GSETT-3

Provisional GSE 2.1

Message Formats & Protocols

Operations Annex 3

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Chapter 1 Concept for GSE Messages

INTRODUCTION

This document proposes extensions and revisions to the GSE 2.0 formats and protocols, which were developed for the Group of Scientific Experts Third Technical Test (GSETT-3). Extensions and revisions are required to meet the expanded objectives of the monitoring system, and to address some deficiencies encountered during GSETT-3. The scope of this proposal is limited to time-series technologies. The proposed format is named GSE 2.1 to provide continuity with the earlier format, and to denote that this is a minor revision. The formats will be extended at a later date to include message formats required for exchange of radionuclide data.

Protocols provide the mechanism for data exchange and formats provide the mechanism for organizing the data exchanged so that handling of messages can be automated. Because the participants of the International Monitoring System (IMS) are globally distributed, standard protocols and formats that are accessible by the international community have been adopted to provide reliable exchange of data and information.

The GSE message formats adopted for GSETT-3 data exchange were built upon the practical experience gained in the two previous GSE Technical Tests and the experience gained within the Federation of Digital Seismograph Networks (FDSN). The GSE Technical Tests demonstrated the capability of the international community to exchange meaningful information for the mutual benefit of all participating states in a proof of concept for future treaty monitoring activities. FDSN has a wealth of experience in the exchange of seismic information which has been tapped in defining these formats.

The e-mail message structure is based on AutoDRM, an automated system that was developed to provide data, station and event information from local seismic networks in response to request messages.[1] These message formats and the request paradigm have been extended to accommodate the broader requirements of the IMS and diverse data formats (e.g., GSE, CSS and SEED).

Chapter 1 describes the GSE message concept and provides basic protocol information and message standards. Chapter 2 is devoted to AutoDRM request messages which are used to request data from a station or data centre. Data and information sent on a routine basis are requested using subscription messages which are described in Chapter 3. Data returned from request and subscription messages as well as unsolicited data are conveyed via data messages (Chapter 4). Chapter 5 describes the minimum AutoDRM configuration that is needed by a station or NDC participating in GSETT-3.

1) Kradolfer, U., *Automating the Exchange of Earthquake Information*, Eos Trans. AGU, 74, 442, 1993.

SUMMARY OF CHANGES FOR REVISION GSE 2.1

A number of changes have been made in GSE 2.1 format. These changes are summarized below, and are denoted by change bars in the left hand column.

Message Formats

- BEGIN GSE2.0 line has changed to BEGIN GSE2.1 (page 9).
- Limit of e-mail messages has increased from 100 kilobytes to 1 megabyte (page 3).
- Floating point format has a new definition (page 5).
- Network names have been added to uniquely describe stations (page 6).
- Channel names now accommodate beams, hydrophones, and infrasonic sensors (page 7).
- ISO standard country codes have been adopted (page 10).
- Implementation of continued messages has changed (page 13).
- Free format comments now begin with % in column one (page 8).
- PIDC will continue to accept requests and data in GSE2.0 format (page 3).
- The concept of data subtype has been introduced (page 28).
- The syntax of sub_format has been modified (page 28).

Dropped Environments

- LINE_LEN
- ASSOCIATE (replaced by RELATIVE_TO; page 26)

New Environments

- BEAM_LIST (page 22)
- NET_LIST (page 21)
- RELATIVE_TO (replaces ASSOCIATE; page 26)
- TIME_STAMP (page 27)

New Data Types

- BEAM (page 73)
- NETWORK (page 69)

Modified Data Types

- WAVEFORM - additional line types for information on stations, beams and associated events. Ability to specify that data are unavailable or will be delayed (page 58).
- STATION - added network and reference coordinate system (page 70).
- CHANNEL - added network and reference coordinate system (page 72).
- ARRIVAL - changed to more closely reflect different stages of processing (page 83).
- OUTAGE - added network (page 82)
- ORIGIN - composed of origin and magnitude blocks (page 89).
- EVENT - composed of origin and magnitude blocks (page 93).
- BULLETIN - long and short format, composition changed (page 94).
- STA_STATUS - added network and increased precision (page 105)
- CHAN_STATUS - added network and increased precision (page 109)
- AUTH_STATUS - added networkand increased precision (page 112)

In addition, the precision and/or the length of several fields has been modified.

The Prototype International Data Centre (PIDC) will continue to accept requests using the line BEGIN GSE2.0 for an indefinite period of time. The PIDC will also accept waveform and bulletin data in GSE2.0 format for an indefinite period of time. In the event that an AutoDRM receives a request for data in GSE 2.1 format, the response may be with data in GSE 2.0 format.

PROTOCOLS

There are two protocols designated for the exchange of a GSE Message: electronic mail (e-mail) and File Transfer Protocol (ftp), the primary one being e-mail. While all messages can be exchanged in some form by either of these protocols, each has distinct advantages and disadvantages that make their efficient use dependent on the message length and content. For example, e-mail is better suited to shorter alpha-numeric messages, while ftp is a more appropriate method for longer messages and those containing “binary” data.

MESSAGE CONVENTIONS

Message Size

There is no limit to the size of a GSE message. Its size may, however, determine which protocol is most appropriate for transmitting the message. While it is recognized that certain sites may be constrained by system limitations to sending e-mail messages smaller than 100 kilobytes, TCP/IP-based e-mail systems are generally considered to be reliable for messages up to at least 1 megabyte. The GSE 2.0 format 100 kilobytes limit on individual message size for e-mail transmission is now raised to 1 megabyte, with the current 100 kilobyte limit being retained at sites where e-mail truncation is known to be a problem.

Messages larger than 1 megabyte should be transferred via ftp or should be broken into several smaller e-mails using the new method for splitting GSE messages as described on page xx. The maximum message size for using the ftp protocol is a function of the bandwidth between the two sites and the space available in the anonymous ftp directory. Requests for extremely large amounts of data may be rejected.

GSE messages are not synonymous with computer files or e-mail messages. Several GSE messages may be included in a single e-mail message or ftp file, or a single GSE data message may span several e-mails or files.

Line Length

ASCII message lines may be up to 1024 characters long excluding the special characters Line Feed (LF) and Carriage Return (CR). An ASCII message line may be terminated by an LF or by an LF followed by a CR. The maximum line length allowed under the GSE paradigm remains unchanged at 1024 characters to allow for future developments.

The format for each of the message lines defined in this document determines the "logical" line length. A "logical" line may be broken into several "physical" lines at the request of the user, however. To break a line, a backslash ("\") is inserted at the break point and the logical line is continued on the next physical line. The backslash may occur in any character position of the line, it is counted as one of the physical lines characters, and does not hold the place of a blank or any other character. The character preceding the backslash abuts the character in character position 1 of the next logical line.

A backslash line continuation character is not required for ASCII waveform data, but the limit on physical line length <u>is</u> observed.

Free Format Lines

Message lines that are not in a fixed format (i.e., free format lines) must be left justified and case insensitive. Free format message lines must also have one or more blank spaces between fields. All of the lines in request and subscription messages are free format lines.

A free format message line consists of a keyword followed (for some) by an argument list. In describing free format message lines in this document the keyword will be followed by a descriptive list of arguments with optional arguments placed in square brackets "[]". Where the arguments may be repeated or continued, three dots "..." are put in their place. Each argument is then described. Throughout this document keywords and strings reserved for arguments will be capitalized (even though they are case insensitive in practice). An example of the format used to describe free format lines in the document is given below:

Syntax: **`KEYWORD`** `arg1 [arg2]`

`arg1`............................. Description of the first argument. In this example it is a mandatory argument.
`arg2`............................. Description of the optional second argument.

A second type of free format line is a comment line in which ASCII text is used to describe or comment. A free format comment line must begin with % in column 1. This is done to prevent the misinterpretation of keywords that may be included in the comment.

Fixed Format Lines

Fixed format lines such as those that appear in a data message may be either header or data lines. The fields in data lines consist of the following format types:

- "a" alphanumeric character strings
- "i" integers
- "f" floating point numbers
- "e" exponential numbers

Moreover, some formats allow combinations of these types; e.g., time and date formats combine "a", "f", and "i".

Character fields in data lines must be left justified, while numeric fields must be right justified.

In GSE 2.0 format, the floating point format was defined to be a fixed number of digits after the decimal point. For example, f5.2 indicated that the floating point number should have two digits after the decimal point, e.g., "15.78". In GSE 2.1 format, this strict policy has been replaced with a ¨significant figure" format. This allows the number of digits after the decimal point to “float” to accommodate anomalous data. For example, f5.2 could accommodate numbers from “.0001” to “9999.”, but the preferred representation will still be two digits after the decimal point.

This new feature should be used judiciously, i.e., only when results are otherwise truncated or inaccurate. For example, if an amplitude is 0.02, and the format specifies f9.1, the amplitude should be reported as 0.02, and not as 0.0.

Date-Time Conventions

The standard format for specifying the date and time in GSE messages is in two fields; one for the date, and one for the time with a separating blank or blanks. The date must always be present, but the time field may be dropped in which case the time is assumed to be 00:00:00.000. The date field is formatted as yyyy/mm/dd, where yyyy is the year, mm is the month number, and dd is the day of the month; e.g., 1994/02/28 is February 28, 1994. The time field format is hh:mm:ss.sss where hh is the hour, mm is the minute, and ss.sss is the second (UTC). The range of times over a day is from 00:00:00.000 to 23:59:59.999 (24:00:00.000 is not a valid time).Leading zeros in any of the number fields may be dropped in free format lines, but they must be present in fixed format lines. In addition, some of the values may be dropped from the time field of free format lines. If the seconds, or the minutes and seconds are dropped, then they are assumed to be 0 (e.g., 21:03 = 21:03:00.000 and 9 = 09:00:00.000).

Example 1.0 - 1 Acceptable date-time formats for free format lines

```
1994/01/01 13:04:12.003
1994/12/23
1995/07/14   01:05
1995/09/10 2:15:33
```

Network Naming Conventions

GSE2.1 format now supports the concept of duplicate station names and recognizes the requirement for network affiliation. This is a general requirement which applies to all points where station name is now used, except in cases of a local product, e.g., the IDC Reviewed Event Bulletin.

To achieve this, the network identifier (ID) must be added to all station identifiers. The network ID will be up to 9 characters in length, and will consist of two parts, separated by an underscore. The first part will be 3 or 4 characters in length, and can be considered the “domain” of the network. This code will either be an internationally recognized affiliation (i.e., EMSC, FDSN, IDA, IDC, IRIS, or NEIC) or a three letter ISO standard country code, as shown in Table 4. The second part of the network ID is the network code (1-4 characters) within that domain. For example, IRIS maintains a registered list of two and four letter network codes. An NDC which sends data to the IDC may use the network code NDC. For example, the 3 letter ISO code for the Czech Republic is CZE, so the default network code for the NDC of the Czech Republic is CZE_NDC.

With proper implementation and coordination, the station identifier coupled with the network ID will guarantee that each station can be identified uniquely.

Station Naming Conventions

It is strongly encouraged that station codes for GSE messages must be registered with the ISC or NEIC. All station codes must be five or fewer characters. Note that array stations will have unique station codes for each element of the array as well as a unique array code that refers to the entire array. The code referencing the array should not be the same as the station code of any of the array elements. Throughout this document station codes are capitalized.

Channel Naming Conventions

The format for channel designators follows that used by the FDSN. Three characters are used to designate a channel. The first specifies the general sampling rate and the response band of the instrument, as shown in Table 1. The second character specifies the instrument code, as shown in Table 2. The third character specifies the physical configuration of the members of a multiple axis instrument package or other parameters as specified for each instrument, as shown in Table 3.

Channel names now accommodate seismic data which have been beamed. The channel instrument code (second letter) for beams is `C`, while the channel orientation code for beams is either `C`, `I`, or `O`, for coherent beams, incoherent beams, or origins beams respectively. For example, an incoherent beam at a short period array is designated `SCI`. The azimuth and slowness values for a beam are given in the new BEA2 line in the WAVEFORM data type and in the BEAM data type.

Table 1. **Channel Band Codes**

Band Code	Band Type	Sample rate (Hz)	Corner period (seconds)
E	Extremely Short Period	≥ 80	< 10 sec
S	Short Period	≥ 10 to < 80	< 10 sec
H	High Broadband	≥ 80	≥ 10 sec
B	Broadband	≥ 10 to < 80	≥ 10 sec
M	Mid Period	> 1 to < 10	
L	Long Period	= 1	
V	Very Long Period	= 0.1	
U	Ultra Long Period	= 0.01	
R	Extremely Long Period	= 0.001	
W	Weather/Environmental		
X	Experimental		

Table 2. **Channel Instrument Codes**

Instrument Code	Description
H	High Gain Seismometer
L	Low Gain Seismometer
G	Gravimeter/Accelerometer Seismometer
M	Mass Position Seismometer
C	Beamed Trace
D	Pressure Sensor

Table 3. **Channel Orientation Codes**

Orientation Code	Description
Z, N, or E	Traditional (Vertical, North-South, East-West)
A, B, or C	Triaxial (along the edges of a cube turned up on a corner)
T or R	For Transverse and Radial rotations
1, 2, or 3	Orthogonal components but non traditional orientations
U, V, or W	Optional components
H	Hydrophone
F	Infrasonic pressure
C	Coherent beam
I	Incoherent beam
O	Origin beam

Auxiliary Naming Conventions

The auxiliary designator is used to distinguish between different instruments or data streams that have the same station and channel codes. This is a four letter designator that is used only when a conflict exists. When not needed, this field should be left blank.

Distance Units Conventions

The units of length or distance in seismology have historically spanned nanometers to degrees. Distance units used for GSE messages are nanometers for ground displacement, degrees for source-receiver distances, and kilometers for all other distance measures (including, e.g., event depth, emplacement depth, and station elevation).

GSE MESSAGE STRUCTURE

The first three lines of a GSE message are BEGIN, MSG_TYPE, and MSG_ID. These lines provide a minimal amount of information that

1. Identifies the message system version number
2. Specifies the type of message
3. Assigns identification codes to the message.

If the message refers to a previous message (e.g., a “data” message in response to a “request” message), then the fourth line is a REF_ID line. These lines are followed by information specific to the message type. The final line of any GSE message is the STOP line. These lines are discussed later in detail.

GSE data messages may span e-mails or files. The mechanism for doing so is described on page 13.

Blank lines are not part of GSE 2.1 format, though they may be added to improve legibility where they do not cause ambiguity.

In GSE 2.0 format, comment lines were identified by having a blank in the first column. In GSE 2.1 format this passive approach be replaced with an active approach by inserting a percent sign “%” in column one.

Comment enclosed in parenthesis can optionally be included in certain types of data messages (e.g., BULLETIN and RESPONSE).

BEGIN

Except in the case of a HELP message, the BEGIN line is the first line of a GSE message. The BEGIN line also contains the version identifier of AutoDRM command syntax.

The syntax version string in the BEGIN line of a request message also implies the default format of the data which are requested. If a specific format string is given on a request line, that format specification will override the default.

Syntax: **BEGIN** version

version .... syntax version identifier (GSE2.1)

Example 1.0 - 2 Sample BEGIN line for GSETT-3 messages

```
BEGIN GSE2.1
```

MSG_TYPE

The MSG_TYPE line is the second line of a GSE message. A message type is required to distinguish between the different types of messages. Only one MSG_TYPE is allowed per message; combining different message types in the same GSE message is prohibited.

Syntax: **MSG_TYPE** type

type............................ identifies the message as REQUEST, DATA, SUBSCRIPTION.

Example 1.0 - 3 Sample message type line for a request message

```
MSG_TYPE REQUEST
```

MSG_ID

Message tracking is provided through the use of MSG_ID and REF_ID lines. The MSG_ID is a convenience for the sender in tracking and identifying messages. It is also used for identifying continuations of messages across e-mails or files. The sender is responsible for providing a MSG_ID that is unique to the sender.

MSG_ID is the third line in a GSE message. The information conveyed by the MSG_ID line includes a unique message identification string containing no blanks or backslash ("\") characters and a message source code. NDCs will adopt a unique code to use as the message source code. The code will be 7 characters, where the first three letters will represent the country and the final four characters will be _NDC, e.g., GBR_NDC for Great Britain. The 3 letter country code will follow the ISO 3166 standard shown in Table 4. All other users should use a code which begins with their ISO 3166 three letter country code, followed by an underscore and a three letter abbreviation of their organization.

Table 4. **Example of GSE Message Source Codes**
The complete list of three letter country codes is given in ISO 3166.

Source Code	ISO 3166 code	Description
GSE_IDC		International Data Centre for GSETT-3
GSE_WGE		Working Group on Evaluation
GSE_WGO		Working Group on Operations
GSE_WGP		Working Group on Planning
DZA_NDC	DZA	Algeria NDC
ARG_NDC	ARG	Argentina NDC
AUS_NDC	AUS	Australia NDC
AUT_NDC	AUT	Austria NDC
BGD_NDC	BGD	Bangladesh NDC
BEL_NDC	BEL	Belgium NDC
BRA_NDC	BRA	Brazil NDC
BGR_NDC	BGR	Bulgaria NDC
CAN_NDC	CAN	Canada NDC
CHL_NDC	CHL	Chile NDC
CHN_NDC	CHN	China NDC
CAF_NDC	CAF	Central African Republic NDC
COL_NDC	COL	Columbia NDC
CZE_NDC	CZE	Czech Republic NDC
EGY_NDC	EGY	Egypt NDC
ETH_NDC	ETH	Ethiopia NDC
FIN_NDC	FIN	Finland NDC
FRA_NDC	FRA	France NDC
DEU_NDC	DEU	Germany NDC
HUN_NDC	HUN	Hungary NDC
IND_NDC	IND	India NDC
IDN_NDC	IDN	Indonesia NDC
IRN_NDC	IRN	Iran NDC

Table 4. **Example of GSE Message Source Codes**
The complete list of three letter country codes is given in ISO 3166.

Source Code	ISO 3166 code	Description
ISR_NDC	ISR	Israel NDC
ITA_NDC	ITA	Italy NDC
JPN_NDC	JPN	Japan NDC
MEX_NDC	MEX	Mexico NDC
NLD_NDC	NLD	Netherlands NDC
NZL_NDC	NZL	New Zealand NDC
PRK_NDC	PRK	North Korea NDC
NOR_NDC	NOR	Norway NDC
PAK_NDC	PAK	Pakistan NDC
PNG_NDC	PNG	Papua New Guinea NDC
PRY_NDC	PRY	Paraguay NDC
PER_NDC	PER	Peru NDC
POL_NDC	POL	Poland NDC
ROM_NDC	ROM	Romania NDC
RUS_NDC	RUS	Russian Federation NDC
SVK_NDC	SVK	Slovakia NDC
ZAF_NDC	ZAF	South African NDC
KOR_NDC	KOR	South Korea NDC
ESP_NDC	ESP	Spain NDC
SWE_NDC	SWE	Sweden NDC
CHE_NDC	CHE	Switzerland NDC
TUR_NDC	TUR	Turkey NDC
TKM_NDC	TKM	Turkmenistan
UKR_NDC	UKR	Ukraine NDC
GBR_NDC	GBR	United Kingdom NDC
USA_NDC	USA	United States NDC
VNM_NDC	VNM	Vietnam NDC
ZAR_NDC	ZAR	Zaire NDC

The format for the MSG_ID line is given below.

Syntax: **`MSG_ID`** `msg_id_string [msg_id_source]`

`identification`..... Unique message identification string (up to 20 characters)
`source`........................ Message source (up to 8 characters)

Example 1.0 - 4 Message from the NDC in country ABC

```
MSG_ID  1994/05/21_0001 ABC_NDC
```

REF_ID

The REF_ID line is used in data messages that are in response to request or subscription messages. The REF_ID is the MSG_ID of the request message to which the response is being given. It follows the MSG_ID line as the fourth line of non-request messages.

Syntax: **REF_ID** msg_id_string [msg_id_source]

msg_id_string .... id_string from MSG_ID line of the request message
msg_id_source .... message source code from MSG_ID line of the request message

Example 1.0 - 5 A request message sent from an NDC to the IDC:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1997/05/21_0001 ABC_NDC
         (request specific information)
STOP
```

Example 1.0 - 6 The IDC response to the request will have a MSG_ID from the IDC and use the request message MSG_ID string in the REF_ID line:

```
BEGIN GSE2.1
MSG_TYPE data
MSG_ID 00000023 GSE_IDC
REF_ID 1997/05/21_0001 ABC_NDC
         (data specific information)
STOP
```

PART

The GSE2.0 format CONTINUED/CONTINUATION method of splitting GSE messages was rarely implemented or used and is dropped in favor of a more intelligent splitting of messages at DATA_TYPE boundaries. This method has the advantages that data sections (especially waveforms) are never broken in the middle and that each split message is headed by a BEGIN, MSG_TYPE and MSG_ID line (and a REF_ID line where appropriate) and terminated by a STOP line, making it totally self-contained. Each MSG_ID line must be unique and for MSG_TYPE DATA messages the REF_ID line should have a PART sequence_number section appended (with the OF total_number section being optional on all but the last section of the split message).

Note that PART sequence_number section is only needed when a message is split into parts.

Syntax: **REF_ID** msg_id_string msg_id_source **PART** sequence_number [**OF** total_number]

sequence_number...Sequence number beginning with 1
total_number..........Total number of parts for this response

Note that the "**OF** total_number" section is optional for all but the last section of the split message.

Example 1.0 - 7 A single data message in response is shown first. Following this is an example of how that single message can be split into two separate messages.

```
BEGIN  GSE2.1                                    (single e-mail; data message)
MSG_TYPE data
MSG_ID reply1 GSE_IDC
REF_ID test1 ANY_NDC
DATA_TYPE type1 GSE2.1
          (data-specific information)
DATA_TYPE type2 GSE2.1
          (data-specific information)
DATA_TYPE type3 GSE2.1
          (data-specific information)
DATA_TYPE type4 GSE2.1
          (data-specific information)
STOP

Becomes:
BEGIN GSE2.1                                     (e-mail 1; data message)
MSG_TYPE data
MSG_ID reply1 GSE_IDC
REF_ID test1 ANY_NDC   PART 1 OF 2
DATA_TYPE type1 GSE2.1
          (data-specific information)
DATA_TYPE type2 GSE2.1
          (data-specific information)
STOP


BEGIN GSE2.1                                     (e-mail 2; data message)
MSG_TYPE data
```

```
MSG_ID reply2 GSE_IDC
REF_ID test1 ANY_NDC   PART 2 OF 2
DATA_TYPE type3 GSE2.1
       (data-specific information)
DATA_TYPE type4 GSE2.1
       (data-specific information)
STOP
```

STOP

The last line of any GSE message is a STOP line. In the case where two or more GSE messages (with different MSG_ID lines!) are included in one e-mail or file, all lines between the STOP and BEGIN lines are ignored. A GSE message without a STOP line is considered incomplete and is ignored.

Chapter 2 GSE Request Messages

INTRODUCTION

The request message formats provide a framework in which almost all data can be requested from a station or data centre. A request message consists of a single BEGIN/STOP block with a MSG_TYPE REQUEST line and that can be uniquely identified by strings on the MSG_ID line. Within a request message, several types of data may be requested. For example, requests may be made for a bulletin and associated waveforms, or for specific event information from several different regions. The order of the requests in the request message is preserved in the response (data) message. The response to a request message must be contained in a single data message that includes the MSG_ID of the request message as the REF_ID.

THE HELP LINE

A HELP line specifies that the requestor would like to have a description of the AutoDRM interface. The HELP line is a special line in that no other message lines are required; the basic message lines BEGIN, MSG_TYPE, and MSG_ID need not be included. HELP may also appear as the message subject in an e-mail that contains no body. Suggestions for the types of information available with the “HELP” mechanism are described in Chapter 5.

REQUEST FORMAT DESCRIPTION

In addition to the basic message information described in Chapter 1 a request message is a series of free format command lines that provide information about the return message (control lines), set the environment for subsequent request lines (environment lines), or specify the type of data that is to be returned within the limits of the environment (request lines). Some request lines must be preceded by environment lines that, by constraining the request, limit the size of the response.

Implementation of the AutoDRM formats will vary from site to site and will depend on the type of data and information that is available from the site. The minimum required configuration for a station or NDC AutoDRM participating in GSETT-3 is outlined in Chapter 5.

REQUEST CONTROL LINES

The request control lines determine the protocol of the return data message. The existing options for specifying the protocol for returning messages in AutoDRM are E-MAIL and FTP. In each GSE message there can only be one method specified (i.e., either one E-MAIL line or one FTP line). If different protocols are desired for return data, separate request messages should be submitted to the AutoDRM.

A request message that contains no E-MAIL or FTP line will be answered using the return e-mail address of the sender. In some cases, the return address may not be reliable, however, so it is strongly suggested that one of the return mechanisms be specified. E-mail will be used as the default method of transmitting data for small ASCII data messages (under 1 megabyte, except at AutoDRMs where this is a known problem); file transfer protocol (ftp) will be used for larger messages and messages with binary data.

E-MAIL

The E-MAIL line is followed by the e-mail address to which the return message should be sent.

Syntax: **`E-MAIL`** `return_address`

`return_address`.....E-mail address to send reply

Default: Return address from e-mail header

FTP

The FTP line specifies that the message should be put in a file or files on the AutoDRM computer for transmission using the file transfer protocol (ftp). The argument for the FTP line is the e-mail address to which e-mail notification should be sent that the ftp file is ready for transfer.

Syntax: **`FTP`** `return_address`

`return_address`.....E-mail address to send notification

The notification message in the return e-mail is of the FTP_LOG data type (DATA_TYPE FTP_LOG, Chapter 4). The format of this message contains the name and location of the ftp file(s), allowing automated retrieval of the data.

ENVIRONMENT LINES

The environment in which the response to the request line will be made is specified using environment lines. Environment lines may constrain the request based on many different parameters, e.g., latitude, longitude, time, depth, station, channel, etc. An environment is defined by its keyword and the arguments that follow. An environment is set when a keyword and value are given, and can be reset with another call with the same keyword. An environment keyword with no arguments resets the constraint on that environmental parameter to the default.

There are two classes of environments: ranges and lists.

A range environment specifies the inclusive limits between which the values satisfy the environment. Ranges are delimited with the word "TO" surrounded by blank spaces.

Syntax: **ENVIRONMENT_KEYWORD** [[Low_Limit] TO [High Limit]]

An open ended range is specified by not giving the low or high limit. The following example specifies all magnitudes of 5.0 and above.

Example 2.0 - 1 All magnitudes of 5.0 and above:

