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GK2A UHRIT Mission Specification Document

Korea Meteorological Administration

The present document has been developed within the NMSC and may be further elaborated for the purposes of NMSC. This specification is provided for development work of GK2A UHRIT receiving station.

Keywords
< GK2A, UHRIT, LDUS >

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Foreword

This specification document has been produced by the National Meteorological Satellite Center (NMSC).

Should NMSC modify the contents of the present document, it will be re-released by NMSC with an identifying change of release date and an increase in version number as follows:

Issue x.y

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1 INTRODUCTION

1.1 Purpose

The Ultra High Rate Information Transmission (UHRIT) specification of the GK2A was written in accordance with ISO 7498 and the CCSDS Recommendation standard. This UHRIT Mission Specification defines the structure and format of the UHRIT file and will provide a way to process and transmit GK2A satellite broadcast data based on the OSI hierarchy.

This document is intended to distribute detailed specifications for providing meteorological data observed through GK2A using UHRIT services.

1.2 References

Applicable documents:

[AD 1] KARI: 'GK2A LRIT/HRIT/UHRIT Mission Specification for GK2A PDS Development', GK2-D0-600-012 F.03, Nov. 07 2018

[AD 2] CGMS: 'Coordination Group for Meteorological Satellites LRIT/HRIT Global Specification', CGMS03 Issue 2.6

Reference documents:

[RD 1] CGMS: 'LRIT/HRIT Global Specification', Rev 2.6.August 1999

[RD 2] ISO: 'Information Processing System - Open System Interconnection - Basic Reference Model', ISO standard 7498, Feb. 1982

[RD 3] CCSDS: 'Networks and Data Links: Architectural Specification', CCSDS Recommendation 701.0-B-3-S, June 2001

[RD 4] KMA: 'COMS LRIT Mission Specification', Issue 1.2, November 30, 2010

[RD 5] KMA: 'COMS HRIT Mission Specification', Issue 1.2, November 30, 2010

[RD 6] ISO: 'Information technology -- JPEG 2000 image coding system: Core coding system', ISO/IEC 15444-1:2004

[RD 7] CGMS: 'LRIT/HRIT Global Specification', Issue 2.8, 30 October 2013

[RD 8] CCSDS: 'Time code formats', CCSDS recommendation 301.0-B-3 January 2002

[RD 9] CCSDS: 'AOS Space Data Link Protocol', CCSDS 732.0-B-2, July 2006

[RD 10] ETSI: 'Digital Video Broadcasting (DVB) Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications', Part 1: DVB-S2, EN 302 307-1, V1.4.1

[RD 11] ISO: 'Information Processing System - Open System Interconnection Basic Reference Model', ISO standard 7498, Feb. 1982

[RD 12] CCSDS: 'TM Synchronization and Channel Coding', CCSDS Recommendation 131.0-B-3- September 2003

[RD 13] Data Encryption Standard (DES) Federal Information Processing Standard (FIPS) PUB 46-2, U.S. Dept. of Commerce, National Institute of Standards and Technology, 30/12/93

[RD 14] CCSDS: 'Space Packet Protocol', CCSDS 133.0-B-1, September 2003

Abbreviations

AMI	Advanced Meteorological Imager
APID	Application Process Identifier
APNH	Asia and Pacific in Northern Hemisphere
CADU	Channel Access Data Unit
CVCDU	Coded Virtual Channel Data Unit
CCSDS	Consultative Committee for Space Data Systems
CGMS	Co-ordination Group for Meteorological Satellite
COMS	Communication, Ocean and Meteorological Satellite
CP_PDU	CCSDS Path Protocol Data Unit
DES	Data Encryption Standard
ECB	Electronic Code Book (DES mode)
ENC	Encryption Process
ELM	Extended Local Model
ENH	Extended Northern Hemisphere
FD	Full Disk
GK2A	Geo-KOMPSAT-2A
GRIB	Gridded Binary
GTS	Global Telecommunication System
HRIT	High Rate Information Transmission
ISO	International Organization for Standardization
JPEG	Joint Photographic Expert Group
KMA	Korea Meteorological Administration
LRIT	Low Rate Information Transmission
LSB	Least Significant Bit
LSH	Limited Southern Hemisphere
MAC	Media Access Control
MSB	Most Significant Bit
NWP	Numerical Weather Prediction
M_PDU	Multiplexing Protocol Data Unit
OSI	Open Systems Interconnection
RF	Radio Frequency
S/C	Spacecraft
SDUS	Small-scale Data Utilization Station
TBC	To Be Confirmed
TBD	To Be Defined
TP_PDU	Transport Protocol Data Unit
UHRIT	Ultra High Rate Information Transmission
VCDU	Virtual Channel Data Unit
WMO	World Meteorological Organization

2 OSI REFERENCE MODEL

2.1 Communication Concept of UHRIT

The GK2A UHRIT dissemination service is based on the Open Systems Interconnection (OSI) Reference Model in [RD2] and the CCSDS AOS in [RD3].

