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DEEP SPACE NETWORK
INTERFACE CHANGE AUTHORIZATION

820-13 MODULE No. TRK-2-21 TITLE DSN Tracking System Interfaces
Timing and Polar Motion Data I/F MK IVA

INITIAL RELEASE DATE February 1, 1985

REVISION DATE March 15, 1985

ABSTRACT:

DESCRIPTION OF CHANGE:

1. New Module.

REASON FOR CHANGE:

2. Meet the requirements of Mark IVA.

CONCURRENCES:

DSN MANAGER	MCCC MANAGER	FLIGHT PROJECT RMOC REPRESENTATIVE
for E.J. Rundquist, GLL		
W.J. Berman		
M. Gaufler		
C. Stelzried		

DISPOSITION:

☐ CHANGE REJECTED. REASONS:

☒ CHANGE RELEASED FOR PUBLICATION

DSN SYSTEM ENGINEER Reginald A. Buckley DATE 1/23/85

TRK-2-21

DSN TRACKING SYSTEM INTERFACES
TIMING AND POLAR MOTION DATA INTERFACE
MARK IVA

(Insert this module document in 820-13; Rev. A)

EFFECTIVE DATE: Mark IVA Implementation

Initial Release Date: February 1, 1985
Revision Date: March 15, 1985

Approved by:

10/30/84 (430)

(338)

12/3/84 (335)

12/7/84 (314)

(441)

A. PURPOSE

This module defines the data format and content of the timing and polar motion data received from the Tracking System Analytical Calibration (TSAC) group.

B. REVISION AND CONTROL

Revisions or changes to the information herein presented may be initiated in accordance with the procedures in Secion I of this document.

C. GENERAL INFORMATION

The DSN uses the timing and polar motion data in the process of generating prediction data and performing orbit determination. These data are to be

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provided at intervals determined by the user's accuracy requirements and as negotiated with the various DSN users.

The data are deliverable via nine track, unblocked, 1600 bpi magnetic tapes compatible with the Digital Equipment Corporation (DEC) VAX 11/780 computer or via electrical interface.

D. DATA FORMATS

The data will be initially available in two formats, a Type 66 format and a namelist-type format.

1. Type 66 Format

The type 66 format consists of three types of records: Header Records, Data Records and Trailer Records. The Header Record marks the beginning of each data group. This record identifies the size of the data records, the type of data in the record, and the meaning of the data in the record (see Tables TRK-2-21-1 through -8). The Trailer Record contains a word count of one and a single data word of zero. The data records vary according to their contents. Detailed descriptions of the data are found in the tables.

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Table TRK-2-21-1. Header Record

Name	Type	Word	Description
NW	3	1	Number of single precision or character words in largest data record, plus one
ITYPE	3	2	Type of data contained in each record of group: 1 = Single precision (32-bit, Floating Point) 3 = Integer (32-bit) 4 = BCD Character data 5 = End of File Header
ISNGL	3	3	Flag to indicate if end of group is marked by a trailer record 1 = No trailer; exactly one data record follows 0 = Trailer; zero or more data records follow
KEY1	3	4	Major flag to indicate meaning of data in group
KEY2	3	5	Not used; set to zero

Table TRK-2-21-2. Header Record for Label Record

Name	Type	Word	Value
NW	3	1	12
ITYPE	3	2	4
ISNGL	3	3	0
KEY1	3	4	821
KEY2	3	5	0

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Table TRK-2-21-3. Label Record

Name	Type	DIM	Description
ALPHA	4	16	Alphanumeric descriptive text

Table TRK-2-21-4. Header Record for TAI-UTC Data

Name	Type	Word	Value
NW	3	1	25
ITYPE	3	2	1
ISNGL	3	3	0
KEY1	3	4	822
KEY2	3	5	0

Table TRK-2-21-5. TAI-UTC Data*

Name	Type	DIM	Description
TIME	1	1	Seconds past ~~Jan 1, 1950~~ 00 hours
UTC	1	1	TAI-UTC at TIME (seconds)
UTCDOT	1	1	d(TAI-UTC)/d(TIME) at TIME (sec/sec)

