NASA/GSFC	MISSION OPERATIONS & DATA SYSTEMS DIRECTORATE (MO&DSD) CONFIGURATION CHANGE REQUEST (CCR)			
1. CCR NO.	CCR-405-ICD-04	**2. DATE** October 31, 1997	**3. PRIORITY** ☐ EMERGENCY ☐ URGENT ■ ROUTINE	**4. CHANGE LEVEL** ☐ A ☐ B ☐ C ■ D ☐ E ☐ F

5. TITLE OF CHANGE

Baseline Merge Assessment 2 (WSC 97005)

6. DOCUMENT TITLE ICD Between the NCC/FDF and the WSC for the TDRS H, I, J Era
(Baseline file name: DL405Baseline.doc)

DOCUMENT NO. 405-TDRS-RP-ICD-001, 8 December 1995

LIST ALL AFFECTED DOCUMENTS INCLUDING PROCEDURES 530-ICD-NCC-FDF/WSC
ICD Between the NCC/FDF and the WSC,Revision t

(CONT ON ATTACHMENT)

7. REASON FOR CHANGE

97005 WSC Baseline update for TDRS H,I,J Hughes evaluation.

(CONT ON ATTACHMENT)

8. DESCRIPTION OF CHANGE

The following 530-ICD-CCRs were incorporated into CCR-405-ICD-04:
CCR-530-ICD-02 (errata) - IFL SHO Clarifications (p. 9-13)
CCR-530-ICD-05 - Update to ICD for NCC 98/WSC Compatibility (p. 1-2, 2-3, 2-4, 2-7, 2-8, 2-12, 2-13, 6-1, 6-2, 9-29, 9-55, 9-57, AB-3)
CCR-530-ICD-07 - OPM-67 Updated (p. 2-1, 9-65, 9-66, 9-67)
CCR-530-ICD-08 - SHO Subheaders 5 and 6 LI Expansion for SPTR and DAB, and Project Antenna (p. 9-9, 9-11, AB-1, AB-4)

(CONT ON ATTACHMENT)

9. IMPACT

YES	NO	
☐	■	SCHEDULE
☐	■	BUDGET
☐	■	FACILITIES
☐	■	TESTING
☐	■	TRAINING
☐	■	SPECIFICATIONS
☐	■	CONTRACTOR SUPPORT
■	☐	INTERFACES

SYSTEM

YES	NO	
☐	■	RELIABILITY/MAINTAINABILITY/SAFETY
☐	■	USER SERVICES/MANUALS
☐	■	RISK MANAGEMENT
☐	■	SECURITY
☐	■	USAF FUNDING REQ'D
☐	■	POWER
☐	■	WEIGHT

YES	NO	
■	☐	GROUND SEGMENT
☐	■	SPACE SEGMENT
☐	■	LOGISTICS
■	☐	DOCUMENTATION
☐	■	HARDWARE
☐	■	SOFTWARE
☐	■	OTHER

ORGANIZATIONAL

YES	NO		YES	NO	
☐	■	501	■	☐	530
☐	■	502	☐	■	540
☐	■	503	■	☐	550
☐	■	510	☐	■	560
☐	■	520	■	☐	OTHER

Code 405

YES	NO	
☐	■	MSFC
☐	■	JSC
☐	■	LERC
☐	■	KSC
☐	■	JPL

YES	NO	
☐	■	CODE E
☐	■	CODE S
☐	■	CODE T
☐	■	OTHER

10. COMMENTS

	SIGNATURE	DATE
STel ANALYST		
HARDWARE ENGINEER		
OPERATIONS REPRESENTATIVE		
SYSTEMS ENGINEER		
I AND T MANAGER		

CONCURRENCE:

CODE 285

DATE

11. BOARD ACTION
☐ APPROVED ☐ WITHDRAWN
☐ DISAPPROVED ☐ DEFERRED UNTIL _____

12. DIRECTION/ACTION REQUIRED
☐ ECP ☐ TECH DIRECTION ☐ CONTRACT MOD
☐ WAIVER ☐ PUBLISH DOCUMENT ☐ PUBLISH DCN
☐ DEVIATION ☐ C.O. LETTER ☐ OTHER _____

13. ORIGINATOR D. Littmann x7643 CODE 530.4
SIGNATURE _____ DATE _____

14. SEGMENT MANAGER'S APPROVAL CODE _____
SIGNATURE _____ DATE _____

15. CCB APPROVAL
SIGNATURE _____ DATE _____

16. CCR IMPLEMENTED
ATR SIGNATURE _____ DATE _____
CCB SIGNATURE _____ DATE _____

1.4 Applicable Documents

This section lists the specifications, standards, and other documents which serve as references for supplemental descriptive information.

1.4.1 Specifications

a. Network Control Center Data System (NCCDS) Detailed Requirements, 530-DRD-NCCDS.

b. Functional Specification, 50 Mbps Statistical Multiplexer, Specification No. 841-79-05.

c. Deleted. ~~Network Control Center Data System Specification, Volumes 1 and 2, 530-SSD-NCCDS.~~

d. White Sands Complex (WSC) Ground Terminal Requirements for the TDRS H, I, J Era, 405-TDRS-RP-SY-011.

e. Network Control Center Data System (NCCDS) System Requirements, 1998, 530-SRD-NCCDS/1998.

1.4.2 Standards

a. NASCOM Interface Standard for Digital Data Transmission (NISDDT), 542-003.

b. IRIG Standard Parallel Binary Time Code Format, X-814-77-64.