Table 2.1 presents the functionalities of the each OSI layer from the view of dissemination system.

Table 2.1 OSI Layer Functionalities for GK2A UHRIT Service

OSI 7 layers	Layer functionalities
Application layer	Acquisition of application data
Presentation layer	Image segmentation, UHRIT file structuring
Session layer	Compression (if required) Encryption (if required)
Transport layer	Determination of APID Split of files into source packet
Network layer	Determination of VCID
Data link layer	Multiplexing, Error of block unit detection, Reed-Solomon encoding Randomization Attachment of sync marker
Physical layer	Serialization, Viterbi encoding, Modulation

This documentation defines data type of each layer as Figure S_PDU is file data of xRIT_Data compressed and encrypted, each data format including S_PDU will described corresponding chapter.

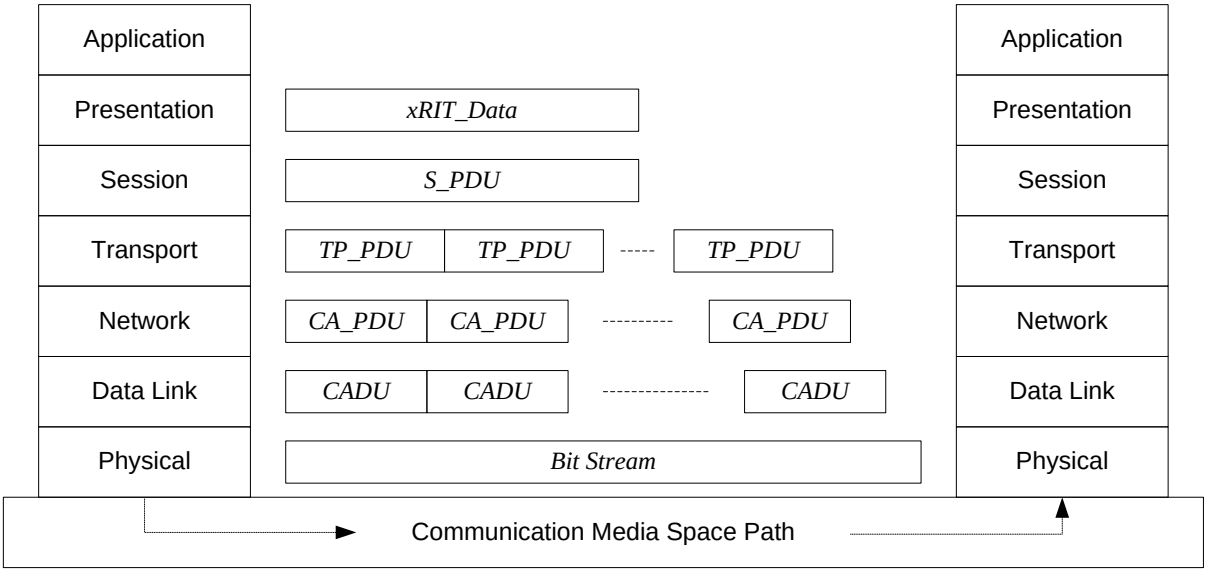


Figure 2.1 Definition of GK2A UHRIT Data Type

3 APPLICATION LAYER

3.1 Data Type

The GK2A UHRIT service will provide specific application data from external systemin the Application Layer as follows,

- Image Data: Full Disk(FD)
- Additional Data:
  Alphanumeric text file
  Level 2 Data(TBD)

3.1.1 Image Data

The type of image data consists of visible channel image and infrared channel image. The projection type of GK2A UHRIT is GEOS. The images defining latitude, longitude, and size are distributed.

- Dissemination mode and image size:
  FD 22,000 x 22,000 (VIS06)
  FD 11,000 x 11,000 (VIS04, VIS05, VIS08)
  FD 5,500 x 5,500 (IR)

- Dissermination time:
  Within 3 minutes afer completion of observation(Observatio period: 10 minute)

Table 3.1.1 Channel and Resolution of GK2A Image Data

No.	Name	Wavelength	Resolution	bit
1	VI004	0.47	1 km	11
2	VI005	0.51	1 km	11
3	VI006	0.64	0.5 km	12
4	VI008	0.86	1 km	13
5	NR013	1.38	2 km	12
6	NR016	1.61	2 km	11
7	SW038	3.90	2 km	14
8	WV063	6.18	2 km	12
9	WV069	6.95	2 km	13
10	WV073	7.34	2 km	13

11	IR087	8.50	2 km	13
12	IR096	9.61	2 km	13
13	IR105	10.3	2 km	13
14	IR112	11.2	2 km	13
15	IR123	12.3	2 km	13
16	IR133	13.3	2km	13

