

Deep Space Network Sequence of Events

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In January 1975 the Network Operations Control Group began generating the Deep Space Network Sequence of Events with a new software system designed for use in the Network Data Processing Area's Sigma 5 computer system. This article provides an overview of the DSN Sequence Generation (DSNSG) Generator capability by describing the inputs, software, and system flow required to construct an SOE.

I. Introduction

The DSN Sequence of Events (SOE), ordinarily prepared on a seven-day basis as an adjunct of the DSN Seven-Day Schedule, provides milestone data for the handling of routine and/or critical daily network operations. It is published as a chronological listing of events and released in both printed text and output file form. The printed text is generated as hard copy (Fig. 1) via a Network Data Processing Area (NDPA) line printer. The output file is maintained on magnetic tape (high-speed data). The high-speed data tape is rewritten to a second magnetic tape that is formatted as an output file message for transmission to DSN stations and other NASA facilities having suitable receive capability. The request for transmission of the DSN SOE is at the discretion of the Network Operations Chief.

II. Inputs

The Network Operations SOE coordinator is responsible for the production of an acceptable DSN SOE. He

begins the generation process by collecting and/or creating the following inputs:

- (1) Event data
- (2) SOE Subsequence file
- (3) Trigger data
- (4) Seven-Day Schedule data
- (5) Master SOE

A description of the above inputs follows.

A. Event Data

The basic unit of data used in the SOE is an event. Each event consists of time, options and text. Time may be either GMT (absolute) or reference time (relative). Options include mission reference symbols, cross reference

symbols, and time symbols. The text consists of statements explaining the DSN station activity to be performed.

Events can be input to the DSN Sequence Generator from cards and/or magnetic tape. The SOE coordinator normally creates this data on cards from information supplied by the DSN project representatives. Project users can supply events on magnetic tape via a machine interface file.

B. SOE Subsequence File

The Subsequence file is a collection of events stored on magnetic tape. Events held in this file differ from the Event data description above in that a subsequence can receive variable information from trigger records at the time of SOE generation. The main attraction to the subsequence file is in the customary benefits derived through the standardization processes. The file is created and updated by the SOE coordinator from inputs supplied by the DSN project representatives.

C. Trigger Data

Trigger records are created from information supplied by the DSN Scheduling Office and the SOE coordinator. These records are generated by the SOE coordinator on cards or magnetic tape. Triggers are used by the DSN Sequence Generator to access and complete the appropriate events from the subsequence file. A trigger file can be supplied to project users for incorporation into a project SOE file.

D. Seven-Day Schedule Data

The Network Operations Scheduling Group supplies the SOE coordinator with card information relating to future station activities; such as start and stop times with calibration requirements. The data usually covers a seven-day period within the following week. The Seven-Day cards are used by the coordinator to create trigger records.

E. Master SOE

The SOE coordinator has the option of declaring the creation of a Master SOE following the generation of an SOE. The Master SOE is stored on magnetic tape and can be input to future DSN Sequence Generator runs. The coordinator may elect to input the Master SOE for generation of additional reports or updated SOEs.

III. Software System

The SOE coordinator has access to three programs for use in creating the DSN SOE. The Preliminary and Final

File programs create triggers that can be used for input to the SOE generation program.

A. Preliminary File Generator

The purpose of this program is to create a tape file of trigger records which contain DSN station tracking information needed to generate the SOE. Trigger records are generated from Seven-day Schedule and user input cards (Fig. 2). Each seven-day record produces two trigger output records. One trigger will contain the scheduled time that a station is to begin tracking (acquisition of signal) while the other reflects the scheduled time that the track will end (loss of signal). Both triggers carry information that is needed to access and complete the appropriate statements from the subsequence library. All triggers generated by this program make up the Preliminary file which will be used as input to the Final File Generation program. The file can also be input to the Network Sequence of Events Generation (NSG) program or to project-designed programs that maintain independent SOE files.

B. Final File Generator

The function of this program is to create a Final Trigger File and to provide file maintenance capabilities to the user. The Final File contains all triggers from the Preliminary File plus any triggers generated by this program. The triggers created by this program consist of two types; transfer and nontransfer. Transfer triggers are generated for conditions where the tracking times for two stations, following the same spacecraft, overlap with sufficient time to adequately complete handover operations. Nontransfer triggers will be created whenever there is either a gap in the tracking of a spacecraft between two stations or the times do not overlap with enough time to complete the handover. Transfer triggers contain the scheduled GMT that the receiving station is to begin tracking, while nontransfer triggers carry either the end of track GMT of the losing station or the start track GMT of the receiving station. Both triggers contain data that are needed to access and complete the appropriate statements from the subsequence library. The Final File is generated through the processing of user and Preliminary File inputs (Fig. 3) and is used as input to the Sequence of Events Generation program.

The file maintenance feature of this program gives the user the ability to add, change, or delete any trigger record held in the Preliminary or Final files. With this processor an updated trigger file tape is produced using update card and (old) trigger file inputs (Fig. 4).

The updating and generation features of this program can be utilized within one processing run as well as in separate runs. (Fig. 5)

C. Sequence of Events Generator

The basic purpose of this program is to generate from inputs a time-ordered Sequence of Events (Fig. 6) and to output it in formats convenient to the users. There are a number of potential inputs to the Sequence of Events generation. They are:

- (1) Events cards (either in card form or on tape)
- (2) Trigger cards (either in card form or on tape)
- (3) Subsequence library
- (4) Master SOE tape from a prior generation

There are also three possible outputs from the Sequence of Events generation. The possible outputs are:

- (1) Listing of the sequence of events
- (2) A data tape suitable for formatting into high-speed data blocks for transmission
- (3) Master SOE tape for input to other SOE generation runs

IV. SOE Generation

The following is a description of the procedure normally used to produce a DSN SOE and is graphically displayed in Fig. 7.