1.4.3 Other Documents

a. Digital Data Source/Destination and Format Codes Handbook for the Nascom Message Switching System, 542-002.

b. Tracking and Acquisition Handbook for the Spaceflight Tracking and Data Network, STDN No. 724.

c. Space Network Users' Guide, STDN No. 101.2

d. Support Identification Code Dictionary, 534-808.

e. PN Codes for use with the Tracking and Data Relay Satellite System (TDRSS), STDN No. 108.

Section 2. Interface Definition and Ground Rules

The messages exchanged between the STGT and the NCC/FDF are generated in the Space to Ground Link Terminal's (SGLT's) at the STGT and in the NCC/FDF at the GSFC. The interface between the SGLT's and NCC is provided by the Data Interface System (DIS) at the STGT. The messages interchanged between the SGLT's and the DIS are shown in Figure 2-1. The protocol and descriptions of the messages between the NCC/FDF and STGT are contained in this ICD.

2.1 Interfaces

The SGLT's interface with the DIS is via the DIS Secure Voice/Data Switch and the Black Data Switch. All messages described in the following sections are exchanged via these interfaces. The DIS provides the acknowledge/retransmit protocol between the SGLT and the NCC/FDF.

2.1.1 NCC to STGT Messages

NCC to STGT messages, consisting of scheduling order messages (SHO's) and operations messages (OPM's), shall be transmitted by the DIS to the SGLT's.

2.1.2 STGT to NCC/FDF Messages

STGT to NCC messages, consisting of operations messages (OPM's), TDRSS Service Level Reports (SLR's), and operations data messages (ODM's) shall be transmitted from the SGLT's to the NCC via the DIS. STGT to FDF messages consist of Tracking Data messages (TDM's) and OPM-Class 67 messages, and are also transmitted from the SGLT's and relayed to the FDF via the DIS. Acknowledgment shall be requested of all OPM and SLR messages sent from STGT to the NCC, except as described below. If there is no message pending transmission to STGT, then the NCC will send a separate OPM (Acknowledgment of Message Received) to STGT. A separate OPM (Acknowledgment of Message Received) shall be used if there is no other message pending transmission to the NCC. STGT will not solicit acknowledgment of the Acknowledgment of Message Received OPM. The DIS Automatic Data Processing Equipment (ADPE) shall provide the acknowledge/retransmit protocol for the STGT.

The originator shall transmit all blocks of a message before initiating the transmission of another message except for separate acknowledgement messages which shall be transmitted, as required, at the next block transmission opportunity.

No acknowledge/retransmit of tracking data messages (TDM's), OPM-Class 67 messages, and operations data messages (ODM's) is required. Section 12 describes these tracking data, format and content. Section 9.5 describes the ODM's.

2.2 Ground Rules

Ground rules applicable to the various message types defined in Section 9 (i.e., SHO's, OPM's and ODM's) are contained in the sections following.

The state vector types that will be processed at STGT are as follows:

Vector Type	Application	Phase
1	Free-flight (On-Orbit)	Free-flight state vectors
2	Transition to free-flight	A type 2 vector is used only as the transition vector from maneuver sequence vectors to free-flight vectors
3		Not used
4	Ignition	First vector in maneuver sequence
5	Burnout	Last vector in maneuver sequence
6	Reentry	Landing maneuver sequence vectors
7	Launch or on-orbit	Launch or on-orbit maneuver
8	Stationary	Stationary state vectors

The following general ground rules apply:

1. Except for permanent Earth stations, user trajectory data is used according to receipt time. For each user, the most recently received vector, regardless of type, will be used from its epoch time forward. Previously received vectors with later epochs will not be used following receipt of a new vector with an equal or earlier epoch.

2. Free-flight (type 1-2) vectors will be rejected by STGT if they fail syntax, check sums, or if (1) the magnitude of the position vector is less than 6356 kilometers or (2) the epoch time of the vector is more than 12 hours earlier than the time of receipt at STGT. If a free-flight vector is rejected for any of the above reasons, a state vector reject message will be sent to the NCC.

3. Except for permanent Earth stations, no stationary state vector will be propagated more than 24 hours from its epoch time. No free-flight state vector will be propagated more than 12 hours from its epoch time.

4. A single state vector OPM may contain up to three state vectors. When three or more state vectors for a single user are to be transmitted, the NCC shall include three state vectors in each state vector OPM until fewer than three state vectors remain. When fewer than three state vectors for a single user are to be transmitted, these state vectors shall be transmitted in a single state vector OPM. All state vector OPMs shall be transmitted with the acknowledgement request flag set.

5. OPM Classes 61, 64 and 65 will be sent to the NCC without TDRSS Operations and Control Center (TOCC2) operator intervention.

6. The formats for free-flight (types 1-2), maneuver sequence (types 4-7), and stationary (type 8) state vector OPM's are identical. The vector types indicate whether an OPM contains free-flight, maneuver sequence, or stationary state vectors.

7. No more than 5000 vectors received from the NCC for each user will be stored at STGT. Vectors with no future applicability will be deleted. No more than 15,000 vectors received from the NCC will be stored at STGT for all users. No more than 72 vectors for each TDRS will be stored at STGT.

The following general ground rules apply only to permanent Earth stations:

8. The NCC will provide the STGT with a list of no more than 63 permanent Earth stations. For permanent Earth stations, vector types 1 through 7 will be rejected by STGT.

9. For permanent Earth stations, the most recently received stationary vector will be used regardless of epoch. Previously received stationary vectors will not be used following receipt of a new vector.

