120 bytes) Message body. Maximum 120 bytes. Does not include any BIT7ESC bytes.
<checksum>	(1 byte) 7 bit, sum all message bytes, excluding SOMx, Count and any Bit7ESCs. Then compliment the Sum and Increment the sum by value of 1. Apply mask 0x7F (or value with binary 01111111). The result is the message checksum.

Special 02x Characters

SOMx (0x0FE)	Signals to the receiver the start of a TYPE 02x message. Any incoming message is completed when the number of bytes expected are received. Any message not completely received when a SOMx (or SOM) is received is simply discarded, and the new message signaled by the SOM(x) is received.
BIT7ESC (0x0F1)	Signals to the receiver to set the previous byte's most significant bit. For example, a 2 is received in byte 5, then an F1 is received in byte 6. The receiver must then set the m.s.b. of byte 5, changing byte 5's value from 2 to 130. The F1 is then discarded and is not counted towards the COUNT field's message byte count. Note: Series 7000/Node Controller traffic should not require an excess of data greater than 127.

Packet Layer

Link Messages

The following two messages are required to establish communications between a controlling device and a Matrix Controller or a Node Controller. Until these messages are received, the Matrix Controller or Node Controller it will not respond to other messages from the controlling device.

MSG_SET_PRIMARY

Command

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Set the Matrix Controller or Node Controller to primary

Hexadecimal: FE 02 53 22 0B

Rate: On demand

Table 51. MSG_SET_PRIMARY Command

Length (5 Bytes)	Element	Description
BYTE	SOMx	= 0x0Fe
BYTE	ByteCount	= 0x002
BYTE	Socket	= 0x053
BYTE	msg Type	= 0x022
BYTE	Checksum	= 0x00B

Response

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Response

Hexadecimal: FE 05 2B 0E 01 00 01 45

Table 52. MSG_SET_PRIMARY Response

Length (8 Bytes)	Element	Description
BYTE	SOMx	= 0x0Fe
BYTE	ByteCount	= 0x05
BYTE	Socket	= 0x2B
BYTE	msg Type	= 0x0E
BYTE		= 0x01
BYTE		= 0x00
BYTE		= 0x01
BYTE	Checksum	= 0x45

MSG_GET_NC_HEALTH

Command

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Get the health Message from the Matrix Controller or Node Controller

Hexadecimal: FE 02 54 1A 12

Rate: On demand

Table 53. MSG_GET_NC_HEALTH Command

Length (5 Bytes)	Element	Description
BYTE	SOMx	= 0x0FE
BYTE	ByteCount	= 0x002
BYTE	Socket	= 0x054
BYTE	msg Type	= 0x01A
BYTE	Checksum	= 0x012

Response

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Response

Hexadecimal: FE 05 2B 32 00 28 02 79

Table 54. MSG_GET_NC_HEALTH Response

Length (8 Bytes)	Element	Description
BYTE	SOMx	= 0x0Fe
BYTE	ByteCount	= 0x05
BYTE	Socket	= 0x2B
BYTE	msg Type	= 0x32
BYTE		= 0x00
BYTE		= 0x28
BYTE		= 0x02
BYTE	Checksum	= 0x79

The Type 02 Command Set

For reference, the following commands used by the standard Pro-Bel 02 protocol are included in this document. For greater detail, see the Pro-Bel

General Switcher Communication Protocol, Issue 7 of May 5 1992 (Appendix 1). All values in the Type 02 commands, excepting the SOM Byte 0x0FF, are specified as decimal values.

Interrogate (1)

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Request for Destination Status

Rate: On demand

Table 55. Interrogate Command

Length (5 bytes)	Element	Description
Byte	SOM	= 0x0FF
Byte	Command	= 1
Byte	Multiplier: Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 All main router destinations. = 0 = 0
Byte	Destination	Destination number MOD 128
Byte	Checksum	

Connect (2)

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Request a crosspoint connect

Rate: On demand

Table 56. Connect Command

Length (6 bytes)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 2
BYTE	Multiplier Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 = 0 = Source number DIV 128
BYTE	Destination	Destination number MOD 128
BYTE	Source	Source number MOD 128
BYTE	Checksum	Calculated

Tally (3)

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Returns Destination Status in response to an `Interrogate (1)` command

Rate: On demand

Table 57. Tally Command

Length (6 bytes)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 3
BYTE	Multiplier Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 = 0 = Source number DIV 128
BYTE	Destination	Destination number MOD 128
BYTE	Source	Source number MOD 128
BYTE	Checksum	Calculated

