Pacsat File Header Definition

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ABSTRACT

A flexible encoding method for PACSAT file headers is described, and "Mandatory", "Extended" and "Optional" Headers are defined. These headers are supplied by the programs which send files and/or messages to PACSAT, and by on-board programs which build files/messages intended for downloading. PACSAT file headers are present in all files stored on PACSAT.

1.0 BACKGROUND

PACSAT is a file and message switch, a BBS and a data generating device. Files may be generated by onboard processes such as telemetry gathering programs, SEU monitor programs, or imaging cameras. Files will also be used to hold the messages in the PACSAT on-board BBS. Files and messages will be sent and received by many nodes: forwarding gateways, individual user stations, command stations, and various on-board tasks. To conserve on-board storage space and communications link time, files may be compressed by a variety of compression methods.

To ensure that these files can be properly identified and processed, each file stored on PACSAT will begin with several header items. Some header items will be present on every PACSAT file; these are described below as the Mandatory Header. Another group of items must be present on all files which contain "messages"; these are described as the Extended Header. Additional special-purpose or user-defined items are described under the Optional Header.

The primary objectives of the PACSAT File Header standard are to

(1) encode all header items in a standardized manner;

(2) maintain complete separation between the file/message header and the file/message body;

(3) provide for expansion through easy incorporation of additional header items.

1.1 Overview of the PACSAT File Header System

Every PACSAT file will start with the byte Oxaa followed by the byte 0x55. This flag is followed by the rest of the PACSAT File Header (PFH). A valid PFH contains all of the items of the Mandatory Header (Section 3), and it may also contain all items of the Extended Header (Section 4) and any number of Optional Header items (Section 5). All HEADER ITEMS are encoded using a standard syntax, described in Section 2.

The PFH is terminated by a special header item, after which the file body begins.

Thus. there are 3 forms of PACSAT file header:

< Oxaa > < 0x55 > < Mandatory hdr > < Hdr end >

< Oxaa > < 0x55 > < Mandatory hdr > < Extended hdr > < Hdr end >

C Oxaa > < 0x55 > < Mandatory hdr > < Extended hdr > [<Optional Items > . . .] < Hdr end >

2.0 PACSAT HEADER ITEM SYNTAX

All PACSAT file header items follow a single format, simplifying both specification and implementation of the PACSAT File Header. The format is:

<id> <length> [<data> . . .]

2.1 <id>

The id is a 2-byte integer in which the bits have **the following meaning:**

bit 15	0 this is an system-defined item. 1 this is an experimental, user defined item.
bits O-14	form the 15-bit unsigned binary number identifying the item.

The <id>, allows some 32,000 system-defined and 32,000 user defined items.

<id> *like all multi-byte integers* is stored least-significant byte first. Refer to the PACSAT Data Specification Standards document for further information.

2.2 <length>

This field is an 8-bit unsigned binary integer giving the number of <data> bytes present. Even if the size of the data item is fixed, the length is still present.

2.3 <data>

The <data> bytes may hold any type of information.

Encoding rules for system-defined items are found in this document. User-defined items may adopt any internal encoding agreed by all users of the item.

2.4 Presentation

The PACSAT File Header must always be transmitted without data compression, even if compression is applied to the body of the attached file.

2.5 Header Termination

The end of the PACSAT File Header will always be indicated by a header item with <id> 0 and <length> 0. The byte sequence is 0x00 0x00 0x00.

3.0 THE PACSAT MANDATORY HEADER

The first two bytes of a PACSAT file should always contain Oxaa followed by 0x55 to confirm that the file contains a PACSAT file header.

The 0xaa, 0x55 sequence must be followed immediately by all items of the Mandatory Header.

Mandatory Header items must be present in order of ascending value of <id>.

When preparing files for uploading to PACSAT, groundstations must initialize header items as specified below.

3.1.1 file number

id : 0x01
length : 4
data : unsigned long file-number

<file number> is a 4-byte unsigned serial number assigned to a file by PACSAT when the file is created. This number uniquely identifies any file.

Since the PACSAT file system makes no distinction between files and "messages", the file number is analogous to a message serial number.

INITIALIZATION - Must be initialized to 0.

3.1.2 file name

id : **0x02**
length : 8
data : char file name[8]

<file name> is the base name of the file as it is stored in the PACSAT file system. If the name is shorter than 8 characters, it is extended on the right with ASCII spaces (0x.20).

INITIALIZATION - Must be initialized to 8 ASCIJ spaces (0x20), allowing **PACSAT to choose** its own name for the file. The <user filename>

Optional item can be used to communicate the file's native name to another user.

