LRIT RECEIVER SPECIFICATION

Version: 1.1

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REVISION HISTORY

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1.0	Baseline release	02-11-03
1.1	Revise field names for header 130	03-12-03
1.2	Insert information on header 131	04-08-03

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LRIT RECEIVER SPECIFICATION

1.0 Introduction

This document describes the technical specifications for building an LRIT receiver station to capture the GOES digital broadcast. The USA LRIT receive station is designed to be interoperable with the JMA and EUMETSAT systems. It is designed to be consistant with the CGMS Specification, CGMS 03, Issue 2.6, August 12, 1999.

1.1 LRIT Service

The mission shall be named Low-Rate Information Transmission (LRIT) because the communications link provides a data rate below 256 kbps.

1.2 Design Application

The design of the LRIT user station will be consistent with the design of the receivers for the CCSDS **Recommendation for Space Data System Standards** for Packet Telemetry. It will be limited to reception of LRIT transmissions.

1.3 System Overview

The user station will consist of four main components as illustrated in Figure 1.

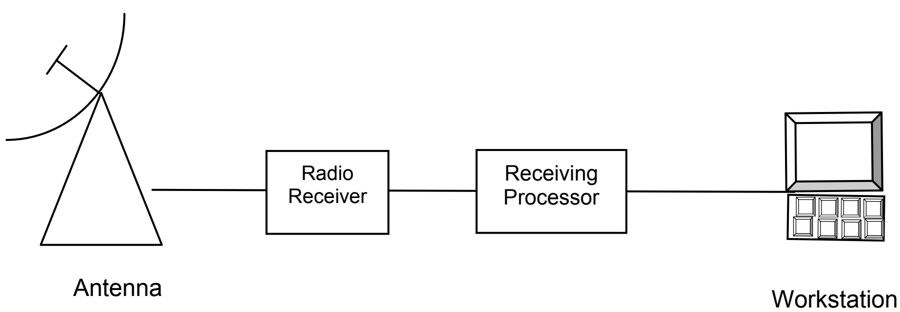

Figure 1. LRIT User Station System Components

The antenna is a parabolic dish antenna with no auto tracking. The downlink signal is received at 1691 megahertz (MHz). The signal may be filtered to reduce adjacent channel interference and/or amplified by a low-noise amplifier. Then it is down-converted to the receiver IF frequency. The IF amplifiers have a bandwidth that is capable of accommodating a 293-kbps symbol stream. The IF signal is then demodulated in a BPSK demodulator and the baseband output to the receiving processor is a serial bit stream. Table 1 shows significant parameters of the RF system.

Table 1. LRIT Downlink Characteristics

Parameter	Value
Satellite EIRP	48.2 dBm
Center Frequency	1691.0 MHz
Useful bandwidth (@ -1 dB)	Sufficient for 293,000 symbols/sec BPSK
Packetized data rate	128 kbps
Total transmitted symbol rate	293 ksymbols/s
Modulation	PCM/NRZ-L/BPSK
Receiver Gain/Temperature (G/T)	-0.3 dB for 1-meter antenna +3.2 dB for 1.8-meter antenna
BER	1×10^{-8}

The receiving processor decodes the bit stream, disassembles the LRIT packets, removes filler packets, removes the header information, reassembles and decompresses the original files, and sends the files to the workstation. The workstation contains the software to produce the images, lists, and text messages.

1.4 Definitions

In the description of the processing of the incoming data stream to the final stored files different words are used which represent divisions of an image or file. The following definitions are offered to describe what each division represents and how it is used in the receiver processing.

1.4.1 Partition

Large images may be divided into partitions, which consist of an integer number of lines of the image. Each partition will be made into a separate LRIT file and will be received at the receiver as a sequentially numbered partition of the image. The partitions will have to be stitched together to create a full image. The purpose of this division is to prevent the loss of a complete image should a file be corrupted beyond recognition.

1.4.2 Segment

A segment is a portion of an LRIT file sized to fit into the transmission packet.

2.0 Introduction to the GOES-Specific OSI Reference Model

Table 2, given below, presents the OSI layers from top to bottom and the equivalent functionality included in the LRIT communication model from the view of the transmission service.