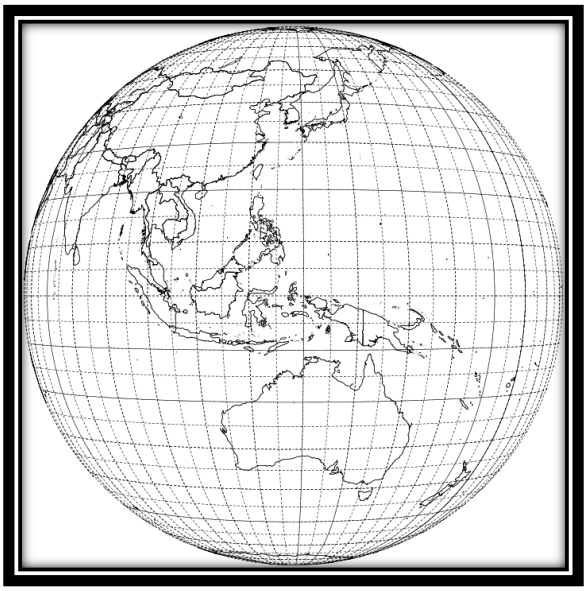


Figure 3.1 GK2A FD Image

3.1.2 Additional Data

Additional data distributed through GK2A satellite broadcasting service are Alphanumeric Text and Level-2 data.

- Alphanumeric Text provides GK2A operation information, observation schedule, satellite broadcast distribution schedule, algorithm update information, data processing parameters, and data conversion factor.

- Level-2 data is provided with meteorological data and utilization data based on GK2A observation data.

4 PRESENTATION LAYER

4.1 Segmentation of GK2A UHRIT

Image segmentation is performed for GK2A UHRIT dissemination services in real-time and for high flexibility with the UHRIT compression/encryption schemes. Compression and encryption is processed with the unit of segment. The whole UHRIT images are composed of a number of UHRIT files.

- UHRIT segment file size: Column x Line

Table 4.1 UHRIT Image Data Segment File Structure

GK2A UHRIT Image Data				
Observation Mode	Segment Files	1 Segment Size		
		2 km	1 km	0.5 km
FD	Segment File #1	125 x 2,500	250 x 11,000	500 x 22,000
	Segment File #2~#22	250 x 2,500	500 x 11,000	1,000 x 22,000
	Segment File #23	125 x 2,500	250 x 11,000	500 x 22,000

4.2 UHRIT File Structure

GK2A UHRIT files are formatted data as shown in figure 4.1. An UHRIT files consists of one or more header records and one data field. The primary header record defines the file type and the size of the complete UHRIT file. The secondary header records include various information relating with the data field.

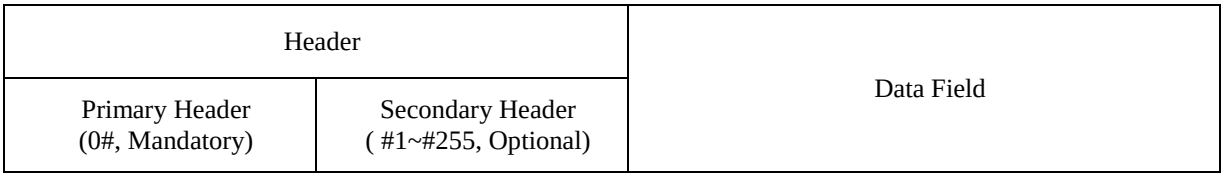


Figure 4.1 UHRIT File Structure

4.3 File Type of UHRIT

GK2A UHRIT file types are described in Table 4.2. The file types (0… 127) have already been defined in [RD 1]. In addition, the mission specific file types (128… 255 have been reserved for the future GK2A UHRIT service expansion.

Table 4.2 UHRIT File Type

Classification	File Type Code	File Type	Application data type contained in the data field
UHRIT basic data	0	Image data	FD observation data (Normalized Geostationary Projection)
	1	GTS message	Not used
	2	Alphanumeric text	Administrative messages including observation/ dissemination schedule
	3	Encryption key Message	Not used
	4~127	Reserved	For further global use
Add data space	128~255	Reserved	For further mission specific use

4.4 Header Records of GK2A UHRIT File

Table 4.3 UHRIT Header Type

Classification	Code	Header Record Type	Remark
Global Header Types	0	Primary header	
	1	Image structure	
	2	Image navigation	
	3	Image data function	
	4	Annotation	
	5	Time stamp	

	6	Ancillary text	Not used
	7	Key header	
	8 ~ 127	Reserved	
Mission Specific Header Type	128	Image segment definition	Image segment file information
	129	Encryption key message header	Not used
	130	Image compensation info. header	
	131	Image observation time header	
	132	Image quality info. header	
	133 ~ 255	Reserved	

4.4.1 Header Type #0 – Primary Header

This header provides the size of total UHRIT file(header records + data field). The padding data with the value of "0x00" will be filled at the end of data field to be line with 64 bits alignment of DES encryption when the encryption is applied.