10. There is no limit to the propagation period for permanent Earth station vectors. The permanent Earth station vectors will be retained permanently at the STGT. Permanent Earth station vectors may be updated by the NCC at any time by use of an OPM 10 or 15.

Section 2 - Maneuver Sequences

This section addresses the ground rules that are related to the use of maneuver sequences. The formats for maneuver vector sequences are shown in Table 2-1.

Table 2-1. Maneuver Vector Sequence Formats

STATE VECTOR NUMBER	VECTOR TYPE	VECTOR EPOCH
1	4	t_1
2	7 (6)	t_2
.	.	.
.	.	.
.	.	.
n	7 (6)	t_n
n+1	2 (8)	t_{n+1}
n+2	7 (6)	t_{n+1}
.	.	.
.	.	.
.	.	.
n+m	7 (6)	t_{n+m-1}
n+m+1	5	t_{n+1} +6 min.

NOTES:
1. ALL MANEUVER SEQUENCES WILL HAVE THE ABOVE FORMAT.
2. THE MANEUVER SEQUENCE THAT INCLUDES THE TYPE 6 AND TYPE 8 VECTORS WILL BE USED FOR REENTRY ONLY.
3. THE VECTOR EPOCH TIME t_{n+1} IS THE END OF THE MANEUVER (TYPE 2 VECTOR) OR THE REENTRY (TYPE 8 VECTOR). THE SUBSEQUENT VECTORS IN THE MANEUVER SEQUENCE ARE SUPPLIED TO PROVIDE TIME FOR THE IMPLEMENTATION OF THE TYPE 2 AND TYPE 8 VECTORS.
4. ~~ONLY THE 4800-BIT BLOCKS CONTAINING THE TYPE 4 VECTOR AND THE TYPE 5 VECTOR OF A MANEUVER SEQUENCE WILL HAVE THE ACKNOWLEDGEMENT BIT SET IN THE REAL-TIME MODE.~~

2. The user will remain in the real-time mode until completion of updating of the user ephemeris. This will generally be within 30 seconds of receipt of the OPM or in the case of a maneuver, 30 seconds after receipt of the last vector in the sequence. (Receipt of multiple Delta-T OPM's may delay implementation.)

3. The STGT will notify the NCC when a user enters and exits the real-time mode.

4. Deleted. ~~Acknowledgement of all blocks of a maneuver sequence shall be requested if the epoch of the Type 4 vector is more than 7 minutes later than start of transmission. If the epoch of the Type 4 is less than 7 minutes later than start of transmission, only the blocks containing the type 4 vector and the type 5 vector shall request acknowledgement.~~

5. There can only be one real-time user per SGLT at any given time.

6. Once maneuver sequence support in the real-time mode has begun, if current time passes the epoch of the last maneuver sequence vector at the STGT, the remainder of the sequence will be rejected and maneuver sequence support will be terminated.

2.2.2 Schedule Order (SHO) Ground Rules

The following ground rules apply to routine service scheduling:

1. In a SHO structure, the sequence of the data sets for the normal services is: Forward - Return - Tracking. Sections 9.2.3.15 and 9.2.3.17 describe how End-to-End Test data sets are incorporated into a SHO structure.

2. Periodic SHOs (type 8) shall be used to schedule user services whose start times are greater than or equal to 2 hours and less than 48 hours from receipt of the SHO at STGT.

3. Routine SHOs (type 2~~), Classes 1 and 3)~~ shall be used to schedule user services whose start times are greater than or equal to five minutes and less than two hours from receipt of the SHO at STGT. These SHOs will be rejected (OPM-51, Problem Code 1) if a service start time is less than five minutes from receipt at STGT.

4. Shuttle does not use MA services, and therefore does not use cross-support. All MA service parameters and all cross-support parameters apply only to normal users.

5. Deleted.

6. The service reconfiguration period (the interval between the stop time of a SHO and the start time of the next SHO on the same Single Access (SA) antenna or using the same Multiple Access (MA) return link ID or using the same MAF link) will be at least 30 seconds. The NCC will ensure that the service reconfiguration period is adequate for slewing the SA antenna to the user position. A slew rate of approximately 0.25°/sec. is assumed. If the service reconfiguration period is less than three (3) minutes, pre-service testing is not required.

7. All SHO's have a unique SHO ID. If a SHO is to be replaced, it will be cancelled by a Cancel SHO Request, OPM-Class 12, prior to sending the replacement SHO.

8. The minimum and maximum times which may be contained within the contiguous time interval covered by a SHO are one minute (minimum time) and 24 hours (maximum time).

9. Schedule conflicts will result in the discard of the later received SHO which caused the conflict and the generation of a conflict message (OPM) which will be sent to the NCC. All previously planned and currently ongoing services will continue.

10. ~~Two separate SHO's cannot schedule back-to-back user support periods on the same link without service interruption, i.e., service reconfiguration periods must be provided.~~ Back-to-back (or overlapping) user support periods may be scheduled by separate SHO's on different ~~uniquely steerable~~ links. A minimum of 15 seconds between Shuttle SHOs scheduled at the same ground terminal (Danzante or Cacique) is required for service support.

11. When requested in the SHO, return link time delay data will be provided on the equipment configuration in use at the start and conclusion of service, when the equipment configuration changes and at reconfigurations during the service period. These return link time delay data will be sent after service termination. The Return Channel Time Delay (RCTD) measurement is valid for DIS MDM return services with symbol rates <6 Msps for NRZ data (3 Msps for biphase) per I or Q channel.