Table 2. LRIT OSI Layer Functionality

OSI Layer	Layer Functionality
Physical Layer	- Convolutional coding - Demodulation
Data Link Layer	- Disassembly of source packets - Demultiplexing - Acquisition of VCDUs - Reed-Solomon decoding - Derandomizing
Network Layer	- (none)
Transport Layer	- Final assembly
Session Layer	- Decryption (not used in USA implementation) - Decompression
Presentation Layer	- Retrieval of User Data from Files
Application Layer	- Processing of application data

3.0 Physical Layer

The physical layer on the LRIT service performs demodulation of the incoming signal into a serialized data stream. The serialized data stream is decoded with a Viterbi soft-decision (a.k.a. maximum likelihood) decoding algorithm.

The convolutional coding has the following characteristics:

• Nomenclature:	• Convolutional code with maximum-likelihood (Viterbi) decoding
• Code rate:	• 1/2 bit per symbol
• Constraint length:	• 7 bits
• Connection vectors:	• G1 = 1111001; G2 = 1011011
• Phase relationship:	• G1 is associated with the first symbol
• Symbol inversion:	• None

4.0 Data Link Layer

This section gives a general overview and discusses input to data link layer, VCA sublayer processing, as well as VCLC sublayer processing.

4.1 Input to Data Link Layer

The Physical Layer provides a decoded serial data stream to the Data Link, which contains LRIT packets.

4.2 General

This layer consists of two sublayers for VCLC processing and VCA processing. This layer receives a bit stream from the physical layer that must be decomposed into the individual packets. Fill packets are identified and discarded. Data packets are further processed and sent to the session layer.

4.3 VCA Sublayer Processing

The VCDU structure is shown in Figure 2.

VCDU Primary Header	VCDU Data Unit Zone
6 octets	886 octets

Figure 2. VCDU Structure

The decomposition of the VCDU header is given in Figure 3.

Version Number	VCDU-ID		VCDU Counter	Signaling Field	
	S/C ID	VC ID		Replay Flag	Spare
2 bits	8 bits	6 bits	24 bits	1 bit	7 bits
6 octets					

Figure 3. VCDU Primary Header

Mission-specific use:

Version Number	'01'b
VCDU-ID	Spacecraft (S/C) ID representing on the disseminating spacecraft VC ID '63'd ('all ones')
VCDU Counter	Sequential count (modulo 16777216) of VCDUs on each virtual channel.
Signaling Field	'all zeros'

The VCA sublayer receives a data stream from the physical layer in a sequence of coded VCDU packets (C_VCDU) (Figure 2). The incoming serial data stream is synchronized into discrete CADUs. After this frame synchronization process, one randomized coded virtual channel unit

CVCU is extracted from each CADU by means of stripping the synchronization markets off. Multiplying all 8160 bits of the randomized C_VCDU with a statically defined pseudo-noise pattern performs derandomization. The packet structure now looks like Figure 4. After derandomization, each clear C_VCDU undergoes a forward error correction (FEC) based on the Reed-Solomon check symbols included in the packet.

After FEC, fill VCDUs, with a VC = 63 are discarded. The VCA-SDU is extracted from the data unit zone of the VCDU; the VCU_ID is defined in the primary header (Figure 4).

VCDU Primary Header	VCDU Data Unit Zone	Reed-Solomon Check Symbols
6 octets	886 octets	128 octets

Figure 4. C_VCDU Structure

4.3.1 Reed-Solomon Coding

The LRIT dissemination service is a Grade-2 service; therefore, the transmission of user data will be error controlled using Reed-Solomon coding as an outer code.

The used Reed-Solomon code is (255,223) with an interleaving of I = 4.

The Reed-Solomon check symbols are extracted from the last 128 octets of the C_VCDU packets forming VCDU packets.

4.3.2 Derandomization

Randomization was applied to all LRIT CVDUs. It is a process in which a pseudo-random sequence is bit wise exclusive-ORed to all 8160 bits of the CVDU to ensure sufficient data transitions.

The de-randomization process will generate the same pseudo-random sequence; synchronize with the incoming bit stream, and exclusive-OR it to extract the original data stream.