Table 4.4 Header Type #0 – Primary Header

Classification	Data Type	Data Size (Bytes)	Value	Remark
Header Type	unsigned integer	1	0	Fixed value
Header Record Length	unsigned integer	2	16	Fixed value
File Type Code	unsigned integer	1	Variable	0: Image data file 1: GTS message(Not used) 2: Alphanumeric text file 3: Encryption key message(Not used)
Total Header Length	unsigned integer	4	Variable	Total Header Record size(Bytes)
Data Field Length	unsigned integer	8	Variable	Data Field size(bits)

4.4.2 Header Type #1 – Image Structure

This header provides number of bits per pixel, number of columns, number of lines of image structure, and compression flag.

Table 4.5 Header Type #1 – Image Structure

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	unsigned integer	1	1	Fixed value
Header Record Length	unsigned integer	2	9	Fixed value
Number of bit per pixel	unsigned integer	1	Variable	Input valid bit according to channel
Number of columns	unsigned integer	2	Variable	Variable size according to observation area and channel
Number of lines	unsigned integer	2	Variable	Variable size according to observation area and channel
Compression Flag	unsigned integer	1	Variable	Compression method 0: No compression 1: Lossless compression 2: Lossy compression

4.4.3 Header Type #2 – Image Navigation

This header provides the information of image projection on the earth .

Table 4.6 Header Type #2 – Image Navigation

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	unsigned integer	1	2	Fixed value
Header Record Length	unsigned integer	2	51	Fixed value
Projection Name	Character	32	Variable	Projection names as defined in [RD7] GEOS(<sub_lon>)
CFAC	integer	4	Variable	Column scaling factor as defined in [RD7]
LFAC	integer	4	Variable	Line scaling factor as defined in [RD7]

COFF	integer	4	Variable	Column offset as defined in [RD7]
LOFF	integer	4	Variable	Line offset factor as defined in [RD7]

4.4.4 Header Type #3 – Image Data Function

This header provides the physical meaning of the image data. It is used to define images which require establishing a relationship between their pixel count and physical units such as radiance/temperature or albedo.

Table 4.7 Header Type #3 – Image Data Function

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	unsigned integer	1	3	Fixed value
Header Record Length	unsigned integer	2	Variable	Max. 65535
Data Definition Block	Character	variable	Variable	Max. 65532 (TBD)

4.4.5 Header Type #4 – Annotation Text

This header provides the annotation record to allow quicker and easier detection of file contents.

Table 4.8 Header Type #4 - Annotation

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	4	Fixed value
Header Record Length	Unsigned integer	2	Variable	Max. 67
Annotation Text	Character	Variable	Variable	Max. 64 File Name IMG_FD_143_VI006_20180627_030000_01.uhrit ADD_ANT_143_20180627_030000__01.uhrit

4.4.6 Header Type #5 – Time Stamp

This header provides processing time in session layer.

Table 4.9 Header Type #5 – Time Stamp

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	5	Fixed value
Header Record Length	Unsigned integer	2	10	Fixed value
Time Stamp (CDS P Field)	Unsigned integer	1	Variable	P-Field fixed value according to [RD8]
Time Stamp (CDS T Field)	Unsigned integer	6	Variable	T-Field fixed value according to [RD8]

4.4.7 Header Type #6 – Ancillary Text (Not used)

The header type #6 will be used for the GK2A UHRIT service expansion.

4.4.8 Header Type #7 – Key Header

This header provides the number of used encryption key.

Table 4.10 Header Type #7 – Key Header

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	7	Fixed value
Header Record Length	Unsigned integer	2	7	Fixed value
Key Number	Unsigned integer	4	Variable	Index of the used encryption key 0: Encryption is not applied

4.4.9 Header Type #128 – Image Segmentation Identification

Table 4.11 Header Type #128 – Image Segmentation Identification

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	128	Fixed value
Header Record Length	Unsigned integer	2	7	Fixed value
Image Segment Seq. No.	Unsigned integer	1	Variable	Image segment sequence number
Total No. Image. Segment	Unsigned integer	1	Variable	Total number of Image segments
Line No. Image. Segment	Unsigned integer	2	Variable	Line number of Image segment

4.4.10 Header Type #129 – Encryption Key Massage(Not used)

4.4.11 Header Type #130 – Image Compensation Information

This header includes the image navigation parameters, such as COFF, LOFF, CFAC, LFAC for the entire image data.

Table 4.12 Header Type #130 – Image Compensation Information

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	130	Fixed value
Header Record Length	Unsigned integer	2	Variable	Max. 65535
Image Compensation Information	Character	Variabel	Variable	Max. 65532

4.4.12 Header Type #131 – Image Observation Time

This header includes the observation time of image data as MJD (Modified Julian Day) format.