```
MAG 5.0 TO
```

Blank may appear in certain limits; specifically, time limits.

Example 2.0 - 2 All times between February 23, 1994 at 00:00:00 and March 10, 1994 at 14:37:02:

```
TIME 1994/02/23 TO 1994/03/10 14:37:02
```

List environment lines contain lists of comma delimited parameters specifying discrete constraints such as station names and channels. Some list environments are allowed only one parameter (e.g., BULL_TYPE), while others may have an unlimited number of parameters. Spaces after the commas are neither required nor prohibited. The general format for a list environment is:

Syntax: **ENVIRONMENT_KEYWORD** [arg1[, arg2[, arg3[,...]]]]

Lists can be quite long, so a wild card character (*) may be used as a substitute for any string of characters in some list environments.

Example 2.0 - 3 Wildcard use

`STA_LIST *` .... All of the stations
`STA_LIST A*` .... All stations beginning with "A"
`CHAN_LIST *Z` .... All channels ending with "Z" (vertical channels)

Descriptions of specific environments follow. For each one, default settings and examples are given. Although there are many environments listed, only certain ones of them may be applicable to a particular AutoDRM installation. Those that have been implemented should be described in the HELP message.

TIME

The time environment is expressed as a range with date and decimal time entries. Unlike most range environments, a space is allowed between the date and time entries of the limits.

Syntax: **TIME** `[[date1 [time1]] TO [date2 [time2]]]`

`date1 time1`............Low range date and time
`date2 time2`............High range date and time

Default: current date and time TO current date and time(returns no data).

Only the date and time fields necessary to obtain the resolution desired need be specified; all other fields are assumed to be 0 or 1 as appropriate (1 for month and day, 0 for hour, minute, and second).

Example 2.0 - 4 Sample TIME environments

```
TIME 1994/02/01 to 1994/03/01
TIME 1994/02/01 23:14:19.7 TO 1994/03/01 12
TIME 1994/2/1 23:14:19.7 to 1994/3/1 12
```

LAT

The LAT environment specifies the range of latitude in degrees. Southern latitudes are negative. The low range value must be smaller than the high range value.

In cases where LAT can apply to origins or stations, e.g., when requesting a bulletin, the constraint will be applied to origins.

Syntax: **LAT** `[[low_lat] TO [high_lat]]`

`low_lat`......................Low range latitude
`high_lat`...................High range latitude

Default: no constraint

Example 2.0 - 5 Latitudes constrained between 12.0 degrees South to 17 degrees North

```
LAT -12 TO 17
```

LON

The GSE 2.1 format LONG environment has been changed to LON. LON specifies the range of longitude in degrees. Western longitudes are negative and the range is interpreted from west to east. It is specific to the LON environment that either both or neither (to return to the default values) of the longitudes must be given.

In cases where LON can apply to origins or stations, e.g., when requesting a bulletin, the constraint will be applied to origins.

Syntax: **LON** [western_long TO eastern_long]

western_long .... Western longitude
eastern_long .... Eastern longitude

Default: No constraint

Example 2.0 - 6 A longitude range of 350 degrees

```
LON -175 TO 175
```

Longitude ranges may span the International Date Line, as shown in the following example.

Example 2.0 - 7 A longitude range of 10 degrees

```
LON 175 TO -175
```

EVENT_STA_DIST

Event - station distance (in degrees) is applied in context to the request. When requesting waveform data associated with specific events, EVENT_STA_DIST helps determine the stations from which the data will be retrieved. When requesting bulletin-type information (bulletins, events, origins, or arrivals), then EVENT_STA_DIST helps determine the events for which the data will be retrieved.

Syntax: **EVENT_STA_DIST** [[low_dist] TO [high_dist]]

low_dist .... Low distance range
high_dist .... High distance range

Default: No constraint

Example 2.0 - 8 A request for bulletin information from events within 20 degrees of stations ABC or DEF must include these lines:

```
STA_LIST ABC, DEF
EVENT_STA_DIST 0 TO 20
BULLETIN GSE2.1
```

Example 2.0 - 9 A request for all waveform data from stations within 20 degrees of an event of 1995/01/01 00:12:17 must include these lines:

```
TIME 1995/1/1 00:12:16.9 to 1995/1/1 00:12:17.01
EVENT_STA_DIST 0 to 20
BULL_TYPE IDC_REB
RELATIVE_TO BULLETIN
WAVEFORM GSE2.1
```

DEPTH

Depth ranges are given in kilometers of depth from the surface. All depths are positive.

Syntax: **DEPTH** [[shallow] TO [deep]]

shallow......................Low depth range
deep..............................High depth range

Default: No constraint

Example 2.0 - 10 Depth environment

```
DEPTH 0.0 TO 10.0
```

DEPTH_MINUS_ERROR

To obtain all events that have a 90% probability of being within a certain depth range, the DEPTH_MINUS_ERROR environment is provided. Depth minus error ranges are given in kilometers of depth from the surface.

Syntax: **DEPTH_MINUS_ERROR** [[shallow] TO [deep]]

shallow......................Low depth range
deep..............................High depth range

Default: No constraint

Example 2.0 - 11 Anything with 90% probability to be within 10 km of the surface

```
DEPTH_MINUS_ERROR 0.0 TO 10.0
```

MAG

Magnitude ranges specify the range of magnitudes to include in the search. If no magnitude range is specified, all events regardless of magnitude will be selected. The type of magnitude (mb, Ms, etc.) is specified in the MAG_TYPE environment.

Syntax: **MAG** [[low_mag] TO [high_mag]]

low_mag......................Low magnitude range
high_mag ....High magnitude range

Default: No constraint

Example 2.0 - 12 Magnitudes above 4.5

```
MAG 4.5 TO
```

MAG_TYPE

The magnitude type to search with the magnitude environment is given in this list. Valid entries will be determined by the data centre and described in the HELP message. Standard accepted magnitude codes are mb (body wave magnitude), Ms (surface wave magnitude), ML (local magnitude), Mn (Nuttli Lg magnitude), MD (duration magnitude), and Mw (moment magnitude).

Syntax: **MAG_TYPE** [mag_type[, mag_type[,...]]]

`mag_type` .... any of: mb, Ms, ML, Mn, MD, or Mw

Default: No constraint

Example 2.0 - 13 mb and Ms magnitudes only

```
MAG_TYPE mb, Ms
```

MB_MINUS_MS

This difference between mb and Ms magnitude values specifies the range of magnitude differences to include in the search.

Syntax: **MB_MINUS_MS** [[low_mag_diff] TO [high_mag_diff]]

`low_mag_diff` .... Low magnitude difference
`high_mag_diff` .... High magnitude difference

Default: No constraint

Example 2.0 - 14 A difference of magnitudes from 1 to 2

```
MB_MINUS_MS 1.0 TO 2.0
```

NET_LIST

The network search list allows stations from a particular network to be selected. Each AutoDRM will make available a list of networks it recognizes and will be described in the HELP message. See also NETWORK data type section described later. The wildcard character (*) is allowed for specifying identification codes.

Syntax: **NET_LIST** [net[, net[, ...]]]

`net` .... Network identification code

Default: *

Example 2.0 - 15

```
NET_LIST IDC_SEIS, IDC_HYDR
```

STA_LIST

The station search list is given in the STA_LIST environment. If an array station is specified, then all elements of the array are implied. Specific array elements may be referenced individually. The default station list is all stations. The wildcard character (*) is allowed for specifying station codes.

When bulletins are requested, STA_LIST can be used to specify which events will be included. If an event in the bulletin contains at least one of the stations in the STA_LIST, that event and all arrivals available for this event will be included in the bulletin.

Syntax: **`STA_LIST`** `[sta[, sta[, ...]]]`

`sta` .... Station or array code

Default: *

Example 2.0 - 16 Four specific stations

```
STA_LIST WHY, WOOL, STKA, FCC
```

Example 2.0 - 17 All stations codes beginning with the character A

```
STA_LIST A*
```

CHAN_LIST

The channel search list is given in the CHAN_LIST environment. The channel search list defaults to all vertical channels (*z). The wildcard character (*) is allowed for specifying channel codes.

Syntax: **`CHAN_LIST`** `[chan[, chan[, ...]]]`

`chan` .... Channel code

Default: *z

Example 2.0 - 18 Three short period channels

```
CHAN_LIST shz, shn, she
```

Example 2.0 - 19 All short period channels

```
CHAN_LIST s*
```

BEAM_LIST

The beam code provides a link between beam parameters described in the BEAM data type, and beam data in the data type WAVEFORM and ARRIVAL:AUTOMATIC (formerly known as DETECTIONS). Beam codes are not case sensitive. The wildcard character (*) is allowed for specifying beam codes. It is left to the discretion of the data centre to decide if requests for specific beams will be fulfilled.

Syntax: **BEAM_LIST** `[beam[, beam[, ...]]]`

`beam` .... Beam code

Default: *

Example 2.0 - 20

```
BEAM_LIST FICB.Pa, FICB.Pb
```

AUX_LIST

Station and channel are not always adequate to completely describe a specific data stream for some seismic stations. An auxiliary identification is supplied for completeness in handling these special cases. The instances in which the auxiliary identifications are necessary should be rare. The wildcard character (*) is allowed in specifying auxiliary codes.

Syntax: **AUX_LIST** `[aux[, aux[, ...]]]`

`aux` .... Auxiliary code

Default: *

Example 2.0 - 21 AUX_LIST chi, med

BULL_TYPE

Data centers may produce more than one bulletin. The BULL_TYPE environment provides a means to specify which bulletin to retrieve. Only one bulletin type may be specified in any BULL_TYPE line. Bulletin naming conventions are not standard, so the valid lists will be data centre dependent and are described in the HELP message.

Syntax: **BULL_TYPE** `[bulletin_name]`

`bulletin_name` .... For the IDC: IDC_AEL, IDC_ABEL, IDC_DEL, IDC_REB, IDC_ECB, GAMMA, or other

Default: Installation dependent (IDC_REB for the IDC)

The IDC will store all bulletins regularly produced; IDC_AEL, IDC_ABEL, IDC_DEL, IDC_REB, and IDC_ECB. Most other bulletins stored at the IDC are considered gamma bulletins and are identified by the three letter country code followed by an underscore and the name of the bulletin. All of these other bulletins are grouped into a single GAMMA bulletin.

Example 2.0 - 22 IDC Reviewed Event Bulletin

```
BULL_TYPE IDC_REB
```

Example 2.0 - 23 Country ABC’s DEF Bulletin

```
BULL_TYPE ABC_DEF
```

GROUP_BULL_LIST

Events are often common between bulletins. It is sometimes desirable to list the various solutions (origins) together. GROUP_BULL_LIST is a list of the bulletins that should be combined with the bulletin specified in BULL_TYPE. Only the origin information from these other bulletins will be included in the combined bulletin that is eventually returned; the arrival information will be for the BULL_TYPE bulletin. Bulletin naming conventions are not standard, so the valid lists will be data centre dependent.

Syntax: **`GROUP_BULL_LIST`** `[bulletin [,bulletin[, ...]]]`

`bulletin` .... For the IDC: IDC_AEL, IDC_ABEL, IDC_DEL, IDC_REB, IDC_ECB, GAMMA, or other

Default: None

Events in the GROUP_BULL_LIST will be grouped with at most one event in the BULL_TYPE bulletin. Grouping of events at the IDC will be done by including all events with locations within three degrees and origin times within sixty seconds. If the initial criteria are met for more than one event, then the differences in distance and origin time will be weighted and a choice made on that basis.

The IDC will store the five bulletins regularly produced; the IDC_AEL, the IDC_ABEL, the IDC_DEL, the IDC_REB, and the IDC_ECB. Gamma bulletins from NDCs will be designated by the three letter country code followed by an underscore and the Bulletin name. At the IDC a shorthand for all gamma bulletin information will be “GAMMA”.

Example 2.0 - 24 IDC_REB with entries from the IDC_ABEL and all GAMMA origins

```
BULL_TYPE IDC_REB
GROUP_BULL_LIST IDC_ABEL, GAMMA
```

ARRIVAL_LIST

A unique arrival identification (ID) number or string is assigned to each arrival. At the IDC this is up to an 8 digit number. This arrival ID appears in the data types for arrivals and bulletins.

Syntax: **`ARRIVAL_LIST`** `[arid[, arid[, ...]]]`

`arid` .... Arrival identification number or string up to 8 characters long

Default: All arrivals

Example 2.0 - 25

```
ARRIVAL_LIST 8971234, 90814
```

ORIGIN_LIST

A unique origin identification (ID) number or string must be assigned to each origin. At the IDC this is up to 8 digit number. This origin ID appears in bulletins and may be used subsequently to request waveforms or comments associated with a specific origin.

Syntax: **`ORIGIN_LIST`** `[orid[, orid[, ...]]]`

`orid`............................ Origin identification number or string (up to 8 characters long)

Default: All origins

Example 2.0 - 26

```
ORIGIN_LIST 132456, 190672
```

EVENT_LIST

A unique event identification number (ID) or string should assigned to each event. At the IDC this is up to 8 digit number. This event ID appears in bulletins and may be used subsequently to request waveforms or comments associated with the specific event.

Syntax: **`EVENT_LIST`** `[evid[, evid[, ...]]]`

`evid`............................ Event identification number or string (up to 8 characters long)

Default: All events

Example 2.0 - 27

```
EVENT_LIST 87623495, 87
```

COMM_LIST

The communications list is the list of communications links to include in status reports. Links are defined by the end of the link furthest from the IDC. Thus, for the link between the USA_NDC and the GSE_IDC the communications link would be designated as USA_NDC. Station codes are used for links from the station to the NDC or from the station to the IDC, etc.

Syntax: **`COMM_LIST`** `[comm[, comm[, ...]]]`

`comm`............................ Communications link code

Default: *NDC

Example 2.0 - 28

```
COMM_LIST  FRA_NDC,RUS_NDC
```

RELATIVE_TO

The concept of association is introduced to provide the ability to tie, or associate, one data type with another. The most common association is the one between waveforms and events allowing a user to request waveforms associated with a particular set of origins. However, since the keyword ASSOCIATE proposed in GSE2.0 format did not adequately express the direction between the triggering item (e.g., origin) and the derived items (waveforms), ASSOCIATE has been replaced with the keyword RELATIVE_TO.

RELATIVE_TO has all of the characteristics of a list environment, except that it is active only for the subsequent request line and the arguments are request keywords (e.g., BULLETIN).

Syntax: `RELATIVE_TO request_keyword`

`request_keyword`...ORIGIN, EVENT, or BULLETIN

The data type given in the RELATIVE_TO line is not returned in the response. That data type must be explicitly requested on another line, which typically precedes the RELATIVE_TO line.

Example 2.0 - 29 Request the associated waveforms in CM6 sub_format for events found in the REB between 12:00 and 13:00.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID   1234567890  ANY_NDC
E-MAIL   JOE@NDC.COMPUTER.XX
TIME 1996/9/15 12:00 to 1996/9/15 13:00
RELATIVE_TO BULLETIN
WAVEFORMS GSE2.1:CM6
STOP
```

Example 2.0 - 30 To also request the bulletin for time period in the example given above, the line BULLETIN GSE2.1 must be added.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID   1234567890  ANY_NDC
E-MAIL   JOE@NDC.COMPUTER.XX
TIME 1996/9/15 12:00 to 1996/9/15 13:00
RELATIVE_TO BULLETIN
BULLETIN GSE2.1
WAVEFORMS GSE2.1:CM6
STOP
```

The data selection and segmentation rules for waveforms is data centre dependent. The rules used at the IDC are described in Appendix A.

TIME_STAMP

TIME_STAMP is an environment used to request that data messages be time stamped. If requested, time stamps will appear at the beginning and end of each data type. Time stamps record the start time and end time that the message entered and exited the processing system.

Syntax: **TIME_STAMP**

Default: No time stamp

Example 2.0 - 31 Request that returned message be time stamped.

```
TIME_STAMP
```

Example 2.0 - 32 Request that the returned station message be time stamped.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
STA_LIST *
TIME_STAMP
STATION GSE2.1
STOP
```

The response to that message will have the form:

```
BEGIN GSE2.1
MSG_TYPE  data
MSG_ID    138710 GSE_IDC
REF_ID    1040 ANY_NDC
DATA_TYPE STATION GSE2.1
TIME_STAMP 1997/03/09 23:31:09
Net       Sta   Type  Latitude  Longitude Coord Sys       Elev   On Date   Off Date
IDC_SEIS   ARCES hfa   69.53490   25.50580 WGS-84       0.40300 1987/09/30
IDC_SEIS   ARA0  3C    69.53490   25.50580 WGS-84       0.40301 1987/09/30
IDC_SEIS   ARA1  1C    69.53630   25.50710 WGS-84       0.41132 1987/09/30
IDC_SEIS   ARA2  1C    69.53380   25.50780 WGS-84       0.39253 1987/09/30
TIME_STAMP 1997/03/09 23:31:12
STOP
```

REQUEST LINES

Request lines specify which information to retrieve from the AutoDRM installation. All of the arguments to a request line are optional and include the format for the return message which is specified as a generic term such as GSE2.0, GSE2.1, CSS3.0, or SEED2.3.

Syntax: **`REQUEST_KEYWORD`**`[:subtype] [format[:sub_format]]`

`REQUEST_KEYWORD`... Specifies the data type to request (e.g., STATION or WAVEFORM)
`subtype`... Specifies which subtype to use with this data type. The subtype allows a more precise data selection. It is used primarily for ARRIVAL requests.
`format`... One of a few generic data types (e.g., GSE2.1)
`sub_format`... Specifies the precise format to use with this data type. The sub_format is used primarily for BULLETIN or WAVEFORM requests.

If no format is specified, the default format will be taken from the BEGIN line.

Note that subtype is appended to REQUEST_KEYWORD with a colon (:), e.g. ARRIVAL:AUTOMATIC. In addition, sub_format is appended to format with a colon, e.g., GSE2.1:CM6. This is a clear deviation from GSE2.0 format, where sub_format was separated by a space, e.g, GSE2.0 CM6.

For each request that is made, a subset of the total environment is applied, as shown in Table 5. All applicable environments are enforced for each request. If the environment is not specified explicitly, then the default is used. Because the default values for some environments specify a zero length range (e.g., TIME), a request made without explicitly defining these environments will result in no data returned. For example, the TIME environment must be specified for bulletin requests. Descriptions of the request lines (below) include the applicable environments. The environments that must be explicitly specified to obtain a result are in bold type, e.g., **`TIME`**.

The order of the request lines is very important, as the environment established prior to the request line is what is used to constrain the request. The environment can be changed between request lines allowing multiple requests for the same type of information within the same GSE request message.

Example 2.0 - 33 To obtain the bulletin information for all events in January, 1997 within the areas defined by 10 to 20 degrees north, 120 to 160 degrees east and 45 to 55 degrees south, 15 to 25 degrees west. Note that the second bulletin will be time stamped

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1997/01/01 TO 1997/02/01
LAT 10.0 TO 20.0
LON 120.0 TO 160.0
BULLETIN GSE2.1
```

```
LAT -45.0 TO -55.0
LON -15.0 TO -25.0
TIME_STAMP
BULLETIN GSE2.1
STOP
```

Requests attempt to provide information of general interest to scientists. The requests listed below are only a set of suggestions for standard requests that may be offered by an AutoDRM. A data centre such as the IDC will provide most, if not all, of the information listed below. A data source such as an NDC or station might provide a very limited number of the data types through requests. The minimum set of environment and request lines that must be implemented by providers of auxiliary data from either stations or NDCs are given in Chapter 5. Table 5 gives the applicable environments for requests.

TIME_STAMP

Table 5. **Applicable Environments for request keywords**

requests \ environments	time	lat	lon	event_sta_dist	depth	depth_minus_error	mag	mag_type	ms_minus_mb	net_list	sta_list	chan_list	beam_list	aux_list	bull_type	relative_to	group_bull_list	arrival_list	origin_list	event_list	time_stamp	comm_list
waveform	X									/	/	/	/	/							/	
arrival	X									/	/	/	/		X			/			/	
origin	X	/	/	/	/	/	/	/	/		/				X	/			/		/	
event	X	/	/	/	/	/	/	/	/		/				X	/	/			/	/	
bulletin	X	/	/	/	/	/	/	/	/		/				X	/	/			/	/	
network											/										/	
station		/	/							/	/										/	
channel		/	/							/	/	/		/							/	
beam																					/	
response	/									/	/	/		/							/	
outage	X									/	/	/		/							/	
comment	/									/	/							/	/	/	/	
sta_status	X									/	/			/							/	
chan_status	X									/	/	/		/							/	
comm_status	X																				/	/
auth_status	X									/	/	/		/							/	

X Required environment

/ Supplemental environment

WAVEFORM

Waveforms are digital time-series data (seismic, hydroacoustic and infrasonic). Waveform request format will typically accept sub_formats that specify how the digital data are formatted within the general format of the waveform data type. The sub_formats include INT, CM6, CM8, AUT, AU6, and AU8, for GSE2.1 data.

Environment: **TIME,** STA_LIST**,** NET_LIST, CHAN_LIST, AUX_LIST, BEAM_LIST, TIME_STAMP

Example 2.0 - 34 Data in 6-bit compressed format from all channels of station ABC for the time between 03:25 and 03:40 on 1 March 1994 is requested with the following message. Note that WAVEFORM line has colon between the format and the sub_format, i.e., GSE2.1:CM6.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1994/03/01 03:25 TO 1994/03/01 03:40
STA_LIST ABC
CHAN_LIST *
WAVEFORM GSE2.1:CM6
STOP
```

ARRIVAL

The definition of arrivals in GSE2.1 format has been changed to more closely reflect different stages of processing. These stages are expressed using the following subtypes, which are appended to the request keyword ARRIVAL with a colon:

ARRIVAL:AUTOMATIC - This subtype replaces the GSE 2.0 format DETECTION data type, and provides the result of some automatic detection process run on waveforms.

ARRIVAL:REVIEWED - These arrivals have been reviewed, and phase names have been assigned. It applies to both automatic and manual review.

ARRIVAL:GROUPED - These arrivals have not only phase names, but have also been grouped together with the assumption that they belong to the same event.

ARRIVAL:ASSOCIATED - These arrivals have been run through a location program, and are associated to an event. [Arrivals with the subtype ASSOCIATED are the same as the GSE 2.0 format ARRIVAL data type.] ASSOCIATED is the default ARRIVAL subtype in GSE2.1 format.

ARRIVAL:UNASSOCIATED - These arrivals have been detected, but have not been not associated with any event.

Note that a specific BULL_TYPE must be defined for ASSOCIATED and UNASSOCIATED arrivals.

Environment: **TIME**, STA_LIST, ARRIVAL_LIST, CHAN_LIST, BEAM_LIST, **BULL_TYPE**, NET_LIST, TIME_STAMP

Example 2.0 - 35 Request for detections from stations ABC and DEF for the month of March 1996. Note that the request line has a colon between the data type and the subtype, i.e., ARRIVAL:AUTOMATIC.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1996/03/01 TO 1996/04/01
STA_LIST ABC, DEF
BULL_TYPE IDC_AEL
ARRIVAL:AUTOMATIC GSE2.1
STOP
```

Example 2.0 - 36 Request for arrivals from the IDC_REB from stations ABC and DEF for the month of March 1996:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/03/01 TO 1996/04/01
```

```
STA_LIST ABC, DEF
BULL_TYPE IDC_REB
ARRIVAL:ASSOCIATED GSE2.1
STOP
```

ORIGIN

Origins are solutions to the location and time of the event. Several origins may be determined by different organizations (e.g., the GSE IDC, NEIC, and ISC) for any one event.

Environment: **TIME**, LAT, LON, DEPTH, STA_LIST, MAG, MAG_TYPE, **BULL_TYPE**, ORIGIN_LIST, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR, TIME_STAMP, RELATIVE_TO

Example 2.0 - 37 Request for origin information for the IDC_REB origins for 8 August 1996.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/08/08 TO 1996/08/09
BULL_TYPE  IDC_REB
ORIGIN GSE2.1
STOP
```

Example 2.0 - 38 Limiting Example 2.5.4-1 to a specific geographic region, magnitude, and depth range is done by including more environment lines.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/08/08 TO 1996/08/09
LAT -60 TO 10.0
LON -81 TO -34
MAG 4.5 TO 5.5
DEPTH 0 TO 10
BULL_TYPE  IDC_REB
ORIGIN GSE2.1
STOP
```

EVENT

An event is representative of the physical occurrence that was detected through the network of sensors. There can be many estimates of the time and location of an event, and these estimates are known as origins. Events are the collection of origin estimates. Only those estimates given in the BULL_TYPE and GROUP_BULL_LIST environments are provided. The origin estimates in BULL_TYPE provide the base for associating the origins in the GROUP_BULL_LIST.