The pseudo-random sequence will be generated using the following polynomial:

$$h(x) = x^8 + x^7 + x^3 + 1$$

This randomizing sequence will begin at the first bit of the CVCDU and be repeated after 255 bits, continuing repeatedly until the end of the CVCDU. The sequence generator will then re-initialized to all-ones for the processing of the next CVCDU.

4.4 VCLC Sublayer Processing

The function of this sublayer is to take the data out of its time order and sort it by virtual channel to collect all the pieces of each LRIT file. In the Transport Layer of the transmission protocol each LRIT file is assigned one of 2048 Application Process Identifiers (APIDs) ranging from 0 to 2047. Upon acquisition of an M_PDU, the layer demultiplexes zero or more source packets from the acquired M_PDU and assembles them into CP_PDUs according to the APIDs. Eventually the available data belonging to the same APID will be assembled. Each M_PDU could contain either a portion of the data assigned to the same APID, data for two or more APIDs, or data and fill. Whenever a source packet associated with an APID is complete, it is checked for being a fill packet: if the APID equals 2047, the packet is assumed to be a fill packet. Fill packets are discarded, whereas other source packets are forwarded to the network layer.

M_PDU Header		M_PDU Packet Zone				
Spare 5 bits	First Header Pointer 11 bits	End of M_SDU # (k-1)	M_SDU # k	M_SDU # (k+1)	....	Beginning of M_SDU # m
2 octets		884 octets				

Figure 5. M_PDU Structure

5.0 Network Layer

Upon acquisition of a source packet, the network layer forwards the source packet to the transport layer. There is no other processing in this layer.

6.0 Transport Layer

This layer reassembles the LRIT files that were subdivided before transmission into transmission packets.

Upon acquisition of source packets, the packets are sorted by their APIDs. The contents of the data fields, except the last two octets are concatenated under control of the sequence flags in the packet headers, resulting in a transport file. As soon as a transport file is complete, the TP_SDU is extracted and routed to the session layer.

The CRC field included in each segment is checked to verify the integrity of the received data. Failures of this test are reported to the user application processor with a warning statement. Errors in the packet headers, which are recognized by the presence of unexpected information, may be corrected by means of redundancy (e.g., implied by sequence) and semantics.

6.1 Source Transport Service Data Unit

The TP_SDU packet structure is defined in detail in Section 6.2.1 (Source Packet Structure) of the transmit specification.

Source Packet Header (48 bits)							Packet Data Field (variable)	
Packet Identification				Packet Sequence Control		Packet Length	User Data Field	
Version No. 3 bits	Type 1 bit	Secondary Header Flag 1 bit	APID 11 bits	Sequence Flags 2 bits	Packet Sequence Count 14 bits	16 bits	Application Data Field Variable	Packet Error Control (CRC) 16 bits
2 octets				2 octets		2 octets	Max. 8190 octets	2 octets

Figure 6. Source Packet Structure (TP_PDU)

6.2 Data Field Integrity Check

The CRC was computed over the entire application data field, using the following generator polynomial:

$$g(x) = x^{16} + x^{12} + x^{5} + 1$$

7.0 Session Layer

The protocol data unit (S_PDU) may be compressed.

If the file is an image file, it is scanned for an image structure record. If the compression flag in the Image Structure Header is non-zero, the image has been compressed. This field along with NOAA-Specific Compression field in the NOAA LRIT Header identifies the type of compression. The data field can be either decompressed or left in its compressed format until displayed for the sake of conserving disk storage. If the data field is decompressed the primary header compression field must be reset to zero.

The resulting file is the service data unit (S_SDU) forwarded to the presentation layer.