Table 4.13 Header Type #131 – Image Observation Time

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	131	Fixed value
Header Record Length	Unsigned integer	2	Variable	Max. 65535
Image Observation Time	Character	Variable	Variable	Max. 65532

4.4.13 Header Type #132 – Image Quality Information

This header represents Error pixel number of the whole image.

Table 4.14 Header Type #132 – Image Quality Information

Classification	Data Type	Data size (Bytes)	Value	Remark
Header Type	Unsigned integer	1	132	Fixed value
Header Record Length	Unsigned integer	2	Variable	Max. 65535
Image Observation Time	Character	Variable	Variable	Max. 65532

4.5 UHRIT File Name

The file name of character strings is stored in the Annotation Header (Header Type # 4). The name of image data files disseminated via UHRIT is defined as follows.

4.5.1 Image Data File Name

The example of UHRIT image data file name:

- IMG_AA_NNN_CHHnn_YYYYMMDD_hhmmss_NN.uhrit

The UHRIT file name of image data is used as follows,

Table 4.15 File Name of Image Data

	File Type	Observation Mode	Sequence No.	Spectral Channel	Dissemination Time	Segment File No.	Ext.
Form	IMG_	AAAAAAA_	NNN_	CHnnn_	YYYYMMDD_hhmmss_	NN	.uhrit
Size	4 Bytes	Maximum 8 Bytes	4 Bytes	6 Bytes	16 Bytes	2 Bytes	6 Bytes
Ex)	IMG_	FD_	143_	VI006_	20180627_030000_	01	.uhrit

- UHRIT Image Data File Type is indicated as IMG_
- Observation mode marked as AAAAAAA_
- Video sequence number starts from 00UTC in order of observation mode, and is indicated as NNN_
- The channel is divided into 16 channels and the central wavelength is marked as CHnnn_
- The sequence number of the split file starts from 01 for each observation image and is displayed as NN

The example of UHRIT additional data file name:

- ADD_AAAAAAA_NNN_ YYYYMMDD_hhmmss_NN.uhrit

The UHRIT file name of additional data is used as follows,

Table 4.16 Additional Data File Name

	File Type	Additional Data Type	Sequence No.	Dissemination Time	Segment File No.	Ext.
Form	ADD_	AAAAAAA_	NNN_	YYYYMMDD_hhmmss_	NN	.uhrit
Size	4 Bytes	Max 8 Bytes	4 Bytes	16 Bytes	2 Bytes	6 Bytes
Ex)	ADD_	ANT_	143_	20180627_030000_	01	.uhrit

- UHRIT Additional Data File Type is indicated as ADD_
- Additional Data Type is marked as AAAAAAA_
- The video sequence number is NNN_ in the order of the additional data type.
- The sequence number of the split files is 01 for each additional data type.

4.6 File Type vs. Header Implementation

Table defines the GK2A UHRIT mission specific use of header record types within certain UHRIT file types.

Table 4.17 File Type vs. Header Implementation

File types		Header record types												
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**128**	**129**	**130**	**131**	**132**
0	Image data file	●	●	◎	◎	◎	◎		◎	◎		○	◎	○
1	GTS Message													
2	Alphanumeric text file	●				◎	◎		◎					

● As requested by [RD7] ◎ KMA mandatory use ○ KMA optional use

0 Primary header
1 Image structure
2 Image navigation
3 Image data function
4 Annotation
5 Time stamp
6 Ancillary text
7 Key header

128 Image segment identification
129 Encryption Key message header
130 Image compensation info. header
131 Image observation time header
132 Image quality information header

5 SESSION LAYER

The session layer includes the definition of data compression and encryption for each xRIT_Data transmitted as file type from application layer. The output of the session layer to the transport layer is S_PDU containing the compressed and encrypted data field.

The Session Layer generates S_PDU by applying to each UHRIT file from the Presentation Layer in the order of compression and encryption.

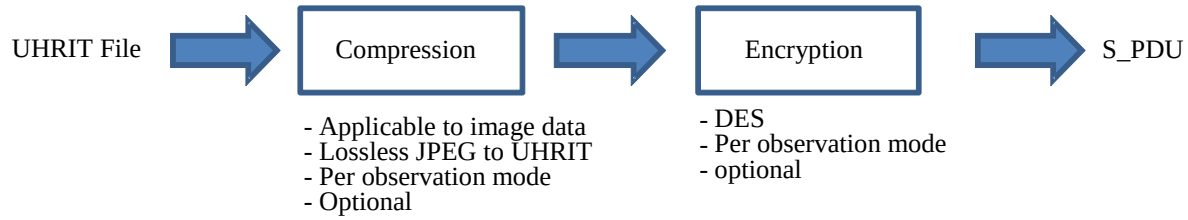


Figure 5.1 Session Layer Processing

5.1 Compression

According to [RD7], Image data file applies lossless(File type code : 0) JPEG2000 [RD6].