Environment: **TIME**, LAT, LON, DEPTH, STA_LIST, MAG, MAG_TYPE, **BULL_TYPE**, GROUP_BULL_LIST,

EVENT_LIST, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR, TIME_STAMP, RELATIVE_TO

Example 2.0 - 39 Request all of the IDC_REB origins within regional distance (20 degrees) of stations ABC and/or DEF and the associated IDC_ABEL origins are obtained for March of 1994 with the following query:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1994/03/01 TO 1994/04/01
BULL_TYPE  IDC_REB
GROUP_BULL_LIST IDC_ABEL
STA_LIST ABC, DEF
EVENT_STA_DIST 0.0 TO 20.0
EVENT GSE2.1
STOP
```

BULLETIN

Bulletins are composed of arrival, origin and event lines. Only the arrival information associated with the event is given in the bulletin. BULLETIN may be used as an argument on RELATIVE_TO lines to constrain waveforms.

Note that GSE2.1 format bulletins as implemented by the IDC have 2 sub_formats, GSE2.1:SHORT and GSE2.1:LONG. If the sub_format is not specified, the “SHORT” sub_format is used.

Environment: **TIME**, LAT, LON, DEPTH, STA_LIST, MAG, MAG_TYPE, **BULL_TYPE**, EVENT_LIST, GROUP_BULL_LIST, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR, TIME_STAMP, RELATIVE_TO

Example 2.0 - 40 Request the IDC_REB for May 25, 1994.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1994/05/25 TO 1994/05/26
BULL_TYPE  IDC_REB
BULLETIN GSE2.1
STOP
```

Example 2.0 - 41 Include the IDC_ABEL origins in Example 2.5.6-1:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1994/05/25 TO 1994/05/26
BULL_TYPE IDC_REB
GROUP_BULL_LIST IDC_ABEL
BULLETIN GSE2.1
STOP
```

Example 2.0 - 42 List only origins whose DEPTH_MINUS_ERROR is less than 10 kilometers in Example 2.5.6-2 in LONG sub_format:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1994/05/25 TO 1994/05/26
DEPTH_MINUS_ERROR  TO 10
BULL_TYPE IDC_REB
GROUP_BULL_LIST IDC_ABEL
BULLETIN GSE2.1:LONG
STOP
```

Example 2.0 - 43 List only origins whose DEPTH_MINUS_ERROR is less than 10 kilometers and whose MB_MINUS_MS is greater than 0.5:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1994/05/25 TO 1994/05/26
DEPTH_MINUS_ERROR  TO 10
MB_MINUS_MS 0.5 TO
BULL_TYPE IDC_REB
GROUP_BULL_LIST IDC_ABEL
BULLETIN GSE2.1
STOP
```

STATION

Station information includes station codes, locations, elevations, station type (e.g., array, 3-C), and dates for which waveform or arrival data are available from an AutoDRM. Additional station codes may be reported for which neither waveform nor arrival data are available, but this can present problems for users of the AutoDRM.

Environment: LAT, LON, STA_LIST, NET_LIST, TIME_STAMP

Example 2.0 - 44 Request station information for all stations serviced by this AutoDRM:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
STA_LIST *
STATION GSE2.1
STOP
```

Example 2.0 - 45 For stations in the Southern hemisphere:

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
LAT -90 TO 0.0
STA_LIST *
STATION GSE2.1
STOP
```

CHANNEL

Channel is a complete set of information about the location, emplacement, and type of seismometers at a station.

Environment: LAT, LON, STA_LIST, CHAN_LIST, AUX_LIST, NET_LIST, TIME_STAMP

Example 2.0 - 46 Request the short period channel information for stations in South America, the LAT and LON environments are set appropriately.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
LAT -60 TO 10.0
LON -81 TO -34
STA_LIST *
CHAN_LIST s*
CHANNEL GSE2.1
STOP
```

RESPONSE

The response is the instrument response of the specified network / station / channel / auxiliary identification code. Responses are valid at any given time and may change in a time interval.

Environment: TIME, NET_LIST, STA_LIST, CHAN_LIST, AUX_LIST, TIME_STAMP

Example 2.0 - 47 Request all the instrument responses for the broadband vertical channel of station ABC used in January 1997

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME 1997/01/01 TO 1997/02/01
STA_LIST ABC
CHAN_LIST bhz
RESPONSE GSE2.1
STOP
```

OUTAGE

The outage message reports the data that are not available for the specified time range.

Environment: **`TIME`**, NET_LIST, STA_LIST, CHAN_LIST, AUX_LIST, TIME_STAMP

Example 2.0 - 48 Request the outage reports for all stations and channels for the month of March in 1996, the station and channels must be specified; otherwise the default station list (*) and channel list (*z) will be in effect.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/03/01 TO 1996/04/01
STA_LIST *
CHAN_LIST *
OUTAGE GSE2.1
STOP
```

COMMENT

Comments may be associated with a station, an event, an origin, or an arrival. To retrieve comments, the station code or the IDs of the arrival, origin, or event can be used. These are listed in the bulletins and are obtained with a request (or subscription to) a bulletin or event list.

Environment: TIME, **NET_LIST**, **STA_LIST**, **ARRIVAL_LIST**, **ORIGIN_LIST**, **EVENT_LIST** (one must be specified), TIME_STAMP

Example 2.0 - 49 Request the comments for events 510 and 512.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
EVENT_LIST 510, 512
COMMENT GSE2.1
STOP
```

STA_STATUS

Station status is given for the stations in the STA_LIST environment. The TIME environment defines the report period. The minimum report period is one day.

Environment: **TIME**, NET_LIST, STA_LIST, AUX_LIST, TIME_STAMP

Example 2.0 - 50 Request the station status reports for all GSE stations over a one week period.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/11/14 TO 1996/11/21
STA_LIST *
STA_STATUS GSE2.1
STOP
```

CHAN_STATUS

Channel status is given for the channels in the CHAN_LIST and AUX_LIST environments for the stations in the STA_LIST environment. The TIME environment defines the report period. The minimum report period is one day.

Environment: **TIME**, NET_LIST, STA_LIST, CHAN_LIST, AUX_LIST, TIME_STAMP

Example 2.0 - 51 Request the channel status reports for the short period channels over a four day period at station ARA0.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1996/11/14 TO 1996/11/18
STA_LIST ARA0
CHAN_LIST s*
CHAN_STATUS GSE2.1
STOP
```

COMM_STATUS

Communications status is given for the communications links listed in the COMM_LIST environment. The TIME environment defines the report period. The minimum report period is one day. The sub_format field is used to indicate a verbose communications status report.

Syntax: **COMM_STATUS** [format[:sub_format]]

`format`........................GSE2.1
`sub_format`..............VERBOSE

Environment: **TIME**, COMM_LIST, TIME_STAMP

Example 2.0 - 52 Request the verbose communications status reports for the link from ANY_NDC to the IDC over a one week period.

```
BEGIN GSE2.1
MSG_TYPE REQUEST
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
TIME  1994/11/14 TO 1994/11/21
COMM_LIST GSE_IDC, ANY_NDC
COMM_STATUS GSE2.1:VERBOSE
STOP
```

Chapter 3 Subscription Messages

INTRODUCTION

Subscriptions allow authorized users to have IDC data and data products forwarded to them automatically on a regular basis. The description blow refers specifically to IDC products, though the system is designed so that it may be implemented at other data centers as well. Included in the products available through subscription are the continuous data from primary stations in near-real-time, bulletins, waveform segments, arrival information, etc. Subscriptions may be set up for delivery continuously (in the case of continuous data), immediately upon receipt or generation at the IDC (e.g., segmented waveform data), or on a daily basis (e.g., daily bulletins and status reports). The only restriction is that the total amount of data forwarded to an NDC per day may not exceed 100 Megabytes (MB) unless special arrangements are made to provide extra bandwidth on the communications link.

SUBSCRIPTION PROCEDURES

A subscription is made by sending a GSE subscription message to the IDC. The e-mail address is autodrm@pidc.org. Upon receipt, the source of a subscription message is first validated for its authenticity. Next the volume of data that will be typically generated by the request is checked. Subscription messages that are not sent by an authorized user from a NDC or Working Group will be rejected. Subscriptions estimated to cause the data volume to exceed the maximum (100 MB) will also be rejected unless special arrangements are made (usually, the special arrangement is provision of a high capacity link between the IDC and NDC).

After validation, the new subscription is added to the existing subscriptions for that user; and notification of the new subscription, in the form of a DATA_TYPE LOG message, is sent. Each subscription is assigned a unique identification number (ID) at the IDC.

SUBSCRIPTION FORMAT DESCRIPTION

Subscription messages follow the same rules as request messages, but because subscription messages provide data on a scheduled basis rather than a single request, they are given a separate message type and have additional capabilities that are not found in request messages. Detailed information relating only to subscriptions is given here, while details on environments and requests can be found in Chapters 2 and 4 respectively.

A subscription request must contain the usual basic GSE message information: BEGIN, MSG_TYPE, MSG_ID, E-MAIL or FTP, and STOP.

Example 3.0 - 1 Subscription Message Generalized Format

```
BEGIN  GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
        (Subscription information)
STOP
```

The subscription information contains the information that describes what data (or data products) to send and how often they should be sent.

Subscriptions are a special message type that are very similar to request message types. Like request messages, subscriptions are defined through environment lines that constrain the data to be sent and request lines that specify which data to send.

Separate subscriptions are delimited by separate request keywords. In other words, each time a request keyword in a subscription message is encountered, a corresponding subscription will be initiated for the user. If issue to that subscription will be sent as a single message.

SUBSCRIPTION ENVIRONMENT LINES

There are seven environment lines that are unique to subscriptions: FREQ, SUBSCR_LIST, SUBSCR_NAME, PRODID_LIST, DELIVID_LIST, SUBSCR_NAME, and SEND_EMPTY. Descriptions of the environment lines from request messages applicable to subscriptions can be found in Chapter 2. They are not repeated here since they are identical to those of request messages. Note that the following request environments are NOT applicable to subscriptions: ARRIVAL_LIST, ORIGIN_LIST, and EVENT_LIST.

TIME

Time in a subscription message is an optional environment, and refers to the active time of a subscription. This is a range variable. The format of TIME is the same as when making requests, with the addition that the start_time may have the value “NOW” which refers to the current time, and that end_time may have the value “FOREVER” which means that the subscription will run indefinitely. The default value of TIME for subscriptions is:

TIME NOW TO FOREVER

In the event that a subscription includes a start_time before NOW, then a request message will be generated which will go from TIME [start_time] TO [NOW].

FREQ

FREQ specifies how often the data should be sent to the subscriber. There are four frequencies allowed: CONTINUOUS, IMMEDIATE, DAILY, or CUSTOM. The parameter is CONTINUOUS when requesting continuous data in the alpha protocol; IMMEDIATE when the product is to be delivered as soon as it is available; DAILY for delivery each day; CUSTOM allows the user to specify how frequently and/or the time at which a product will be delivered. FREQ may appear only once in each subscription message

Syntax: **FREQ** `[schedule]`

`schedule` .... any of: CONTINUOUS, IMMEDIATE, DAILY, or CUSTOM period/dow:dom:hour

Default: DAILY

Example 3.0 - 2 FREQ CUSTOM -1/-1:3:0

In the case of custom, PERIOD is the periodicity (how often the subscription is processed) of the subscription in hours (format is HHH). The first hour of the day is 0. The three items after the slash '/' specify the delivery schedule. DOW is the day of the week to send (where Sunday is 0, Monday is 1, etc.), DOM is the day of month to send, and HOUR is the hour to send. If the particular value should be ignored, then it should be given the value -1 For example, if the subscription should be processed on the third day of every month at 00 GMT, PERIOD and DOW would have no meaning.

Note: Each product type has an inherent granularity. For example, the REB is currently generated once a day. Therefore, subscribing to the REB every four hours would have no effect, and the REB will still be sent once a day.

SUBSCR_LIST

SUBSCR_LIST is a list of subscription IDs. A subscription ID is a unique identifier for a subscription. It is returned to the user in the confirmation message that a subscription has been initiated. It can also be obtained with a SUBSCR_PROD or SUBSCR_LOG request. All of the IDs in this list will be processed when a subscription request line is reached.

Syntax: **SUBSCR_LIST** `[subscr_id[, subscr_id[,...]]]`

`subscr_id`................. identification number of the subscription

Default: None for UNSUBSCRIBE; all for SUBSCR_PROD and SUBSCR_LOG

PRODID_LIST

PRODID_LIST is a list of product IDs. A product ID is a unique identifier for a product, and may be shared by multiple subscribers. It is returned to the user in the confirmation message that a subscription has been initiated. It can also be obtained with a SUBSCR_PROD or SUBSCR_LOG request. All of the IDs in this list will be processed when a subscription request line is reached.

Syntax: **`PRODID_LIST`** `[prod_id[, prod_id[,...]]]`

`prod_id`......................identification number of the product

Default: None for UNSUBSCRIBE; all for SUBSCR_PROD and SUBSCR_LOG

DELIVID_LIST

DELIVID_LIST is a list of delivery IDs. The delivery ID is a consecutive number which appears as the second argument in the MSG_ID line for each message sent to a user for a given subscription. This feature allows a user to identify if an issue to a subscription is missing. This environment is only used with the command SUBSCR_RESEND.

Syntax: **`DELIVID_LIST`** `[deliv_id[, deliv_id[,...]]]`

`id`.................................identification number of the product

Default: None.

SUBSCR_NAME

SUBSCR_NAME is a list of subscription names. Certain "standard products" will have names, which will be made available by the IDC (e.g., REB for daily reviewed event bulletins, INST_AEL for instant AEL bulletins, etc.). These names may be used instead of subscription IDs or product IDs.

Syntax: **`SUBSCR_NAME`** `[name[, name[,...]]]`

`name`............................name of the subscription

Default: None.

SEND_EMPTY

SEND_EMPTY is a boolean environment which controls if a message is sent even if there is no data that matches the subscription. This option allows a user to be notified of the absence of an event.

This environment is not available when FREQ is IMMEDIATE, since it could force the system to send a very large number of empty messages.

Syntax: **`SEND_EMPTY`**

Default: None, i.e., empty messages are not sent.

SUBSCRIPTION REQUEST LINES

Subscription message request lines specify which information to send in the return data message. The arguments to a request line define the format for the return data message which are specified as a generic term such as GSE2.0, GSE2.1, CSS3.0, or SEED2.3; an optional sub_format specific to the data type being requested.

Syntax: **`REQUEST_KEYWORD`**`[:subtype] [format[:sub_format]]`

`REQUEST_KEYWORD` .. specifies the data type to request (e.g., STATION or WAVEFORM)
`subtype` .... specifies which subtype to use with this data type. The subtype is used primarily for ARRIVAL requests,
`format` .... one of a few generic data types (e.g., GSE2.1)
`sub_format` .... specifies which internal format to use with this data type. The sub_format is used primarily for BULLETIN or WAVEFORM requests.

If no format is specified, then the installation dependent default format will be used.

Note that subtype is appended to REQUEST_KEYWORD with a colon (:), e.g. ARRIVAL:AUTOMATIC. In addition, sub_format is appended to format with a colon, e.g., GSE2.1:CM6. This is a clear deviation from GSE2.0 format, where sub_format was separated by a space, e.g, GSE2.0 CM6.

All data types described in Chapter 4 are available through subscription at the IDC. The following requests are unique to the subscription system: SUBSCRIBE, SUBSCR_PROD, CHANGE, SUBSCR_RESEND, SUBSCR_LOG, and UNSUBSCRIBE.

If a user subscribes to the same product with the exact same constraints twice, the second subscription will be rejected.

Example 3.0 - 3 A subscription to the IDC_REB can be initiated with the following message. Note that an alternative method for making this same request is given in Example 3.0-6.

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL  name@my.computer
FREQ DAILY
BULL_TYPE IDC_REB
BULLETIN GSE2.1
STOP
```

Example 3.0 - 4

The subscriber will receive the following confirmation response. The subscription ID and product ID are explicitly listed in this message. Note that the subscription request (Example 3.0-3) specified GSE2.1 format, which is equivalent to GSE2.1:short format for a bulletin.

```
BEGIN GSE2.1
MSG_TYPE DATA
MSG_ID 138710 GSE_IDC
REF_ID 1040 ANY_NDC
TIME_STAMP 1997/01/12 19:36:03
DATA_TYPE LOG GSE2.1
 SUBSCRIPTION ID: 52
 PRODUCT ID: 74
  Added at 1997/01/12 19:36:00
  FREQ DAILY
  BULL_TYPE IDC_REB
  BULLETIN GSE2.1:short
  E-MAIL name@my.computer
  TIME_STAMP 1997/01/12 19:36:04
STOP
```

Example 3.0 - 5

The following messages are the first three messages which the subscriber will receive over the next three days. The second field of the MSG_ID line is the delivery ID. Note that these numbers are in sequence in the messages, i.e., 30, 31, and 32.

```
BEGIN GSE2.1            (e-mail 1; data message)
MSG_TYPE DATA
MSG_ID 30 GSE_IDC
PROD_ID 74
DATA_TYPE BULLETIN GSE2.1:short
Reviewed Event Bulletin of the GSE_IDC from 1997/01/10 00:00:00 to 1997/01/11 00:00:00
...
STOP

BEGIN GSE2.1            (e-mail 2; data message)
MSG_TYPE DATA
MSG_ID 31 GSE_IDC
PROD_ID 74
DATA_TYPE BULLETIN GSE2.1:short
Reviewed Event Bulletin of the GSE_IDC from 1997/01/11 00:00:00 to 1997/01/12 00:00:00
...
STOP

BEGIN GSE2.1            (e-mail 1; data message)
MSG_TYPE DATA
MSG_ID 32 GSE_IDC
PROD_ID 74
DATA_TYPE BULLETIN GSE2.1:short
Reviewed Event Bulletin of the GSE_IDC from 1997/01/12 00:00:00 to 1997/01/13 00:00:00
...
STOP
```

SUBSCRIBE

SUBSCRIBE is a request for initiate a new subscription for each “standard product” given by the SUBSCR_NAME environment.

Environment: **SUBSCR_NAME**

Example 3.0 - 6 A subscription to the IDC_REB can be initiated with the following message. Note that this request is the same as that given in Example 3.0-3.

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL  name@my.computer
SUBSCR_NAME REB
SUBSCRIBE
STOP
```

SUBSCR_PROD

SUBSCR_PROD is a request for a list of the products currently subscribed to by the user. Included in the response to this request is the subscription ID, product ID, subscription name (where applicable) and a listing of the environment and request lines that define the specific product. The response is sent as a DATA_TYPE LOG message. If neither SUBSCR_LIST, PRODID_LIST, nor SUBSCR_NAME are specified, all products currently subscribed to by the user are listed.

Environment: SUBSCR_LIST or PRODID_LIST or SUBSCR_NAME

Example 3.0 - 7 The current list of subscriptions that are in effect for the user is obtained by using the SUBSCR_PROD request line.

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
SUBSCR_PROD
STOP


The response to this message is a LOG data message from the IDC:
BEGIN  GSE2.1
MSG_TYPE DATA
MSG_ID 1040 GSE_IDC
REF_ID  1040 ANY_NDC
DATA_TYPE LOG GSE2.1
 The following data products are subscribed
 to by name@my.computer:
 Subscription ID: 52
 Product ID: 74
   FREQ DAILY
   BULL_TYPE IDC_REB
   BULLETIN GSE2.1
 Subscription ID: 57
 Product ID: 78
   FREQ IMMEDIATE
   LAT  0.0 TO 10.0
   LON 120.0 TO 140.0
   BULL_TYPE IDC_ABEL
   BULLETIN GSE2.1
STOP
```

CHANGE

After a subscription is established, it can be modified by using the command CHANGE. CHANGE is used by specifying the subscription by SUBSCR_LIST, PRODID_LIST or SUBSCR_NAME, then listing the changed environments and new values followed by the applicable product. Note that after the change, the subscription ID will remain the same, but the product ID and the delivery ID will change.

Environment: **SUBSCR_LIST** or **PRODID_LIST** or **SUBSCR_NAME**

Example 3.0 - 8 The following example demonstrates how to change the LAT and LON for a BULLETIN subscription:

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID EXAMPLE ANY_NDC
E-MAIL name@my.computer
SUBSCR_LIST 52
CHANGE
LAT 12 to 22
LON 18 to 28
BULLETIN GSE2.1
STOP
```

SUBSCR_RESEND

SUBSCR_RESEND causes a subscribed product to be redelivered. This command gives the subscriber the ability to re-request delivery of a product.

Environment: **SUBSCR_LIST** or **PRODID_LIST** or **SUBSCR_NAME, DELIVID_LIST**

Example 3.0 - 9

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID ID ANY_NDC
SUBSCR_LIST 52
DELIVID_LIST 32
RESEND
STOP
```

SUBSCR_LOG

SUBSCR_LOG returns a log of all of the users changes to the subscriptions. The subscribers e-mail address is used to determine to which subscriptions a user is subscribed. Based on the e-mail address, a log of all changes is send out. The SUBSCR_LOG can be further constrained by use of the environments SUBSCR_LIST, PRODID_LIST, or SUBSCR_NAME.

Environment: SUBSCR_LIST or PRODID_LIST or SUBSCR_NAME

Example 3.0 - 10

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
```

```
MSG_ID ID ANY_NDC
SUBSCR_LIST 74
E-MAIL name@my.computer
SUBSCR_LOG
STOP
```

will result in a log of subscription number 74. The response to the preceding message is:

```
BEGIN GSE2.1
MSG_TYPE DATA
MSG_ID 132430 GSE_IDC
REF_ID 24591
DATATYPE LOG GSE2.1
  SUBSCRIPTION ID: 52
  PRODUCT ID: 74
      was added at 1997/01/09 19:36:00
      FREQ IMMEDIATE
      BULL_TYPE IDC_REB
      BULLETIN GSE2.1
  SUBSCRIPTION ID: 52
  PRODUCT ID: 94
      was changed at 1997/01/21 15:24:13
      The new product constraints are:
      FREQ IMMEDIATE
      LAT 12.00 to 22.00
      LON 18.00 to 28.00
      BULL_TYPE IDC_REB
      BULLETIN GSE2.1
STOP
```

UNSUBSCRIBE

UNSUBSCRIBE informs the IDC that the user wishes to remove the subscriptions referenced by the list in the SUBSCR_LIST environment. A DATA_TYPE LOG message is sent confirming that the subscription has been cancelled.

To stop the delivery of a subscription, the *subscription identification number* must be known. The previous example of using the SUBSCR_PROD request demonstrates how the *subscription identification number* may be obtained. The identification numbers of the subscriptions that are to be deleted are listed on the SUBSCR_LIST environment line. This is followed by an UNSUBSCRIBE request line.

Environment: **SUBSCR_LIST** or **PRODID_LIST** or **SUBSCR_NAME**

Example 3.0 - 11

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
SUBSCR_LIST 52, 57
UNSUBSCRIBE
STOP
```

Example 3.0 - 12 A confirmation log message from the IDC to the subscription user will be sent verifying that the subscription has been terminated.

```
BEGIN  GSE2.1
MSG_TYPE DATA
MSG_ID 1040 GSE_IDC
REF_ID 1040 ANY_NDC
DATA_TYPE LOG GSE2.1
 The following data products have been removed
 by name@my.computer:
 Subscription ID: 52
 Product ID: 94
   FREQ DAILY
   BULL_TYPE IDC_REB
   BULLETIN GSE2.1
 Subscription ID: 57
 Product ID: 101
   FREQ IMMEDIATE
   BULL_TYPE IDC_ABEL
   BULLETIN GSE2.1
STOP
```

WAVEFORM

Waveforms are the digital time series data. Waveform requests will typically accept sub_formats that specify how the digital data are formatted within the general format of the waveform data type. The available formats for waveform data from the IDC subscription service are standard continuous data format for continuous data and GSE2.1 format for all other waveform data. The sub_formats supported are INT, CM6, CM8, AUT, AU6, and AU8.

Environment: **FREQ**, **STA_LIST**, NET_LIST, CHAN_LIST, AUX_LIST

Continuous data from a primary station may be subscribed to very simply using the mechanism provided. The FREQ environment should be set to CONTINUOUS and the stations/channels for forwarding should be specified in STA_LIST and CHAN_LIST environments. Continuous data will be forwarded from the IDC in the alpha protocol (described in Chapter 7). Because the volume of continuous data from more than a few channels could exceed 100 MB, special arrangements are necessary to receive it.

Example 3.0 - 13 To subscribe to continuous data from the short-period, high-gain, vertical channels from the ABAR array and from the central site (CDA0) of the CDAR array, the FREQ environment is set to CONTINUOUS, the appropriate station and channel lists are defined (ABAR refers to all sites within the array ABAR), and WAVEFORM are requested.

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
FREQ CONTINUOUS
STA_LIST ABAR, CDA0
CHAN_LIST shz
WAVEFORM GSE2.1
STOP
```

Example 3.0 - 14 Waveform segments retrieved from auxiliary stations by the IDC can be retrieved automatically for all events by constraining only the station and requesting waveforms. The data will be forwarded in the appropriate format using e-mail or ftp. Here, waveforms from station ABC are requested:

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
FREQ IMMEDIATE
STA_LIST ABC
WAVEFORM GSE2.1
STOP
```

ARRIVAL

The definition of arrivals in GSE2.1 format has been changed to more closely reflect different stages of processing. These stages are expressed using the following subtypes: ARRIVAL:AUTOMATIC, ARRIVAL:REVIEWED, ARRIVAL:GROUPED, ARRIVAL:ASSOCIATED, and ARRIVAL:UNASSOCIATED.

Environment: **FREQ**, **STA_LIST**, NET_LIST, ARRIVAL_LIST, **BULL_TYPE**

Example 3.0 - 15 To obtain the automatic arrivals (detections) from stations ABC and DEF from the IDC_AEL bulletin each day:

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ DAILY
STA_LIST ABC, DEF
BULL_TYPE IDC_AEL
ARRIVAL:AUTOMATIC GSE2.1
STOP
```

ORIGIN

Origins are solutions to the location and time of the source. Several origins may be determined by different organizations (e.g., the GSE IDC, NEIC, and ISC) for any one source.

Environment: **FREQ**, LAT, LON, DEPTH, MAG, MAG_TYPE, STA_LIST, **BULL_TYPE**, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR

Example 3.0 - 16 The first example shows how to obtain the origin information for the daily IDC_REB delivered when the IDC_REB is finished.

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ  DAILY
BULL_TYPE  IDC_REB
ORIGIN GSE2.1
STOP
```

Example 3.0 - 17 The request above can be further limited to a specific geographic region, magnitude, and depth range by including more environment lines.