12. All services in the SHO must cover a contiguous time period. During the time interval from the earliest service start time to the latest service stop time in the SHO, there must not be any period for which no service is being provided to the user. Within a SHO, the minimum time between the stop time of a service and the start time of the same service shall be 15 seconds. MA Return (MAR) Channel availability is based on the assumption that a MAR Channel is allocated to a SHO from the earliest MAR service start time to the latest MAR service stop time in the SHO. Overlapping of MAR services in a SHO shall be rejected by the STGT. This ground rule applies to SMAR also.

13. All services in the SHO must be for the same TDRS. With the exception of S-band Single Access (SSA) combining, all services in the SHO shall be for the same TDRS SA antenna.

14. For tracking services, the related forward and/or return services must be scheduled for the entire duration of the tracking service and must be described in the same SHO. Simultaneous SSA and Ku-band Single Access (KSA) services from the same SA antenna must be described in the same SHO.

15. For optimal performance, all coherent services (i.e., Data Group 1 (DG-1) Modes 1 and 3 and all coherent carrier services) should have the forward and return services starting at the same time. If operational considerations require starting the forward service before the return service, no reconfigurations of the forward service (i.e., OPMs 02, 03, and 11) shall be sent within 30 seconds of the start of return service. OPM 04 shall not be sent within 150 seconds of the start of the return service. These messages will not be rejected, but could cause inaccuracies in subsequently scheduled tracking data.

d. N4, Number from 0 to 5 of consecutive, undetected sync words in the flywheel mode.

e. N5, Enable/Disable of best match strategy in the search mode (1 = enable, 0 = disable).

40. DIS Pre Service Test (PST) shall not be performed when any DIS Shuttle chain is already assigned. A DIS Shuttle chain is assigned from the earliest SHO service start time minus PST period to last service stop time.

41. The minimum value of the Max Data Rate parameter in a SHO shall be 1000 bps.

42. For users transmitting from a single source by QPSK modulation, only the I Channel data of Subheader 6 is applicable. For users transmitting BPSK, the applicable channel of Subheader 6 is as specified in Ground Rule 33.

43. MA services are applicable for TDRS A-G only. SSA and KSA services are applicable for TDRS A-J. SMA and KaSA services are applicable for TDRS H-J only. Incorrectly scheduled services for a TDRS shall be rejected.

44. Simultaneous scheduling of Ku and Ka Band services on the same SA antenna is not permitted.

45. Ka-Band services are DG-2, noncoherent only. There are no tracking services at Ka-Band.

46. IFL SHOs shall be applicable for Cacique only and shall not be reconfigurable. The number of services in an IFL SHO is always 1. Each service in a normal or EET SHO that specifies potential use of the Danzante HDRM will result in an IFL SHO being scheduled at Cacique. The number of data channels which may be accounted for in the IFL SHO's Subheader 6 is always 2. For Shuttle KSAR, channel 1 is always omitted.

2.2.3 End-To-End Test (EET) Data Ground Rules

The following ground rules apply to End-to-End Test SHO's:

1. Deleted.

2. End-to-End Test services cannot be scheduled alone, i.e., the related traffic services must be included in the SHO.

3. In an End-to-End Test SHO, the start time specified in an End-to-End Test data set must be the same as that of the related traffic service and the stop time in the End-to-End Test data set must be the same as that of the related traffic service.

4. End-to-End Test services cannot be included in a normal SHO. An End-to-End Test SHO must be used for End-to-End Test services.

5. All End-to-End Test SHO reject messages shall be sent to the NCC without operator intervention.

6. ~~Shuttle End-to-End Test and pre-service test shall not overlap on the same SA antenna on any TDRS, e.g., if Shuttle End-to-End Test services are on-going on SGLT1 SA-1,~~

~~then in order to avoid conflict, schedule overlapping Shuttle pre-service tests on SA-2 of SGLT1, 2 or 3, i.e., not on SA-1 of SGLT2 or 3. Shuttle SHO's shall not be rejected if End-to-End Tests and pre-service tests overlap, i.e., the Shuttle SHO shall be serviced without pre-service test.~~ If Shuttle End-to-End Test SHOs overlap with Shuttle SHO pre-service test periods and both require use of the same DIS resources, the Shuttle SHO shall be serviced without pre-serrvice test.

7. End-to-End Test services ~~which use forward and return data from NASA~~ shall be reconfigurable by OPM classes 02, ~~(return only),~~ 03, 07 and 11. ~~Local mode End-to-End Tests shall not be reconfigurable.~~

8. Shuttle End-to-End Tests shall be supported only in the local mode.

9. EET EIRP calibration shall be performed during preservice testing.

10. There will only be one S-band (forward and return) and one K-band (forward and return) service per EET SHO. The EIRP of the return EET service shall not be reconfigured.

11. An End-to-End Test SHO which does not have a three minute Preservice Test period shall be rejected with a Problem Code 6 in OPM 51.

12. End-to-End Test for Ka services is not applicable. End-to-End Test SHO's for Ka services shall be rejected with an OPM 51 Problem Code of 18 (End-to-End Test SHO format error).

13. Shuttle End-to-End Test (EET) services (S-Forward, S-Return, K-Forward, K-Return) shall not be required simultaneously at the same ground terminal and ~~. These EET services~~ shall be scheduled with separate EET SHO's.