5.2 Encryption

The encryption and decryption of GK2A UHRIT are based on a processing in accordance with the ECB (Electronic Code Book) mode of DES (Data Encryption Standard) [RD 13]. Figure 5.2 shows the principle of encryption and decryption.
The UHRIT File is encrypted using an encryption master key managed by NMSC. The inverse process, decryption is also processed at LDUS at S/W level.

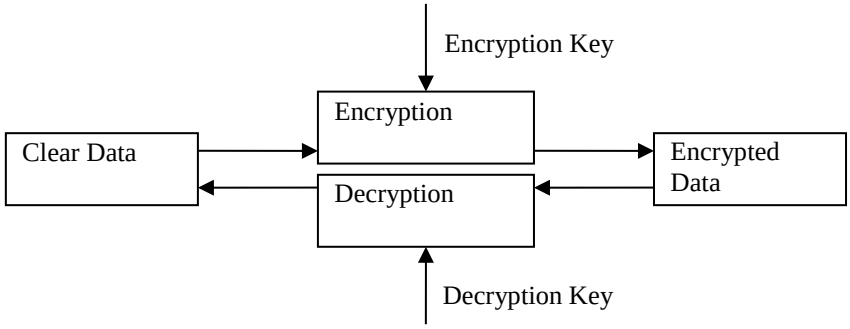


Figure 5.2 Principle of Encryption and Decryption for UHRIT

6 TRANSPORT LAYER

The Transport Layer generates TP_File with S_PDUs from session layer as byte unit and splits it into one or more CP_PDU. The CP_PDU is the CCSDS Path Protocol Data Unit [RD3].

6.1 Transport File(TP_File)

In the Transport Layer, 10 byte TP_header is attached to the beginning of S_PDU and several bits (0~7) are filled at the end of S_PDU to make it in byte units. The structure of TP_File is shown in Table 6.1 and TP_Header is described as bellows.

Table 6.1 Transport File Structure

TP_Header		**S_PDU**	**Filler**
File Counter	File Length		
16 bits	64 bits	$1 \sim (2^{64} - 1)$ bits	0~7 bits

Table 6.2: UHRIT TP_Header

Field	**Bits**	**Description**
File Counter	16	UHRIT FD File Number: VI004: 0~22 VI005: 23~45 VI006: 46~68 VI008: 69~91 NR013: 92~ 114 NR016: 115~137 SW038: 138~160 WV063: 161~183 WV069: 184~206 WV073: 207~229 IR087: 230~252 IR096: 253~275 IR105: 276~298 IR112: 299~321 IR123: 322~344 IR:133: 345~367
File Length	64	File Length(bits)

6.2 Space Packet (CP_PDU)

The CP_PDU are structur to Space Packet Hearder and Space Packet Data Field. The structure of Space Packet is shown in Table 6.3 and Space Paket Header(Primary, Secondary) are described as bellows.

Table 6.3 Space Packet Structure

Packet Header		User Data Field	
Packet Primary Header	Packet Secondary Header	1 ~ 16,372 Bytes	CRC
6 Bytes	8 Bytes		4 Bytes

- Space Packet Checksum uses the CRC defined in ISO 13239 High-Level Data Link Control (HDLC).
- The CRC includes Primary, Secondary Header, and Payload data. We refer to CCSDS 133.0-B-1 [RD14].

Table 6.4 Space Packet Primary Header

Bits	Field	Description
3	Packet Version Number	CCSDS protocol version · 0 (fixed)
1	Packet Type	Indicates whether this is a telecommand or telemetry packet · 0 (fixed)
1	Secondary Header Flag	Indicates whether this packet has a secondary header · 1 (fixed)
11	Application Process Identifier (APID)	Identifies the specific data content of the packet
2	Sequence Flags	Flags for data segmentation · 11: Single data · 01: First segment · 00: Contained segment · 10: Last Segment
14	Packet Sequence Count	Counter that ascends sequentially for packets with the same APID
16	Packet Data Length	Packet size information (Bytes)

Table 6.5 Space Packet Secondary Header

Bits	Field	Description
16	Days Since the Epoch	Number of days since the start of the standard J2000 epoch (January 1, 2000 12:00:00 UTC) for packet creation time
32	Milliseconds of the Day	Milliseconds since start of day (12:00:00 UTC) for packet creation time
5	UHRIT Version	UHRIT version number · Current: 0
5	UHRIT Payload Variant	Type of payload · AMI: 0
2	Assembler Identifier	Ground system UHRIT assembly function hardware instance that generated the packet · PDS@NMSC: 0 · PDS@SOC: 1
4	System Environment	Ground system computing environment generating the packet · Development: 0 · Integration and Test: 1 ·Operational: 2

7 NETWORK LAYER

The only function of Network Layer is to generate Virtual Channel ID (VCID) for each APID[RD7].