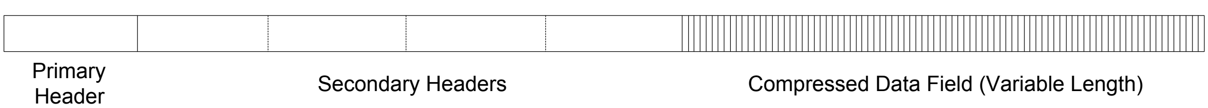

Figure 7. LRIT File Structure with Compressed Data Field

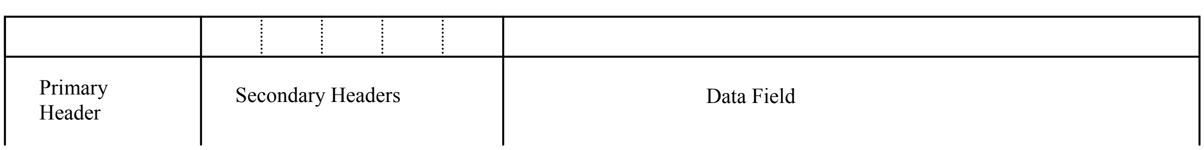

Figure 8. LRIT Session Protocol Data Unit (S_PDU)

7.1 Decompression

For NOAA LRIT, the compression flag from the Image Structure Header and the NOAA LRIT Header will be required to determine the compression. If Rice compression is to be used, the lossless compression flag will be set in the Image Structure Header and the NOAA LRIT Header will be set to 1. All the NOAA Specific compression fields are shown in Table 19.

In the case of alphanumeric data (text), the Image Structure Header will not exist. To determine if the text was compressed (Zipped), the NOAA-Specific Compression field will be set to 10.

7.2 Decryption

The GOES LRIT service will not use encryption.

8.0 Presentation Layer

The presentation layer converts the decompressed LRIT files (packets) into user data files. Several LRIT packets may contain the data for a single application file. Packets and their sequence will be determined from the header file and the files are reassembled in the correct order.

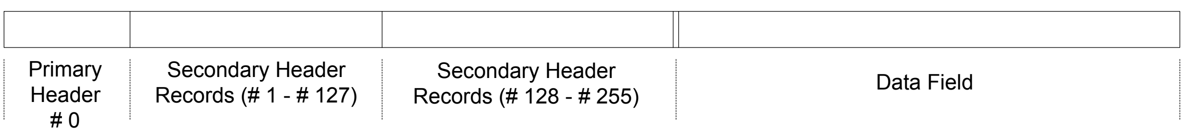

Figure 9. LRIT File Structure

Table3. Header Types in the LRIT Files

Code	Header Record Type	Structure
Headers as Defined in LRIT Global Specification		
0	Primary header	
1	Image structure	
2	Image navigation	
3	Image data function	
4	Annotation	
5	Time stamp	
6	Ancillary text	
7	Key header	Optional
8…127	Reserved	
Mission-Specific Headers		
128	Segment identification	
129	NOAA specific	
130	Header Structure Record	
131…255	Reserved	

The headers present in the LRIT file will depend upon the file type. Table 4 below shows the headers that could come with each file type.

Table 4. Use of Header Records versus File Type

File Types	Header Record Types											
	0	1	2	3	4	5	6	7	128	129	130	131
Image Data	●	●	♦	♦	●	♦	♦	♦	♦	●	●	♦
Service Messages	●						♦			●	♦	♦
Alphanumeric Text	●				●	♦	♦	♦		●	♦	♦
Meteorological Data	●				●	♦	♦	♦		●	♦	♦
GTS Messages	●				●	●		♦		●	♦	♦

● = Mandatory
♦ = Optional

The LRIT file structure will make the identification of the headers and their presence easily identifiable. Header 5 contains a time stamp indicating the time that the file was transmitted, and is not specifically needed to interpret the data. Header 4 will contain the file name used by the GOES LRIT transmitting domain. It can be extracted and used as the name of the file. Header type 0, which is present on all LRIT files will contain the length of the header and data fields for parsing of the LRIT files into application files and metadata, if used.

8.1 Primary Header Format

The primary header is required for all LRIT files. The structure of the primary header record is as follows:

Table 5. LRIT Primary Header Format

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to 0
2	Integer, unsigned	Header record length, set to 16
1	Integer, unsigned	File type code, determining the top level structure of the file data field
4	Integer, unsigned	Total header length, specifying the total size of al header records (including this one) in octets
8	Integer, unsigned	Data field length, specifying the total size of the file data field in bits.

8.2 Secondary Header Formats

Seven additional secondary headers can be used as defined in the CGMS Specification, CGMS 03, Issue 2.6, August 12, 1999. Three additional secondary header types are defined for mission specific applications. The secondary header types are shown in Table 3.