14. In order to prevent RF interference with S-band Command and Telemetry, the following S-band EET frequency ranges are excluded:

EET Forward	2031 to 2041 Mhz
EET Return	2206 to 2216 Mhz

15. EET Forward and Return frequencies for non-coherent carrier services are constrained as follows:

    [Return Frequency - (240/221) Forward Frequency] $\leq$ 1 Mhz (S-Band)

    [Return Frequency - $\left(\frac{1600}{1469}\right)$ Forward Frequency] $\leq$ 1 Mhz (K-Band)

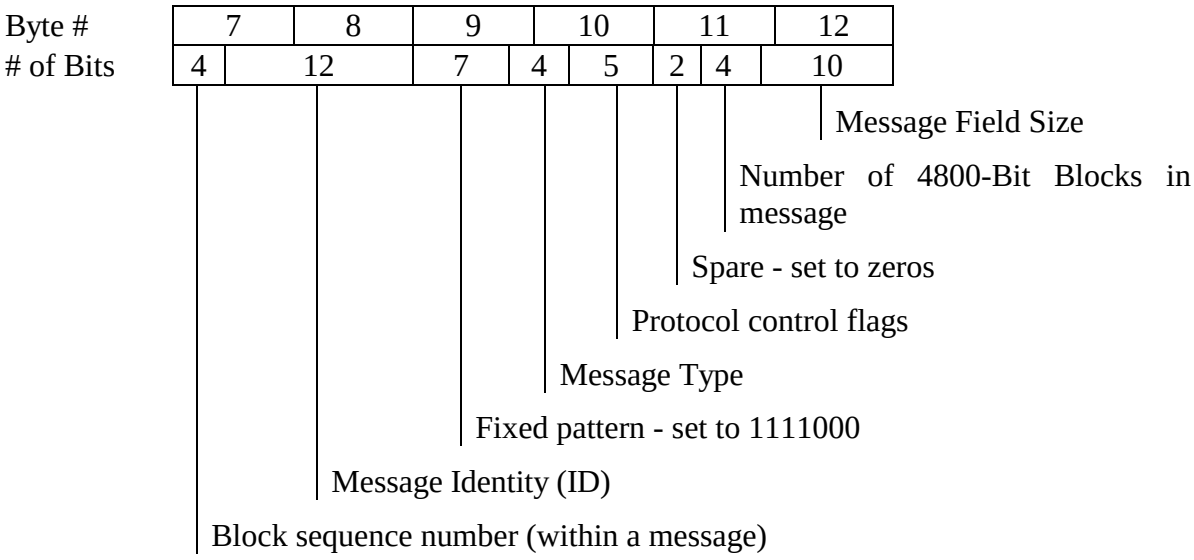
    Non-coherent Forward and Return carrier frequencies cannot be reconfigured by more than 1 MHz.

16. Forward EET services shall always be scheduled with Doppler compensation enabled. For Shuttle SSAF EET services, Doppler compensation of both carrier and PN rate shall be scheduled.

2.2.4 Operations Message (OPM) Ground Rules

The following ground rules apply to operation messages:

Section 6. TDRSS Header



Note: Bytes 7 through 12 have a unique format for TDMs to be transmitted to JSC. Refer to Section 12.1.1.

6.1 Block Sequence Number

4 bits

This subfield is a binary count which indicates the sequence of each block within a message. The count starts at one and increments by one for each subsequent 4800-bit data block in a multiblock message. The range of the count is one to $15_{(10)}$.

6.2 Message Identity ID

12 bits

This subfield contains a binary number from a modulo - 2^{12} binary counter (i.e., expressed in decimal, the number will lie within the range 0-4095). It is used by the Sender to uniquely identify each message sent on a line.

Although multiple tracking data sets may be contained in a single 4800-bit data block the number of this subfield will be incremented by one from the preceding 4800-bit data block for tracking messages. For all other types of messages (SHO, OPM, and SLR) which use one or more 4800-bit data blocks per message, the number in this subfield will be incremented by one from the number of the preceding message for each message sent from the same subsystem. If multiple subsystems send messages on the same line each such subsystem may not use any of the numbers used by any of the other subsystems. Messages transmitted from the NCC related to scheduling

and acquisition data, and free-text messages (i.e., OPM-01, OPM-13) will have message identity IDs in the range 2048 – 4095. Other messages transmitted from the NCC will have message identity IDs in the range 0 – 2047. Depending on the type and class of the message being acknowledged, message identity IDs for acknowledgement messages (OPM-14) may fall into either range. In case of multiblock messages, all the 4800-bit data blocks of the message will contain the same value in this subfield. ~~The range of this subfield will cycle: 0 to 4095 to $0_{(10)}$.~~

6.3 Fixed Pattern

- Set to 1111000

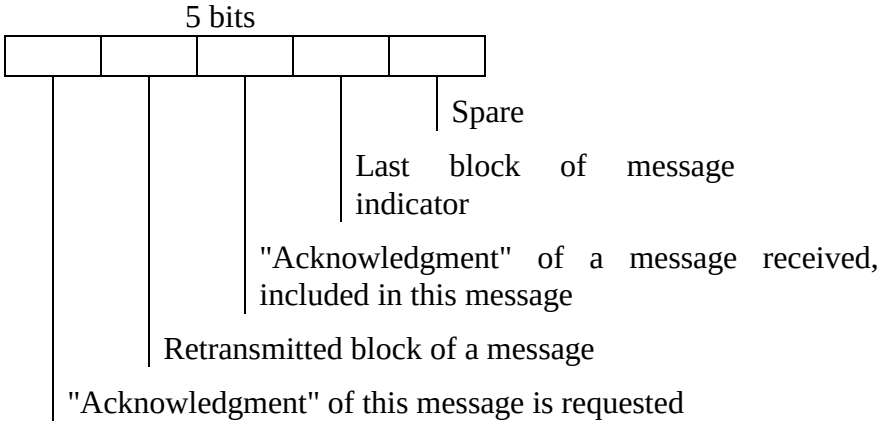
6.4 Message Type

This 4-bit binary subfield is used to identify types of messages as follows:

Decimal*	Binary	Message Type
1	0001	Tracking Data
2	0010	Scheduling (SHO) - Routine
3	0011	Operations (OPM)
4	0100	TDRSS Service Level Status (SLR)
5	0101	SA/SMAR Operations Data
6	0110	MA/SMAF Operations Data
7	0111	End-to-End Test Operations Data
8	1000	Scheduling (SHO) - Periodic Schedules

*These data are binary. The decimal values are shown only for reader convenience.

6.5 Protocol Control Flags



# of Bytes	Data Item
	DIS Disable Time
2	Year
3	Day
2	Hours
2	Minutes
2	Seconds
1	Data Source (the following parameters in Subheader No. 5 are for control of the designated Demultiplexer (DEMUX)). 1 = GSFC Demux 2 = JSC Demux 3 = Local Interface (LI)
1	LI*** 0 = Spare (Unused) 1-4 = Nominal LI Channel I.D. 5-9 = Spare (Unused) A-D = EDOS Ebnet Channel ID E-F = Landsat-7 Channel ID G = SPTR Channel ID H = DAB Channel ID I = Project Antenna Channel ID J~~G-~~X = Spare (Unused) Y-Z = LI Test Channel ID a-z = Spare (Unused)
2	Port Address* 4 Hexadecimal characters
1	Blocked/Unblocked Data* 1 = Blocked 2 = Unblocked
1	Clamped/Unclamped Clock* 1 = Clamped 0 = Unclamped
1	Clock Tracking* ** 1 = Yes 0 = No

* Applicable to MDM only.

** The clock tracking parameter for DEMUX configuration shall not be used for Shuttle Forward Data or for any End-to-End Test user return data.

*** A zero (0) shall be specified if the data source is not LI.

# of Bytes	Data Item
2	Hours
2	Minutes
2	Seconds
1	Data Destination 1 = LI 2 = HDRM 3 = MDM 4 = Record Only 5 = Television (TV) - Shuttle Only 6 = Analog Data - Shuttle Only
1	LI* 0 = McMurdo TDRS Relay System (MTRS) High Rate Channel ID 1-4 = Nominal Low Rate (LR) Channel ID 100 BPS ≤ Data Rate ≤ 10 MBPS 5-8 = Nominal High Rate (HR) Channel ID 10 MBPS < Data Rate ≤ 300 MBPS If Data rate is ≥ 150 MBPS, 5-8 specifies the service, i.e., no Q-Channel specified. 9 = Spare (Unused) A-F = EDOS EBnet Low Rate Channel ID G-H = EDOS GSIF High Rate Channel ID I-J = Landsat-7 Low Rate Channel ID K = SPTR SSAR Low Rate Channel ID L = SPTR KSAR Low Rate Channel ID M-N = DAB Low Rate Channel ID O = Project Antenna Low Rate Channel ID P~~K~~-R = Spare (Unused) S-V = LI Test Low Rate Channel ID W-Z = LI Test High Rate Channel ID a-z = Spare (Unused)
1	HDRM 0 = Not used 1-4 Input Port Number

* A zero (0) shall be specified if the data destination is not LI.

# of Bytes	Data Item
31	Spare
70(n)	

Where:
n = 2 For QPSK, BPSK, or Shuttle S-Band
n = 3 For Shuttle K-Band

Q-Channel
Repeat 70 bytes for Q-Channel (n = 2).
For Shuttle S-Band I Channel is applicable,
Q Channel is not applicable (N). For Shuttle
K-Band repeat 70 bytes for Channels 1, 2 and 3 (n = 3).
When repeats are not applicable, the first byte shall be
"N" and remaining bytes ASCII Space.

For normal and EET SHOs (SHO Classes 1 and 3) a valid data rate is required to configure a DIS data pat~~c~~h for Data Destinations 1, 2, 3, and 4. A zero data rate for these Data Destinations shall indicate that a DIS data path shall not be initially configured for this channel, but that the channel may be established via reconfiguration. Non-zero ~~D~~data rates less than 125 kbps for Data Destination 2 shall be rejected. For Data Destinations 5 and 6, a zero data rate may be specified to indicate a DIS path shall be configured for the channel. These destinations shall be reconfigurable.

For IFL SHOs (SHO Class 6) a zero or non-zero data rate greater than or equal to 125 kbps shall be used.

# of Bytes	Data Item
1	DG1 Mode - Normal User 1 = Mode 1 - Coherent 2 = Mode 2 - Noncoherent 3 = Mode 3 - Coherent
1	DG2 Type - Normal User 1 = Noncoherent 2 = Coherent
1	Shuttle Mode 1 = Mode 1 2 = Mode 2, Channel 3 Digital 3 = Mode 2, Channel 3 Analog 4 = Mode 2, Channel 3 TV
1	~~Data Format, Channel 1 (Mode 1 or 2) - Shuttle~~ ~~3 = BIϕ-L~~Spare
1	Data Bit Jitter, Channel 1 (Mode 1 or 2) - Shuttle 0 = None 1 = 0.01% 2 = 0.1%
1	Data Format, Channel 2 (Mode 1 or 2) - Shuttle* 0 = NRZ-L 1 = NRZ-M 2 = NRZ-S 3 = BIϕ-L 4 = BIϕ-M 5 = BIϕ-S

* In Mode 2, simultaneous support of digital data on Channel 3 and the 1.024 MHz subcarrier on Channel 2 is not required.