Connected (4)

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Returns Destination Status after a new source has been connected, usually in response to a `Connect (2)` command

Rate: On demand

Table 58. Connected Command

Length (6)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 4
BYTE	Multiplier Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 = 0 = Source number DIV 128
BYTE	Destination	Destination number MOD 128
BYTE	Source	Source number MOD 128
BYTE	Checksum	Calculated

Connect_On_Go (5)

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Preload Salvo crosspoint

Rate: On demand

Table 59. Connect_On_Go Command

Length (6)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 5
BYTE	Multiplier Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 = 0 = Source number DIV 128
BYTE	Destination	Destination number MOD 128
BYTE	Source	Source number MOD 128
BYTE	Checksum	Calculated

Go (6)

Direction: Controlling Device -> Series 7000 Node Controller

Purpose: Take preloaded Salvo

Rate: On demand

Table 60. Go Command

Length (4)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 6
BYTE	Action	= 0 then Set previously received crosspoints = 1 then Clear previously received crosspoints
BYTE	Checksum	Calculated

Connect_On_Go_Acknowledge (12)

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Response to a `Connect_On_Go (5) command`

Rate: On demand

Table 61. Connect_On_Go_Acknowledge Command

Length (6)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 12
BYTE	Multiplier Bit 7 Bit 4-6 Bit 3 BIT 0-2	 = 0 Destination number DIV 128 = 0 = Source number DIV 128
BYTE	Destination	Destination number MOD 128
BYTE	Source	Source number MOD 128
BYTE	Checksum	Calculated

Go_Done (13)

Direction: Series 7000 Node Controller -> Controlling Device

Purpose: Response to a `Go (6) command`

Rate: On demand

Table 62. Go_Done Command

Length (4)	Element	Description
BYTE	SOM	= 0x0FF
BYTE	Command	= 13
BYTE	Action	= 0 then Set previously received crosspoints = 1 then Clear previously received crosspoints
BYTE	Checksum	Calculated

Section 5

Terminal/Computer Interface Protocol

Introduction

The Terminal/Computer Interface (T/CI) is an asynchronous serial ASCII command protocol that is used for control of the Acappella router using the RS-422 9 pin D connector on the rear of the router.

Commands may be issued to control the router by either an operator entering commands manually (using a terminal interface like hyperterminal), or by an automation system. This connection is point-to-point; a cable from the serial connector on the Acappella router to the command Input device.

An Acappella router can physically be either a single frame, or a combination of frames. The virtual maximum size of the router and the number of Levels are 16x16x4 (Inputs x Outputs x Levels). Therefore, an Acappella router can be controlled by a single serial connection, irregardless of its physical configuration.

T/CI Protocol commands allow control of the router signal paths and allow control of the all Level (Destination) protect feature.

Table 65 lists variables used in the commands provided.

Table 63. Variables

Variable	Represents	Description
on	Output Number	Used to indicate a specific Output.
in	Input Number	Used to indicate a specific Input.
ln	Level Number	Used to indicate a specific Level.
[]	Optional Parameter	Indicates parameters that may be added to a command string but are not required.
<nl>	New Line	Indicates where new lines will appear in the reply to a command.
!Enn	Terse Error Message	Indicates an Error message with number and short description.
<cr>	Carriage Return	Indicates the ASCII carriage return, which terminates the command entry string.

The names of the commands are chosen to be easily remembered, see Table 64.

Table 64. Command Characters

First Character	Represents
C	Clear
D	Display
S	Set
T	Take

Second and Third Characters	Represents
IN	Inputs in use
PO	Protected Output

The first character of a command indicates the type of action taken. The second and third characters indicate on what the action is taken.

The ASCII upper case or lower case alpha characters may be used for the commands.

Acappella uses only numeric Input names and terse replies.

Table 65. T/CI Protocol Commands

Command Name	Parameters	ACTION
CPO	on	Clear Protected Outputs
DIN	[on1][,on2][,In]	Display Inputs in use
DPO	[on]	Display Protected Outputs
SPO	on	Set Protected Outputs
TIN	on,in[,In]	Take Input to in use

Description

Commands and responses exchanged by the Acappella router and its user consist of blocks of asynchronous serial ASCII characters.

Each character consists of a start bit, either seven or eight data bits, and even parity bit, an odd parity bit, or no parity bit followed by either one, one and one half, or two stop bits. The number of data bits and stop bits and the type of parity and baud rate used is selectable during web page based configuration.