8.2.1 Image Structure Record

This record determines the structure of the image. It is mandatory for and only applicable to image data files. The structure is as follows:

Table 6. Image Structure Record

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to1
2	Integer, unsigned	Header record length, set to 9
1	Integer, unsigned	Number of bits per pixel (1…255)
2	Integer, unsigned	Number of columns (1…65535)
2	Integer, unsigned	Number for lines (1…65535)
1	Integer, unsigned	Compression flag (0,1,2)

The image record is three-dimensional. Each picture element (pixel) is in an array with horizontal and vertical alignment with other elements in the array. For each pixel there is a number of bits that gives the characteristics of that pixel, such as intensity, shading, and hue.

The compression flag determines if RICE compression will be performed. It will not be a function of the LRIT communications processor to determine if compression is needed. The values will be: "0" no compression, "1" lossless compression. A NOAA specific secondary header #130 will contain fields relative to other compression types such as JPG or ZIP.

8.2.2 Image Navigation Record

This record determines the mapping of the image onto the Earth. It is only applicable to image data files. The structure is as follows:

Table7. Image Navigation Record

Size in Octets	Data Type	Contents	Abbreviation
1	Integer, unsigned	Header type, set to2	
2	Integer, unsigned	Header record length, set to 51	
32	Character	Projection name	
4	Integer, unsigned	Column scaling factor	CFAC
4	Integer, unsigned	Line scaling factor	LFAC

4	Integer, unsigned	Column offset	COFF
4	Integer, unsigned	Line offset	LOFF

The LRIT dissemination may use projection names such as Geostationary, Polar-stereographic, and Mercator. All unused characters will be set to an ASCII 'space' ('20'h)

- CFAC/LFAC - The column and line scaling factors contain variable values that depend on the input data and their specific segmentation approach. The sign of the CFAC/LFAC values will define the spacecraft's scan direction.
- COFF/LOFF - These values are projection-specific offsets and define the position of an image segment file window within the projection area.

8.2.3 Image Data Function Record

This record determines the physical meaning of the image data. The structure is as follows:

Table 8. Image Data Function Record

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to 3
2	Integer, unsigned	Header record length
Up to 65532	Character	Data definition block

Data Definition Block: This character string allows the definition of complex data structures. It can be used to define overlay-type images and images which require the establishment of a relationship between their pixel values and an engineering unit. This header type will only be included in the files containing imagery type or overlay type of Meteorological products, Foreign Satellite Data, or service messages.

8.2.4 Annotation Record

This header is used to specify an alphanumeric annotation for the file. Header type 4 will be mandatory and will contain in characters the name of the file as presented by the LRIT Products Processor to the LRIT Preprocessor. The structure is as follows:

Table 9. Annotation Record

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to 4
2	Integer, unsigned	Header record length
Up to 64	Character	Annotation Text

The annotation text will be used to transfer the file names for the products. The extra capacity of the character field can be available for other data or annotations as needed. As an alternative architecture another header type can be assigned to the file name.

8.2.5 Time Stamp Record

This record is used to apply a time stamp to the file. It is optional for all file types. The LRIT mission will represent the time that the image was processed for transmission. The insertion of this header does not occur in this layer. The time stamp will be written after the end of the session layer processing (i.e., after compression and encryption processing). The structure is as follows:

Table 10. Time Stamp Record

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to 5
2	Integer, unsigned	Header record length, set to 10
7	CCSDS time	Time stamp

The time stamp may contain a first byte = "01000000"b, a 2-byte counter of the days from 1 January 1958, and a 4-byte counter of the milliseconds of the day.

8.2.6 Ancillary Text Record

This record is used to attach ancillary text information to the file. It is optional for all file types. The structure is as follows:

Table 11. Ancillary Text Record

Size in Octets	Data Type	Contents
1	Integer, unsigned	Header type, set to 6
2	Integer, unsigned	Header record length
Up to 65532	Character	Ancillary Text

The ancillary text will contain descriptive text identifying the contents of the LRIT file in cases where the other headers are not conclusive. The ancillary text will be used for service message types (e.g., overlay files, test messages, alphanumeric messages).