9.3.3.18 Delta-T Adjustment, OPM - Class 18

This message shall be used by the NCC to adjust the epoch time within State Vectors. The structure of this message is:

# of Bytes	Data Item	
12	OPM Header	
4	User ID, Support Identification Code (SIC)	
2	User ID, Vehicle Identification Code (VIC)	
1	Sign 0 = Plus 1 = Minus	} Delta-T
5	Time Period, LSD = 1 Second	
24		

9.3.4 STGT OPM's

9.3.4.1 SHO Status OPM - Class 51

This message shall be used to inform the NCC of the status of a SHO. The structure of this message is:

# of Bytes	Data Item
12	OPM Header
7	SHO ID
1	SHO Status Code: 0 = Accepted 1 = Rejected 2 = Problem at SHO start 3 = (Spare) 4 = Problem with processing User or TDRS trajectory at SHO start 5 = SHO terminated or cancelled
7	Conflicting SHO ID

9.3.4.2 Return Channel Time Delay, OPM - Class 52

When a SHO includes a request for return channel time delay data, this message shall be used to send the NCC that data. The return channel time delay data will be obtained at the start and stop of the return service, when equipment configuration changes, and at service reconfiguration. These data will be sent to the NCC after termination of the return service.

The RCTD OPM-52 provides a measurement of the time delay from the WSC SGLT Antenna to the time tagging of the return data in the DIS multiplexer/demultiplexer (MDM). This measurement is valid for DIS MDM return services with symbol rates < 6 Msps for NRZ data (3 Msps for biphase) per I or Q channel. The RCTD measurement shall be accurate to within one microsecond for data rates > 250 kbps, and with 25 percent of the data bit period for data rates < 250 kbps.

The message structure is:

# of Bytes	Data Item
12	OPM Header
11	OPM Subheader
	Time delay at service start (LSB = 1 microsecond)
7	I Channel
7	Q Channel
7	Spare
	Time delay at service stop (LSB = 1 microsecond)
7	I Channel
7	Q Channel
7	Spare
	Interim Time Delays
2	Number of Time Delays to follow
9	Day, Hour, Minute, Second of Delay Time
	Time Delay (LSB = 1 microsecond)
7	I Channel
7	Q Channel
7	Spare
67+30n	Repeat last 30 bytes as required

9.3.4.13 Time Transfer, OPM - Class 66

This message shall be used to provide time transfer data to the NCC. This message shall be transmitted to the NCC within 1 minute of termination of service for which time transfer was requested in the SHO. Multiple blocks may be required.

# of Bytes	Data Item
12	OPM Header
11	OPM Subheader
4	Forward PN time delay (Binary, LSB = 10 nanoseconds)
4	Return PN time delay (Binary, LSB = 10 nanoseconds)
1	Number of Time Transfer Samples (Binary, 20 - 255)
5	NASA PB-1 Time Sample (Binary)
1	Receiver PN Lock 0 = No Lock 1 = Lock
3	Forward Delta Time (Binary, LSB = 200 nanoseconds)
3	Return Delta Time (Binary, LSB = 200 nanoseconds)
32 + 12n	Repeat last 12 bytes for each measurement

9.3.4.14 Stationkeeping/Momentum Dump Data, OPM - Class 67

The format and transmission requirements of this section are applicable to TDRS F1-F7 only. TDRS H, I, J requirements for OPM-Class 67 are TBS. This message shall be sent only to the FDF and the Special Projects and Missions~~LI~~ on the ~~LI~~ TDM lines.

This message shall be manually generated and sent at least one hour prior to the ~~first thruster action~~ burn start time for stationkeeping maneuvers ~~or~~ and at least 30 minutes prior to the first thruster action for momentum dump maneuvers. In the event that a stationkeeping maneuver is cancelled after sending the OPM-Class 67, an additional OPM-Class 67 shall be sent with identical values with the exception that the predicted delta velocity components shall be zero. In the event that a momentum dump is cancelled after sending the OPM-Class 67, an additional OPM-Class 67 shall be sent with identical values with the exception that the predicted momentum wheel delta RPM sum and difference shall be zero.

This message shall start in Byte 23 of the 4800 bit block. Bytes 19 through 22 shall contain zeros. The message structure is:

# of Bytes	Data Item
2	Message Type 03

# of Bytes	Data Item	
	Message Date/Time:	
2	Year	
3	Day	
2	Hour	
2	Minute	
1	Message Source 0 = STGT 1 = WSGTU	
2	Message Class 67	
4	TDRS SIC (1300-1399)	
1	Activity 0 = Stationkeeping 1 = Momentum Dump	
	Planned Start Time	Stationkeeping: Accurate to within + 1 second Momentum Dump: Accurate to within +10 minutes
3	Day	
2	Hour	
2	Minute	
2	Second	
	Planned Stop Time	Stationkeeping: Accurate to within + 1 second Momentum Dump: Accurate to within +10 minutes
3	Day	
2	Hour	
2	Minute	
2	Second	

Stationkeeping Information (Zeros if momentum dump)