Commands are sent to the router only after the prompt is issued. This prompt is three-ASCII-character sequence as follows

- ASCII carriage return (code 0x0D)
- ASCII line feed (code 0x0A)
- ASCII greater than > (code 0x3E)

Incoming command strings are terminated using carriage return. As the router receives each character of the command string, it echoes it as an indication that it was received. This echo is the feedback that will be a flag that communication is without error. Parity, baud rate, and data bit errors will affect this echo. After the command reply is completed the new line <nl> sequence will be issued to indicate the next command is ready to be processed. It is not mandatory that echo be received before the next command character is sent. However, arriving characters are only saved and processed between the time the router issued the <nl> and the time the router receives the carriage return that terminates the command. The Acappella router will process a stream of commands without the sending computer waiting for the new line prompt after a reply.

An ASCII backspace (code 0x08) is allowed if any characters have already received. The most recently received character is removed.

An ASCII NAK (code 0x15) causes any partially received command to be discarded and the two-character sequence ^U (code 0x5E and 0x55) echoed before the issue of the <nl> prompt.

XON/XOFF flow control is implemented on both receive and transmit.

Parameter Type Description

Most T/CI commands will accept parameters to control their operation.

Parameters are a sequence of ASCII characters which are delimited by a space or a comma. These parameters convert into a decimal router Output, Input, or Level numbers. In the Acappella router the numbers always start with zero (0 based), not one, as the first Output, Input or Level.

A command string allows a space between the three alpha triplet and the first parameter. This space is removed for processing, so the presence of this space is ignored. However, using a comma between the three alpha triplet and the first parameter is significant in the DIN command and the use of comma delimiter is important to flag skip of a parameter.

(DIN 3<cr> is same as DIN3<cr> is same as din3<cr>)

(DIN 3<cr> is not the same as DIN,3<cr>)

(DOP 3<cr> is same as DOP3<cr> is same as dop3<cr>)

(DOP 3<cr> is the same as DOP,3<cr>)

Table 66. Parameters

Parameter Object	Parameter Range[a]	Example
Output number	0 to 15	0, 001, 10, 015 (1 to 3 digit)
Input number	0 to 15	0, 1, 013, 015 (1 to 3 digit)
Level number	0 to 3	0, 1,2, 3 (1 digit only)

[a] The range may be restricted by the actual hardware configuration.

Limitations

- A client can send a maximum of 32 bytes per second under normal load conditions. Clients need to be programmed to ensure that any combination of commands sent does not exceed this maximum. For example, a TIN (Take) command (without level bitmap) requires 8 bytes. A DIN command requires 4 bytes. In this example two TIN commands and four DIN commands can be sent every second.

T/CI Command Descriptions

TIN

COMMAND

```
TIN on,in[,ln]<cr>
```

Description Take Input.

This command modifies a signal path in the router matrix.

Both a router Output number and a router Input number are required parameters. Optionally, a control Level number may be included. If the Level is omitted, the command will affect all control Levels present in the router.

This command response has two formats

- An All Level Take of Input numbers on an Output, or
- A single Level Take of an Input number on an Output.

If the optional Level parameter is omitted, the response is

```
<nl>nnn in0 in1 in2 in3
```

Where `nnn` is replaced by the Output number, and `in0 in1 in2 in3` is replaced by the 3 digit Input number in use on each control Level for this Output. Three spaces follow each Input number.

If the Level number is included in the command, the response is

```
<nl>nnn in
```

Where again `nnn` is replaced by the Output number, and `in` is replaced by only the 3 digit Input number in use on the specified Level of this Output.

Examples

Table 67. TIN Command Examples

`TIN4 2 1<cr>`	Command line
`<nl>004 002`	Response shows only Level 1 of Output 4 is taken to Input 2
`<nl>>`	Greater than > is prompt character

`tin 13 4<cr>`	Command line
`<nl>013 004 004 004 ---`[a]	Response shows Levels 0, 1, and 2, of Output 13 is taken to Input 4, Level 3 has no crosspoints
`<nl>>`	Greater than > is prompt character

[a] If the indicated Output and Level have no crosspoint, the Input number is replaced by --- (3dashes).

Errors

Errors that can be returned using the TIN command are in Table 68.