3.1.3 file ext

id : **0x03**
length : 3
data : char file ext[3]

<file_ext > is a 3 character file name extension. **If** the extension is shorter than 3 characters? it is ex**tended on the** right **with ASCII spaces (0x20).**

INITIALIZATION - **Must be** initialized to 3 **ASCII spaces** (0x20), **allowing PACSAT to choose** its own name for the file. The <user_filename > optional item can be used to communicate the file's native name to another user.

3.1.4 file size

id : 0x04
length : 4
data : unsigned long file size

<file_size > is a 4-byte unsigned integer indicating the total number of bytes in the file, including the **HEADER FLAG, all HEADER FIELD** structures, and the file body.

INITIALIZATION - Correct <file size > must be provided.

3.1.5 create time

id : 0x05
length : 4
data : unsigned long create time

< create time > is a 4-byte unsigned integer time-stamp telling when the file was created. This time-stamp counts the seconds since Jan 1, 1970.

INITIALIZATION - If <create time > **is** initialized to **0, PACSAT** will set the time upon receiving the file header. Otherwise **PACSAT does** not alter this item.

3.1.6 last modified time

id : 0x06
length: **4**
data : unsigned long last modified time

INITIALIZATION - If <last modified time > is initialized to 0, PACSAT will set the time upon receiving the file header. Otherwise PACSAT does not alter this item.

3.1.7 seu flag

id : 0x07
length : 1
data : unsigned char seu_flag

Files stored on PACSAT may experience Single-Event Upsets, caused by radiation. <seu flag> is an unsigned 8-bit integer for which 3 values are currently defined:

0 means there have been no Single Event Upsets detected in this file.

1 means that one or more correctable Single Event Upsets have occurred and been corrected in this file. It will be possible., though unlikely, that multiple SEU-caused bit errors in a file block will cause an improper correction. An overall file checksum is provided as additional protection.

2 means that an uncorrectable corruption was detected in this file.

INITIALIZATION - this item must be initialized to 0.

3.1.8 file type

id : 0x08
length : 1
data : unsigned char file type

<file type > is an unsigned 8-bit integer indicating what-type of data is presented in the file body. Values for this item are defined in a separate document. The value Oxff is reserved as an escape indicator, in which case an Optional item of type <file description > must be provided.

INITIALIZATION - this item must be appropriately initialized.

NOTE - It is intended that this item be used to limit the scope of message searches, therefore, values will be defined for important types of files such as: **RLI/MBL** compatible single messages. **RLI/MBL** compatible import files, VITA-only messages, etc. See Appendix A for details.

3.1.9 body checksum

id : 0x09
length : 2
data : unsigned int body checksum

A 16 bit checksum formed by adding all bytes in the file body into a 16 bit variable, ignoring overflow. The <body_checksum > does *not* include the bytes comprising the PACSAT file header.

The <body checksum> is primarily intended to detect mis-corrected multi-bit errors caused by Single Event Upsets in the PACSAT memory.

INITIALIZATION - The correct <body checksum> must be supplied.

3.1.10 header checksum

id : 0x0a
length: 2
data : unsigned int header checksum

A 16 bit checksum formed by adding ALL bytes in PACSAT File Header, including the leading 0x55 Oxaa sequence, into a 16 bit variable, ignoring overflow. This number is then stored as the c header_checksum > . When calculating the sum the 2 <header checksum> data bytes are assumed to be 0, and the <body checksum> must have already been calculated.

The <header checksum> is primarily intended to confirm correct header reception during file transfers.

INITIALIZATION - the <header checksum> must be correctly initialized.

3.1.11 <body offset >

id : 0x0b
length : 2
data unsigned int body offset

<body_offset > provides the byte offset of the first byte of the file body. <body_offset > is taken with respect to the first byte of the file, which has offset 0. The byte at offset 0 contains the Oxaa marking the beginning of the PFH. Note also that <body offset > is equal to the length of the PFH, in bytes.

INITIALIZATION - c body offset > must be correctly initialized.

3.2 Mandatory Header Summary

The PFH Mandatory header will be present on every PACSAT file. When preparing to upload a file or message to PACSAT, groundstation software must create a valid Mandatory header and insert it at the beginning of the file/message.

4.0 THE PACSAT EXTENDED HEADER

The PACSAT Mandatory Header defined above is designed for file transfer. It contains sufficient information to reliably upload and download PACSAT files, including transfers spread over several satellite passes. It does not contain all the header fields which are desirable for forwarding BBS messages or for implementing a complex PACSAT end-user message system. The additional header fields needed for these tasks are placed in the PACSAT file after the Mandatory Header.

A standard set of message-related header fields called the PACSAT Extended Header is described in this section. All message files uploaded to PACSAT should contain both the Mandatory and Extended headers.

If a Extended Header is present, it must immediately follow the final item in the Mandatory Header.

If any Extended Header item is present, all must be present.