- Refer to Appendix B for APID and VCID

8 DATA LINK LAYER

Data Link Layer uses the “CCSDS, AOS Space Data Link Protocol, CCSDS 732.0-B-2”[RD9].

8.1 M_PDU

The Source Packet is entered into the M_PDU in units of 2,034 Bytes. In the M_PDU Packet Zone, no Space Packet is input or multiple Space Packets can be input.

Table 8.1 M_PDU Structure

M_PDU Header		**M_PDU Packet Zone**		
RSVD Spare	First Header Pointer	End of Space Packet (N)	Space Packet (N+1)	Start of Space Packet (N+2)
5 bits	11 bits	2,034 bytes		
2,063 bytes				

Table 8.2 M_PDU Header

Bits	**Field**	**Description**
5	Reserved Spare	Reserved · 0 (fixed)
11	First Header Pointer	Offset to the location of the first Space Packet that starts in the M_PDU Packet Zone (Byte)

8.2 AOS Transfer Frame

The M_PDU data is input to the AOS Transfer Frame.

Table 8.3 AOS Transfer Frame Structure

<table>
<tr><td colspan="8">Transfer Frame Primary Header</td><td rowspan="4">Transfer Frame Data Field</td><td rowspan="4">Frame Error Control Field</td></tr>
<tr><td colspan="2">Master Channel ID</td><td></td><td></td><td colspan="4">Signaling Field</td></tr>
<tr><td>Transfer Frame Version Number</td><td>Spacecraft ID</td><td>Virtual Channel ID</td><td>Virtual Channel Frame Count</td><td>Replay Flag</td><td>Virtual Channel Frame Count Usage Flag</td><td>RSVD Spare</td><td>Virtual Channel Count Cycle</td></tr>
<tr><td>2 bits</td><td>8 bits</td><td>6 bits</td><td>24 bits</td><td>1 bits</td><td>1 bits</td><td>2 bits</td><td>4 bits</td></tr>
<tr><td colspan="3">2 Bytes</td><td>3 Bytes</td><td colspan="4">1 Bytes</td></tr>
<tr><td colspan="8">6 Bytes</td><td>2,036 Bytes</td><td>2 Bytes</td></tr>
<tr><td colspan="10">2,044 Bytes</td></tr>
</table>

- Transfor Frame Primary Header

Table 8.4 Transfer Frame Primary Header

Bits	Field	Description
2	Transfer Frame Version Number	0 (fixed)
8	Spacecraft ID	Spacecraft ID (XXh)
6	Virtual Channel ID	Virtual Channel ID (Table 6.4)
24	Virtual Channel Frame Count	Virtual Channel Frame Count
1	Replay Flag	Replay Flag
1	Virtual Channel Frame Count Usage Flag	Virtual Channel Frame Count Usage Flag
2	Reserved Spare	Reserved Spare
4	Virtual Channel Count Cycle	Virtual Channel Count Cycle

- Transfer Frame Error Control Field

Refer to Section 4.4.6 of the “CCSDS 732.0-B-2, AOS Space Data Link Protocol Blue Book” [RD9].

8.3 CADU

CADU is the addition of Sync Marker 0x1ACFFC1D (4 Bytes) to the beginning of the AOS Transfer Frame. The following shows the CADU structure.

Table 8.5 CADU Structure

Sync (0x1ACFFC1D)	AOS Transfer Frame
4 Bytes	2,044 Bytes
2,048 Bytes	

9 PHYSICAL LAYER

The physical layer is a process performed in the CDAS, and performs BCH, LDPC FEC, and DVBS2 physical layer frame modulation on the CADU stream transmitted by the PDS.

9.1 Baseband Layer Frame (BBFRAME)

The following table shows the BBFRAME structure of 8PSK 2/3.

Table 9.1 BBFRAME

BBFRAME(43040 bits)		
BBHEADER	DFL	PADDING(if necessary)
80 bits	Up to 42960 bits	43040 bits – BBHEADER-DFL

BBHEADER is defined as follows.

- MMATYPE definition: 0x7100
  - MATYPE-1: 0x71
  - MATTYPE-2: 0x00
- UPL: 0x0
- SYNC: 0xFF

Table 9.2 MATYPE-1 Field Mapping

TS/GS	SIS/MIS	CCM/ACM	ISSYI	NPD	RO
11 = Transport	1 = single	1 = CCM	1 = active	1 = active	00 = 0.35
00 = Generic Packetized	0 = multiple	0 = ACM	0 = not-active	0 = not-active	01 = 0.25
01 = Generic continuous					10 = 0.20
10 = reserved					11 = reserved

9.2 XFEC Frame (XFECFRAME)

The following figure shows the XFECFRAME structure of 8PSK 2/3.

Table 9.3 DVB-S2 FECFRAME for 8PSK 2/3

BBFRAME	BCHFEC	LDPCFEC
43040 bits	160 bits	21600 bits

9.3 Physical Layer Frame (PLFRAME)

XFECFRAME is input as PLFRAME, and its structure is shown in the following table.