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ  DAILY
LAT -60 TO 10.0
LON -81 TO -34
MAG 4.5 TO 5.5
DEPTH 0 TO 10
BULL_TYPE  IDC_REB
ORIGIN GSE2.1
STOP
```

EVENT

An event is defined as the preferred origin according to the provider of the data.

Environment: **FREQ**, LAT, LON, DEPTH, MAG, MAG_TYPE, STA_LIST, **BULL_TYPE**, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR

Example 3.0 - 18 In this example, all of the IDC_REB events within regional distance (20 degrees) of stations ABC and DEF are obtained.

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ DAILY
BULL_TYPE  IDC_REB
STA_LIST ABC, DEF
EVENT_STA_DIST 0.0 TO 20.0
EVENT GSE2.1
STOP
```

BULLETIN

Bulletins are composed of arrival, origin and event lines. Only the arrival information associated with the event is given in the bulletin.

Environment: **FREQ**, LAT, LON, DEPTH, MAG, MAG_TYPE, STA_LIST, **BULL_TYPE**, GROUP_BULL_LIST, EVENT_STA_DIST, MB_MINUS_MS, DEPTH_MINUS_ERROR

Example 3.0 - 19 In the first example the daily IDC_REB is requested with no constraints; i.e., all IDC_REB events will be sent regardless of location, magnitude, depth, etc. The frequency of delivery (FREQ) is set to DAILY, which means that the IDC_REB will be delivered for each data day, when analysis at the IDC has been completed.

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
FREQ DAILY
BULL_TYPE IDC_REB
BULLETIN GSE2.1
STOP
```

To subscribe to the immediate IDC_AEL and IDC_ABEL, two BULLETIN commands are used. The FREQ environment is set to IMMEDIATE. Soon after an event has been located (about an hour after real time for the IDC_AEL and about four hours after real time for the IDC_ABEL), the subscription software will forward the results to the user. In the example below, messages would be sent to the user quite often (as often as once every twenty minutes) since there are no constraints on the request. This arrangement would be appropriate for an NDC system that accepts the data automatically.

Example 3.0 - 20 Subscribe to both AEL and ABEL. Each time the request keyword BULLETIN is encountered, a new subscription will be initiated.

```
BEGIN  GSE2.1
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
FREQ IMMEDIATE
BULL_TYPE IDC_AEL
BULLETIN GSE2.1
BULL_TYPE IDC_ABEL
BULLETIN GSE2.1
STOP
```

To subscribe to the daily IDC_REB for events within some region for selected magnitude ranges the proper environments are set prior to the request lines. In the example below two latitude longitude boxes are described and all events shallower than 30 km depth between magnitudes 3.5 and 4.5 within these boxes would be delivered in each subscription.

Example 3.0 - 21 Subscribe only to reports in an area of interest

```
BEGIN  GSE2.1
```

```
MSG_TYPE  SUBSCRIPTION
MSG_ID  1040 ANY_NDC
E-MAIL  name@my.computer
FREQ DAILY
BULL_TYPE IDC_REB
MAG 3.5 To 4.5
DEPTH  TO 30
LAT -30 TO -20
LON -180 TO -140
BULLETIN GSE2.1
LAT 75 TO 79
LON 110 TO 140
BULLETIN GSE2.1
STOP
```

Note that once an environment has been established, it remains in effect until changed. Also note that the depth is given as “DEPTH TO 30”, which is interpreted as DEPTH < 30.

STA_STATUS

Station status is given for the stations in the STA_LIST environment.

Environment: FREQ, STA_LIST, AUX_LIST

Example 3.0 - 22 Request the daily station status reports for all GSE stations:

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ DAILY
STA_LIST *
STA_STATUS GSE2.1
STOP
```

CHAN_STATUS

Channel status is given for the channels in the CHAN_LIST and AUX_LIST environments for the stations in the STA_LIST environment.

Environment: FREQ, STA_LIST, CHAN_LIST, AUX_LIST

Example 3.0 - 23 Request the daily channel status reports for the short period channels at station ARA0:

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ DAILY
STA_LIST ARA0
CHAN_LIST s*
CHAN_STATUS GSE2.1
STOP
```

COMM_STATUS

Communications status is given for the communications links listed in the COMM_LIST environment. A verbose communications status report listing individual circuit dropouts is obtained by using the VERBOSE sub_format.

Environment: FREQ, COMM_LIST

Example 3.0 - 24 To obtain the verbose communications status reports for the links from ABC_NDC to the IDC and from XYZ_NDC to the IDC:

```
BEGIN GSE2.1
MSG_TYPE SUBSCRIPTION
MSG_ID 1040 ANY_NDC
E-MAIL name@my.computer
FREQ DAILY
COMM_LIST ABC_NDC, XYZ_NDC
COMM_STATUS GSE2.1:VERBOSE
STOP
```

O P E R A T I O N S

Chapter 4 Data Messages

GSE DATA MESSAGE FORMATS

GSE data formats provide a common format for data and data product exchange. The data formats all contain ASCII options that allow the exchange of information via e-mail (even for waveforms). Waveforms in binary format may also be sent using the GSE message format, but the transmission of data messages with binary information must be via ftp.

Each data message contains the required information described in Chapter 1 for all GSE messages. All messages must contain the BEGIN line and be followed by a MSG_TYPE DATA line and a MSG_ID line using the proper formats for the arguments. Since a data message may be a response to a request, a REF_ID line may also appear. Following the identification line(s) are sections of data specific information.

Many different types of data may be exchanged using the message formats described here. These include seismic waveforms, bulletins, station information, and many others. For some of these data types, multiple data formats may be supported by the AutoDRM (e.g., GSE2.0, GSE2.1, CSS3.0, and SEED2.3). Data messages in GSETT-3 must be available in the GSE2.0 and/or GSE2.1 formats. sub_formats may also be available within a specific data type. A classic example of this is for GSE2.1 waveforms in which there are several internal data formats (e.g., INT, CM6, etc.). The type of data that is included in a data section and the format of the data are designated with a DATA_TYPE line.

DATA_TYPE

Data sections must begin with a DATA_TYPE line. The arguments to DATA_TYPE are the type of data that follows (WAVEFORM, BULETIN, etc.) and the format (e.g., GSE2.0, GSE2.1, CSS3.0, or SEED2.3). The subtype and sub_format allow more precise selection of the data_type and format, respectively.

Syntax: **`DATA_TYPE`** `data_type[:subtype] format[:sub_format]`

- `data_type`................. the type of data that follows; typical examples are WAVEFORM, BULLETIN, and RESPONSE.
- `subtype`..................... specifies which subtype to use with this data type. The subtype is used primarily for ARRIVAL data types.
- `format`........................ the general format of the data (e.g., GSE2.0, GSE2.1, CSS3.0, or SEED2.3).
- `sub_format`.............. specifies which internal format to use with this data type. The sub_format is used primarily for BULLETIN and WAVEFORM data types.

Example 4.0 - 1 Example DATA_TYPE line.

```
DATA_TYPE  WAVEFORM  GSE2.1:CM6
```

There is no line that is used to end a data section. The end of the section is implied by another DATA_TYPE line, or a STOP line.

GSE2.0 and GSE2.1 are most frequently used message data formats. The CSS3.0 format is the internal format of the IDC and describes the table format for all of the IDC database tables. NDC and station AutoDRMs will typically use GSE2.0 and/or GSE2.1 format

LOG

In response to a request, the AutoDRM will log its progress and errors in a DATA_TYPE LOG section placed just before the data type section containing the data. Free format ASCII lines are used through out. The exact content of the logs is unspecified.

LOG data types contain information about changes that may have been made in the format of the return message (e.g., a default format may be used if the requested format is not available); or the protocol of the return message (e.g., a large return e-mail message may be changed to ftp).

Example 4.0 - 2 The following example is a data message sent to a requestor of data. Just before the data section, a log section is used to state that the waveform request command was processed.

```
BEGIN GSE2.1
MSG_TYPE DATA
MSG_ID 1040 GSE_IDC
REF_ID 9733 ANY_NDC
DATA_TYPE LOG GSE2.1
    Command waveform processed.
DATA_TYPE WAVEFORM GSE2.1:cm6
        (waveform data)
STOP
```

ERROR_LOG

A special data type ERROR_LOG is reserved for error logs so that they can be identified easily in the case that something goes wrong in a request message. Specific formats have not been defined at this time, although it is recommended that the request message be given with the line or lines causing the error identified.

Example 4.0 - 3 The following example shows how the ERROR_LOG section is used to identify that the request message line in a request failed.

```
BEGIN GSE2.1
MSG_TYPE DATA
MSG_ID 1243 GSE_IDC
REF_ID 1040 ANY_NDC
DATA_TYPE ERROR_LOG GSE2.1
    An error was detected in the following request message:
   BEGIN GSE2.1
   MSG_TYPE request
   MSG_ID 1040 ANY_NDC
   TIME 94/03/01 TO 94/03/02
    *** Unrecognized time format ***
   STA_LIST ARA0
   WAVEFORM
   STOP
STOP
```

FTP_LOG

In response to a large data request, data are provided via ftp and a message is sent to the user by e-mail with information on the location of the file to be retrieved by the requestor using ftp. Data type FTP_LOG section is provided to convey this information in a consistent manner so that automated data retrieval programs can easily obtain the data.

The optional field COMPRESS, which appeared in earlier documentation, is dropped in GSE 2.1 format. Common conventions (i.e., `.Z` and `.gz`) exist for expressing that a file is compressed. It is strongly recommended that all files should be compressed.

The first line of the FTP_LOG data type must contain the essential information for retrieving the message file.

Syntax: **`FTP_FILE`** `net_address login_mode directory file`

`net_address`............ address of machine where data reside (although names are preferred, the IP number may be used).
`login_mode`.............. either USER or GUEST. If USER, then the requestor should log in as a user to ftp the data (an account is required). If GUEST, the requestor should log in as anonymous to ftp the data (an account is not required).
`directory`................ specifies the directory in which the message file will reside. Note that this may depend on the login_mode. The directory name is case sensitive.
`file`............................. is the name of the file that contains the message. The file name is case sensitive.

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Free format log information may follow the FTP_FILE line.

Example 4.0 - 4 The following example is a data message sent to a requestor of data. It indicates that the data are on machine “pidc.org” in directory “/pub/data” in file “1994125001.msg.gz”. The requestor must log into pidc.org as a user to obtain the data.

```
BEGIN GSE2.1
MSG_TYPE DATA
MSG_ID 1040 GSE_IDC
REF_ID 5493 ANY_NDC
DATA_TYPE FTP_LOG GSE2.1
FTP_FILE pidc.org USER /pub/data/ANY_NDC 1994125001.msg.gz
%  The original request could not be satisfied using e-mail due to
%  the size of the requested information; ftp was used instead.
%  Please log into your user account to retrieve the data.  Data
%  will be removed by 1996/10/23.
STOP
```

WAVEFORM

The capabilities of waveform data messages have been expanded in GSE 2.1 format. In addition to sending waveform data, the data type can be used to respond that no data are available for a request, or that the response to the request will be delayed. This is done with the new lines OUT2 and DLY2. Information on the structure of how the new lines are used is given in Table 6. In addition, the new STA2 line contains station information. It is a mandatory line, and must immediately follow the WID2, OUT2, and DLY2 lines.

The optional EID2 line(s) specifies to which event(s) a waveform is associated. This is used when waveforms are requested from a bulletin with the keyword RELATIVE_TO. The EID2 line may be repeated for each event with which a waveform is associated.

The optional BEA2 line specifies how a beamed waveform was formed. This line is only used when the waveform is the result of beaming.

Table 6. **Applicable line types for waveform messages**

Message type / Line Type	WID2	OUT2	DLY2	STA2	EID2	BEA2	DAT2	CHK2
waveform data message	X			X	/	/	X	X
no data message		X		X				
data delayed message			X	X				

X Required line

/ Supplemental line

The GSE2.1 format for waveform data messages consists of a waveform identification line (see WID2, Table 7) followed by the STA2 line, the waveform information itself (DAT2), and a checksum of the data (see CHK2, Table 9). Each data (DAT2) section should end with a checksum so that the validity (or otherwise) of the data can be verified.

The WID2 line gives the date and time of the first data sample; the station, channel, and auxiliary codes; the sub_format of the data; the number of samples and sample rate; the calibration of the instrument represented as the number of nanometers per digital count at the calibration period; the type of instrument, as shown in Table 8; and the horizontal and vertical orientation of the instrument. Note that the auxiliary code will be blank in most cases; it is only used when there is a conflict between two data streams with the same station and channel codes. Instrument response information must be obtained separately using a RESPONSE request.

Data following the DAT2 block may be in any of six different sub_formats recognized in the GSE2.1 waveform format. They are INT, CM6, CM8, AUT, AU6, and AU8. INT is a simple ASCII sub_format, the “CM” sub_formats are for compressed data, and the “AU” sub_formats are for authentication data. All of the GSE formats represent the numbers as integers.

A checksum must be computed for the waveform data in the GSE2.1 waveform format. The checksum is computed from integer data values prior to converting them to any of the sub_formats. To prevent overflow, the checksum is computed modulo 100,000,000 and stored as an eight digit integer without sign. To avoid possible confusion and bypass incompatibility problems, a C function and a F77 subroutine are provided in Appendix B demonstrating the exact algorithm for checksum computation.

The line length limits for GSE messages are enforced for the GSE2.1 data formats; that is, no line may be longer than 1024 bytes long and the default line length is 132 characters. The line continuation character (“\”) is not used in waveform data lines.

Table 7. **WID2 Line Format**

Position	Name	Format	Description
1-4	“WID2”	a4	Must be “WID2”
6-15	Date	i4,a1,i2,a1,i2	Date of the first sample (yyyy/mm/dd)
17-28	Time	i2,a1,i2,a1,f6.3	Time of the first sample (hh:mm:ss.sss)
30-34	Station	a5	Station code
36-38	Channel	a3	FDSN channel code
40-43	Auxid	a4	Auxiliary identification code
45-47	Sub_format	a3	“INT”, “CMn”, or “AUx” INT is free format integers as ASCII characters; “CM” denotes compressed data, and n is either 6 (6-bit compression), or 8 (8-bit binary compression) “AU” signifies authentication and x is T (uncompressed binary integers), 6 (6-bit compression), or 8 (8-bit binary compression)
49-56	Samps	i8	Number of samples
58-68	Samprate	f11.6	Data sampling rate (Hz)
70-79	Calib	e10.2	Calibration factor; i.e., the ground motion in nanometers per digital count at calibration period (calper)
81-87	Calper	f7.3	Calibration reference period; i.e., the period in seconds at which calib is valid; calper should be near the flat part of the response curve. (in most cases, 1 sec)
89-94	Instype	a6	Instrument type (from Table 8)
96-100	Hang	f5.1	Horizontal orientation of sensor, measured in positive degrees clockwise from North (-1.0 if vertical)
102-105	Vang	f4.1	Vertical orientation of sensor, measured in degrees from vertical (90.0 if horizontal)

Table 8. **GSE Instrument Types**

instype	Description
Akashi	Akashi
20171A	Geotech 20171A
23900	Geotech 23900
7505A	Geotech 7505A
8700C	Geotech 8700C
BB-13V	Geotech BB-13V
CMG-3	Guralp CMG-3
CMG-3N	Guralp CMG-3NSN
CMG-3T	Guralp CMG-3T
CMG-3E	Guralp CMG3-ESP
FBA-23	Kinemetrics FBA-23
GS-13	Geotech GS-13
GS-21	Geotech GS-21
HM-500	HM-500
KS3600	Geotech KS-36000
KS360i	Geotech KS-36000-I
KS5400	Geotech KS-54000
LE-3D	LE-3D
Mk II	Willmore Mk II
MP-L4C	Mark Products L4C
Oki	Oki
Parus2	Parus-2
Podrst	Podrost
S-13	Geotech S-13
S-500	Geotech S-500
S-750	Geotech S-750
STS-1	Streckeisen STS-1
STS-2	Streckeisen STS-2
SDSE-1	SDSE-1
SOSUS	SOSUS
TSJ-1e	TSJ-1e

Table 9. **DAT2 Block Format**

Position	Name	Format	Description
Header Line			
1-4	“DAT2”	a4	Must be “DAT2”
Data Lines			
1-1024 (variable)	Data	i, a, or f	Data values

Table 10. **STA2 Line Format**

Position	Name	Format	Description
1-4	“STA2”	a4	Must be “STA2”
6-14	Network	a9	Network identifier
16-34	Lat	f9.5	Latitude (degrees, S is negative)
36-45	Lon	f10.5	Longitude (degrees, W is negative)
47-58	Coordsys	a12	Reference coordinate system (e.g., WGS-84)
60-64	Elev	f5.3	Elevation (km)
66-70	Edepth	f5.3	Emplacement depth (km)

Table 11. **OUT2 Line Format**

Position	Name	Format	Description
1-4	“OUT2”	a4	Must be “OUT2”
6-15	Date	i4,a1,i2,a1,i2	Date of the first missing sample (yyyy/mm/dd)
17-28	Time	i2,a1,i2,a1,f6.3	Time of the first missing sample (hh:mm:ss.sss)
30-34	Station	a5	Station code
36-38	Channel	a3	FDSN channel code
40-43	Auxid	a4	Auxiliary identification code
45-55	Duration	f11.3	Duration that data are unavailable (seconds)

Table 12. **DLY2 Line Format**

Position	Name	Format	Description
1-4	“DLY2”	a4	Must be “DLY2”
6-15	Date	i4,a1,i2,a1,i2	Date of the first delayed sample (yyyy/mm/dd)
17-28	Time	i2,a1,i2,a1,f6.3	Time of the first delayed sample (hh:mm:ss.sss)
30-34	Station	a5	Station code
36-38	Channel	a3	FDSN channel code
40-43	Auxid	a4	Auxiliary identification code
45-55	Queuetim	f11.3	Duration of queue (seconds)

Table 13. **CHK2 Block Format**

Position	Name	Format	Description
Checksum Line			
1-4	“CHK2”	a4	Must be “CHK2”
6-13	Checksum	i8	For checksum algorithm see Appendix B

Example 4.0 - 5 OUT2 example. The following message would be sent if data are not available from station KAF, channel shz from 1996 October 15 9:56:00.000 through 1996 October 15 9:57:00.000.

```
DATA_TYPE WAVEFORM GSE2.1:CM6
WID2 1996/10/15 09:54:00.000 KAF   shz      CM6     2400   20.000000   2.70e-01  1.0000 S-13    -1.0  0.0
STA2 IDC_SEIS    62.11270   26.30621 WGS-84       0.195 0.014
DAT2
AFkFCUHTkHUHCkRMUK-F4N+2-M1UHkGT6UHkGRUG6kQDDkEPUI7kO0UKLMUFLP6-F2R+AKkFC3OGA+kG65kEABQR
8DQIAFS+BR5UFTkFUG5SFCNH70LF7HP5BkG-AMkG6U
...
CHK2 1439544
OUT2 1996/10/15 09:56:00.000 KAF   shz          60.000
STA2 IDC_SEIS    62.11270   26.30621 WGS-84       0.195 0.014
WID2 1996/10/15 09:57:00.000 KAF   shz      CM6     1200   20.000000   2.70e-01  1.0000 S-13    -1.0  0.0
STA2 IDC_SEIS    62.11270   26.30621 WGS-84       0.195 0.014
DAT2
AFkFCUHTkHUHCkRMUK-F4N+2-M1UHkGT6UHkGRUG6kQDDkEPUI7kO0UKLMUFLP6-FH62R+AKkFC3OGA+kG65kEABQR
8DQIAFS+BR5UFTkFUG5SFCNH70LF7HP5BkG-AMkG6U
...
CHK2 8648264
STOP
```

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Table 14. **EID2 Line Format**

Position	Name	Format	Description
1-4	"EID2"	a4	Must be "EID2"
6-13	EventID	a8	Event ID of associated event
15-23	Bull_type	a9	Bulletin type

Table 15. **BEA2 Line Format**

Position	Name	Format	Description
1-4	"BEA2"	a4	Must be "BEA2"
6-17	BeamID	a12	BeamID for the waveform (provides a link to data type BEAM)
19-23	Azimuth	f5.1	Azimuth used to steer the beam (measured in positive degrees clockwise from North)
25-29	Slowness	f5.1	Slowness used to steer the beam (s/deg, -999.0 if vertical beam)

Example 4.0 - 6

BEA2 and EID2 example. The following waveform has the channel code scc, which indicates that it is a short period coherent beam. The EID2 line shows that this waveform is associated with the IDC_REB event 54903285. The BEA2 line reveals that the beam was formed with an azimuth of 127.6 degrees, and slowness of 0.125 degrees/second. The BeamID FICB.Pa may be used to get more detailed beam information from the BEAM data type.

```
DATA_TYPE WAVEFORM GSE2.1:CM6
WID2 1996/10/15 09:54:00.000 ARCES  scc      CM6     1200   20.000000   2.70e-01  1.0000 S-13    -1.0  0.0
STA2 IDC_SEIS    69.53489   25.50580 WGS-84       0.402 0.009
EID2 54903285 IDC_REB
BEA2 FICB.Pa      127.6  0.125
DAT2
AFkFCUHTkHUHCkRMUK-F4N+2-M1UHkGT6UHkGRUG6kQDDkEPUI7kO0UKLMUFLP6-F2R+AKkFC3OGA+kG65kEABQR
8DQIAFS+BR5UFTkFUG5SFCNH70LF7HP5BkG-AMkG6U
...
CHK2 8439546
STOP
```

O P E R A T I O N S

Sub_format INT

The INT waveform sub_format represents integer data as blank or NewLine delimited ASCII characters. The number of blank spaces between samples is unspecified and an individual sample value may not be continued on the next line.

Example 4.0 - 7 Waveform with data in INT sub_format:

```
DATA_TYPE WAVEFORM GSE2.1:INT
WID2 1994/03/10 12:13:14.800 BLA   shz      INT    32490   40.000000   1.30e-02   2.000 GS-13   -1.0  0.0
STA2 IDC_SEIS    37.21130  -80.42050 WGS-84       0.491 0.009
DAT2
1873 1734 1690 1200 873 340 -290 -478 -1300 -209 -1972 -24 13 25 64 81 102 76 53 23 -10 -80 -132 -487
...
12 15 36 75 53 80 27 6 -17 -32 -95 -73 -43 -4 3 29 46 59 100 125 103 76 52 10 -30
CHK2  4968214
```

Compression Schemes

Two different compression schemes are recognized in the GSE2.1 waveform format; CM6 and CM8; the 6-bit and 8-bit second difference schemes used in GSETT2.

The basis of these compression schemes is that, for seismic data, the difference between data samples is usually very much smaller than their instantaneous magnitudes, and the difference of the differences (the second difference) is even smaller. So, transmitting the second differences requires fewer significant bits. Reductions in the message length can be achieved if the number of bits to convey the information is reduced when the signal level is small and expanded when the signal level rises. Since samples will take a variable number of bits, an Index is required in order to indicate how many bits each sample takes.

Both of the compression schemes use second differences as a first step to reducing the number of significant bits required to convey the information contained in the time series. A first difference is computed as the difference between successive samples. Second differences are simply the difference between the differences. The first value in both steps keeps its absolute value (see below).

The following paragraphs describe the compression schemes to reduce the number of bits and/or to make transmission easy.

Sub_format CM6

CM6 is a data compression algorithm which was successfully employed in GSETT2 and was referred to as 6-bit compression of second differences. The advantage of this method is in its conversion of binary integer data to ASCII characters that can be successfully transmitted using e-mail. The compression algorithm converts waveforms into a set of printable ASCII characters carefully avoiding those which have been found to cause problems to either communications circuits or the computers connected to them. It uses only the 64 characters +, -, 0 - 9, A - Z and a - z.

Initially, all data samples in the packet are represented as 32 bit, 2's complement integer, with a range of - (2^{31}) to +(2^{31}- 1). Second difference samples are encoded as the difference between the first differences and can be computed using the following formula:

$$D_2(j) = S(j) - 2S(j-1) + S(j-2)$$

where zero and negative indices are ignored. Thus the second difference data for N samples are:

$$S(1), S(2) - 2S(1), S(3) - 2S(2) + S(1), \ldots, S(N) - 2S(N-1) + S(N-2)$$

To compress the numbers, the second differences are converted from two's complement to sign and magnitude. These numbers are then fit into a variable number of bytes in which only the six most significant bits are utilized. The most significant usable bit of each byte is used as a flag or control bit which, if set, is used to signify that the following byte also contains information relating to the same sample. The second most significant bit is used as a sign bit in the first byte pertaining to a sample and as a data bit in all following bytes of the sample. All other bits are used to represent the value of the second difference of the sample:

MSB							LSB
control	**sign/ data**	**data**	**data**	**data**	**data**	**unused**	**unused**

These six-bit bytes are then used to refer to a look-up table (Table 16) from which one of 64 different ASCII characters (+, -, 0-9, A-Z, a-z) is extracted.

Table 16. **ASCII Representation of Bit Patterns for CM6**

Bit Pattern	Char	Bit Pattern	Char	Bit Pattern	Char	Bit Pattern	Char
000000	+	010000	E	100000	U	110000	k
000001	-	010001	F	100001	V	110001	l
000010	0	010010	G	100010	W	110010	m
000011	1	010011	H	100011	X	110011	n
000100	2	010100	I	100100	Y	110100	o
000101	3	010101	J	100101	Z	110101	p
000110	4	010110	K	100110	a	110110	q
000111	5	010111	L	100111	b	110111	r
001000	6	011000	M	101000	c	111000	s
001001	7	011001	N	101001	d	111001	t
001010	8	011010	O	101010	e	111010	u
001011	9	011011	P	101011	f	111011	v
001100	A	011100	Q	101100	g	111100	w
001101	B	011101	R	101101	h	111101	x
001110	C	011110	S	101110	i	111110	y
001111	D	011111	T	101111	j	111111	z

Example 4.0 - 8 Waveform with data in CM6 sub_format:

```
DATA_TYPE WAVEFORM GSE2.1:CM6
WID2 1994/03/10 12:13:14.800 BLA   shz      CM6    32490   40.000000   1.30e-02   2.000 GS-13   -1.0  0.0
STA2 IDC_SEIS    37.21130  -80.42050 WGS-84       0.491 0.009
DAT2
hsYbhas76hJHjhd7sk+bsaybaueJjhZ87iu97Dfiu97iuhDSjhgHESKHbs923kjGE+GE6gdas723hs7S7jk2hahsJHAsyd0-hd72
...
kjSKuhlksfkluhAkf874kjklds87kjhZ87iu97Dfiu97iuhDSf796khsdfuhskldf672KSEfkiu++kjh
CHK2 4968214
```

Sub_format CM8

The CM8 sub_format is similar to the CM6 sub_format. The same algorithm is used, but the compression is more efficient than the 6-bit sub_format since there are no unused bits. The 8-bit scheme is a binary format that cannot be transmitted using e-mail; ftp must be used.

The second difference integers are first converted from 2's complement to sign and magnitude. These numbers are then fit into a variable number of bytes in which all eight significant bits are utilized. The most significant usable bit of each byte is used as a flag or control bit which, if set, is used to signify that the following byte also contains information relating to the same sample. The second most significant bit is used as a sign bit in the first byte pertaining to a sample and as data in all following bytes. All other bits are used to represent the value of the second difference:

MSB							LSB
control	**sign/ data**	**data**	**data**	**data**	**data**	**data**	**data**

Sub_format AUT

Waveform data that have been signed for authentication must contain more than just waveform samples; it must also contain time and status information. The GSE2.1 authentication sub_format includes this information in packets that are individually signed for authentication. The signed data in this sub_format include the time-stamp, the number of samples, the status word, and the data. Waveform segments consist of several of these packets concatenated, as shown in Table 17. The data are binary integers.

Table 17. **Authentication Data Format**

Name	Format	Description
length of packet	4-byte IEEE integer	length of packet in bytes, not counting this word, for channel data that follows (divisible by 4)
authentication	40-byte string	authentication signature
timestamp	8-byte IEEE float	seconds since 1 January 1970 00:00 for first sample. Must be within one sample of nominal time.
samples	4-byte IEEE integer	number of samples in channel packet
status word	4-byte string	Data status byte (most significant byte): bit 31 1=dead channel bit 30 1=zeroed data bit 29 1=clipped bit 28 1=calibration signal bits 24-27 undefined Station status byte: bit 23 1=vault door open bit 22 1=authentication box opened bit 21 1=equipment moved bit 20 1=clock differential too large bits 16-19 undefined Station specific bits: bits 0-15 user defined (e.g., station status counter)
data	(length of packet minus 56 bytes - based on original 4-byte IEEE integers)	raw 4-byte integers or compressed data

Sub_formats AU6 and AU8

Data that have an authentication signature may be compressed for ease in transmission. The same authentication sub_format described above is used for compressed authenticated data, with the difference that the data are compressed. The AU6 and AU8 authentication formats are compressed using the 6-bit and 8-bit compression schemes described above. The compression algorithm is applied only to the data, not to the 60 bytes of header information given in Table 17. Before verifying the authenticity of the data, it must be uncompressed using the appropriate decompression scheme.

NETWORK

The NETWORK data type provides a descriptive name for each network code. The network ID will be up to 9 characters in length, and will consist of two parts, separated by an underscore. The first part will be 3 or 4 characters in length, and can be considered the “domain” of the network. This code will either be an internationally recognized affiliation (i.e., EMSC, FDSN, IDA, IDC, IRIS, or NEIC) or a three letter ISO standard country code, as shown in Table 4. The second part of the network ID is the network code (1-4 characters) within that domain. For example, IRIS maintains a registered list of two and four letter network codes. An NDC which sends data to the IDC may use the network code NDC. For example, the 3 letter ISO code for the Czech Republic is CZE, so the default network code for the NDC of the Czech Republic is CZE_NDC.

With proper implementation and coordination, the station identifier coupled with the network ID will guarantee that each station can be identified uniquely.

Table 18. **Network Header and Data Format**

Position	Name/Text	Format	Description
Network Header			
1-3	“Net”	a3	Text
11-21	“Description”	a11	Text
Network Data			
1-9	Network	a9	Network code
11-74	Description	a64	Descriptive network name

Example 4.0 - 9 NETWORK data type

```
DATA_TYPE NETWORK GSE2.1
Net       Description
IDC_SEIS  International Data Centre Seismic Network
IDC_HYDR  International Data Centre Hydroacoustic Network
```

STATION

The STATION data type contains information describing the site, location and dates of operation. For arrays, the unique array code which defines a reference point (used for beamforming) should be given along with the information from each element.

Table 19. **Station Header and Data Formats**

Position	Name	Format	Description
Station Header			
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
17-20	"Type"	a4	Text
23-30	"Latitude"	a8	Text
33-41	"Longitude"	a9	Text
43-51	"Coord Sys"	a9	Text
59-60	"Elev"	a4	Text
64-70	"On Date"	a7	Text
74-81	"Off Date"	a8	Text
Station Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station Code
17-20	Statype	a4	1C=single component 3C=three-component hfa=high frequency array lpa=long period array
22-30	Lat	f9.5	Latitude (degrees, S is negative)
32-41	Lon	f10.5	Longitude (degrees, W is negative)
43-54	Coordsys	a12	Coordinate system (e.g., WGS-84)
56-60	Elev	f5.3	Elevation (km)
62-71	Ondate	i4,a1,i2,a1,i2	Start of station operation (yyyy/mm/dd)
73-82	Offdate	i4,a1,i2,a1,i2	End of station operation (yyyy/mm/dd)

Example 4.0 - 10 STATION data type

```
DATA_TYPE STATION GSE2.1
Net        Sta   Type  Latitude  Longitude Coord Sys     Elev   On Date   Off Date
IDC_SEIS  ARCES hfa   69.53490   25.50580 WGS-84       0.403 1987/09/30
IDC_SEIS  ARA0  3C    69.53490   25.50580 WGS-84       0.403 1987/09/30
IDC_SEIS  ARA1  1C    69.53630   25.50710 WGS-84       0.411 1987/09/30
IDC_SEIS  ARA2  1C    69.53380   25.50780 WGS-84       0.392 1987/09/30
IDC_SEIS  ARA3  1C    69.53460   25.50190 WGS-84       0.402 1987/09/30
IDC_SEIS  ARB1  1C    69.53790   25.50790 WGS-84       0.414 1987/09/30
IDC_SEIS  ARB2  1C    69.53570   25.51340 WGS-84       0.397 1987/09/30
IDC_SEIS  ARB3  1C    69.53240   25.51060 WGS-84       0.376 1987/09/30
IDC_SEIS  ARB4  1C    69.53280   25.49980 WGS-84       0.378 1987/09/30
IDC_SEIS  ARB5  1C    69.53630   25.49850 WGS-84       0.400 1987/09/30
IDC_SEIS  ARC1  1C    69.54110   25.50790 WGS-84       0.381 1987/09/30
IDC_SEIS  ARC2  3C    69.53830   25.52290 WGS-84       0.395 1987/09/30
IDC_SEIS  ARC3  1C    69.53290   25.52310 WGS-84       0.376 1987/09/30
IDC_SEIS  ARC4  3C    69.52930   25.51170 WGS-84       0.377 1987/09/30
IDC_SEIS  ARC5  1C    69.53000   25.49820 WGS-84       0.374 1987/09/30
IDC_SEIS  ARC6  1C    69.53410   25.48820 WGS-84       0.395 1987/09/30
IDC_SEIS  ARC7  3C    69.53960   25.49360 WGS-84       0.362 1987/09/30
IDC_SEIS  ARD1  1C    69.54830   25.50930 WGS-84       0.395 1987/09/30
IDC_SEIS  ARD2  1C    69.54520   25.53080 WGS-84       0.366 1987/09/30
```

CHANNEL

The channel data type contains information describing the sensors and their emplacement (see Table 20)

Table 20. **Channel Header & Data Formats**

Position	Name/Text	Format	Description
Channel Header			
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
16-19	"Chan"	a4	Text
21-23	"Aux"	a3	Text
27-34	"Latitude"	a8	Text
36-45	"Longitude"	a9	Text
47-55	"Coord Sys"	a9	Text
63-66	"Elev"	a4	Text
70-74	"Depth"	a5	Text
78-81	"Hang"	a4	Text
84-87	"Vang"	a4	Text
89-99	"Sample Rate"	a11	Text
101-104	"Inst"	a4	Text
111-117	"On Date"	a7	Text
122-128	"Off Date	a7	Text
Channel Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-19	Chan	a3	FDSN channel code
21-24	Auxid	a4	Auxiliary code
26-34	Lat	f9.5	Latitude (degrees, S is negative)
36-45	Lon	f10.5	Longitude (degrees, W is negative)
47-58	Coordsys	a12	Coordinate system (e.g., WGS-84)
60-64	Elev	f5.3	Elevation (km)
66-70	Edepth	f5.3	Emplacement depth (km)
72-77	Hang	f6.1	Horizontal angle of emplacement (positive degrees clockwise from North, -1.0 if vertical)
79-83	Vang	f5.1	Vertical angle of emplacement (degrees from vertical, 90.0 if horizontal)
85-95	Samprate	f11.6	Sample rate (samples/sec)
97-103	Inst	a6	Instrument type (e.g., see Table 8)
105-114	Ondate	i4,a1,i2,a1,i2	Start date of channel operation (yyyy/mm/dd)
116-125	Offdate	i4,a1,i2,a1,i2	End date of channel operation (yyyy/mm/dd)

Example 4.0 - 11 CHANNEL Data Type

```
DATA_TYPE CHANNEL GSE2.1
Net       Sta  Chan Aux   Latitude  Longitude Coord Sys     Elev Depth   Hang  Vang Sample Rate Inst      On Date   Off Date
IDC_SEIS  ARA0  she       69.53490   25.50580 WGS-84       0.403 0.010   90.0  90.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARA0  shn       69.53490   25.50580 WGS-84       0.403 0.011    0.0  90.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARA0  shz       69.53490   25.50580 WGS-84       0.403 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARA1  shz       69.53630   25.50710 WGS-84       0.411 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARA2  shz       69.53380   25.50780 WGS-84       0.392 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARA3  shz       69.53460   25.50190 WGS-84       0.402 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARB1  shz       69.53790   25.50790 WGS-84       0.414 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARB2  shz       69.53570   25.51340 WGS-84       0.397 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARB3  shz       69.53240   25.51060 WGS-84       0.376 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARB4  shz       69.53280   25.49980 WGS-84       0.378 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARB5  shz       69.53630   25.49850 WGS-84       0.405 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC1  shz       69.54110   25.50790 WGS-84       0.381 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC2  she       69.53830   25.52290 WGS-84       0.395 0.010   90.0  90.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC2  shn       69.53830   25.52290 WGS-84       0.395 0.010    0.0  90.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC2  shz       69.53830   25.52290 WGS-84       0.395 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC3  shz       69.53290   25.52310 WGS-84       0.376 0.010   -1.0   0.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC4  she       69.52930   25.51170 WGS-84       0.377 0.010   90.0  90.0   40.000000 GS-13   1987/09/30
IDC_SEIS  ARC4  shn       69.52930   25.51170 WGS-84       0.377 0.010    0.0  90.0   40.000000 GS-13   1987/09/30
```

BEAM

BEAM is a new data type which describes processing done on waveforms. It is most frequently used to describe parameters used to create beams at arrays, but it can also be used to describe parameters used for detection at three component stations.

The BEAM data type consists of two blocks, the beam group block and the beam parameter block. The beam group block describes which channel(s) were used to form the beam, while the beam parameter block describes the filter applied and the azimuth and slowness which were used to steer the beam.

Table 21. **Beam Header & Data Format**

Position	Name/Text	Format	Description
Beam Group Block Header			
1-6	“Bgroup”	a6	Text
10-12	“Sta”	a3	Text
15-18	“Chan”	a4	Text
20-22	“Aux”	a3	Text
25-27	“Wgt”	a3	Text
33-37	“Delay”	a5	Text
Beam Group Block Data			
1-8	Bgroup	a8	Beam group
10-14	Sta	a5	Station Code
16-18	Chan	a3	Channel code
20-23	Auxid	a4	Auxiliary code
25-27	Wgt	i3	Weight used for this component when the beam was formed
29-37	Delay	f9.5	Beam delay for each component (s) (used for beams formed by non-plane waves)

Table 22. **Beam Parameter Block Header & Data Format**

Position	Name	Format	Description
Beam Parameter Block Header			
1-6	“BeamID”	a6	Text
14-19	“Bgroup”	a6	Text
21-25	“Btype”	a5	Text
27	“R”	a1	Text
30-33	“Azim”	a4	Text
36-39	“Slow”	a4	Text
41-45	“Phase”	a5	Text
53-55	“Flo”	a3	Text
60-62	“Fhi”	a3	Text
65	“O”	a1	Text
67	“Z”	a1	Text
71	“F”	a1	Text
74-80	“On Date”	a7	Text
85-92	“Off Date”	a8	Text
Beam Parameter Block Data			
1-12	BeamID	a12	Beam ID (not case sensitive)
14-21	Bgroup	a8	Beam group
23-25	Type	a3	Beam type (inc=incoherent, coh=coherent)
27-27	Rot	a1	Rotation flag (y=yes, n=no)
29-33	Azimuth	f5.1	Azimuth used to steer the beam (measured in positive degrees clockwise from North)
35-39	Slowness	f5.1	Slowness used to steer the beam (s/deg, -999.0 if vertical beam))
41-48	Phase	a8	Phase used to set the beam slowness for origin-based beams
50-55	Flo	f6.2	Low frequency cut-off for the beam filter (Hz)
57-62	Fhi	f6.2	High frequency cut-off for the beam filter (Hz)
64-65	Ford	i2	Filter order
67-67	Zero-phase	a1	Flag to indicate zero-phase filtering (y=yes, n=no)
69-70	Ftype	a2	Type of filtering (BP-band pass, LP=low pass, HP=high pass, BR=band reject)
72-81	Ondate	i4,a1,i2,a1,i2	Start date of beam use (yyyy/mm/dd)
83-92	Offdate	i4,a1,i2,a1,i2	End date of beam use (yyyy/mm/dd)

Example 4.0 - 12 BEAM data type. The top part of the example shows which elements contribute to form a beam. The vertical components form beam group 1 (`FIG1`), while the horizontal components form beam group 2 (`FIG2`). The second part of the example shows the parameters used for particular beams. The first three beams have fixed azimuth and slowness, and no phase. The second set of beams specify no azimuth, but do have slowness and phase values. The azimuth values for this type of beam is determined by the origin used to steer the beam, and is given in the BEA2 line in waveform data messages. This type of beam is known as an origin beam, and is commonly used to form a beam after an origin is established.

```
DATA_TYPE BEAM GSE2.1
Bgroup   Sta  Chan Aux  Wgt     Delay
FIG1     FIA0  shz        1
FIG1     FIB1  shz        1
FIG1     FIB2  shz        0
FIG1     FIB3  shz        0
FIG1     FIB4  shz        1
FIG1     FIB5  shz        1
FIG1     FIC1  shz        1
FIG1     FIC2  shz        0
FIG1     FIC3  shz        0
FIG1     FIC4  shz        0
FIG1     FIC5  shz        1
FIG1     FIC6  shz        0
FIG2     FIA0  shn        1
FIG2     FIA0  she        1
FIG2     FIC7  shn        1
FIG2     FIC7  she        1

BeamID       Bgroup Btype R  Azim  Slow Phase       Flo    Fhi  O Z F    On Date   Off Date
FICB.01      FIG1     coh n  30.0 0.090 -          3.50   5.50  3 y BP 1997/01/01
FICB.02      FIG1     coh n  90.0 0.090 -          3.50   5.50  3 y BP 1997/01/01
FIIB.01      FIG2     inc n   0.0 0.000 -          8.00  16.00  3 y BP 1997/01/01
FICB.Pa      FIG1     coh n  -1.0 0.125 P          0.50  12.00  3 y BP 1997/01/01
FIIB.Sa      FIG1     inc n  -1.0 0.222 S          2.00   4.00  3 y BP 1997/01/01
FIIB.Lga     FIG2     inc n  -1.0 0.250 Lg         2.00   4.00  3 y BP 1997/01/01
FICB.Pb      FIG1     coh n  -1.0 0.125 P          0.50  12.00  3 y BP 1997/01/01
FIIB.Sb      FIG1     inc n  -1.0 0.222 S          2.00   4.00  3 y BP 1997/01/01
FIIB.Lgb     FIG2     inc n  -1.0 0.250 Lg         2.00   4.00  3 y BP 1997/01/01
```

RESPONSE

The RESPONSE data type allows the complete response to be given as a series of response groups that can be cascaded. Modern instruments are composed of several different components, each with its own response. This format mimics the actual configuration of the instrumentation.

A complete response description is made up of the CAL2 identification line plus one or more of the PAZ2, FAP2, GEN2, DIG2, and FIR2 response sections in any order. The response sections should be given sequential stage numbers (beginning with 1) in the order they occur in the system response.

Each response section is comprised of a header line and sufficient occurrences of the values lines to provide all required coefficients. Note that the DIG2 section may occur only once per response and that it requires no values lines. Comments may be inserted after the CAL2 header and after any response section as desired, provided that they are enclosed with parenthesis beginning in column 2. Successive channel responses should also be separated by blank lines for readability.

The input of the earth is in nanometers of displacement (i.e., all of the responses are displacement responses). Velocity or acceleration responses can be obtained by multiplying the response curve by $i\omega$ or $i\omega^2$, respectively.

CAL2 Line

The first line is the “CAL2” line giving general information about the response information that follows in Table 23.

Table 23. **Calibration Identification Line (CAL2) Format**

Position	Name	Format	Description
1-4	“CAL2”	a4	must be “CAL2”
6-10	Sta	a5	station code
12-14	Chan	a3	FDSN channel code
16-19	Auxid	a4	auxiliary identification code
21-26	Instype	a6	instrument type (see Table 7).
28-42	Calib*	e10.2	system sensitivity (nm/count) at reference period (calper)
44-50	Calper*	f7.3	calibration reference period (seconds)
52-62	Samprat*	f11.5	system output sample rate (Hz)
64-73	Ondate**	i4,a1,i2,a1,i2	effective start date (yyyy/mm/dd)
75-79	Ontime**	i2,a1,i2	effective start time (hh:mm)
81-90	Offdate**	i4,a1,i2,a1,i2	effective end date (yyyy/mm/dd)
92-96	Offtime**	i2,a1,i2	effective end time (hh:mm)

* Calibration, cal period, and sample rate should be the same as in the WID2 header.
** The start/end date-times specify the time period for which the response is valid. If the response is still valid, the off date-time should be left blank.

O P E R A T I O N S

Poles and Zeros Section

A poles and zeros section (PAZ2) can be used for either an analog filter or an IIR filter. In the data section, poles are always given first followed by zeros, as shown in Table 20.

Table 24. **Poles and Zeros Section Format**

Position	Name	Format	Description
Header			
1-4	"PAZ2"	a4	must be "PAZ2"
6-7	Snum	i2	stage sequence number
9	Ounits*	a1	output units code (V=volts, A=amps, C=counts)
11-25	Sfactor**	e15.8	scale factor
27-30	Deci***	i4	decimation (blank if analog)
32-39	Corr***	f8.3	group correction applied (seconds)
41-43	Npole****	i3	number of poles
45-47	Nzero	i3	number of zeros
49-73	Descrip	a25	description
Data			
2-16	Rroot	e15.8	real part of pole or zero
18-32	Iroot	e15.8	imaginary part of pole or zero

* Output units are V for volts, A for amps, and C for counts. Seismometers typically output volts or amps while an IIR filter would output counts. However, a simple response might give the seismometer with an output directly in counts implying that the digitizer response is included.

** The scale factor is in output units per input units. If this is the first (seismometer) section the input units are nm. Otherwise, the input units are the output units of the previous section.

*** The decimation factor and group correction must be blank for an analogue filter and must be non-blank (zero for no decimation or no group correction) for a digital filter.

****For an analogue filter the poles and zeros specify the Laplace transform. For an IIR filter, they specify the Z-transform.

Frequency, Amplitude, and Phase Section

Like PAZ2, the FAP2 section can be used to specify the response of analogue or digital filters, or some combination of them including a complete system response, as shown in Table 25.

Table 25. **Frequency, Amplitude and Phase Section Format**

Position	Name	Format	Description
Header			
1-4	"FAP2"	a4	must be "FAP2"
6-7	snum	i2	stage sequence number
9	ounits*	a1	output units code (V=volts, A=amps, C=counts)
11-14	deci**	i4	decimation (blank if analog)
16-23	corr**	f8.3	group correction applied (seconds)
25-27	Ntrip	i3	number of frequency, amplitude, phase triplets
29-53	Descrip	a25	description
Data (Triplets)			
2-11	Freq	f10.5	frequency (Hz)
13-27	Amp	e15.8	amplitude (input units/output units)
29-32	Phase	i4	phase delay (degrees)

* Output units are V for volts, A for amps, and C for counts. Seismometers typically output volts or amps while an IIR filter would output counts. However, a simple response might give the seismometer with an output directly in counts implying that the digitizer response is included.

** The decimation factor and group correction must be blank for an analogue filter and must be non-blank (zero for no decimation or no group correction) for a digital filter.

Generic Response

Like PAZ2, the GEN2 section can be used to specify the response of analogue or digital filters, or some combination of them including a complete system response, as shown in Table 26.

Table 26. **Generic Response Section Format**

Position	Name	Format	Description
Header			
1-4	"GEN2"	a4	must be "GEN2"
6-7	Snum	i2	stage sequence number
9	Ounits*	a1	output units code (V=volts, A=amps, C=counts)
11-25	Calib*	e15.8	section sensitivity (input units/output units)
27-32	Calper*	f7.3	calibration reference period (seconds)
35-38	Deci**	i4	decimation (blank if analog)

Table 26. **Generic Response Section Format**

40-47	corr**	f8.3	group correction applied (seconds)
49-51	ncorner	i3	number of corners
53-77	descrip	a25	description
Data			
2-12	cfreq	f11.5	corner frequency (Hz)
14-19	slope	f6.2	slope above corner (dB/decade)

* Output units are V for volts, A for amps, and C for counts. Seismometers typically output volts or amps while an IIR filter would output counts. However, a simple response might give the seismometer with an output directly in counts implying that the digitizer response is included.

** The decimation factor and group correction must be blank for an analogue filter and must be non-blank (zero for no decimation or no group correction) for a digital filter.

Digitizer Response Section

There is no values section for the digitizer as this just specifies the digitizer sample rate and sensitivity, as shown in Table 27. It also gives the user a chance to identify the model of digitizer being used.

Table 27. **Digitizer Response Section Format**

Position	Name	Format	Description
1-4DIG2	"DIG2"	a4	must be "DIG2"
6-7	Snum	i2	stage sequence number
9-23	Sensitivity	e15.8	sensitivity (counts/input unit)
25-35	Samprat	f11.5	digitizer sample rate (Hz)
37-61	Descrip	a25	description

Finite Impulse Response Section

The finite impulse response section is used to describe the response of digital filters, as shown in Table 28. The data lines may be repeated as necessary**.**

Table 28. **Finite Impulse Response Section Format**

Position	Name	Format	Description
Header			
1-4	"FIR2"	a4	must be "FIR2"
6-7	Snum	i2	stage sequence number
9-18	Gain	e10.2	filter gain (relative factor, not in dB)
20-23	Deci*	i4	decimation (blank if analog)
25-32	Corr*	f8.3	group correction applied (seconds)
34	Symflag**	a1	symmetry flag (A=asymetric, B=symetric (odd), C=symetric (even))

Table 28. **Finite Impulse Response Section Format**

36-39	Nfactor	i4	number of factors
41-65	Descrip	a25	description
Data			
2-16	Factor(i)	e15.8	factor(i)
18-32	Factor(i+1)	e15.8	factor(i+1)
34-48	Factor(i+2)	e15.8	factor(i+2)
50-64	Factor(i+3)	e15.8	factor(i+3)
66-80	Factor(i+4)	e15.8	factor(i+4)

* The decimation factor and group correction must be blank for an analogue filter and must be non-blank (zero for no decimation or no group correction) for a digital filter.

** The symmetry code may be A (asymmetric filter, all coefficients are given; B (symmetric filter with an odd number of coefficients - the nfactor factors represent 2*nfactor-1 coefficients; and C (symmetric filter with an even number of coefficients - the nfactor factors represent 2*nfactor coefficients).

Comments

Comments are enclosed in parentheses, as shown in Table 29.

Table 29. **Response Comment Section Format**

Position	Name	Format	Description
2	“(“	a1	Text
3-n	comment	a<n-1>	Comment
n+1	“)”	a1	Text

Sample Response Section

Example 4.0 - 13 Example of an instrument response.