8.2.7 Key Header Record

This record is used to control encryption of the file; it has no meaning within the presentation layer. The presentation layer shall ignore any such header record, identified by header type 7. The structure is as follows:

This header record will not be used unless LRIT GOES mission requirements change; however, the capability to provide this header will be provided. The specifics will depend upon the encryption scheme chosen.

8.3 Mission Specific Headers

Mission-Specific Headers are not presented in the CGMS Global specification. They are presented below.

8.3.1 Segment Identification Record

This record is used for images such as a full Earth disk image. This image will be sent in files that contain partitions of the image. A partition refers to the image portions created in the application layer. For example, if the image contains 2048 lines and each file contains 16 lines of the image, then there will be 128 individual files sent and this record will provide the sequence number.

Table 12. Image Segment Identification Header

Size (octets)	Type	Contents	Value
1	Uint	Header type	128
2	Uint	Header record length	17
2	Uint	Image identifier	0..65535
2	Uint	Segment sequence number	0…Max segment-1
2	Uint	Start column of segment	0…Max column-1
2	Uint	Start line of segment	0…Max row - 1
2	Uint	Max segment	Number of segments
2	Uint	Max column	Width of final image
2	Uint	Max row	Height of final image

8.3.2 NOAA LRIT Header

This header is used to identify the NOAA product in the image.

Table 13. NOAA LRIT Header

Size (octets)	Type	Contents	Value
1	Uint	Header type	129
2	Uint	Header record length	14
4	Char	Agency Signature	“NOAA”
2	Uint	Product ID	Table 16
2	Uint	Product SubID	Table 16
2	Uint	Parameter	Table16
1	Uint	NOAA-Specific Compression	Table 17

8.3.3 Header Structure Record

The Header Structure Record identifies each field in the header, its length in octets, and data type. The Header Structure field describes the secondary headers and their format.

Table 14. Header Structure Record

Size (octets)	Type	Contents	Value
1	Uint	Header type	130
2	Uint	Header record length	Variable
Up to 65532	Char	Header Structure	See Table 15 Example: ANNOtation 1 UI ANNOfield 2 UI ANNOtxt 36 CHAR TimeStamp 1 UI TSfieldlen 2 UI TSccsdspfield 1 UI TSccsdsday 2 UI TSccsdsms 4 UI

The example is interpreted as follows:
ANNOtation 1 UI = Annotation field header type one octet unsigned integer
ANNOfield 2 UI = Annotation field length two unsigned integers
ANNOtxt 36 CHAR = Annotation field text of 36 characters
TimeStamp 1 UI = Time Stamp header type one octet unsigned integer
TSfieldlen 2 UI = Time Stamp field length two octets unsigned integer
TSccsdspfield 1 UI =”01000000”b
TSccsdsday 2 UI = a two octet counter of days from a reference data
TSccsdsms 4 UI = a four octet counter of milliseconds of the day.

Table 15. Header Structure Field

Value	Meaning
NOAALRIT	NOAA LRIT header type
NLfieldlen	NOAA LRIT header record length
NLagency	Agency signature
NLprodID	Product ID
NLprodSubID	Product SubID
NLprodParm	Parameter
NLcompressflag	NOAA-specific compression
ImageStruct	Image Structure header type
ISfieldlen	Image Structure header record length
ISbitsperpix	Number of bits per pixel
ISimagecols	Number of columns in image
ISimagelines	Number of lines in image
IScompressflag	Compression flag
ImageNav	Image Navigation header type
INfieldlen	Image Navigation header record length
INprojection	Projection name
INcolscalefctr	Column scaling factor
INlinescalefctr	Line scaling factor
INcoloffset	Column offset
INlineoffset	Line offset
ImageDataFunct	Image Data Function header type
IDFfieldlen	Image Data Function header record length
IDFdatadef	Data definition block
ANNOtation	Annotation header type
ANNOfieldlen	Annotation header record length
ANNOtxt	Annotation text
TimeStamp	Time Stamp header type
TSfieldlen	Time Stamp header record length
TSccsdspfield	CCSDS p-field
TSccsdsday	CCSDS day
TSccsdsms	CCSDS millisecond of day
ANCillary	Ancillary header type
ANCfieldlen	Ancillary header record length
ANCtxt	Ancillary text
SegmentID	Segment ID header type
SIDfieldlen	Segment ID header record length
SIDsequencenum	Image identifier
SIDstartcol	Start column of segment
SIDstartrow	Start line of segment
SIDtotalnum	Max segment
SIDmaxcol	Max column
SIDmaxrow	Max row
RiceID	Rice ID header type
RIDfieldlen	Rice ID header record length
RIDflags	Rice compression option flags
RIDpixel	Number of pixels in each CDS
RIDline	Number of compressed scan lines in one packet