*Repeated eight times

Table TRK-2-21-6. Header Record for Timing and Polar Motion Data

Name	Type	Word	Value
NW	3	1	113
ITYPE	3	2	1
ISNGL	3	3	0
KEY1	3	4	823
KEY2	3	5	0

Table TRK-2-21-7. Timing and Polar Motion Data*

Name	Type	DIM	Description
TIME	1	1	Seconds past Jan. 1, 1950 00 hours
UT1	1	1	TAI-UT1 at TIME (seconds)
UT1DOT	1	1	d(TAI-UT1)/d(TIME) at TIME (sec/sec)
X	1	1	X-coordinate of polar motion at TIME (arc seconds)
XDOT	1	1	d(X)/d(TIME) at TIME (arc sec/sec)
Y	1	1	Y-coordinate of polar motion at TIME (arc seconds)
YDOT	1	1	d(Y)/d(TIME) at TIME (arc sec/sec)

*Repeated sixteen times

Table TRK-2-21-8. End of File Record

Name	Type	Word	Value
NW	3	1	1
ITYPE	3	2	5
ISNGL	3	3	0
KEY1	3	4	0
KEY2	3	5	0

2. Namelist Format

The timing and polar motion data file in this format consists of 88 card image records in Fortran Namelist format; i.e., each variable in a single record is of the form

variable(i) = value(i), value(i+1), value(i+2)...value(i+j-1),

where i is an index running from 1 to 335 and j is the number of data values of the variable given on a single record. The subscripts i+1 through i+j are not given explicitly.

All time rates of change are with respect to International Atomic Time (TAI).

Specific inputs are as follows:

First record:	TIMPOL	A label naming the Univac file and element for the data set and giving the date of the last input datum (LD) and the last date predictions exist that are good enough for orbit determination (PT). (See Figure TRK-2-21-1 for LD and PT locations.)
		Format: 11A6 (Univac 36-bit words) or 16A4 (VAX 32-bit words)
Records 2-14:	IT(i), i = 1-39	Thirteen calendar dates, one date per record, that apply to all remaining data in the record. Epoch for those data is at 00 hr on the given date. (The purpose of these values is to improve human readability: they are not used by programs that read this file.)
		Format: YYMMDD
	TP(i), i = 1-39	Time tags and TAI-UTC values and rates for 13 dates. (It is here that leap seconds appear.)

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Format: TP(i) = TIME, UTC, UTCDOT

where

TIME = Time tag for the remaining data, in UTC seconds past Jan. 1, 1950 00 hours (SSSSSSSSSS.). Programs that read this file use TIME as epoch for all the remaining data in the record.

UTC = TAI-UTC at TIME (±SS.SSSSSS).

UTCDOT = Rate of change of UTC at TIME, in seconds/second (nnnnn.nnnnE-10). Zero by definition since 1 Jan 1972; i.e., since then the UTC second has had the same length as the TAI second.

Records 15-51: IT(i), i = 40-150 — Calendar date for data in record, as discussed above.

TP(i), i = 40-150 — Time tags and TAI-UT1 values and rates for 37 dates.

Format: TP(i) = TIME, UT1, UT1DOT

where

TIME = Seconds past 1950 (see above).

UT1 = TAI-UT1 at TIME (±SS.SSSSSS).

UT1DOT = Rate of change of (TAI-UT1) at TIME, in seconds/second (nnnnn.nnnnE-10).

Records 52-88: TP(i), i = 151-335 — Time tags and polar motion data for 37 dates.

Format: TP(i) = TIME, X, XDOT, Y, YDOT

where

TIME = Seconds past 1950 (see above).

X = X coordinate of polar motion at TIME in arc seconds (±.XXXXX).

XDOT = Rate of change of X at TIME in arc seconds/TAI second (±.RRRRR-EE).

Y = Y coordinate of polar motion at TIME in arc seconds (±.YYYYY).

YDOT = Rate of change of Y at TIME in arc seconds/TAI second (±.RRRRR-EE).

Note that the variables TIME, UTC, UTCDOT, UT1, UT1DOT, X, XDOT, Y, and YDOT are identical to the variables with the same names in the Type 66 file.

An example of these data may be found in Figure TRK-2-21-1.