# of Bytes	Data Item		
	Predicted Thruster Configuration		
4	1) ID #1	(+/-,A-Z,0-9,A-Z)	
4	2) ID #2	(+/-,A-Z,0-9,A-Z)	
4	3) Spare	(Zeros)	
4	4) Spare	(Zeros)	
	Predicted Delta Velocity (ft./sec.)		Accurate to + 5 %
8	1) Body R	(+/-00.0000 to +/-99.9999)	
8	2) Body I	(+/-00.0000 to +/-99.9999)	
8	3) Body C	(+/-00.0000 to +/-99.9999)	

Momentum Dump Information (Zeros if stationkeeping)

# of Bytes	Data Item		
1	Dump Type 0 = roll/yaw 1 = pitch		
	Predicted Thruster Configuration		
4	1) ID #1	(+/-,A-Z,0-9,A-Z)	
4	2) ID #2	(+/-,A-Z,0-9,A-Z)	All zeros for pitch momentum unloads
4	3) Spare (Zeros)		
4	4) Spare (Zeros)		
2	Predicted Pulse Count (pitch) or		Value 00-99
~~2~~	Predicted Pulse Pairs (roll/yaw)~~Count (00-99)~~		Accurate to + 2
	Predicted Start Momentum (ft-lb-sec~~Newtons/sec~~$^{\sim\sim 2}$)		Accurate to + 20%
5	1) Hx	(±0.00 to ±1.00)	Local TDRS Body
5	2) Hy	(±0.00~~ to ±1.00~~)	Coordinate System
5	3) Hz	(±0.00 to ±1.00)	
	Predicted Stop Momentum (ft-lb-sec~~Newtons/sec~~$^{\sim\sim 2}$)		Accurate to + 20%
5	1) Hx	(±0.00 to ±1.00)	
5	2) Hy	(±0.00~~ to ±1.00~~)	
5	3) Hz	(±0.00 to ±1.00)	
	Predicted Momentum Wheel		Accurate to + 20%
7	1) Delta RPM Sum	(±000.00 to ±999.00)	
7	2) Delta RPM Difference	(±000.00 to ±999.00)	
140			

9.4 Message Subfield for SLR's (Service Level Status Report)

The STGT service level status information shall be sent from the STGT to the NCC in the form of service level status report (SLR's) as changes in equipment status occur or as requested verbally by the NCC.

9.4.1 SLR Header

The SLR provides the service availability of the STGT to the NCC for user service scheduling. SLR's shall be sent to the NCC (1) upon verbal request from the NCC, (2) upon change in any reported parameter within 15 minutes of the change.

Abbreviations and Acronyms

ACS	Attitude Control System
ADPE	Automatic Data Processing Equipment
ASCII	American Standard Code for Information Interchange
BED	Block Error Detector
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BR	Bit Rate
CAB	Circuit Assurance Block
CCB	Configuration Control Board
CCR	Configuration Change Request
CDCN	Control and Display Computer Network
CMD	Command
CTFS	Common Time and Frequency System
DAB	Demand Access Buffer
DCN	Document Change Notice
DEMUX	Demultiplexer
DG	Data Group
DIS	Data Interface System
DQM	Data Quality Monitor
Ebnet	EOSDIS Backbone Network Communications
EDOS	EOS Data and Operations System
EET	End-to-End Test
EIRP	Effective Isotropic Radiated Power
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
EOT	End of Track
EXEC	Executive

LI	Local Interface
LO	Local Oscillator
LOR	Line Outage Recorder
LRBS	Low Rate Black Switch
LRD	Low Rate Demodulator
LSB	Least Significant Bit or Byte
LSD	Logistics Support Depot
LSD	Least Significant Digit
MA	Multiple Access
MAF	Multiple Access Forward
MAR	Multiple Access Return
Mbps	Megabits Per Second
MCC	Message Class Codes
MDM	Multiplexer/Demultiplexer
MHz	Mega Hertz
MO&DSD	Mission Operations and Data Systems Directorate
MS	Mission Support
MSB	Most Significant Bit
MSD	Most Significant Digit
MSM	Maintenance and Software Delivery Mode
Msps	Megasymbols Per Second
MTRS	McMurdo TDRSS Relay System
MUX	Multiplexer
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network
NCC	Network Control Center
NCCDS	Network Control Center Data System
ND	Networks Division
NGT	NASA Ground Terminal
NRZ	Non-Return to Zero

NRZ-L	Non-Return to Zero-Level
NRZ-M	Non-Return to Zero-Mark
NRZ-S	Non-Return to Zero-Space
ODM	Operations Data Messages
OPM	Operations Messages
PDA	Pin Diode Attenuator
PM	Preventative Maintenance
PMMS	Performance Measuring and Monitoring Subsystem
PTE	PMMS Test Equipment
QPSK	Quadrature Phase Shift Keying
RCP	Right-Hand Circular Polarization
RF	Radio Frequency
SA	Single Access
SDU	Signal Distribution Unit
SGLT	Space Ground Link Terminal
SHO	Schedule Order
SIC	Support Identification Code
SLR	Service Level Report
SMA	S-Band Multiple Access
SMAF	S-Band Multiple Access Forward
SMAR	S-Band Multiple Access Return
SPTR	South Pole TDRS Relay
SQPSK	Staggered Quadrature Phase Shift Keying
SRDP	Shuttle Return Data Processor
SSA	S-Band Single Access
SSAF	S-Band Single Access Forward
SSAR	S-Band Single Access Return
SSH	S-Band Shuttle
STGT	Second (TDRSS) Ground Terminal/Danzante Ground Terminal
SUE	Shuttle-Unique Equipment

S-Band Multiple Access refers to the MA services provided by TDRSs with ID's 1307, 1308 or 1309.