Table 16. NOAA Product Identifiers

Product ID*	Product SubID*	Parameter	Description
0	N/A	N/A	All
1	0	N/A	All Admin Messages
2	0	N/A	All Bulletins
3	0	N/A	All GMS Products
3	1	0	GMS IR Full Disk
3	2	Sector number	GMS IR Sector
3	3	0	GMS VIS Full Disk
3	4	Sector number	GMS VIS Sector
4	0	N/A	All METEOSAT Products
4	1	0	METEOSAT IR Full Disk
4	2	Sector number	METEOSAT IR Sector
4	3	0	METEOSAT VIS Full Disk
4	4	Sector number	METEOSAT VIS Sector
4	5	0	METEOSAT WV Full Disk
4	6	Sector number	METEOSAT WV Sector
5	0	N/A	All NOAA-16 Products
5	1	0=North, 1=South	NOAA-16 IR Polar
5	2	Enumerate Projections	NOAA-16 IR Mercator
6	0	N/A	All NWS Products
7	0	N/A	All GOES Products
7	1	0	GOES IR Full Disk
7	2	0	GOES IR northern hemisphere
7	3	0	GOES IR southern hemisphere
7	4	0	GOES IR U.S.
7	5-10	0	GOES IR special interest
7	11	0	GOES VIS Full Disk
7	12	0	GOES VIS northern hemisphere
7	13	0	GOES VIS southern hemisphere
7	14	0	GOES VIS U.S.
7	15-20	0	GOES VIS special interest
7	21	0	GOES WV Full Disk
7	22	0	GOES WV northern hemisphere
7	23	0	GOES WV southern hemisphere
7	24	0	GOES WV U.S.
7	25-30	0	GOES WV special interest
8	0	N/A	All DCS Products

* 0 is reserved to represent all Ids

Table 17. Compression Type

Global Image Compression Flag	NOAA Compression Flag	Compression
0 – None	0 – None	None
1 – Lossless	1 – Rice – JPEG 2000 – PNG – GIF – TIFF . . Only lossless compression schemes can be referenced	Rice compression JPEG2000 compression Portable Network Graphics Graphics Interchange Format Tagged Image File Format . .
2 – Lossy	– JPEG 3 – JPEG 2000	Global-compatible JPEG lossy image compression JPEG2000 compression
None	10 – Zip	Zip compression (For Text)

Service messages should be used as they arrive. The service message should be displayed for the attention of the operator.

8.3.4 Rice Compression Secondary Header

The Rice Compression Secondary Header in **Error! Reference source not found.**5 shall be used to communicate Rice compression parameters between sender and receiver.

Table 18. Rice Compression Record

Field Name	Size	Type	Description	Value
headerType	1	Uint	NOAA-specific header type code for Rice Compression Header	131
headerLength	2	Uint	Header length in octets	7
flags	2	Uint	Compression option flags	Sum (bit-wise “or”) of values in Table 19
pixelsPerBlock	1	Uint	Number of pixels in each CDS	Even number, $4 \leq value \leq 64$
scanLinesPerPacket	1	Uint	Number of compressed scan lines in one packet	1-255

If this header is missing from a file that specifies Rice Compression, the default values in Table 20 shall be used by both sender and receiver. The defaults for all parameters shall also be used if the header is provided, but one or more parameters are out of range.