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TIMPOL='STOIC.LD840709/PT840729 .LAST DATUM 84 7 9 .PREDICTS TO 84 729.   ',
IT(  1)=8110 1,TP(  1)= 1001894400.,  20.000000,      .0000E-10,
IT(  4)=82 7 1,TP(  4)= 1025481600.,  21.000000,      .0000E-10,
IT(  7)=83 7 1,TP(  7)= 1057017600.,  22.000000,      .0000E-10,
IT( 10)=90 1 1,TP( 10)= 1262304000.,    .000000,      .0000E-10,
IT( 13)=99 1 1,TP( 13)=          0.,    .000000,      .0000E-10,
IT( 16)=99 1 1,TP( 16)=          0.,    .000000,      .0000E-10,
IT( 19)=99 1 1,TP( 19)=          0.,    .000000,      .0000E-10,
IT( 22)=99 1 1,TP( 22)=          0.,    .000000,      .0000E-10,
IT( 25)=99 1 1,TP( 25)=          0.,    .000000,      .0000E-10,
IT( 28)=99 1 1,TP( 28)=          0.,    .000000,      .0000E-10,
IT( 31)=99 1 1,TP( 31)=          0.,    .000000,      .0000E-10,
IT( 34)=99 1 1,TP( 34)=          0.,    .000000,      .0000E-10,
IT( 37)=99 1 1,TP( 37)=          0.,    .000000,      .0000E-10,
IT( 40)=8110 1,TP( 40)= 1001894400., 19,776400,  252,3150E-10,
IT( 43)=8111 1,TP( 43)= 1004572800., 19,849400,  280,0920E-10,
IT( 46)=8112 1,TP( 46)= 1007164800., 19,917200,  254,6280E-10,
IT( 49)=82 1 1,TP( 49)= 1009843200., 19,983800,  250,0030E-10,
IT( 52)=82 2 1,TP( 52)= 1012521600., 20,048800,  233,7990E-10,
IT( 55)=82 3 1,TP( 55)= 1014940800., 20,112400,  256,9460E-10,
IT( 58)=82 4 1,TP( 58)= 1017619200., 20,185200,  298,6140E-10,
IT( 61)=82 5 1,TP( 61)= 1020211200., 20,262700,  287,0410E-10,
IT( 64)=82 6 1,TP( 64)= 1022889600., 20,331000,  249,9970E-10,
IT( 67)=82 7 1,TP( 67)= 1025481600., 20,386200,  173,6150E-10,
IT( 70)=82 8 1,TP( 70)= 1028160000., 20,430900,  162,0360E-10,
IT( 73)=82 9 1,TP( 73)= 1030838400., 20,482700,  226,8560E-10,
IT( 76)=8210 1,TP( 76)= 1033430400., 20,549800,  277,7740E-10,
IT( 79)=8211 1,TP( 79)= 1036108800., 20,622100,  263,8890E-10,
IT( 82)=8212 1,TP( 82)= 1038700800., 20,695100,  284,7230E-10,
IT( 85)=83 1 1,TP( 85)= 1041379200., 20,773400,  319,4480E-10,
IT( 88)=83 2 1,TP( 88)= 1044057600., 20,858200,  400,4660E-10,
IT( 91)=83 3 1,TP( 91)= 1046476800., 20,942900,  349,5370E-10,
IT( 94)=83 4 1,TP( 94)= 1049155200., 21,034200,  347,2190E-10,
IT( 97)=83 5 1,TP( 97)= 1051747200., 21,116600,  300,9260E-10,
IT(100)=83 6 1,TP(100)= 1054425600., 21,193100,  252,3150E-10,
IT(103)=83 7 1,TP(103)= 1057017600., 21,250900,  173,6110E-10,
IT(106)=83 8 1,TP(106)= 1059696000., 21,293800,  171,2970E-10,
IT(109)=83 9 1,TP(109)= 1062374400., 21,346100,  187,5010E-10,
IT(112)=8310 1,TP(112)= 1064966400., 21,401500,  245,3720E-10,
IT(115)=8311 1,TP(115)= 1067644800., 21,469500,  273,1490E-10,
IT(118)=8312 1,TP(118)= 1070236800., 21,541200,  254,6330E-10,
IT(121)=84 1 1,TP(121)= 1072915200., 21,603500,  196,7560E-10,
IT(124)=84 2 1,TP(124)= 1075593600., 21,653600,  149,0720E-10,
IT(127)=84 3 1,TP(127)= 1078099200., 21,699400,  203,0090E-10,
IT(130)=84 4 1,TP(130)= 1080777600., 21,761600,  236,3430E-10,
IT(133)=84 5 1,TP(133)= 1083369600., 21,820800,  228,7000E-10,
IT(136)=84 6 1,TP(136)= 1086048000., 21,871200,  147,9190E-10,
IT(139)=84 619,TP(139)= 1087603200., 21,895357,  100,3859E-10,
IT(142)=84 7 9,TP(142)= 1089331200., 21,909976,   71,3057E-10,
IT(145)=84 729,TP(145)= 1091059200., 21,921116,   61,3585E-10,
IT(148)=90 1 1,TP(148)= 1262304000., 29,000000,  400,0000E-10,
IT(151)=8110 1,TP(151)= 1001894400.,-.04500, -.20830-07, .21000,  .13890-07,
IT(156)=8111 1,TP(156)= 1004572800.,-.08500, -.11570-07, .25300,  .18520-07,
IT(161)=8112 1,TP(161)= 1007164800.,-.10300, -.46300-08, .31400,  .25460-07,