```
DATA_TYPE RESPONSE GSE2.1
CAL2 MIAR  BHZ      CMG-3N  4.11000000E+00  16.000   40.00000 1992/09/23 20:00
 (USNSN station at Mount Ida, Arkansas, USA)
PAZ2  1 V  7.29000000E+04   1.000         6   3       CMG-3 (NSN) Acc-Vel (Std)
 -3.14000000E-02  3.14000000E-04
 -1.97000000E-01  1.97000000E-03
 -2.01000000E+02  2.01000000E+00
 -6.97000000E+02  6.97000000E+00
 -7.54000000E+02  7.54000000E+00
 -1.05000000E+03  1.05000000E+01
  0.00000000E+00  0.00000000E+00
  0.00000000E+00  0.00000000E+00
  0.00000000E+00  0.00000000E+00
 (Theoretical response provided by Guralp Systems, Ltd.)
DIG2  2  4.18000000E+05  5120.00000                   Quanterra QX80
FIR2  3   1.00E+00   16    0.006 C   32          QDP380/900616 stage 1
 -1.11328112e-03 -1.00800209e-03 -1.35286082e-03 -1.73045369e-03 -2.08418001e-03
 -2.38537718e-03 -2.60955630e-03 -2.73352256e-03 -2.73316190e-03 -2.58472445e-03
 -2.26411712e-03 -1.74846814e-03 -1.01403310e-03 -3.51681737e-05  1.23782025e-03
  3.15983174e-03  6.99944980e-03  9.09959897e-03  1.25423642e-02  1.63123012e-02
  2.02632397e-02  2.43172608e-02  2.84051094e-02  3.24604138e-02  3.64142842e-02
  4.01987396e-02  4.37450483e-02  4.69873249e-02  4.98572923e-02  5.22795729e-02
  5.41139580e-02  5.43902851e-02
FIR2  4   1.00E+00    4    0.077 C   36          QDP380/900616 stage 2
  1.50487336e-04  3.05924157e-04  4.42948687e-04  3.87117383e-04 -4.73786931e-05
 -9.70771827e-04 -2.30317097e-03 -3.70637676e-03 -4.62504662e-03 -4.46480140e-03
 -2.86984467e-03  7.00860891e-06  3.38519946e-03  6.00352836e-03  6.55093602e-03
  4.25995188e-03 -5.76023943e-04 -6.43416447e-03 -1.09213749e-02 -1.16364118e-02
 -7.26515194e-03  1.53727445e-03  1.19331051e-02  1.96156967e-02  2.03516278e-02
  1.18680289e-02 -4.64369030e-03 -2.41125356e-02 -3.86382937e-02 -3.98499220e-02
 -2.18683947e-02  1.61612257e-02  6.89623653e-02  1.26003325e-01  1.74229354e-01
  2.01834172e-01
FIR2  5   1.00E+00    2    0.379 C   32          QDP380/900616 stage 3,4,5
  2.88049545e-04  1.55313976e-03  2.98230513e-03  2.51714466e-03 -5.02926821e-04
 -2.81205843e-03 -8.08708369e-04  3.21542984e-03  2.71266000e-03 -2.91550322e-03
 -5.09429071e-03  1.33933034e-03  7.40034366e-03  1.82796526e-03 -8.81958286e-03
 -6.56719319e-03  8.38608573e-03  1.24268681e-02 -5.12978853e-03 -1.84868593e-02
 -1.79236766e-03  2.33604181e-02  1.30477296e-02 -2.51709446e-02 -2.93134767e-02
  2.12669298e-02  5.21898977e-02 -6.61517353e-03 -8.83535221e-02 -3.66062373e-02
  1.86273292e-01  4.03764486e-01
```

OUTAGE

Outage information is reported using the formats in Table 30.

Table 30. **Outage Header & Data Formats**

Position	Name/Text	Format	Description
Main Header			
1-18	"Report period from"	a18	Text
20-29	Start_date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
31-42	Start_time	i2,a1,i2,a1,f6.3	Time (hh:mm:ss.sss)
44-45	"to"	a2	Text
47-56	End_date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
58-67	End_time	i2,a1,i2,a1,f6.3	Time (hh:mm:ss.sss)
Table Header			
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
16-19	"Chan"	a4	Text
21-23	"Aux"	a3	Text
30-44	"Start Date Time"	a15	Text
55-67	"End Date Time"	a13	Text
76-83	"Duration"	a8	Text
85-91	"Comment"	a7	Text
Data			
1-9	Net	a9	Network code
11-15	Sta	a5	Station code
17-19	Chan	a3	FDSN channel code
21-24	Aux	a4	Auxiliary identification code
26-35	Start_Date	i4,a1,i2,a1,i2	Start date of outage interval*
37-48	Start_Time	i2,a1,i2,a1,f6.3	Start time of outage interval*
50-59	End_Date	i4,a1,i2,a1,i2	End date of outage interval**
61-72	End_Time	i2,a1,i2,a1,f6.3	End time of outage interval**
74-83	Duration	f10.3	Duration of interval (seconds)
85-132	Comment	a48	Comment

* Time of last available sample preceeding the outage or the start time of the report period.

** Time of first available sample after the outage or the end time of the report period.

Example 4.0 - 14 Outage data

```
DATA_TYPE OUTAGE GSE2.1
Report period from 1994/12/24 00:00:00.000 to 1994/12/25 12:00:00.000
NET       Sta  Chan Aux      Start Date Time          End Date Time        Duration Comment
IDC_SEIS  APL   shz      1994/12/24 08:13:05.000 1994/12/24 08:14:10.000     65.000
IDC_SEIS  APL   shn      1994/12/25 10:00:00.000 1994/12/25 10:00:00.030      0.030
```

ARRIVAL

The data type ARRIVAL is subdivided into five subtypes (AUTOMATIC, REVIEWED,GROUPED, ASSOCIATED, and UNASSOCIATED) in order to reflect the different stages of the processing more closely.

SUBTYPE: AUTOMATIC

The subtype AUTOMATIC replaces the GSE 2.0 format data type DETECTION, and provides the result of a detection process run on waveforms

Table 31. **Automatic Arrivals Header & Data Format**

Position	Name/Text	Format	Description
		Header	
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
17-22	"BeamID"	a6	Text
33-36	"Date"	a4	Text
44-47	"Time"	a4	Text
54-58	"Phase"	a5	Text
64-67	"Azim"	a4	Text
70-73	"Slow"	a4	Text
77-79	"SNR"	a3	Text
87-89	"Amp"	a3	Text
93-95	"Per"	a3	Text
99-101	"STA"	a3	Text
105-107	"Dur"	a3	Text
109-114	"Author"	a4	Text
122-126	"DetID"	a5	Text
		Data	
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-28	Beamid	a12	Beam ID
30-39	Date	i4,a1,i2,a1,i2	Detection date (yyyy/mm/dd)
41-52	Time	i2,a1,i2,a1,f6.3	Detection time (hh:mm:ss.sss)
54-61	Phase	a8	Preliminary phase code
63-67	Azim	f5.1	Observed backazimuth (degrees)
69-73	Slow	f5.1	Observed slowness (seconds/degree)
75-79	SNR	f5.1	Signal-to-noise ratio
81-89	Amp	f9.1	Amplitude (nanometers)
91-95	Per	f5.2	Period (seconds)
97-101	STA	f5.1	Short term average
103-107	Duration	f5.1	Detection duration (seconds)
109-117	Author	a9	Author of the detection
119-126	DetID	a8	Detection ID

Example 4.0 - 15 ARRIVAL:AUTOMATIC example.

```
DATA_TYPE ARRIVAL:AUTOMATIC GSE2.1
Net       Sta   BeamID        Date       Time      Phase      Azim  Slow   SNR       Amp   Per   STA   Dur Author       DetID
IDC_SEIS  BBB   BP0.5_4.0    1996/08/16 03:41:40.523 P        256.3  16.2  13.4     228.6  0.33   4.5   0.2 IDC_REB   11618391
IDC_SEIS  BBB   BP0.2_1.0    1996/08/16 03:42:04.531 S        334.7  18.6   8.2     338.6  0.33   9.1   1.2 IDC_REB   11618393
IDC_SEIS  DLBC  BP0.2_2.0    1996/08/16 03:42:58.584 P        166.7  16.5  16.5       1.5  0.33   2.0   0.4 IDC_REB   11618396
IDC_SEIS  DLBC  BP0.4_6.0    1996/08/16 03:44:59.808                                                       IDC_REB   11621022
```

SUBTYPE: REVIEWED ARRIVAL

The subtype REVIEWED is used for arrivals which have been reviewed, and phase names have been assigned. It is not expected that the phase names have been verified by location.

Table 32. **Reviewed Arrivals Header & Data Format**

Position	Name/Text	Format	Description
Header			
1-3	“Net”	a3	Text
11-13	“Sta”	a3	Text
16-19	“Chan”	a4	Text
22-24	“Aux”	a3	Text
30-33	“Date”	a4	Text
40-43	“Time”	a4	Text
50-54	“Phase”	a5	Text
60-62	“Azim”	a4	Text
66-69	“Slow”	a4	Text
73-75	“SNR”	a3	Text
83-85	“Amp”	a3	Text
89-91	“Per”	a3	Text
93-96	“Qual”	a4	Text
98-103	“Author”	a6	Text
110-114	“ArrID”	a5	Text
Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-19	Channel	a3	FDSN channel code
21-24	Auxid	a4	Auxiliary identification code
26-35	Date	i4,a1,i2,a1,i2	Arrival date (yyyy/mm/dd)
37-48	Time	i2,a1,i2,a1,f6.3	Arrival time (hh:mm:ss.s)
50-57	Phase	a8	Phase code
59-63	Azim	f5.1	Observed azimuth (degrees)
65-69	Slow	f5.1	Observed slowness (seconds/degree)
71-75	SNR	f5.1	Signal-to-noise ratio
77-85	Amp	f9.1	Amplitude (nanometers)
87-91	Per	f5.2	Period (seconds)

93	Picktype	a1	Type of pick (a=automatic, m=manual)
94	Direction	a1	Direction of short period motion (c=compression, d=dilatation, _=null)
95	Detchar	a1	Onset quality (i=impulsuve, e=emergent, q=questionable, _=null)
97-105	Author	a9	Author of the arrival
107-114	ArrID	a8	Arrival ID

Table 33. **Detection Character from Estimated Uncertainty in Onset Time**

detchar	uncertainty for local phases	uncertainty for regional/teleseismic phases
i	< 0.05 sec	< 0.2 sec
e	< 0.25 sec	< 1.0 sec
q	> 0.25 sec	> 1.0 sec

Example 4.0 - 16 ARRIVAL:REVIEWED example.

```
DATA_TYPE ARRIVAL:REVIEWED GSE2.1
Net        Sta  Chan  Aux      Date       Time      Phase     Azim  Slow   SNR       Amp   Per Qual Author      ArrID
IDC_SEIS   BBB   bhz      1996/08/16 03:41:40.523 P        256.3  16.2  13.4     228.6  0.33 a__ IDC_REB   11618391
IDC_SEIS   BBB   bhz      1996/08/16 03:42:04.531 S        334.7  18.6   8.2     338.6  0.33 a__ IDC_REB   11618393
IDC_SEIS   DLBC  bhz      1996/08/16 03:42:58.584 P        166.7  16.5  16.5       1.5  0.33 a__ IDC_REB   11618396
IDC_SEIS   DLBC  bhz      1996/08/16 03:44:59.808 S                                          m__ IDC_REB   11621022
IDC_SEIS   NEW   bhz      1996/08/16 03:43:23.394 P        308.2   6.6   4.2       0.3  0.33 a__ IDC_REB   11614783
IDC_SEIS   NEW   bhz      1996/08/16 03:46:03.321 S        337.6  12.2   4.1       0.2  0.33 a__ IDC_REB   11614787
```

SUBTYPE: GROUPED ARRIVAL

The subtype GROUPED is used for arrivals which have phase names, and have been grouped together, with the implication that they were generated by the same seismic event.

Table 34. **Grouped Arrivals Header & Data Format**

Position	Name/ Text	Format	Description
Header			
1-3	“Net”	a3	Text
11-13	“Sta”	a3	Text
16-19	“Chan”	a4	Text
21-23	“Aux”	a3	Text
29-32	“Date”	a4	Text
39-42	“Time”	a4	Text
50-54	“Phase”	a5	Text
59-62	“Azim”	a4	Text
66-69	“Slow”	a4	Text
73-75	“SNR”	a3	Text

83-85	“Amp”	a3	Text
89-91	“Per”	a3	Text
93-96	“Qual”	a4	Text
100-104	“Group”	a5	Text
106	“C”	a1	Text
108-113	“Author”	a6	Text
121-125	“ArrID”	a5	Text
Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-19	Channel	a3	FDSN channel code
21-24	Auxid	a4	Auxiliary identification code
26-35	Date	i4,a1,i2,a1,i2	Arrival date (yyyy/mm/dd)
37-48	Time	i2,a1,i2,a1,f6.3	Arrival time (hh:mm:ss.s)
50-57	Phase	a8	Phase code
59-63	Azim	f5.1	Observed azimuth (degrees)
65-69	Slow	f5.1	Observed slowness (seconds/degree)
71-75	SNR	f5.1	Signal-to-noise ratio
77-85	Amp	f9.1	Amplitude (nanometers)
87-91	Per	f5.2	Period (seconds)
93	Picktype	a1	Type of pick (a=automatic, m=manual)
94	direction	a1	Direction of short period motion (c=compression, d=dilitation, _=null)
95	Detchar	a1	Onset quality (i=impulsuve, e=emergent, q=questionable, _=null)
97-104	Groupid	a8	Group ID
106	Conflict	i1	Conflict flag (number of times an arrival belongs to more than one group, leave blank if arrival only belongs to one group)
108-116	Author	a9	Author of the arrival
118-125	ArrID	a8	Arrival ID

Example 4.0 - 17 ARRIVAL:GROUPED example.

```
DATA_TYPE ARRIVAL:GROUPED GSE2.1
Net       Sta  Chan Aux     Date       Time        Phase    Azim   Slow   SNR       Amp   Per Qual   Group C Author       ArrID
IDC_SEIS  BBB   bhz      1996/08/16 03:41:40.523 P        256.3  16.2  13.4     228.6  0.33 a__     5636   IDC_REB   11618395
IDC_SEIS  BBB   bhz      1996/08/16 03:42:04.531 S        334.7  18.6   8.2     338.6  0.33 a__     5636   IDC_REB   11618393
IDC_SEIS  DLBC  bhz      1996/08/16 03:42:58.584 P        166.7  16.5  16.5       1.5  0.33 a__     5636   IDC_REB   11618396
IDC_SEIS  DLBC  bhz      1996/08/16 03:44:59.808 S                                          m__     5636   IDC_REB   11621022
IDC_SEIS  NEW   bhz      1996/08/16 03:43:23.394 P        308.2   6.6   4.2       0.3  0.33 a__     5636   IDC_REB   11614783
IDC_SEIS  NEW   bhz      1996/08/16 03:46:03.321 S        337.6  12.2   4.1       0.2  0.33 a__     5636   IDC_REB   11614787
```

SUBTYPE: ASSOCIATED ARRIVAL

The subtype ASSOCIATED is used for arrivals which have been run through a location program, and have formed a seismic event. If multiple magnitude measurements have been made on an arrival, the subsequent magnitudes will appear on lines immediately after the arrival. If different amplitude measurements are used for different magnitudes, the amplitudes may also be repeated on the subsequent magnitude lines.

Table 35. **Associated Arrivals Header & Data Format**

Position	Name	Format	Description
Header			
1-3	“Net”	a3	Text
11-13	“Sta”	a3	Text
19-22	“Dist”	a4	Text
25-28	“EvAz”	a4	Text
30-34	“Phase”	a5	Text
41-44	“Date”	a4	Text
53-56	“Time”	a4	Text
64-67	“TRes”	a4	Text
70-73	“Azim”	a4	Text
75-79	“AzRes”	a5	Text
82-85	“Slow”	a4	Text
89-91	“SRes”	a4	Text
93-95	“Def”	a3	Text
99-101	“SNR”	a3	Text
109-111	“Amp”	a3	Text
115-117	“Per”	a3	Text
119-122	“Qual”	a4	Text
124-132	“Magnitude”	a9	Text
136-141	“OrigID”	a6	Text
143-148	“Author”	a6	Text
156-160	“ArrID”	a5	Text
Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-22	Dist	f6.2	Station to event distance (degrees)
24-28	EvAz	f5.1	Event to station azimuth (degrees)
30-37	Phase	a8	Phase code
39-48	Date	i4,a1,i2,a1,i2	Arrival date (yyyy/mm/dd)
50-61	Time	i2,a1,i2,a1,f6.3	Arrival time (hh:mm:ss.s)
63-67	TRes	f5.1	Time residual (seconds)
69-73	Azim	f5.1	Observed azimuth (degrees)
75-79	ARes	f5.1	Azimuth residual (degrees)
81-85	Slow	f5.1	Observed slowness (seconds/degree)
87-91	SRes	f5.1	Slowness residual (seconds/degree)
93	Tdef	a1	Time defining flag (T or _)

94	Adef	a1	Azimuth defining flag (A or _)
95	Sdef	a1	Slowness defining flag (S or _)
97-101	SNR	f5.1	Signal-to-noise ratio
103-111	Amp	f9.1	Amplitude (nanometers)
113-117	Per	f5.2	Period (seconds)
119	Picktype	a1	Type of pick (a=automatic, m=manual)
120	Direction	a1	Direction of short period motion (c=compression, d=dilitation, _=null)
121	Detchar	a1	Onset quality (i=impulsuve, e=emergent, q=questionable, _=null)
123-127	Mtype	a5	Magnitude type (mb, Ms, ML, mbmle, etc.)
128	Mindicator	a1	Min max indicator (<, >, or blank)
129-132	Magnitude	f4.1	Magnitude value
134-141	OrigID	a8	Origin ID
143-151	Author	a9	Author of the arrival
153-160	ArrID	a8	Arrival ID

Example 4.0 - 18 ARRIVAL:ASSOCIATED example.

```
DATA_TYPE ARRIVAL:ASSOCIATED GSE2.1

Net      Sta      Dist  EvAz Phase       Date       Time       TRes  Azim AzRes  Slow  SRes Def   SNR       Amp   Per Qual Magnitude   OrigID Author       ArrID
IDC_SEIS  BBB     1.61  57.1 Pg       1996/08/16 03:41:40.523  -1.1 256.3  17.5  16.2  -2.4 T__  13.4     228.6  0.33 a__ ML     4.1   769476 IDC_REB   11618399
IDC_SEIS  BBB     1.61  57.1 Lg       1996/08/16 03:42:04.531   1.1 334.7  95.9  18.6 -12.5 T__   8.2     338.6  0.33 a__                769476 IDC_REB   11618393
IDC_SEIS  DLBC    7.12   1.2 Pn       1996/08/16 03:42:58.584   0.5 166.7 -14.8  16.5   2.8 T__  16.5       1.5  0.33 a__ ML     4.2   769476 IDC_REB   11618396
IDC_SEIS  DLBC    7.12   1.2 Lg       1996/08/16 03:44:59.808   1.1                         T__                         a__                769476 IDC_REB   11621022
IDC_SEIS  NEW     9.07 104.6 Pn       1996/08/16 03:43:23.394  -1.3 308.2  13.5   6.6  -7.2 T__   4.2       0.3  0.33 a__ ML     3.5   769476 IDC_REB   11614783
IDC_SEIS  NEW     9.07 104.6 Lg       1996/08/16 03:46:03.321   2.8 337.6  42.9  12.2 -19.6 ___   4.1       0.2  0.33 a__                769476 IDC_REB   11614787
IDC_SEIS  YKA    14.05  31.2 Pn       1996/08/16 03:44:30.887  -1.7 222.6  -1.8  12.4  -1.2 T__  11.9       0.5  0.33 a__ ML     4.5   769476 IDC_REB   11614280
IDC_SEIS  YKA    14.05  31.2 Lg       1996/08/16 03:48:37.793  -0.9 216.7  -7.7  27.0  -4.8 T__   4.2       0.2  0.33 a__                769476 IDC_REB   11614284
IDC_SEIS  WAKE   58.41 261.4 T        1996/08/16 04:52:31.503 -94.3                         ___   3.1                   m__                769476 IDC_REB   11614764
IDC_SEIS  HFS    65.16  18.9 P        1996/08/16 03:51:55.581   0.9 343.9   7.9   3.5  -3.0 T__   5.0       1.2  0.55 a__ mb     4.1   769476 IDC_REB   11614380
                                                                                                                            mbmle  4.4   769476 IDC_REB   11614380
IDC_SEIS   FINES 66.00 12.2 P         1996/08/16 03:51:59.637  -0.4  56.9  72.9   4.1  -2.3 T__   7.5       2.8  0.85 a__ mb     4.3   769476 IDC_REB   11614355
```

SUBTYPE: UNASSOCIATED ARRIVAL

The subtype UNASSOCIATED is used for arrivals which have been detected and reviewed, but have not been not associated with a seismic origin. The format of the subtype UNASSOCIATED line is the same as the format for the AUTOMATIC subtype (see Table 31).

Example 4.0 - 19 ARRIVAL:UNASSOCIATED example.

```
DATA_TYPE ARRIVAL:UNASSOCIATED GSE2.1
Net       Sta   BeamID         Date       Time       Phase      Azim  Slow   SNR       Amp   Per   STA   Dur Author       DetID
IDC_SEIS  BBB   BP0.5_4.0    1996/08/16 03:41:40.523 P         256.3  16.2  13.4     228.6  0.33   4.5   0.2 IDC_REB   11618391
IDC_SEIS  BBB   BP0.2_1.0    1996/08/16 03:42:04.531 S         334.7  18.6   8.2     338.6  0.33   9.1   1.2 IDC_REB   11618393
IDC_SEIS  DLBC  BP0.2_2.0    1996/08/16 03:42:58.584 P         166.7  16.5  16.5       1.5  0.33   2.0   0.4 IDC_REB   11618396
IDC_SEIS  DLBC  BP0.4_6.0    1996/08/16 03:44:59.808                                                         IDC_REB   11621022
```

O P E R A T I O N S

ORIGINS

The origin format consists of an origin block and a magnitude block which are linked together by OrigID. The format for origin data in GSE2.1 format is given in Table 36, Table 37, Table 38, Table 39, and Table 40. Multiple magnitudes may be given for the same origin by repeating the magnitude block line. Each origin group has the following structure:

- origin header line
- 1 blank line (optional)
- 1 origin block line
- 1 blank line (optional)
- magnitude block header line
- n magnitude block line(s)
- 1 blank line (optional)
- comment line(s) optional

Table 36. **Origin Block Header Lines**

Position	Text	Format	Description
4-7	“Date”	a4	Text
15-18	“Time”	a4	Text
27-29	“Err”	a3	Text
33-35	“RMS”	a3	Text
37-44	“Latitude”	a8	Text
46-54	“Longitude”	a9	Text
57-60	“Smaj”	a4	Text
63-66	“Smin”	a4	Text
69-70	“Az”	a2	Text
72-76	“Depth”	a5	Text
78-80	“Err”	a3	Text
82-85	“Ndef”	a4	Text
86-89	“Nsta”	a4	Text
94-96	“Gap”	a3	Text
99-103	“mdist”	a5	Text
106-110	“Mdist”	a5	Text
112-115	“Qual”	a4	Text
119-124	“Author”	a6	Text
131-136	“OrigID”	a6	Text

Table 37. **Origin Data Line**

Position	Name	Format	Description
Data Line 1			
1-10	Date	i4,a1,i2,a1,i2	Epicenter date (yyyy/mm/dd)
12-22	Time	i2,a1,i2,a1,f5.2	Epicenter time (hh:mm:ss.ss)
23	fixf	a1	Fixed flag (f=fixed origin time solution, or blank)
25-29	Err	f5.2	Origin time error (seconds, blank if fixed origin time)
31-35	rms	f5.2	Root mean square of time residuals (seconds)
37-44	Latitude	f8.4	Latitude (negative for South)
46-54	Longitude	f9.4	Longitude (negative for West)
55	fixf	a1	Fixed flag (f= fixed epicenter solution, or blank)
57-60	Smajor	f4.1	Semi-major axis of 90% ellipse or its estimate (km, blank if fixed epicenter)
62-66	Sminor	f5.1	Semi-minor axis of 90% ellipse or its estimate (km, blank if fixed epicenter)
68-70	strike	i3	Strike (0 <= x <= 360) of error ellipse clockwise from North (degrees)
72-76	Depth	f5.1	Depth (km)
77	fixf	a1	Fixed flag (f= fixed depth station, d=depth phases, or blank)
79-83	Err	f4.1	Depth error 90% (km, blank if fixed depth)
84-87	Ndef	i4	Number of defining phases
89-92	Nsta	i4	Number of defining stations
94-96	Gap	i3	Gap in azimuth coverage (degrees)
98-103	mdist	f6.2	Distance to closest station (degrees)
105-110	Mdist	f6.2	Distance to furthest station (degrees)
112	antype	a1	Analysis type: (a=automatic, m=manual, g=guess)
114	loctype	a1	Location method: (i=inversion, p=pattern recognition, g=ground truth, o=other)
116-117	evtype	a2	Event type: uk = unknown, ke = known earthquake se = suspected earthquake kr = known rockburst sr = suspected rockburst ki = known induced event si = suspected induced event km = known mine expl. sm = suspected mine expl. kx = known experimental expl. sx = suspected experimental expl. kn = known nuclear expl. sn = suspected nuclear explosion ls = landslide
119-127	author	a9	Author of the origin
129-136	OrigID	a8	Origin ID

OPERATIONS

Table 38. **Origin Comment Lines (with Any Origin Group)**

Position	Name/Text	Format	Description
2	“(”	a1	Text
3-M	comment	a(M-2)	Comment
M+1	“(”	a1	Text

Table 39. **Magnitude Block Header line**

Position	Text	Format	Description
1-9	“Magnitude”	a9	Text
12-14	“Err”	a3	Text
16-19	“Nsta”	a4	Text
21-26	“Author”	a6	Text
33-38	“OrigID”	a6	Text

Table 40. **Magnitude Block Data Line**

Position	Name	Format	Description
Data Line			
1-5	Mtype	a5	Magnitude type (mb, Ms, ML, mbmle, etc.)
6	Mindicator	a1	Min max indicator (<, > or blank)
7-10	Magnitude	f4.1	Magnitude value
12-14	Err	f3.1	Standard magnitude error
16-19	Nsta	i4	Number of stations used to calculate magnitude
21-29	Author	a9	Author of the origin
31-38	OrigID	a8	Origin ID

Example 4.0 - 20 ORIGIN data type

```
DATA_TYPE ORIGIN GSE2.1
   Date       Time        Err   RMS Latitude Longitude  Smaj  Smin  Az  Depth  Err Ndef Nsta Gap  mdist  Mdist Qual   Author      OrigID
1996/08/16 03:41:12.45   0.88  0.92  51.3300 -130.3100  16.6   7.7  63   0.0f        23   18 192   1.61  77.98 m i uk IDC_REB     769476