Table 9.4 DVB-S2 Physical Layer Framing

<table>
<tr><th colspan="2">PLHEADER</th><th colspan="7">XFECFRAME</th></tr>
<tr><td>SOF</td><td>PLSCODE</td><td>SLOT 1</td><td>SLOT 1</td><td>SLOT 1</td><td rowspan="2">…</td><td>SLOT S-1</td><td>SLOT S</td></tr>
<tr><td>26 Symbols</td><td>64 Symbols</td><td>90 Symbols</td><td>90 Symbols</td><td>90 Symbols</td><td>90 Symbols</td><td>90 Symbols</td></tr>
<tr><td colspan="2">90 Symbols</td><td colspan="6">S X 90 Symbols</td></tr>
<tr><td colspan="8">(S + 1) X 90 Symbols</td></tr>
</table>

The following table shows the header structure of the PLFRAME.

Table 9.5 DVB-S2 PLHEADER

Symbols	Field	Description
26	Start of Frame(SOF)	0x18D2E82
16	Physical Layering Signal Code(PLSCODE)	Refer to Section 4.4.6 of the DVB-S2 Standard [RD10]

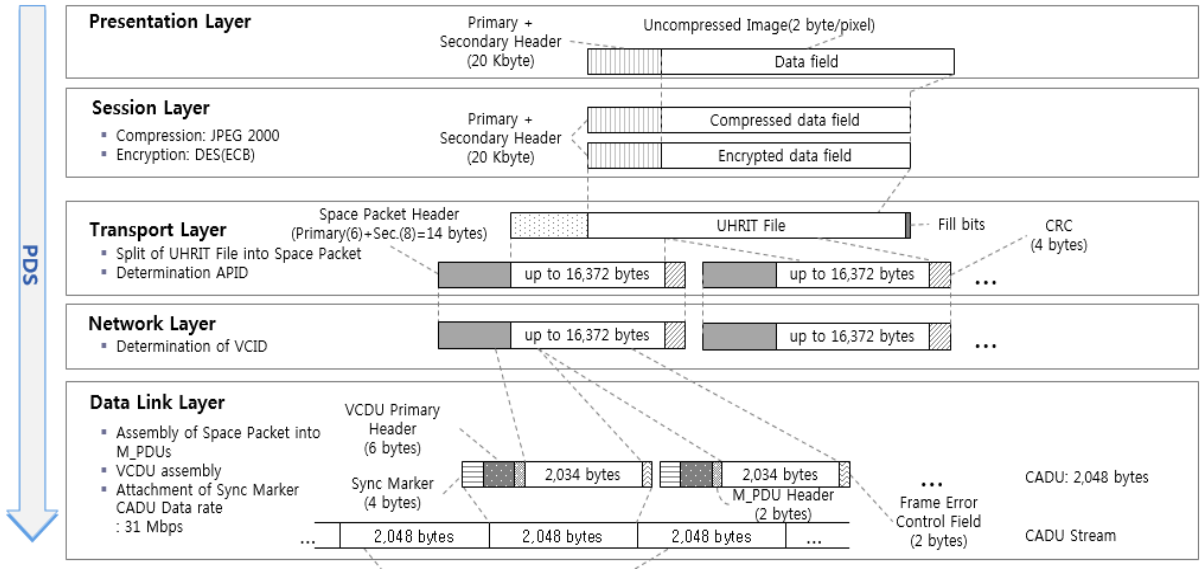
The parameter sets of the physical layer are specified in the Table 9.6.

Table 9.6 Parameters of UHRIT Communication Link

Parameters	Values
Downloading frequency	8070 MHz
Bandwidth	≤ 20 MHz
Information data rate*	31 Mbps
Satellite EIRP	31.4 dBW
Minimum G/T of ground antenna (MDUS)	11.1 dB/K
Maximum BER	10-8
Coding	BCH+LDPC 2/3 of DVB-S2 Standard
Pulse shaping	Root-Raised Cosine with 0.25 of roll-off factor
Polarization	LHCP
Modulation	NRZ-L/8PSK
Length of one CADU	2048 bytes

APPENDIX

Appendix A: GK2A UHRIT Data Format and Procedures



Appendix B: GK2A LRIT/HRIT/UHRIT APID and VCID

In the future, the actual APIDs and VCIDs will be determined by NMSC's broadcasting policy. Next table shows current values of them. The APIDs and VCIDs will be deteremined w.r.t broadcasting data categories, not w.r.t broadcasting channels(LRIT/HRIT/UHRIT).

Category 1	Category 2	Category 3	APID	VCID
Image Data	FD	VI004	0	0
		VI005	1	
		…	…	
		IR113	14	
		IR133	15	
	Reserved	-	32 ~ 127	1 ~ 3
Additional Data	Alpha-numeric Text	-	128	4
	Additional Data	-	160	5