Table 68. Error Codes for TIN Command

Error Code	Explanation
!E02	!E02 - Output Number too big or Invalid Format (page 188)
!E04	!E04 - Level Number too big or Invalid Format (page 189)
!E07	!E07 - Input Number too big or Invalid Format (page 189)
!E12	!E12 - Output Number Required (page 189)
!E13	!E13 - Input Number Required (page 189)
!E75	!E75 - Output Protected from Change to a Different Input (page 189)

After issuance of any of the above error messages, the command terminates.

DIN

COMMAND

`DIN [on1][,on2][,ln]`

Description Display Inputs in use.

The response to this command is the router matrix current status.

This response is in one of two forms

- An All Level status of Input numbers on an Output, or
- A single Level status of Input numbers on an Output.

Omitted (`on1`) will default to Output = 0.

Omitted (on2) will default to Output = maximum.

Omitting the Level (ln) parameter creates an All Level status.

With no Level parameter, the response will start with the selected Output in router (on1), with multiple Inputs (in0-3) indexed in the line behind the colon. The first Input number is always level0, next is level1, level2, level3.

```
<nl>nnn in0 in1 in2 in3
<nl>nnn in0 in1 in2 in3
….
<nl>nnn in0 in1 in2 in3
```

Where nnn is replaced by the Output number, and in0 in1 in2 in3 is replaced by the 3 digit Input number in use on each control Level for this Output. Three spaces follow each Input number.

The selection of which and how many Output number lines replied are set by the choice of on1 and on2 to create the range of desired Outputs. If on1=1 and on2=3 Output lines start with 1 and end at 3. If on1 is skipped (din ,3) using a comma, the Output lines start with 0 and end at on2=3. If on1, on2, ln are missing the default is multiple lines of all Outputs and all 4 Levels per line.

If the Level number (ln) is included in the command, the response is

```
<nl>nn in
```

Where nnn is replaced by the specified Output number, and in is replaced by the 3 digit Input number in use on control Level (ln) for this specified Output.

Examples

Table 69. DIN Command Examples

din<cr>	Command line omits on1,on2, and ln parameters
<nl>000 012 012 012 012	Output 0 has Input 12 on all Levels 1,2,3,4
<nl>001 014 008 008 008	Output 1 has Input 14 on Level 0, but Input 8 on Levels 1,2,3
….	Lines 002 to 014 are omitted for this example of 16 Output router
<nl>015 001 002 003 004	
<nl>>	Greater than > is prompt character

DIN 3<cr>	Command line has on1, but omits on2 and ln parameters
<nl>003 010 010 010 010	
<nl>>	

DIN 3,4<cr>	Command line has on1 and on2, but omits ln parameter
<nl>003 010 010 010 010	Output 3 is starting Output and finish at Output 4
<nl>004 011 012 013 014	
<nl>>	

DIN,1<cr>	Command line has skipped on1, has on2, and omits ln parameter
<nl>000 000 000 000 000	Output 0 is starting Output and finish at Output 1
<nl>001 001 002 003 004	
<nl>>	

DIN,,2<cr>	Command line skips on1,on2, but has ln parameter
<nl>000 013	Output 0 has Input 13 on Level 2
<nl>001 014	Output 1 has Input 14 on Level 2
….….	Lines 002 to 014 are omitted for this example of 16 Output router
<nl>015 001	Output 15 has Input 1 on Level 2
<nl>>	

DIN 5,,1<cr>	Command line skips on2, but has on1 and ln parameter
<nl>005 015	Output 5 has Input 15 on Level 1
<nl>>	

DIN, 1,3<cr>	Command line has skipped on1, has on2, and ln parameter
<nl>000 012	Output 0 has Input 12 on Level 3
<nl>001 008	Output 1 has Input 8 on Level 3
<nl>	

DIN 1,2,3<cr>	Command line has on1, has on2, and ln parameter
<nl>001 008	Output 1 has Input 8 on Level 3
<nl>002 002	Output 2 has Input 2 on Level 3
<nl>	

Errors

If the indicated Output and Level have no crosspoint, the Input number is replaced by --- (3dashes).

Errors that can be returned using the TIN command are in Table 70.

Table 70. Error Codes for DIN Command

Error Code	Explanation
!E02	!E02 - Output Number too big or Invalid Format (page 188)
!E04	!E04 - Level Number too big or Invalid Format (page 189)

After issuance of any of the above error messages, the command terminates.

DPO

COMMAND

```
DPO [on]
```

Description Display Protected Outputs

The response to this command is the protect status of the router Output.