Magnitude  Err Nsta Author      OrigID
ML     3.8 0.5    7 IDC_REB     769476
mb     4.0 0.2    6 IDC_REB     769476

   Date       Time        Err   RMS Latitude Longitude  Smaj  Smin  Az  Depth  Err Ndef Nsta Gap  mdist  Mdist Qual   Author      OrigID
1996/08/16 04:35:17.66   2.72  0.29   2.1300  127.8800  55.1  44.2  71   0.0f         9    9 150  22.84  92.33 m i uk IDC_REB     769435

Magnitude  Err Nsta Author      OrigID
mb     4.1 0.4    7 IDC_REB     769435
```

EVENT

For any seismic event, there can be several origins derived from different organizations or procedures. The format for events places these different origins into groups separated by origin headers. There is a title line at the beginning of the data section which must include the name of the bulletin that was used as the basis for associating the separate origin estimates, as shown in Table 41. For each event, there is an event identification string and the geographic region name given as shown in Table 42. Following the title, each event group has the following structure:

- 1 event identification and geographic region name
- origin block header line
- 1 blank line (optional)
- n origin block data lines
- 1 blank line (optional)
- magnitude block header line
- n magnitude block lines
- 1 blank line (optional)
- comment line(s) (optional)
- 2 blank line (optional)

Table 41. **Title Line**

Position	Name	Format	Description
1-80	Title	a80	Bulletin title

Table 42. **Event Identification and Geographic Region Name**

Position	Name/Text	Format	Description
1-5	“Event”	a5	Text
7-14	EventID	a8	Event ID
16-80	Geogreg	a65	geographic region

Example 4.0 - 21 EVENT data type

```
DATA_TYPE EVENT GSE2.1:short
Reviewed Event Bulletin (REB) of the GSE_IDC for August 16, 1996
Event 768958   QUEEN CHARLOTTE ISLANDS REGION
   Date       Time        Err   rms Latitude Longitude  Smaj  Smin  Az  Depth  Err Ndef Nsta Gap  mdist  Mdist Qual   Author      OrigID
1996/08/16 03:41:12.45   0.88  0.92  51.3310 -130.3125  16.6   7.7  63   0.0f        23   18 192   1.61  77.98 m i uk IDC_REB     769476
1996/08/16 03:41:17.63   1.20  4.26  51.4100 -129.7300  18.9  12.4  70   0.0f        18   17 160   1.27  77.69 m i uk IDC_DEL     768958

Magnitude  Err Nsta Author      OrigID
ML     3.8 0.5    7 IDC_REB     769476
mb     4.0 0.2    6 IDC_REB     769476
ML     3.9 0.2    6 IDC_DEL     768958
mb     4.1 0.4   10 IDC_DEL     768958
```

BULLETIN

Bulletins are composed of origin and arrival information. These elements can be further decomposed into blocks: event block (origin block and magnitude block), phase block, phase correction block, event characterization origin block, and event characterization arrival block. The verbosity of a bulletin can be controlled by specifying the format type, which can be GSE2.1, GSE2.1:short, or GSE2.1:long. GSE2.1 format is equivalent to GSE2.1:short, and is the default.

The BULL_TYPE and the format type control which blocks of information appear in the bulletin. The matrix of which blocks appear with each IDC BULL_TYPE is given in Table 38.

The GSE2.1:short format for BULL_TYPE IDC_AEL, IDC_ABEL, IDC_DEL, and IDC_REB are identical, and are very similar to GSE2.0 format. GSE2.1:long format for these bulletins is the same as GSE2.1:short format, but an additional block is added for phase related corrections.

The GSE2.1:short format for the IDC_ECB type is the same as GSE2.1:short format for the other bulletins, with an additional block for origin related event characterization information. The GSE2.1:long format for the IDC_ECB subtype is the same as GSE2.1:long format for the other bulletins, with additional blocks are for origin and arrival related event characterization information.

Table 43. **Matrix of which blocks appear in which bulletin format.**

Block Name / Bulletin Format	REB short	REB long	ECB short	ECB long
origin block	X	X	X	X
magnitude block	X	X	X	X
phase block	X	X	X	X
phase correction block		X		X
Event Characterization arrival block				X
Event Characterization origin block			X	X

The event block is the same as the GES2.1 event format. The phase block format is nearly identical to the ASSOCIATED ARRIVAL format, with the only differences being that the phase block format does include the attributes date, origin ID or author.

The phase correction block format has not yet been finalized.

The GSE2.1:short format for the IDC_AEL, IDC_ABEL, IDC_DEL, and the IDC_REB has the following structure:

- 1 event identification line and geographic region name
- origin header line
- 1 blank line (optional)
- n origin block lines
- 1 blank line (optional)
- magnitude block header line
- n magnitude block lines
- 1 blank line (optional)
- comment line(s) (optional)
- 1 blank line (optional)
- phase header line
- m phase lines

- 2 blank lines (optional)

The long format of those bulletins is the same, with the addition of the phase correction block after the phase block. This is not included here, but will be included in the next format revision.

The GSE2.1:short format for the IDC_ECB is the same as that listed above, with the addition of the Event Characterization Origin block after the phase block. The long format also has detailed information in the Event Characterization Arrival block.

The BULLETIN data format should not be used to submit gamma information for GSETT-3; the ORIGIN format is the proper one to use.

Table 44. **Phase Block Header & Data Format**

Position	Name/Text	Format	Description
		Header	
1-3	"Sta"	a3	Text
9-12	"Dist"	a4	Text
15-18	"EvAz"	a4	Text
20-24	"Phase"	a5	Text
33-36	"Time"	a4	Text
43-46	"TRes"	a4	Text
49-52	"Azim"	a4	Text
54-58	"AzRes"	a5	Text
62-65	"Slow"	a4	Text
69-72	"SRes"	a4	Text
74-76	"Def"	a3	Text
80-82	"SNR"	a3	Text
90-92	"Amp"	a3	Text
96-98	"Per"	a3	Text
100-103	"Qual"	a4	Text
105-113	"Magnitude"	a9	Text
118-122	"ArrID"	a5	Text
		Data	
1-5	sta	a5	Station code
7-12	Dist	f6.2	Station to event distance (degrees)
14-18	EvAz	f5.1	Event to station azimuth (degrees)
20-27	phase	a8	Phase code
29-40	Time	i2,a1,i2,a1,f6.3	Arrival time (hh:mm:ss.sss)
42-46	TRes	f5.1	Time residual (seconds)
48-52	Azim	f5.1	Observed azimuth (degrees)
54-58	ARes	f5.1	Azimuth residual (degrees)
60-65	Slow	f5.1	Observed slowness (seconds/degree)
67-72	SRes	f5.1	Slowness residual (seconds/degree)
74	tdef	a1	Time defining flag (T or _)
75	adef	a1	Azimuth defining flag (A or _)
76	sdef	a1	Slowness defining flag (S or _)

78-82	SNR	f5.1	Signal-to-noise ratio
84-92	Amp	f9.1	Amplitude (nanometers)
94-98	Per	f5.2	Period (seconds)
100	picktype	a1	Type of pick (a=automatic, m=manual)
101	direction	a1	Direction of short period motion (c, d, _=null)
102	detchar	a1	Detection character (i, e, q, _=null)
104-108	Mtype	a5	Magnitude type (mb, Ms, ML, mbmle, etc.)
109	mindicator	a1	Min max indicator (<, >, or blank)
110-113	magnitude	f4.1	Magnitude value
115-122	ArrID	a8	Arrival ID

Example 4.0 - 22 GSE 2.1:short IDC_REB example.

```
DATA_TYPE BULLETIN GSE2.1:short
Reviewed Event Bulletin (REB) of the GSE_IDC for August 16, 1996
EVENT 768958  QUEEN CHARLOTTE ISLANDS REGION
    Date       Time       Err   RMS Latitude Longitude  Smaj  Smin  Az  Depth  Err Ndef Nsta Gap  mdist  Mdist Qual   Author      OrigID
1996/08/16 03:41:12.45   0.88  0.92  51.3300 -130.3100  16.6   7.7  63   0.0f        23   18 192   1.61  77.98 m i uk IDC_REB     769476

Magnitude  Err Nsta   Author   OrigID
ML     3.8 0.5    7  IDC_REB   769476
mb     4.0 0.2    6  IDC_REB   769476


Sta     Dist  EvAz Phase        Time      TRes  Azim AzRes   Slow   SRes Def   SNR       Amp   Per Qual Magnitude    ArrID
BBB     1.61  57.1 Pg       03:41:40.523  -1.1 256.3  17.5   16.2   -2.4 T__  13.4     228.6  0.33 a__ ML     4.1 11618391
BBB     1.61  57.1 Lg       03:42:04.531   1.1 334.7  95.9   18.6  -12.5 T__   8.2     338.6  0.33 a__            11618393
DLBC    7.12   1.2 Pn       03:42:58.584   0.5 166.7 -14.8   16.5    2.8 T__  16.5       1.5  0.33 a__ ML     4.2 11618396
DLBC    7.12   1.2 Lg       03:44:59.808   1.1                           T__                       m__            11621022
NEW     9.07 104.6 Pn       03:43:23.394  -1.3 308.2  13.5    6.6   -7.2 T__   4.2       0.3  0.33 a__ ML     3.5 11614783
NEW     9.07 104.6 Lg       03:46:03.321   2.8 337.6  42.9   12.2  -19.6 ___   4.1       0.2  0.33 a__            11614787
YKA    14.05  31.2 Pn       03:44:30.887  -1.7 222.6  -1.8   12.4   -1.2 T__  11.9       0.5  0.33 a__ ML     4.5 11614280
YKA    14.05  31.2 Lg       03:48:37.793  -0.9 216.7  -7.7   27.0   -4.8 T__   4.2       0.2  0.33 a__            11614284
WAKE   58.41 261.4 T        04:52:31.503 -94.3                           ___   3.1                 m__            11614764
HFS    65.16  18.9 P        03:51:55.581   0.9 343.9   7.9    3.5   -3.0 T__   5.0       1.2  0.55 a__ mb     4.1 11614380
                                                                                                       mbmle  4.4 11614380
FINES  66.00  12.2 P        03:51:59.637  -0.4  56.9  72.9    4.1   -2.3 T__   7.5       2.8  0.85 a__ mb     4.3 11614355
          .
          .
          .
```

O P E R A T I O N S

Event Characterization

The Event Characterization Bulletin (IDC_ECB) contains several new blocks of information, as described in Tables 45 through 56. The description of those blocks is given in the following tables.

Event Characterization Origin Block

Table 45. **Event Characterization Origin Header Line**

Position	Text	Format	Description
4-7	“Date”	a4	Text
15-18	“Time”	a4	Text
24-31	“Latitude”	a8	Text
33-41	“Longitude”	a9	Text
44-47	“Smaj”	a4	Text
50-53	“Smin”	a4	Text
56-60	“Depth”	a5	Text
62-66	“mb-Ms”	a5	Text
68-75	“Offshore”	a8	Text
77-83	“Author”	a6	Text
87-92	“OrigID”	a6	Text

Table 46. **Event Characterization Origin Data Line**

Position	Name/Text	Format	Description
1-10	Date	i4,a1,i2,a1,i2	Epicenter date (yyyy/mm/dd)
12-22	Time	i2,a1,i2,a1,f5.2	Epicenter time (hh:mm:ss.s)
24-31	Latitude	f8.4	Latitude (negative for South)
33-41	Longitude	f9.4	Longitude (negative for West)
43-47	Smajor	f4.1	Semi-major axis of 90% ellipse or its estimate (km)
49-53	Sminor	f5.1	Semi-minor axis of 90% ellipse or its estimate (km)
55-59	Depth	f4.1	Depth (km)
60	Fixf	a1	Fixed flag (f= fixed epicenter solution, or blank)
63-66	mb-Ms	f4.1	mb-Ms
71-73	Offshore	a3	Offshore flag (“yes” or “no”)
75-83	Author	a9	Author of the origin
85-92	OrigID	a8	Origin ID

Event Characterization Arrival Block

Table 47. **Cepstral Peak Analysis Header Lines**

Position	Text	Format	Description
1-3	“Sta”	a3	Text
8-14	“PeakAmp”	a7	Text
16-23	“PeakQuef”	a8	Text

Table 48. **Data Line of Cepstral Peak Analysis**

Position	Name	Format	Description
1-5	Sta	a5	Station code
8-14	PeakAmp	f7.5	Peak amplitude
16-23	PeakQuef	f8.4	Peak quefrency

Table 49. **Short-period/Long-period Energy Ration Header Lines**

Position	Text	Format	Description
1-3	“Sta”	a3	Text
13-17	“Ratio”	a5	Text

Table 50. **Data Line of Short-period/Long-period Energy Ratio**

Position	Name	Format	Description
1-5	Sta	a5	Station code
8-17	Ratio	f10.8	Short-period/long-period energy ratio

Table 51. **Origin-based Frequency-dependent Phase Amplitude Header Lines**

Position	Text	Format	Description
1-3	“Sta”	a3	Text
7-11	“Phase”	a5	Text
19-24	“Amp2-4”	a6	Text
27-32	“SNR2-4”	a6	Text
37-42	“Amp4-6”	a6	Text
45-50	“SNR4-6”	a6	Text
55-60	“Amp6-8”	a6	Text
63-68	“SNR6-8”	a6	Text
72-78	“Amp8-10”	a7	Text
80-86	“SNR8-10”	a7	Text

Table 52. **Data Line of Short-period/Long-period Energy Ratio**

Position	Name/Text	Format	Description
1-5	Sta	a5	Station code
7-14	Phase	a8	Associated phase
16-24	Amp2-4	f9.1	Amplitude in 2-4 band
28-32	SNR2-4	f5.1	Signal/noise ratio in 2-4 band
34-42	Amp4-6	f9.1	Amplitude in 4-6 band
46-50	SNR4-6	f5.1	Signal/noise ratio in 4-6 band
52-60	Amp6-8	f9.1	Amplitude in 6-8 band
64-68	SNR6-8	f5.1	Signal/noise ratio in 6-8 range
70-78	Amp8-10	f9.1	Amplitude in 8-10 band
82-86	SNR8-10	f5.1	Signal/noise ratio in 8-10 range

Table 53. **Spectral Variance of the detrended Log Spectrum Header Lines**

Position	Text	Format	Description
1-3	“Sta”	a3	Text
7-11	“Phase”	a5	Text
16-22	“MinFreq”	a7	Text
24-30	“MaxFreq”	a7	Text
37-43	“SpecVar”	a7	Text

Table 54. **Data Line of Spectral Variance**

Position	Name	Format	Description
1-5	Sta	a5	Station code
7-14	Phase	a8	Associated phase
16-22	MinFreq	f7.2	Minimum frequency
24-30	MaxFreq	f7.2	Maximum frequency
32-43	SpecVar	f12.6	Spectral variance of detrended log spectrum

Table 55. **Complexity Header Line**

Position	Text	Format	Description
1-3	“Sta”	a3	Text
7-11	“Phase”	a5	Text
17-26	“Complexity”	a10	Text
30-32	SNR	a3	Text

Table 56. **Data Line of Complexity**

Position	Name	Format	Description
1-5	Sta	a5	Station code
7-14	Phase	a8 (add 3)	Associated phase
16-26	Complexity	f11.4	Complexity
28-32	SNR	f5.1	Signal to noise ratio of complexity

Example 4.0 - 23 GSE2.1:long IDC_ECB example.

```
NOTE: still need to copy top part of example from example 4.0-22.

EVENT CHARACTERIZATION
   Date       Time     Latitude Longitude  Smaj  Smin  Depth mb-Ms Offshore  Author   OrigID
1996/08/16 03:41:12.45  51.3300 -130.3100  16.6   7.7   0.0f          yes   IDC_ECB   769476

CEPSTRAL PEAK ANALYSIS
Sta    PeakAmp PeakQuef
BBB    0.46775   0.1000
NEW    0.15770   0.0750
YKA    0.04499   0.1500
INK    0.09547   0.0750

SHORT-PERIOD/LONG-PERIOD ENERGY RATIO
Sta         Ratio
BBB    0.08338475

ORIGIN-BASED FREQUENCY-DEPENDENT PHASE AMPLITUDE
Sta   Phase       Amp2-4  SNR2-4    Amp4-6  SNR4-6    Amp6-8  SNR6-8   Amp8-10 SNR8-10
BBB   Pn             8.7     0.8       1.4     0.8       0.3     0.4       0.1     0.4
BBB   Pg           102.2    11.4      42.3    43.4      12.4    24.8      15.3   128.6
BBB   Sn          1617.4     1.3     508.4     1.2     299.6     2.0     100.5     2.7
BBB   Lg          1617.4     3.0     508.4     2.5     299.6     4.9     100.5     3.8
DLBC  Pn             7.5    25.2       2.2    17.2       0.6     8.8       0.3     6.9
DLBC  Pg            11.8     1.5       1.3     0.9       0.3     0.7       0.2     1.2
DLBC  Sn             3.5     1.1       0.6     2.4       0.1     2.3       0.1     1.8
DLBC  Lg             5.7     1.9       0.5     1.6       0.2     2.7       0.1     1.9
NEW   Pn             0.9     3.4       0.2     1.1       0.2     1.1       0.1     1.5
NEW   Pg             0.7     1.1       0.2     1.4       0.1     1.1       0.1     1.1
NEW   Sn             0.6     1.2       0.2     1.7       0.1     1.1       0.1     1.5
NEW   Lg             0.9     1.8       0.2     1.2       0.2     0.9       0.1     1.2
YKA   Pn             0.9     6.2       0.2     3.7       0.1     3.3
YKA   Pg             0.4     1.0       0.1     1.0       0.0     1.0
YKA   Sn             0.4     1.3       0.1     1.2       0.0     1.2
YKA   Lg             0.4     1.4       0.1     1.2       0.0     1.6
ELK   Pn             0.0     1.1       0.0     1.1       0.0     1.7       0.0     1.4
ELK   Pg             0.0     1.1       0.0     1.3       0.0     1.3       0.0     1.2
ELK   Sn             0.0     1.7       0.0     1.4       0.0     1.2       0.0     1.5
ELK   Lg             0.0     1.2       0.0     1.3       0.0     1.6       0.0     1.2
MNV   Pn             0.0     2.0       0.0     2.1       0.0     2.1       0.0     2.0
MNV   Pg             0.0     1.7       0.0     0.9       0.0     1.1       0.0     2.0
MNV   Sn             0.0     1.2       0.0     1.4       0.0     1.3       0.0     0.9
MNV   Lg             0.1     2.3       0.0     1.1       0.0     0.4       0.0     1.4
ILAR  Pn             0.2     3.7       0.0     1.0       0.0     0.8
ILAR  Pg             0.1     1.2       0.0     1.2       0.0     1.8
ILAR  Sn             0.1     1.1       0.0     1.3       0.0     1.4
ILAR  Lg             0.1     1.4       0.0     1.4       0.0     1.8
PDAR  Pn             0.4     4.9       0.1     1.7       0.1     1.6       6.1     1.1
PDAR  Pg             0.1     0.8       0.1     1.5       0.1     1.1       6.2     1.2
PDAR  Sn             0.1     1.2       0.1     1.2       0.1     1.0       5.9     1.0
PDAR  Lg             0.1     1.1       0.1     1.4       0.1     1.3       6.1     1.1
INK   Pn             0.2     4.1       0.0     1.4       0.0     1.6       0.0     1.0
INK   Pg             0.2     1.0       0.0     1.2       0.0     0.8       0.0     1.4
INK   Sn             0.1     1.4       0.0     1.0       0.0     1.4       0.0     0.4
INK   Lg             0.1     1.4       0.0     2.1       0.0     1.5       0.0     1.8

SPECTRAL VARIANCE OF THE DETRENDED LOG SPECTRUM
Sta   Phase    MinFreq MaxFreq      SpecVar
BBB   Pg          1.88   19.53    15.369587
BBB   Lg          1.88   19.53     3.027103
DLBC  Pn          1.88    7.50     0.064550
YKA   Pn          1.88    8.12     0.032531

COMPLEXITY
Sta   Phase     Complexity   SNR
NRI   P             0.0385   3.4
PDY   P             0.0997   1.8
HFS   P             0.0280   1.3
FINES P            -0.0189   0.8
KSAR  P             0.0769   1.7
```

```
LOR   P           0.0228   1.5
GERES P           0.0095   1.4
ESDC  P           0.017    1.5
```

COMMENTS

The first line of data type comment provides a mechanism for associating the comment to a station, arrival, origin, event, etc. If no association is needed, then this line may be left blank. The comment is written in free format and may be up to 1024 characters long. See Table 57.

Table 57. **Comment Format**

Position	Name	Format	Description
Header			
1-10	idtype	a10	identification type (“Station”, “Arrival”, “Origin”, “Event”)
12-19	id	a8	identification string of the idtype
Data			
1-1024	comment	a1024	Free format comment

Example 4.0 - 24 Comments example.

```
DATA_TYPE COMMENT GSE2.1

  Almost anything may be typed into the space between the
  DATA_TYPE line and the STOP line.  No association was
  desired for this comment, so the association line was
  left blank.  Note that this comment is indented so that
  the DATA_TYPE in the second line of this paragraph is
  not interpreted as a command line.
DATA_TYPE COMMENT GSE2.1
Event      7687234
  The referenced event was felt over a wide area (300 square
  kilometers) near the epicenter.
```

COMMUNICATIONS STATUS REPORTS

Communications status is given over the time interval specified in the TIME or FREQ environments for AutoDRM or subscription requests, respectively. The report is comprised of a line giving the report period; a summary section in which each link is described with statistics of link performance for the reporting period; and finally a list of the link outages for each link. The link outages are reported only in the extended format (COMM_E); if a summary report is requested (COMM), these will not be included. The link performance statistics contain a description of the link (nominal link speed in kilobits per second, kbps), the mode of the link (full or half duplex), the percent of time that the link was operational, and the link utilization (1.0 is full utilization) in each direction. See Table 58, Table 59, and Table 60.

Table 58. **Report Period**

Position	Name/Text	Format	Description
1-18	"Report period from"	a18	Text
20-29	Start_date	i4,a1,i2,a1,i2	Start date (yyyy/mm/dd)
31-40	Start_time	i2,a1,i2,a1,f4.1	Start time (hh:mm:ss.s)
42-43	"to"	a2	Text
45-54	End_date	i4,a1,i2,a1,i2	End date (yyyy/mm/dd)
56-65	End_time	i2,a1,i2,a1,f4.1	End time (hh:mm:ss.s)

Table 59. **Communications Status Format**

Position	Name/Text	Format	Description
Header			
1-4	“Link”	a4	Text
22-33	“Nominal_kbps”	a12	Text
36-39	“Mode”	a4	Text
43-46	“%_up”	a4	Text
49-57	“From”	a4	Text
60-71	“Util”	a4	Text
49-57	“From”	a4	Text
60-71	“Util”	a4	Text
Data			
1-8	link	a8	Link code (farthest from IDC)
10	“-”	a1	Text
12-19	link	a8	Link code (closest to IDC)
22-27	speed	f6.1	Nominal speed of link in kbps
30-33	mode	a4	“full” for full-duplex or “half” for half-duplex
35-39	uptime	f5.1	Percent uptime
42-49	link	a8	Link Code (farthest from IDC)
51-54	utilization	f4.2	Utilization of link (dat_rate/speed)
57-64	link	a8	Link Code (closest to IDC)
66-69	utilization	f4.2	Utilization of link (dat_rate/speed)

Table 60. **Communications Outage Format**

Position	Name/Text	Format	Description
Link Identification			
1-8	link	a8	Link code (farthest from IDC)
10	“-”	a1	Text
12-19	link	a8	Link code (closest to IDC)
21-32	“link outages”	a12	Text
Header			
10-13	“From”	a4	Text
30-36	“Through”	a7	Text
50-57	“Duration”	a8	Text
Data			
1-10	date	i4,a1,i2,a1,i2	Date of beginning of outage (yyyy/mm/dd)
12-21	time	i2,a1,i2,a1,f4.1	Time of beginning of outage (hh:mm:ss.s)
24-33	date	i4,a1,i2,a1,i2	Date of end of outage (yyyy/mm/dd)
35-44	time	i2,a1,i2,a1,f4.1	Time of end of outage (hh:mm:ss.s)
47-60	duration	i3,a1,i2,a1,i2,a1,f4.1	Duration of outage (ddd hh:mm:ss.s)

Example 4.0 - 25 Communications Status Report

```
DATA_TYPE COMM_STATUS GSE2.1
Report period from 1994/12/03 00:00:00.0 to 1994/12/04 00:00:00.0
Link               Nom_kbps  Mode  %_Up   From    Util   From    Util
AUS_NDC  - GSE_IDC     56.0  full  88.4  AUS_NDC  0.50  GSE_IDC  0.08
NOR_NDC  - GSE_IDC    128.0  full  99.2  NOR_NDC  0.77  GSE_IDC  0.10
USA_NDC  - GSE_IDC   1000.0  full 100.0  USA_NDC  0.25  GSE_IDC  0.25

AUS_NDC  - GSE_IDC  link outages
         From                Through            Duration
1994/12/02 20:23:14.0  1994/12/03 00:48:28.0  000 00:25:14.0
1994/12/03 02:34:31.0  1994/12/03 02:49:39.0  000 00:15:08.0
1994/12/03 19:02:27.0  1994/12/03 19:12:29.0  000 00:10:02.0