Extended Header items must be present in order of ascending value of <id >, with the exception that multiple destinations are represented by multiple occurrences of items 0x14, 0x15, and 0x16.

4.1 Extended Header Summary

The Extended Header provides necessary information concerning the source and destination of a message file. Source data is encoded in a variable-length <source> item, which can contain any type of identifier. The AX.25 address of the station which uploaded the message is also provided, along with the time at which the upload was completed. Destination data is provided in the same

format, and provisions are made to allow a single **message file** to have several specified destinations.

Three other items useful for **PACSAT** message handling are defined: compression technique, expire time, and priority.

4.2.1 source

id : 0x10
length : variable
data : char source[]

<source> is an **ASCII** string used to identify the originator of tbe file/message. <source> can be a **mixed-case** string, containing any character from 0x20 to 0x7e.

INITIALIZATION - This item should contain the address of and possibly the route to the file originator. Exact details of the use for this item must be agreed among parties **using PACSAT** for message forwarding.

Stations using PACSAT as their "home **BBS"** are requested to use the form <call> @ **OSCAR <num >**, e.g. G0K8KA @ OSCAR14.

VITA will devise its own addressing scheme, which should be used by VITA groundstation software.

4.2.2 ax25 uploader

id : 0x11
length : 6
data : char ax25 uploader[]

Contains the ax.25 address of the station which uploaded the file. The SSID is not included in this address. If the callsign is less than 6 characters long, it will be filled to 6 characters by appending spaces (0x20) on the right.

INITIALIZATION - No initialization required.

4.2.4 upload time

id : 0x12
length: **4**
data : unsigned long upload-time

This field tells the time at which the upload was completed. If the upload is still in progress, upload time will be 0x0000. <upload time> is an unsigned integer counting the number of seconds since 0000 UTC Jan 1, 1970.

INITIALIZATION - Must be set to **0.**

4.2.5 download count

id : **0x13**
length : 1
data : unsigned char download-count

<download count > is an 8-bit unsigned integer incremented each time the associated file is successfully downloaded.

INITIALIZATION - set to 0.

4.2.6 destination

id : 0x14
length : variable
data : char destination[]

<destination > is an **ASCII** string used to identify the originator of the file/message. <destination > can be a mixed-case string, containing any character from 0x20 to 0x7f.

INITIALIZATION - **PACSAT** makes no attempt to interpret this item. It must be initialized to an address which will be recognized by the station intended to download the message. When addressing messages to stations using PACSAT as a "home bbs", please use <callsign > @ OSCAR <num >, e.g. NK6K @ OSCAR16.

4.2.7 ax25 downloader

id : 0x15
length : 6
data : char ax25 downloader[6]

<ax25_downloader > **is the ASCII** address of the groundstation which has downloaded this file for the recipient specified in the immediately preceding < destination > item.

A <destination > item must be immediately followed by an <ax25 downloader> item.

INITIALIZATION - **Must** be initialized to six **ASCII** blanks - 0x20.

4.2.8 download time

id : 0x16
length : 4
data unsigned long download time

<download time> is the time at which the message was completely downloaded by the immediately preceding < ax25 downloader > groundstation. <download-time > is an unsigned integer counting the number of seconds since **0000 UTC** January 1, 1970.

An <ax25 downloader> item must be immediately followed by a <download-time > item.

INITIALIZATION - Set to 0.

NOTE - A message may have several intended destinations. For each destination, the PFH **Extended** header must contain header items 0x14, 0x15 and 0x16. Multiple destinations are numbered in the order of occurrence; the first < destination > < ax25 downloader > <download time> set is destination 0, the next destination 1, etc.

4.2.11 expire time

id : 0x17
length : 4
data : unsigned long expire time

<expire time > is the time after which this file should be considered inactive. As with other timestamps, this field is an unsigned long integer counting seconds since Jan 1, 1970. Expired files may be purged by the PACSAT when more free file space is needed.

INITIALIZATION - Groundstations may set this field in uploaded files, or may leave it set to 0. **If** a groundstation-selected <expire-time > is within system limits, it will be retained, otherwise the **PACSAT** will choose its own <expire time > .

4.2.12 priority

id : 0x18
length: 1
data : unsigned char priority

This field carries the message priority field. Higher numbers are considered higher priority than lower numbers.

INITIALIZATION - The groundstation must initialize this field. Groundstation software should exercise some control over the user's abuse of this field, so that it retains some meaning in operation! Over use of high priorities reduces the utility of this field.

5.0 OPTIONAL HEADER ITEMS

The Mandatory Header and Extended Header may be followed by any number of Optional Header items. It is intended that any expansion of the PFH definition will involve only addition of Optional Items

Optional Header items need not be presented in increasing order of <id > .