This response is in one of two forms

- If the optional Output number parameter is omitted, the response will be multiple lines, one for each Output in router, with bit per Level status in the line behind the colon.

Note This router will only protect All Levels as a monolith. Individual Levels cannot be separately protected if other Levels of this same Output are not.

Thus, `abcd` is always 0000 (not protected), or 1111 (protected) in the response.

```
<nl>nnn abcd
<nl>nnn abcd
….
<nl>nnn abcd
```

Where `nnn` is replaced by the Output number, and `abcd` is replaced by the protect status on each control Level for this Output.

- If the Output number is included in the command, the response is a single line

  ```
  <nl>nnn abcd
  ```

Where `nnn` is replaced by the specified Output number, and `abcd` is replaced by the protect status on each control Level for this specified Output.

The first protect status bit number is always level0, next is level1, level2, level3.

`a` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 0.

`b` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 1.

`c` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 2.

`d` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 3.

Examples

Table 71. DPO Command Examples

DPO<cr>	Command line
<nl>001 0000	Shows this Output is not protected on all Levels
<nl>002 1111	Shows this Output is protected on all Levels
<nl>003 0000	
<nl>004 0000	
<nl>>	Greater than > is prompt character

dpo 3<cr>	Command line
<nl>003 0000	Shows this Output is not protected on all Levels
<nl>>	

dpo2<cr>	Command line
<nl>002 1111	Shows this Output is protected on all Levels
<nl>>	

Errors

Errors that can be returned using the DPO command are in Table 72.

Table 72. Error Code for DPO Command

Error Code	Explanation
!E02	!E02 - Output Number too big or Invalid Format (page 188)

After issuance of any of the above error messages, the command terminates.

SPO

Command

```
SPO on
```

Description Set Protected Outputs

This command protects the state of a router Output by preventing the change of current Input.

A router Output number must be specified. All control Levels present before the specified Output are protected.

This command response produces a single line indicating Levels of the specified Output are protected after the execution of the command.

Note This router will only protect All Levels as a monolith. Individual Levels cannot be separately protected if other Levels of this same Output are not.

Thus, `abcd` is always 0000 (not protected), or 1111 (protected) in the response.

```
<nl>nnn abcd
```

Where `nnn` is replaced by the specified Output number, and `abcd` is replaced by the protect status on each control Level for this specified Output.

`a` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 0.

`b` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 1.

`c` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 2.

`d` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 3.

Examples

Table 73. SPO Command Examples

SPO2<cr>	Command line
<nl>002 1111	Response shows this Output number 2 is protected on all Levels
<nl>>	

Errors

Errors that can be returned using the SPO command are in Table 74.

Table 74. Error Code for SPO Command

Error Code	Explanation
!E02	!E02 - Output Number too big or Invalid Format (page 188)

CPO

Command

```
CPO on
```

Description Clear Protected Outputs

This command removes protect from a router Output, thus allowing the change of current Input.

A router Output number must be specified. All control Levels present for the specified Output are unprotected.

This command response produces a single line indicating Levels of the specified Output that are unprotected, or possibly still protected via some possible override, after the execution of the command.

Thus, `abcd` is always 0000 (not protected), or 1111 (protected) in the response.

```
<nl>nnn abcd
```

Where `nnn` is replaced by the specified Output number, and `abcd` is replaced by the protect status on each control Level for this specified Output.

The first protect status bit number is always level1, next is level2, level3, level4.

`a` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 0.

`b` is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 1.

c is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 2.

d is replaced by ASCII 0 or 1 (0=not protected, 1=protected) for Level 3.

Examples

Table 75. CPO Command Examples

CPO2<cr>	Command line
<nl>002 0000	Response shows this Output number 2 is unprotected on all Levels
<nl>>	

Errors

Errors that can be returned using the SPO command are in Table 76.

Table 76. Error Code for CPO Command

Error Code	Explanation
!E02	!E02 - Output Number too big or Invalid Format (page 188)

T/CI Error Messages

These are the error messages that can be issued by the T/CI. In this T/CI version only the !Enn code is returned as an error response. Each error code is described with its meaning and possible corrective action.

!E01 - Unrecognized Command

This code is issued if the first three characters of a command are not recognized as a valid T/CI triplet. This could be the result of a communications error on the serial link. Another possible cause is the incompatibility between the software versions of T/CI used in this Acappella router and the T/CI version used for the GPI in Horizon systems. Many Horizon router features like Salvos, Exclusions, and Time are not implemented in Acappella.