Table 19 Compression Flags

Name	Value
ALLOW_K13_OPTION_MASK	1
CHIP_OPTION_MASK	2
EC_OPTION_MASK	4
LSB_OPTION_MASK	8
MSB_OPTION_MASK	16
NN_OPTION_MASK	32
RAW_OPTION_MASK	128

Table 20 Default Rice Compression Parameters

Field	Default Value
flags	ALLOW_K13_OPTION_MASK MSB_OPTION_MASK NN_OPTION_MASK
pixelsPerBlock	16
scanLinesPerPacket	1

9.0 Application Layer

The application layer receives the LRIT files from the session layer. The files are transmitted from the receiving processor to the workstation.

In the workstation, the files are stored and identified for their applicability to the specific requirements of the user facility.

The application files will be saved on a mass storage medium available to the LRIT processor and the application processor. The file name will be extracted from the secondary header record Type 4, the annotation record.

Image files that have been partitioned in the transmit application layer will have the partition number and number of partitions recorded in header type #128. The partitions are based upon a number of scan lines of the image. The partition files should be kept separate and identified as being part of an image.

LRIT files that are administrative messages should be either printed or displayed to the user automatically. Images are sent to the application program for interpretation and display. List files are printed or displayed under autonomous control based upon a preselected setup option of the workstation operator.

9.1 File Handling

The applications processor must contain an autonomous file handling system because:

Data in the files requires immediate attention of the user,

- Mass storage is limited,
- The image files are large,
- The data is time sensitive and becomes obsolete after a short period of time, and
- Data files will be received as a continuous input.

Each file will be identified to determine what further processing is necessary. The file handling processor will keep a record of the activity of each file. The file transmission time will be extracted from header 5 and the reception time from the system clock. The file handler will pass the file to the appropriate applications processor and know when the processing is complete. The file will be purged from the mass storage according to a user-defined storage time or passed to another processor if required by the user's specific installation. The timing of the process should be fast enough so that a new image with the same file name will not coexist in the applications processor with the older image. The files should be processed fast enough so that a file is not overwritten by the new image before it has completed processing.

9.2 Data Processing

The types of files that will be received are:

- Image data files
- Service messages
- Alphanumeric files
- Global Transmission System (GTS) messages

9.2.1 Processing Image Files

The image file structure is presented in the CGMS Specification, CGMS 03, Issue 2.6, August 12, 1999. Image files will contain images in a series of 4-bit or 8-bit pixels. Each pixel represents a 128-level or 256-level gray scale (no color in the WEFAX images). GOES and POES images will have 1395 pixels per line and a number of lines that varies with the image. Images from other sources may have different dimensions and gray scale. Header type 1 will identify the dimensions of the image and the number of bits per pixel. The applications processor should have the capability to produce the image on the display screen and to print it.

The file structures will be as follows:

Table 21. Data Field Parameters for LRIT Image Files

LRIT Product	Number of Bits per Pixel	Number of Columns	Number of Lines
GOES			
Full Disk	8	1396	698
North Hemisphere	8	1396	740
South Hemisphere	8	1396	740
North West	8	1396	740
North East	8	1396	698
South West	8	1396	690
South East	8	1396	740
POES [Polar Stereographic Projection (PS)]	4	854	387
POES [Mercator Projection (MR)]	4	854	403
NWS	8	1200	900 (varies)
GMS	8	1200	804
METEOSAT	8	1200	804

Large images such as the full disk file will be stored in smaller files containing segments with only a certain number of lines of an image. In order to decrease the latency of the data image, the processor should start producing the image without waiting for reception of all the files. The data from each file should be used to build the image as soon as it is received.

If an image file is an overlay for another image, the processor should be able to overlay the image on the original figure. Overlays can be grids, isobars, or text.

9.2.2 Processing Alphanumeric Files

The files should contain data in American Standard Code for Information Interchange (ASCII) alphanumeric format. Often these files are tables or lists. The application processor should display or print these files in their original format.

9.2.3 Processing Service Messages

It will be assumed that these messages have high priority and the user terminal operator should be alerted to them as soon as possible. When these messages are received, some method of alerting the operator should be used such as an audible alarm or flashing screen. The message should be displayed on the monitor after the image processing is complete. As a user option the message can be printed.

9.2.4 GTS Message

The meteorological data and products acquired from the Global Transmission Service (GTS) will contain GTS Data and Products.