IT(166)=82 1 1,TP(166)= 1009843200.,-.09100,  .11570-07, .37800,  .23150-07,
IT(171)=82 2 1,TP(171)= 1012521600.,-.04300,  .25460-07, .42100,  .11570-07,
IT(176)=82 3 1,TP(176)= 1014940800.,  .01900,  .25460-07, .43900,  .23150-07,
IT(181)=82 4 1,TP(181)= 1017619200.,  .09300,  .27780-07, .43100, -.92590-08,
IT(186)=82 5 1,TP(186)= 1020211200.,  .15900,  .23150-07, .39800, -.18520-07,
IT(191)=82 6 1,TP(191)= 1022889600.,  .21400,  .13890-07, .33200, -.32410-07,
IT(196)=82 7 1,TP(196)= 1025481600.,  .23100, -.23150-08, .23900, -.37040-07,
IT(201)=82 8 1,TP(201)= 1028160000.,  .20700, -.13890-07, .15200, -.30090-07,
IT(206)=82 9 1,TP(206)= 1030838400.,  .13600, -.32410-07, .08700, -.18520-07,
IT(211)=8210 1,TP(211)= 1033430400.,  .03600, -.41670-07, .06000, -.23150-08,
IT(216)=8211 1,TP(216)= 1036108800.,-.07300, -.39350-07, .09400,  .23150-07,
IT(221)=8212 1,TP(221)= 1038700800.,-.17100, -.34720-07, .15400,  .27780-07,
IT(226)=83 1 1,TP(226)= 1041379200.,-.21100, -.46300-08, .24900,  .41670-07,
IT(231)=83 2 1,TP(231)= 1044057600.,-.20000,  .11570-07, .36900,  .41670-07,
IT(236)=83 3 1,TP(236)= 1046476800.,-.15800,  .20830-07, .45700,  .34720-07,
IT(241)=83 4 1,TP(241)= 1049155200.,-.06900,  .48610-07, .53800,  .18520-07,
IT(246)=83 5 1,TP(246)= 1051747200.,  .05500,  .48610-07, .56400,  .00000   ,
IT(251)=83 6 1,TP(251)= 1054425600.,  .17700,  .41670-07, .53200, -.25460-07,
IT(256)=83 7 1,TP(256)= 1057017600.,  .26900,  .25460-07, .43600, -.43980-07,
IT(261)=83 8 1,TP(261)= 1059696000.,  .32800,  .92590-08, .30600, -.48610-07,
IT(266)=83 9 1,TP(266)= 1062374400.,  .31600, -.18520-07, .17600, -.48610-07,
IT(271)=8310 1,TP(271)= 1064966400.,  .23500, -.41670-07, .06900, -.32410-07,
IT(276)=8311 1,TP(276)= 1067644800.,  .10000, -.53240-07, .01800, -.92590-08,
IT(281)=8312 1,TP(281)= 1070236800.,-.02900, -.46300-07, .03200,  .13890-07,
IT(286)=84 1 1,TP(286)= 1072915200.,-.12500, -.30090-07, .08900,  .27780-07,
IT(291)=84 2 1,TP(291)= 1075593600.,-.19700, -.25230-07, .18300,  .38890-07,
IT(296)=84 3 1,TP(296)= 1078099200.,-.24100, -.48610-08, .28800,  .44910-07,
IT(301)=84 4 1,TP(301)= 1080777600.,-.21100,  .26850-07, .41000,  .44440-07,
IT(306)=84 5 1,TP(306)= 1083369600.,-.12600,  .28470-07, .50600,  .41200-07,
IT(311)=84 6 1,TP(311)= 1086048000.,-.00700,  .48610-07, .55800,  .81020-08,
IT(316)=84 619,TP(316)= 1087603200.,  .06828,  .50269-07, .55575, -.79823-08,
IT(321)=84 7 9,TP(321)= 1089331200.,  .15279,  .46879-07, .52974, -.21998-07,
IT(326)=84 729,TP(326)= 1091059200.,  .22804,  .39598-07, .48047, -.34728-07,
IT(331)=90 1 1,TP(331)= 1262304000.,  .00000,  .00000   , .25000,  .00000   ,
```

Figure TRK 2-21-1. Example of Namelist Format

APPENDIX A
TYPE 66 FILE FORMAT

The Type-66 file format is designed for recording various types of data on a mass storage device in a flexible but consistent manner. The format allows documenting the file's content on the file itself, enables identification of unknown files, and simplifies transfer of files between computers of different manufacturers.

A Type-66 file contains three types of records: header records, data records, and trailer records.

A Type-66 file generally contains more than one kind of data record. One or more data records follow the header record. If a group contains more than one data record, the end of the group must be marked by a trailer record; if a group contains only one data record, the trailer record is optional (see NW below). There is no limit on the number of data records per group or the number of groups except that a Type-66 tape cannot exceed one reel.