!E02 - Output Number too big or Invalid Format

May be issued by TIN, DIN DPO, SPO, CPO command response. Indicates this Output number specified in the command was not recognized as a valid router Output number. Output numbers must be 1 or 2 decimal digits. T/CI is 0 based format, thus Output number zero is valid. Acappella hardware has 1 based labels on Outputs and Inputs. Note maximum valid

T/CI Output number for a 16 Output system is 15. To change Output 1 on Acappella, use T/CI Output number 0.

!E04 - Level Number too big or Invalid Format

May be issued by TIN command response. Indicates this Level number specified in the command was not recognized as a valid router Level number. Level numbers must be 1 decimal digit, i.e. 0,1,2,3. T/CI is 0based format, thus Level number zero is valid.

!E07 - Input Number too big or Invalid Format

May be issued by TIN command response. Indicates this Input number specified in the command was not recognized as a valid router Input number. Input numbers must be 1 or 2 decimal digits. T/CI is 0based format, thus Input number zero is valid. Acappella hardware has 1based labels on Outputs and Inputs. Note maximum valid T/CI Input number for a 16 Input system is 15. To change Input 1 on Acappella, use T/CI Input number 0.

!E12 - Output Number Required

May be issued by TIN, SPO, or CPO commands. Indicates that the Output number parameter required for this command was not found.

!E13 - Input Number Required

May be issued by TIN command. Indicates that the Input number parameter required for this command was not found.

!E75 - Output Protected from Change to a Different Input

May be issued by TIN command. Indicates that the Output is protected. This is a simple Output protection that will not allow any change of Input until the protection is removed. There is nothing special about who did the protection. If the Output is protected, even the panel that caused the protect must remove the protection before any change can be made.

Appendix A

Reference Materials

CheckSum Calculation Code Snippet

This code snippet is provided as one of the ways to calculate the Checksum.

```
/*****************************************************************************

Function    :    checksumCalc

Description :    checksumCalc calculates the checksum for the message in the buffer pucMsgBuf

Arguments   :    pucMsgBuf – Buffer with the message whose checksum needs to be calculated

                 IMsgLen – Number of characters in the buffer pucMsgBuf

                 pucChkSum – Pointer to an unsigned char in which the calculated checksum will be filled in

Return type:     void

*****************************************************************************/

void checksumCalc(unsigned char *pucMsgBuf, int iMsgLen, unsigned char *pucChkSum)

{

    unsigned char pucTmpChar;

    pucTmpChar = 0;

    *pucChkSum = 0;

    while(iMsgLen --)

    {

        pucTmpChar += * pucMsgBuf;
```

```
            pucMsgBuf++;
        }
        pucTmpChar = pucTmpChar % 256;
        * pucChkSum = - pucTmpChar;
        printf("Check sum is %1X\n",* pucChkSum);
}
```

ASCII Characters

Table 77. ASCII Character Table

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	NUL	32	20		64	40	@	96	60	`
1	1	SOH	33	21	!	65	41	A	97	61	a
2	2	STX	34	22	“	66	42	B	98	62	b
3	3	ETX	35	23	#	67	43	C	99	63	c
4	4	EOT	36	24	$	68	44	D	100	64	d
5	5	ENQ	37	25	%	69	45	E	101	65	e
6	6	ACK	38	26	&	70	46	F	102	66	f
7	7	BEL	39	27	'	71	47	G	103	67	g
8	8	BS	40	28	(	72	48	H	104	68	h
9	9	TAB	41	29	)	73	49	I	105	69	i
10	A	LF	42	2A	*	74	4A	J	106	6A	j
11	B	VT	43	2B	+	75	4B	K	107	6B	k
12	C	FF	44	2C	,	76	4C	L	108	6C	l
13	D	CR	45	2D	-	77	4D	M	109	6D	m
14	E	SO	46	2E	.	78	4E	N	110	6E	n
15	F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	DC1	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

Appendix B

Level 4 Error Codes

Router Control Language Error Codes

Router Control Language level 4 error codes are listed in Table 78. The Description column is the text returned by the RCL Server when queried by the RCL Client. The Condition column is what caused the error.