NOR_NDC  - GSE_IDC  link outages
         From                Through            Duration
1994/12/03 04:34:31.0  1994/12/03 06:35:39.0  000 00:45:13.0
```

STATION STATUS REPORTS

Station status is given over the time interval specified in the TIME or FREQ environments for AutoDRM or subscription requests, respectively. The report is comprised of statistics that can be used to evaluate the overall performance of one or more stations. The first line of the report gives the report period. The status lines give the station code and the nominal number of channels for the station. This is followed by the “Station Capability” in which station problems are grouped into four categories depending on the impact each failure has on the capability of that station. Station capability is assessed relative to the maximum performance of that particular station, with given instrument configuration and site characteristics. The station status does not assess the affect of a station problem on the performance of the monitoring network.

In the context of assessing station status, the station consists of the sensors, digitizers, communications within the site and data loggers. Station status is assessed at the IDC based on data that is available at the IDC, and may therefore include the effects of problems with long-haul communications and problems at a National Data centre or Data Relay centre. Moreover, because data may arrive late at the IDC, the station status assessment is a snapshot of station capability at a single time.

- Fully capable

  The system is operating and contributing data to the mission at the level for which it was designed.

- Partially capable

  The system is impaired and contributing significant data to the mission but of degraded quality, reduced quantity, or reduced operational capability.

- Low capability

The system is severely impaired and is contributing data that do not meet minimum requirements for the designed mission but are still useful for the global monitoring network.

- Not capable

  The system completely inoperative or the data being contributed are not useful for the global monitoring network in any way.

For arrays, capability is estimated based on the theoretical array gain for the available channels relative to maximum array gain with all channels operational. The array gain is estimated from the square root of the number of channels; the geometry of the active channels and the relative values of individual array elements is neglected.

Station mission capability may be estimated based on data available at the IDC. Non-station problems, such as outages of long-haul or tail communication circuits and problems with forwarding the data from NDCs will be folded into the capability estimates. Problems affecting the quality or timing of seismic waveforms will not be included in the automated station capability estimate, at least in the first instance, and thus capability may be overestimated. See Table 61.

Table 61. **Station Capability Criteria**

Station Type	Fully Capable	Partial Capability	Low Capability	Non-Capable
SP or HF array	array gain ≥ 90% max	70% ≤ array gain < 90% max	array gain < 70% max, at least one channel operational	no channels operational
3-C BB station	all channels operational	one vertical & one horizontal operational	1 channel operational	no channel operational
Examples:	**Fully Capable**	**Partial Capability**	**Low Capability**	**Non-Capable**
25 element array	21-25	13-20	1-12	0
19 element array	16-19	10-15	1-9	0
16 element array	13-16	8-12	1-7	0
9 element array	8-9	5-7	1-4	0
7 element array	6-7	4-5	1-3	0

Following the station capability entries is the maximum data time which is the cumulative amount of time for which data are expected for this station. For primary stations, this will be the entire report period; for auxiliary stations, this will be the sum of the data segment time intervals requested. Availability indicates the percent of data that are available at the IDC relative to that expected. If an array with ten channels sends nine channels of data to the IDC for the entire period, then the data availability would be 90.0 (even though the data capability may be fully capable 100% of the time!) The median delay measures the time delay between ground motion and receipt of data at the

IDC for primary stations, and the delay between request and receipt for auxiliary stations. Finally, the number of successful retrievals of data from the auxiliary stations and the number of retrieval attempts are given. See Table 62 for the station status format.

Example 4.0 - 26 Station Status Report

```
DATA_TYPE STA_STATUS GSE2.1
Report period from 1994/12/03 00:00:00.0 to 1994/12/04 00:00:00.0
                           Station Capability
Net       Sta   Ch  Full      Part     Low     Non Max_Exp_Time   Avail   Med_Delay   Att   Suc   Pnd
IDC_SEIS  ARCES 33 100.000   0.000   0.000   0.000 000 24:00:00  98.587 000 00:42.9
IDC_SEIS  ABC    3  90.056   5.944   0.000   4.000 000 00:23:35  90.089 000 00:55.7     3     3     0
IDC_SEIS  DEF    3  80.154  19.846   0.000   0.000 000 24:00:00  83.080 000 05:23.6
```

O P E R A T I O N S

Table 62. **Station Status Format**

Position	Name/Text	Format	Description
Report Period			
1-18	"Report period from"	a18	Text
20-29	Start_date	i4,a1,i2,a1,i2	Start date (yyyy/mm/dd)
31-40	Start_time	i2,a1,i2,a1,f4.1	Start time (hh:mm:ss.s)
42-43	"to"	a2	Text
45-54	End_date	i4,a1,i2,a1,i2	End date (yyyy/mm/dd)
56-65	End_time	i2,a1,i2,a1,f4.1	End time (hh:mm:ss.s)
Header LIne 1			
28-45	"Sta Capability"	a4	Text
Header Line 2			
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
17-18	"Ch"	a2	Text
21-24	"Full"	a4	Text
31-34	"Part"	a4	Text
40-42	"Low"	a3	Text
48-50	"Non"	a3	Text
52-63	"Max_Exp_Time"	a12	Text
67-71	"Avail"	a5	Text
75-83	"Med_Delay"	a9	Text
87-89	"Att"	a3	Text
93-95	"Suc"	a3	Text
99-101	"Pnd"	a3	Text
Data			
1-9	Net	a9	Network Code
11-15	Sta	a5	Station code
17-18	ch	i2	Nominal number of channels
20-26	Full	f7.3	Full station capability (% of report period)
28-34	Part	f7.3	Partial station capability (% of report period)
36-42	Low	f7.3	Low station capability (% of report period)
44-50	Non	f7.3	Non-capable station (% of report period)
52-63	Max_Exp_Time	i3,a1,i2,a1,i2,a1,i2	Maximum data time possible (ddd hh:mm:ss)
65-71	Avail	f7.3	Percent of data available at the IDC
73-83	Med_Delay	i3,a1,i2,a1,f4.1	Median delay of data from station to IDC (ddd hh:mm:ss.s)

Table 62. **Station Status Format**

85-89	Att	i5	Number of IDC attempts to retrieve data
91-95	Suc	i5	Number of successful attempts to retrieve data from auxiliary station
97-101	Pnd	i5	Number of IDC pending data retrievals

CHANNEL STATUS REPORTS

Channel status reports give specific information on the data that have been received at the IDC by station and channel. Detailed statistics on data gaps and timeliness are included. The first line of the report gives the reporting period over which the statistics are calculated. The first section gives data availability statistics with the station, channel, and auxiliary codes that identify the reporting data stream; the amount of data expected for the data stream; the availability of the data at the IDC as a percentage of the data that were expected over the report period; and the total number of gaps followed by the median, mean, standard deviation, minimum, and maximum gap size. The second section gives data timeliness statistics with the station, channel, and auxiliary codes that identify the reporting data stream; the amount of data expected for the data stream; and the median, mean, standard deviation, minimum and maximum delay times for data arriving at the IDC. For readability, the information is grouped by station with a blank line between stations in each of the sections. See Table 63 for the channel status format and Table 64 for the data timeliness format.

Table 63. **Channel Status Format**

Position	Text/Name	Format	Description
Report Period			
1-18	“Report period from”	a18	Text
20-29	Start_date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
31-40	Start_time	i2,a1,i2,a1,f4.1	Time (hh:mm:ss.s)
42-43	“to”	a2	Text
45-54	End_date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
56-65	End_time	i2,a1,i2,a1,f4.1	Time (hh:mm:ss.s)
Title			
1-28	“Data Availability Statistics”	a28	Text
Header			
1-3	“Net”	a3	Text
11-13	“Sta”	a3	Text
17-20	“Chan”	a4	Text
22-24	“Aux”	a3	Text
29-40	“Max_Exp_Time”	a12	Text
46-52	“%_Avail”	a6	Text
55-58	“Gaps”	a4	Text
63-68	“Median”	a6	Text
75-77	“Min”	a3	Text
86-88	“Max”	a3	Text
Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
18-20	Chan	a3	FDSN channel code
22-25	Aux	a4	Auxiliary identification code
29-40	Max_Exp_Time	i3,a1,i2,a1,i2,a1,f4.1	Maximum data time possible (ddd hh:mm:ss.s)
46-52	%_Avail	f7.3	Percent of data available at the IDC
54-58	Gaps	i5	Number of data gaps
61-69	Median	13,a1,i2,a1,i2	Median length of data gaps (hhh:mm:ss)
72-80	Min	13,a1,i2,a1,i2	Minimum length of data gaps (hhh:mm:ss)
83-91	Max	13,a1,i2,a1,i2	Maximum length of data gaps (hhh:mm:ss)

Table 64. **Data Timeliness Format**

Position	Name/Text	Format	Description
		Title	
1-26	"Data Timeliness Statistics"	a26	Text
		Header	
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
17-20	"Chan"	a4	Text
22-24	"Aux"	a3	Text
28-39	"Max_Exp_Time"	a12	Text
42-50	"Delay_Med"	a12	Text
56-59	"Mean"	a4	Text
65-71	"Std_Dev"	a7	Text
78-80	"Min"	a4	Text
89-91	"Max"	a7	Text
		Data	
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
18-20	Chan	a3	Channel code
22-25	Aux	a4	Auxiliary code
28-39	Max_Exp_Time	i3,a1,i2,a1,i2,a1,f4.1	Maximum data time possible (ddd hh:mm:ss.s)
42-50	Median Delay	13,a1,i2,a1,i2	Median delay time (hhh:mm:ss)
53-61	Mean	13,a1,i2,a1,i2	Mean delay time (hhh:mm:ss)
64-72	Std_Dev	13,a1,i2,a1,i2	Standard deviation of delay time (hhh:mm:ss)
75-83	Min	13,a1,i2,a1,i2	Minimum delay time (hhh:mm:ss)
86-94	Max	13,a1,i2,a1,i2	Maximum delay time (hhh:mm:ss)

Example 4.0 - 27 Channel Status

```
DATA_TYPE CHAN_STATUS GSE2.1
Report period from 1994/12/03 00:00:00.0 to 1994/12/04 00:00:00.0
Data Availability Statistics
Net        Sta   Chan Aux    Max_Exp_Time     %_Avail  Gaps    Median      Min        Max
IDC_SEIS  OBN    bhz         000 00:05:00     100.000     0  000:00:00  000:00:00  000:00:00
IDC_SEIS  OBN    bhn         000 00:05:00      99.034     6  000:00:10  000:00:00  000:00:24
IDC_SEIS  OBN    bhe         000 00:05:00     100.000     0  000:00:00  000:00:00  000:00:00

IDC_SEIS  ARU    bhz         000 01:23:14      99.843     8  000:00:07  000:00:00  000:00:12
IDC_SEIS  ARU    bhn         000 01:23:14      99.843    12  000:00:10  000:00:00  000:00:12
IDC_SEIS  ARU    bhe         000 01:23:14      99.843    12  000:00:10  000:00:00  000:00:12

IDC_SEIS  KIV0   shz         000 01:53:48      99.743    59  000:00:17  000:00:06  000:16:06
IDC_SEIS  KIV0   shn         000 01:53:48      99.744    79  000:00:00  000:00:06  000:16:06
IDC_SEIS  KIV0   she         000 01:53:48      99.823    55  000:00:00  000:00:06  000:16:06
IDC_SEIS  KIV1   shz         000 01:53:48      99.733    72  000:00:00  000:00:06  000:16:06
IDC_SEIS  KIV2   shz         000 01:53:48      99.754    62  000:00:00  000:00:06  000:16:06
IDC_SEIS  KIV3   shz         000 01:53:48      99.845    64  000:00:00  000:00:06  000:16:06

Data Timeliness Statistics
Net        Sta   Chan Aux   Max_Exp_Time  Delay_Med     Mean     Std_Dev      Min        Max
IDC_SEIS  OBN    bhz        000 00:05:00  000:00:00  000:00:00  000:00:00  000:00:00  000:00:00
IDC_SEIS  OBN    bhn        000 00:05:00  000:00:00  000:00:00  000:00:00  000:00:00  000:00:00
IDC_SEIS  OBN    bhe        000 00:05:00  000:00:00  000:00:00  000:00:00  000:00:00  000:00:00

IDC_SEIS  ARU    bhz        000 01:23:14  000:46:22  000:50:17  000:25:50  000:44:14  000:58:01
IDC_SEIS  ARU    bhn        000 01:23:14  000:46:27  000:50:21  000:25:55  000:44:16  000:58:05
IDC_SEIS  ARU    bhe        000 01:23:14  000:45:53  000:49:39  000:26:28  000:43:45  000:57:39

IDC_SEIS  KIV0   shz        000 01:53:48  000:24:19  000:22:21  000:14:00  000:00:01  000:37:57
IDC_SEIS  KIV0   shn        000 01:53:48  000:24:06  000:22:03  000:13:44  000:00:02  000:37:29
IDC_SEIS  KIV0   she        000 01:53:48  000:23:40  000:21:54  000:13:51  000:00:01  000:37:44
IDC_SEIS  KIV1   shz        000 01:53:48  000:23:54  000:21:47  000:13:52  000:00:10  000:37:17
IDC_SEIS  KIV2   shz        000 01:53:48  000:23:16  000:21:52  000:13:59  000:00:10  000:37:37
IDC_SEIS  KIV3   shz        000 01:53:48  000:23:59  000:21:59  000:14:00  000:00:06  000:37:39
```

AUTHENTICATION STATUS REPORTS

Some data channels in GSETT-3 will be contain authentication signatures which will be verified at the IDC. The authentication status report will provide statistics on the authentication process over the time of the report. The first section of the report gives, by station, the number of packets tested, the number that passed, and the number that failed. Below this, the failures are grouped as intervals for each data channel that failed to verify the authentication signature. See Table 65 and Table 66.

Table 65. **Report Period**

Position	Name/Text	Format	Description
Report Period			
1-18	"Report period from"	a18	Text
20-29	date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
31-40	time	i2,a1,i2,a1,f4.1	Time (hh:mm:ss.s)
42-43	"to"	a2	Text
45-54	date	i4,a1,i2,a1,i2	Date (yyyy/mm/dd)
56-65	time	i2,a1,i2,a1,f4.1	Time (hh:mm:ss.s)
Header			
1-3	"Net"	a3	Text
11-13	"Sta"	a3	Text
16-19	"Chan"	a4	Text
21-23	"Aux"	a3	Text
27-40	"Packets_Tested"	a14	Text
43-56	"Packets_Failed"	a14	Text
Data			
1-9	Network	a9	Network code
11-15	Sta	a5	Station code
17-19	Chan	a3	FSDN Channel code
21-24	Aux	a4	Auxiliary Identification code
22-40	Packets_Tested	i8	Number of packets tested
49-56	Packets_Failed	i8	Number of packets failing verification

Table 66. **Authentication List Format**

Position	Name/Text	Format	Description
Title			
1-23	“Failed Packet Intervals”	a23	Text
Header			
1-3	'Net”	a3	Text
11-13	“Sta”	a3	Text
16-19	“Chan”	a4	Text
21-23	“Aux”	a3	Text
31-40	“Start_Time”	a10	Text
55-61	“End_Time”	a8	Text
71-77	“Comment”	a7	Text
Data			
1-9	Network	a9	Network code
11-15	sta	a5	Station code
17-19	chan	a3	Channel code
21-24	aux	a4	Auxiliary Identification code
26-35	s_date	i4,a1,i2,a1,i2	Start date of failure interval (yyyy/mm/dd)
37-46	s_time	i2,a1,i2,a1,f4.1	Start time of failure interval (hh:mm:ss.s)
49-58	e_date	i4,a1,i2,a1,i2	End date of failure interval (yyyy/mm/dd)
60-69	e_time	i2,a1,i2,a1,f4.1	End time of failure interval (hh:mm:ss.s)
71-132	comment	a62	Comment

Example 4.0 - 28 Authentication Status

```
DATA_TYPE AUTH_STATUS GSE2.1
Report period from 1994/12/03 00:00:00.0 to 1994/12/04 00:00:00.0
Net       Sta  Chan Aux   Packets_Tested  Packets_Failed
IDC_SEIS  ABC   shz                 8640               3
IDC_SEIS  DEF   bhz                 8640               0
 Failed Packet Intervals
Net       Sta  Chan Aux      Start_Time            End_Time          Comment
IDC_SEIS  ABC   shz      1994/12/03 14:28:40  1994/12/03 14:29:10  Unknown cause
```

Chapter 5 Station AutoDRM Basics

INTRODUCTION

Stations and NDCs providing station data must have a minimum capability to provide data to the IDC through the GSE message system. Clearly, all of the functionality of the request and data messages cannot be supported by these stations to the full extent, and a minimal AutoDRM capability is all that is necessary. This chapter describes the minimal AutoDRM configuration necessary to fulfill the duties of an auxiliary station for GSETT-3.

BASIC MESSAGE SUPPORT

A station/NDC providing segmented data must adhere to all of the basic GSE message conventions on size, line length, date-time formats, station and channel naming, and use of units. The basic message formats that must be supported include:

BEGIN Line and GSE2.1 Revision

All messages must contain the BEGIN line and must support GSE2.0 and/or GSE2.1 format.

MSG_TYPE

The REQUEST message type must be supported for receiving requests; the DATA message type must be supported for sending data messages.

MSG_ID

The id_string and optional source of the MSG_ID must be recognized in request messages, and an unique id_string must be generated for data messages.

REF_ID

The message id of the request message must be used as the reference id of the returned data message.

E-MAIL Line

Electronic mail must be supported as a data return mechanism. FTP is not required.

ENVIRONMENT LINES

Many of the environment lines described in Chapter 2 are not applicable to a limited station capability for AutoDRM's. The ones that are required include TIME, STA_LIST, and CHAN_LIST. AUX_LIST is required only if necessary to distinguish between two different data streams. NET_LIST is required if more than one network ID is used. Using these three environments, simple requests can be made that obtain data from a particular station and channel within a specified time interval.

REQUEST LINES

The request lines specify what data can be obtained from the AutoDRM. A simple station AutoDRM should be able to provide WAVEFORM, STATION, CHANNEL, RESPONSE, and OUTAGE data.

Request lines may have one or more arguments that specify subtype, formats, and sub_formats. A simple AutoDRM must support the GSE2.0 or GSE2.1 format as the main format for all requests, as well as one of the ASCII sub_formats (INT, CM6, or AU6) for waveforms. sub_formats that are supported should be stated in the HELP facility, as well as the default format and sub_formats.

DATA TYPES

Data messages are sent in response to requests sent to the AutoDRM. Thus, WAVEFORM, STATION, CHANNEL, and RESPONSE data types must be supported by a simple AutoDRM in the GSE2.0 and/or GSE2.1 format.

AUTODRM IMPLEMENTATION SAFEGUARDS

Responding to requests in an automatic system requires safeguards against repeated requests, excessive numbers of requests, excessively large requests, and failures of the e-mail system (e.g., returned mail). Although each installation of the AutoDRM will be different, some general guidelines are suggested to avoid major problems.

Message Size

GSE Messages returned by e-mail will have a maximum size of 1 megabyte. Each AutoDRM site may set their own limit for the maximum size of an ftp message, and may give priority to trusted users as they see fit.

Request Echo

The original request message should be echoed back in the returned data message as DATA_TYPE LOG.

Repeat Requests

Repeated requests for the same data by the same requestor within ten minutes of the original request may be ignored by AutoDRM.

Returned Messages

An error in the address for a data message sent out by an AutoDRM will result in an e-mail returned to the AutoDRM by the e-mail system. The senders name (before the @ character in the mail-address) for such an e-mail will be either mailer-daemon or postmaster (with any combination of upper and lower case letters). The AutoDRM will forward these messages to the local AutoDRM-operator; no other action is taken and no response is sent. The AutoDRM may also recognize returned messages by the DATA_TYPE which will be DATA, or by the presence of a REF_ID line which are not used in request messages.

Syntax Errors

In case any syntax error is detected while processing a request message, a DATA_TYPE ERROR_LOG message is sent. Also, if a request is made with an unimplemented keyword, a DATA_TYPE ERROR_LOG message is sent.

A serious syntax error anywhere in a message should abort the entire message, but local policy can override this suggestion.

AutoDRM Internal Problem Logging

Any problem other than a syntax error revealed during processing of a GSE request message should be reported to the AutoDRM operator who should take appropriate action. All REQUEST messages must be answered; DATA_TYPE ERROR_LOG is sent as response for these types of errors.

AutoDRM Operation Logs

It is recommended that all local AutoDRM installations keep logs of incoming and outgoing messages, parameters of MSG_ID lines, volume of data transferred, and UTC times of message receipt and dispatch.

HELP RECOMMENDATIONS

The HELP mechanism can be used to convey a wide variety of information. The following provides an outline of topics which may be provided by an AutoDRM HELP message. It is strongly suggested that items in bold be addressed in the HELP message.

Introduction

- Information about the local data centre
- **E-mail address of local contact (in case of problems)**
- Recently added features
- Date that the HELP message was last updated

Description of GSE Message Formats and Protocols

- Basic message format
- Sending and receiving e-mail through AutoDRM

Description of commands understood by this AutoDRM

- **Supported ENVIRONMENTS**
- **Supported DATA_TYPES**
  - **Supported subtypes. Default subtype.**
  - **Supported sub_formats. Default sub_format.**
- Local extensions

Local limits

- Maximum size of e-mail message
- Maximum size of FTP message
- Types of requests which will be rejected (e.g., sent by root or mailer-daemon)
- Repeated identical requests from the same user over a short interval

Local Data

- Description of what DATA_TYPES are available from what stations/channels
- Description of local data archive
  - Segmented vs. continuous
  - Delay in data collection (how soon after real time is data available)
  - For what time period are data available

Example messages

Appendix A IDC Data Selection and Segmentation Rules

A wide range of data selection and segmentation rules could be used in selecting what data are “associated” with an event when the environment RELATIVE_TO. The PIDC will use the following rules, which were first circulated as GSE/WGO/Informal 3 in August 1995.

The PIDC provides a waveform product composed of three-component waveform segments and array beams for each event contained in the REB covering most phases of interest to the GSE. The archive is placed in the PIDC archive for rapid access based on particular events and/or time windows provided by the user. The following segmenting rules are applied:

1. For data from three-component station at regional distances (less than 20 degrees) from an event, three channels of unfiltered waveform data from one minute before the first arrival to a group velocity of 2.5 km/second plus one minute are provided.
2. For data from array stations at regional distances from an event, the rules for three-component stations would apply for a reference three-component station for the array. In addition an incoherent array beam over the same time window would be provided along with a five minute segment of array beam directed to the theoretical P-wave slowness and azimuth beginning one minute before the first arrival.
3. For data from three-component stations at teleseismic distances from an event, data from three broad-band (preferred) or short-period channels beginning one minute before the first arrival and extending for a total of five minutes would be provided. To include surface waves, three-component broad-band or long-period channel data filtered and decimated to one sample per second and extending from one minute prior to the first arrival through a time corresponding to a group velocity of 2.5 km/second plus one minute are provided.
4. For data from array stations at teleseismic distances from an event, the rules for three-component stations would apply for a reference three-component site within the array. In addition, a five minute segment of array beam directed to the theoretical P-wave slowness and azimuth beginning one minute before prior to the first arrival through. In addition, the data from a group velocity of 4.5 to 2.8 km/second would also be included.
5. For data from hydroacoustic stations with associated arrivals, data from all channels 2 minutes before the T phase to 4 minutes after the T phase will be provided.

The preceding waveform segment time windows would be applied to:

1. all stations with at least one phase associated with the REB event
2. all primary stations within 30 degrees of the REB event location
3. all auxiliary stations for which the PIDC has waveform data

Appendix B Checksum Algorithm

B.1 C FUNCTION FOR COMPUTING THE CHK2 CHECKSUM

```
#include <stdlib.h>
#include <math.h>

/*
    This function computes the GSE2.0 checksum used in the CHK2 line
*/
void
compute_checksum(signal_int, number_of_samples, _checksum)
        int     *signal_int;
        int     number_of_samples;
        int     *_checksum;
{
        int     i_sample;
        int     sample_value;
        int     modulo;
        int     checksum;

        int     MODULO_VALUE = 100000000;

        checksum = 0;

        modulo = MODULO_VALUE;

        for (i_sample=0; i_sample < number_of_samples; i_sample++)
        {
                /* check on sample value overflow */

                sample_value = signal_int[i_sample];

                if (abs(sample_value) >= modulo)
                {
                        sample_value = sample_value -
                                (sample_value/modulo)*modulo;
                }

                /* add the sample value to the checksum */

                checksum += sample_value;

                /* apply modulo division to the checksum */

                if (abs(checksum) >= modulo)
                {
                        checksum = checksum -
                                (checksum/modulo)*modulo;
                }
        }

        /* compute absolute value of the checksum */

        *_checksum = abs(checksum);
}
```

O P E R A T I O N S

B.2 FORTRAN SUBROUTINE FOR COMPUTING CHK2 CHECKSUM

```
      subroutine
   compute_checksum(signal_int,number_of_samples,checksum)
c*****************************************************************
c  This subroutine computes GSE2.0 checksum used in the CHK2 line
c*****************************************************************
c  declarations
c
      implicit none
c
      integer*4 signal_int(*)        ! (input)  seismic signal
                                   !        (counts, integer values)
      integer*4 number_of_samples    ! (input)  number of used
   samples
      integer*4 checksum             ! (output) computed checksum
c
      integer*4 i_sample                ! index
      integer*4 sample_value            ! value of one sample after
                                        ! sample overflow check
      integer*4 modulo                  ! overflow protection value
c
      integer*4 MODULO_VALUE            ! overflow protection value
      parameter (MODULO_VALUE = 100 000 000)
c
c  initialize the checksum
c
      checksum = 0
c  use modulo variable besides MODULO_VALUE parameter to suppress
c  optimizing compilers to bypass local modulo division computation
c
      modulo = MODULO_VALUE
c
c  loop over all samples (counts, integer values)
c
      do i_sample = 1, number_of_samples
c
c  check on sample value overflow
c
          sample_value = signal_int(i_sample)
          if(abs(sample_value) .ge. modulo)then
              sample_value = sample_value-
     *        (sample_value/modulo)*modulo
          endif
c
c  add the sample value to the checksum
c
          checksum = checksum+sample_value
c
c  apply modulo division to the checksum
c
          if(abs(checksum) .ge. modulo)then
              checksum = checksum-
     *        (checksum/modulo)*modulo
          endif
c
c  end of loop over samples
      enddo
c
c  compute absolute value of the checksum
c
      checksum = abs(checksum)
c
      return
      end
```

O P E R A T I O N S