A Type-66 file may be binary or character. If the file is binary, each record of the file constitutes one logical record, regardless of length. If the file is character data, header and trailer records each constitute one logical record, but data records are broken into a number of logical records. For character data files, the logical record length is fixed at 108 bytes; logical records may be blocked in any convenient integer number; e.g., 100 logical records yielding a block size of 10800 bytes.

Each header record is five integer words long and does not contain a word count.

The five header integers are defined as follows:

NW — The maximum size in single-precision words of any record in the group including the word count.

ITYPE — A flag to indicate the type of data contained in each record of the group. All data in a group must be of the same type. If a change of type is needed, the current group must be terminated and a new group begun.

ITYPE = 1 Single-precision scalar data
ITYPE = 2 Double-precision scalar data
ITYPE = 3 Integer data
ITYPE = 5 End-of-file header, no data follows
ITYPE = 7 Character data

NRECS — A flag to indicate whether the group's end is marked by a trailer record. Each group with two or more data records must have a trailer. A group with only one data record may or may not have a trailer.

NRECS = 1 means exactly one data record follows, followed by a new header reocrd. There is no trailer record.

NRECS = 0 means one or more data records follow. The last data record is followed by a trailer.

KEY1 — Major flag to indicate the meaning of the data in the group. This flag must be an integer greater than zero.

KEY2 — Minor flag to indicate the meaning of the data in the group.

Each data record begins with an integer (NWORDS) defining the number of words to follow. Except for the integer word count, all words must be of the type specified by the group header word ITYPE. All data records must contain at least two data words in addition to the integer word count.

A trailer record must contain a word count of one and a single data word of zero of the type specified by the group header record; respectively 0.0, 0.D0, 0, and alphameric zero.

In summary, a Type-66 file must begin with a group header record and end with an end-of-file header record. The shortest possible meaningful file would have a group header, a single data record consisting of a word count (two) plus two data words, and an end-of-file header.

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APPENDIX B

GLOSSARY

CIO — Conventional International Origin: the point on the Earth`s crust representing the mean location of the true pole during the years 1900 - 1905; also called the Mean Pole 1903.0

TAI — International Atomic Time (French word order)

UTC — Universal Time, Coordinated: civil time, formerly called GMT

UT1 — Universal Time 1: time determined from astronomical observations after correction for polar motion; a measure of the instantaneous rotation angle of the Earth; also formerly called GMT

X,Y — Coordinates of the point where the spin axis of the Earth pierces the Earth`s crust in the northern hemisphere, the "true pole." X is measured in arc-seconds from the Conventional International Orgin (CIO) south along the Greenwich meridian of 1903.0; Y is measured in arc-seconds from the CIO south along the 90 deg W meridian of 1903.0.