Table 78. Level 4 Error Codes for Router Control Language Protocol

Decimal Code	Hex Code	Description	Condition
1	1	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
2	2	Unknown error code	Error code sent by QE, error_code is not known.
3	3	Internal system error	Catastrophic system error
4	4	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
5	5	Command not implemented	The Command sent by the client is not implemented.
6	6	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
7	7	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
8	8	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
66	42	Unknown destination name	Destination name specified in operation not known in the router.
67	43	Unknown source name	Source name specified in operation not known in the router.
68	44	Unknown salvo name	Salvo name specified in operation not known in the router.
69	45	Unknown level bitmap	Level specified in operation (using level bit map) is bad.
70	46	Invalid control level	Level specified in operation is not among the set of controllable levels configured for the device
71	47	No permission. Configured as a query only device	Device has been configured as query only device.
72	48	No permission. Chop not allowed	Chop lock has been configured for the device. Hence cannot perform chop using the specific device.
73	49	No permission. Salvo not allowed	Salvo lock has been configured for the device. Hence cannot perform salvo using the specific device.
74	4A	No permission. Monitor control not allowed	Monitor lock has been configured for the device. Hence cannot perform monitor using the specific device.
75	4B	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
76	4C	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
77	4D	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
78	4E	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
79	4F	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.

Table 78. Level 4 Error Codes for Router Control Language Protocol - (continued)

Decimal Code	Hex Code	Description	Condition
128	80	Unknown command	Command sent is not known.
129	81	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
130	82	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
131	83	Invalid number of sources	Number of sources specified in TA and TJ not known
132	84	Invalid error code	Error code sent as part of QE is bad.
133	85	Incomplete command packet	EOT is not present in the packet.
134	86	Separator field missing	HT is not present in the packet.
135	87	Invalid protect flag	Not used.
136	88	Invalid destination name	Destination name specified in operation is bad.
137	89	Invalid source name	Source name specified in operation is bad.
138	8A	Too many sources specified in Take command	Too many sources specified in Take command
139	8B	Invalid parameter	Parameter sent for BK command is bad
140	8C	Invalid flags	Mask sent for BK, f command is bad
141	8D	Invalid client identifier	Invalid client identifier
142	8E	Checksum error	Check sum sent in the packet is bad
143	8F	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
144	90	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
145	91	Invalid destination index	Destination Index specified in operation is bad.
146	92	Unknown destination index	Destination name specified in operation is not known in the operation
147	93	Invalid source index	Source Index specified in operation is bad.
148	94	Unknown source index	Source name specified in operation is not known in the operation
149	95	Invalid level Index	Level Index specified in operation is bad.
150	96	Invalid control level Index	Level specified in operation is not among the set of controllable levels configured for the device
151	97	Destination is not present in the level	Destination is not present in the level specified in operation
152	98	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
153	99	Error code not used in RCL.	Error code not used in RCL. Maintained for NP compatibility.
154	9A	Unknown destination status	Destination specified in the operation does not have any status
155	9B	Error setting time	Error trying to set time using ST
156	9C	Date format error	Date format error while trying to set time using ST
157	9D	Time format error	Time format error while trying to set time using ST
158	9E	Invalid salvo name	Salvo name specified in operation is bad.
159	9F	Router not available	Router not available in the specified area.
160	A0	No router present	No router present in the network to perform operations on.
161	A1	Invalid area index	Area index specified as part of the operation is invalid.
162	A2	Invalid area bitmap	Area bitmap specified as part of the operation is invalid.
163	A3	Invalid area name	Area name specified as part of the operation is invalid.
164	A4	No level present in destination	The destination specified is not present in any level.
165	A5	No level present in source	The source specified is not present in any level.
166	A6	Level(s) Excluded	The level(s) specified are excluded with respect to this client.
167	A7	Destination protected	The destination specified is protected and hence the operation cannot be carried on this destination.

Table 78. Level 4 Error Codes for Router Control Language Protocol - (continued)