5.1 System-defined Optional Header Fields

5.1.1 compression type

id : 0x19
length : 1
data : unsigned char compression_technique

The body of a **PACSAT** message may be compressed to reduce the communications bandwidth and on-board storage required for the message. Groundstations, and not **PACSAT,** must compress and de-compress PACSAT files.

The <compression type > item is a l-byte unsigned binary integer. Values are available for assignment to common compression schemes. <compression-type > Oxff is reserved as an escape code indicating that additional information is to be found in a <compression description > item.

Currently assigned values can be found in Appendix B.

INITIALIZATION - If present, must be correctly set by the uploading station.

5.1.1 bbs message type

id : 0x20
length : 1
data : char bbs message-type

This field carries the single **ASCII** character used to indicate message type on **RLI/MBL BBS** messages.

5.1.2 bulletin_id_number

id : 0x21
length : variable
data char bid[]

The <bid> item holds an ASCII string uniquely identifying the file/message. This field is used by terrestrial BBSs to stop the duplication of flood bulletins.

INITIALIZATION - PACSAT will not itself initialize <bid> on an uploaded file. It is the responsibility of the uploading station to initialize this field, if the message is a bulletin intended for introduction into the Amateur Radio PBBS network.

5.1.3 title

id : 0x22
length : variable
data : char title]]

This field carries the ASCII string message title. Most messages will have a <title>, initialized by the user to indicate the contents of the message. In some systems, this is called the Subject.

5.1.4 keywords

id : 0x23
length : variable
data : char keywords[]

This field carries one or more ASCII keywords describing the file/message. Multiple keywords must be separated by at least one ASCII space character (0x20).

5.1.5 file description

id : 0x24
length : variable
data : char file description[]

The <file_description> item is used only if none of the system standard <file type> values can adequately describe the fife body.

A <file_description> item is up to 255 ASCII characters describing the format of the file body. This field must be included if the <file_type> field in the Mandatory Header is set to 0xff.

For example, an uploading station might set the <file type> to Oxff and <file_description> to 'This-body contains all of the files associated with a Ventura Publisher document".

5.1.6 compression description

id : 0x25
length : variable
data : char compression description[]

A compression-description item is used when a non-standard method of file-body compression has been used.

The item is up to 255 ASCII characters describing the method or (preferably) providing a reference to further information concerning the method. The field must be present when compression-technique in the fixed portion of the Extended File Header is set to 0xff.

For example, an uploading station might set compression technique Oxff and compression-description to "Compressed using bmpack version 1.4, see file with title = "BMPACK specification".

5.1.7 user file name

id : 0x26
length : variable
data : char user file name[]

This field is used by groundstations using PACSAT as a file switch to transfer named files. The originating station places the desired file name in a user file_name field, and the destination station uses this field as the name of the file after it has been received.

This field is included in addition to the file name field because the file name field is strictly constrained by PACSAT (e.g. no two files may have the same file name, and the name must be no longer than 8 characters with a 3 character extension). The file-name is used by PACSAT for internal purposes, and this item, user_file_name is used for end-to-end transparent communication of a file name.

6.0 Implementation Status

Files with these headers are currently in use on the PACSATs. Additional system header items may be added from time to time, as well as file and compression types. To suggest new standard items, contact the authors.

Address comments to:

Telemail:	HPRICE or UOSAT
Compuserve:	71635,1174
Packet:	NK6K @ WB6YMH
	or G0K8KA @ GB2UP
Internet:	71635.1174
	@COMPUSERVE.COM
Mail:	Jeff Ward
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	University of Surrey
	Guildford, Surrey GU2 5XH
	UK

APPENDIX A - PACSAT FILE TYPES

Unless explicitly stated. a file of any <file type > can have a compressed body. If the body is compressed, its PFH must contain the optional <compression_type > item. The PFH is never compressed.

0x00	ASCII text file intended for display/printing. Not Compressed.
0x01	RLI/MBL message body. Single message.
0X-02	RLI/MBL import/export file. Multiple message.
0x03	UoSAT Whole Orbit Data
0x04	Microsat Whole Orbit Data
0x05	UoSAT CPE Data
0x06	MS/PC-DOS .exe file
0x07	MS/PC-DOS .com file
0x08	Keplerian elements NASA 2-line format
0x09	Keplerian elements "AMSAT" format
0x0a	Simple ASCII text file, but compressed.
Oxff	ESCAPE - indicates that the message header includes a variable- length body description item (see below) describing the body type, or providing a reference for further information. This code will be used for new techniques, until they can be assigned a formal identifier.

APPENDIX B - PACS.AT COMPRESSION TYPES (PROPOSED)

0x00	body not compressed
0x01	body compressed using PKARC
0x02	body compressed using PKZIP

There is no intent to limit compression types to the IBM-PC. The prototype implementation of the ground station software is PC based.