Decimal Code	Hex Code	Description	Condition
168	A8	RCL connection not established	The requested operation cannot be carried out before establishing RCL connection.
169	A9	Time out error	Timed out error in sending the response for the requested operation.
170	AA	No cross point	The requested take cannot be performed, as there is no cross point to establish connection.
171	AB	Invalid subscription type	The subscription type specified in subscribe or unsubscribe request is invalid.
172	AC	Subscription service not initialized	The subscription service was not initialized in the system.
173	AD	Duplicate subscription	The client has already subscribed for the same event.
174	AE	Subscription Services Shutdown	The subscription Service has been shutdown due to internal errors.
175	AF	Subscription Services reset.	The RCL server has reset the subscription service. All existing subscriptions are lost and the client has to issue all subscription requests again.
176	B0	Time Stamp error.	There is an error in the time stamp provided as part of the operation request.
177	B1	No VITC	Vertical Interval Time Code is not connected to the system.
178	B2	Time out of bound	The time at which the operation has been requested is out of bounds.
179	B3	Invalid Monitor Name	Monitor name specified in operation is bad
180	B4	Invalid Room Name	Room name specified in operation is bad
181	B5	Unknown Room name	Room name specified in operation not known in router
182	B6	Invalid Tieline Name	Tie line name specified in operation is bad
183	B7	Unknown Tieline name	Tie line name specified in operation not known in router
184	B8	Invalid Alias Name	Alias name specified in operation is bad
185	B9	Unconfig Short Name	Short name for source or destination is not configured.
186	BA	Unconfig Long Name	Long name for source or destination is not configured.
187	BB	Dest Excluded	Destination name specified in operation is excluded.
188	BC	Unknown Alarm Type	Alarm index specified in operation is unknown
189	BD	Invalid Alarm Id	Alarm index specified in operation is invalid.
190	BE	Invalid Alarm Range	Alarm range specified in operation is invalid
191	BF	Invalid Dest Range	Destination range specified in operation is invalid
192	C0	Invalid Command format	Command format specified in operation is invalid.
193	C1	Salvo Excluded	Salvo name specified in operation is excluded.
194	C2	Invalid Number Of Entries	The number of entries provided in operation is invalid.
195	C3	Invalid Attribute value	Attribute value specified in operation is invalid.
196	C4	Bad Number of Entries	The number of entries provided in operation is bad.
197	C5	Not Supported	The request operation is not supported.
198	C6	SNMP Disabled	The SNMP is disabled for control system.
199	C7	Not Supported in WIN32	The request operation is not supported for WIN32.

Native Protocol Error Codes

Native Protocol level 4 error codes are listed in Table 79.

Table 79. Level 4 Error Codes for Native Protocols

Decimal Code	Hex Code	Meaning
1	1	Directed Response Error
2	2	Unknown Error Code
3	3	System Error
4	4	System Table Error
5	5	Not Implemented
6	6	Semaphore Create Error
7	7	Semaphore Give Error
8	8	Semaphore Take Error
66	42	Unknown Dest Name
67	43	Unknown Source Name
68	44	Unknown Salvo name
69	45	Bad Level Bit Map
70	46	Invalid Control Level
71	47	Panel Locked
72	48	Chop Lock
73	49	Salvo Lock
74	4A	No Monitor Control
75	4B	Send To MCPU Error
76	4C	Redirect CoProc Msgs Err
77	4D	Assignments Not Enabled
78	4E	New Net Detected, But Not Active
79	4F	Previously Detected Net Now Not Active
128	80	Unknown Command
129	81	CL-CMD Disabled
130	82	Bad CL-CMD Syntax
131	83	Bad Nbr of Sources
132	84	BadError Code
133	85	Parse EOT missing
134	86	Parse HT missing
135	87	Parse Bad Protect Flag
136	88	Parse Bad Dst Name
137	89	Parse Bad Src Name
138	8A	Too Many Sources
139	8B	Bad Parameter
140	8C	Bad Mask
141	8D	Unknown Tag For RCL
142	8E	Chksum Lvl4 Err
143	8F	Lvl4 Embedded SOH Err
144	90	Lvl4 Embedded EOT Err
145	91	Bad Dst Index
146	92	Unknown Dst Index
147	93	Bad Src Index
148	94	Unknown Src Index
149	95	Bad Level Index
150	96	Invalid Ctl Lvl Index
151	97	Level Not In Destination
152	98	Rooms Not Enabled
153	99	Room Count Is Zero
154	9A	No Dest Status Exists
155	9B	Err Trying To Set Time in MCPU
156	9C	Date format error
157	9D	Time format error
158	9E	Parse Bad Salvo Name
188	BC	Unknown Alarm Type
189	BD	Invalid Alarm Id
190	BE	Invalid Alarm Range
191	BF	Invalid Dest Range
192	C0	Invalid Command format
193	C1	Salvo Excluded
194	C2	Invalid Number Of Entries
195	C3	Invalid Attribute value
196	C4	Bad Number of Entries
197	C5	Not Supported
198	C6	SNMP Disabled
199	C7	Not Supported in WIN32

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