The SOE coordinator usually receives the Seven-Day Schedule cards first. The deck is input to the DSNSG which produces the Preliminary file. A duplicate can then be passed to projects that have established a machine data file interface. The Preliminary file tape is then input to the DSNSG for production of the Final file.

While performing the above task the coordinator is also receiving inputs from the various projects. He must code information on cards for those projects that have not established a machine data file interface.

After the coordinator has collected and created all the various inputs necessary to the SOE, he then generates the final product. The output listing must be reviewed by each DSN Project Representative before the tape is released to the NDPA and the Network Operations Chief can be notified of its availability.

V. Conclusion

The DSNSG which is a major redesign of the Sequence of Events Generator (SEG), residing in the Mission Control and Computing Center IBM 360/75 system, allows the Network Operations Section to create a DSN SOE with much less procedural complications and provides greater flexibility on the part of the DSN toward establishing acceptable project interfaces.

DSN WEEKLY SCE FOR PERIOD 154/00002 TO 161/03302 TAPE 12402

ITEM NO.	MISSION TIME 000 HH MM SS	GMT TIME 000 HH MM SS	ACTION BY	USER S/C ID	DSN	CMD	EVENTS	SORT
402.0		156 14 00 00	ARC	PNF-23			PA303	
403.0	EM + 067 17 13 07	156 14 00 00	14 TRK	M73-76	62->14		2-WAY TRANSFER FROM DSS 62 TO DSS 14	RX4T
404.0	EM + 067 17 18 07	156 14 05 00	14 CPCH	M73-76	14		DSS 14 CMD MOD ON (AFTER TUNING)	RX4T
406.0	EM + 067 17 42 01	156 14 28 54	14 TRK	M73-76	14		DSS 14 2-WAY	RX4E
408.0	EM + 067 18 34 03	156 15 20 56	62 TRK		62		DSS 62 3-WAY	
409.0		156 15 50 00		M73-76			**OWLT = 14M ZTS (867 SEC) **	MA4N
411.0		156 16 20 00	DSS 44	PNG-24			START PRE-COUNT LEVEL 303343 - CONF 1000	
412.0		156 16 25 00	CMCH	PNG-24			TURN OVER DSS 44 CKTS TO NETWORK OPERATIONS	4
413.0		156 17 00 00	NOC	PNG-24			VERIFY DSS 44 HAS PROX FOR PASS	
414.0		156 17 20 00	ARC	PNG-24			FGM201	
415.0		156 17 20 00	NOC	PNG-24			START DSN DATA VERIFICATION TEST FOR DSS 44	
416.0		156 17 20 00	44 TRK	PNG-24	44 ACS		DSS 44 ACS - RPT ACQ PARAMETERS AS RCVD	4
417.0		156 17 35 00	NOC	PNG-24			REPORT SCA BEST LCCK FREQ	
418.0		156 17 35 00	TRK	PNG-24			PREPARE FOR 2-WAY XFER OF S/C FROM	
419.0		156 17 40 00	NOC	PNG-24			DSS 11 TO DSS 44 PASS 427 IN 20 MIN	
420.0		156 17 40 00	TRK	PNG-24	11 TO 44		PER SOP 8 3-32-31-02/REV 8	
421.0		156 17 45 00	DSS 44	PNG-24			TURN CMD MOD OFF	
422.0		156 17 45 00	TRK	PNG-24			REPORT CMD MOD OFF - DSS 11	
423.0		156 17 50 00	NOC	PNG-24			2-WAY XFER FROM DSS 11 TO DSS 44	
424.0		156 17 50 00	TRK	PNG-24	11 LOS		PERFORM PROCEDURES IN TABLE 6-2	4
425.0		156 17 50 00	DSS 44	PNG-24			616-20 REV-A VOL. VII	
			TRK	PNG-24			TURN CMD MOD ON	
			NOC	PNG-24			REPORT CMD MOD ON - DSS 44	
			NOC	PNG-24			AT COMPLETION OF DATA VERIFICATION TEST	
			NOC	PNG-24			BRIDGE DSS-NET (T/L) TO 44 VOICE CKT AND	
			NOC	PNG-24			PERFORM ARC11 VOICE CHECK	
			NOC	PNG-24	11 LOS		DSS 11 LOS - INITIATE 1 HR POST PASS AS	4
			NOC	PNG-24			SPECIFIED	
			NOC	PNG-24			DSS 11 END TRACK	4

Fig. 1. Typical DSN sequence of events page format

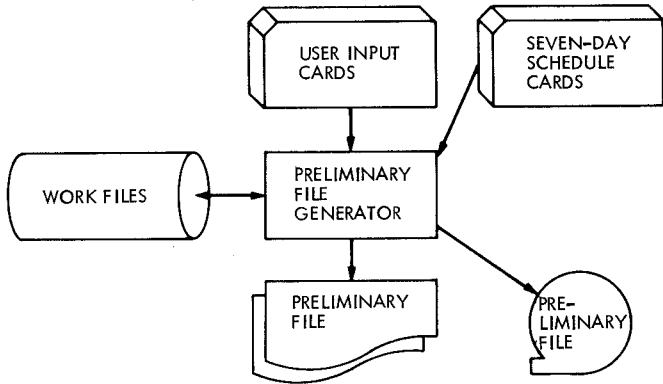


Fig. 2. Preliminary file generation

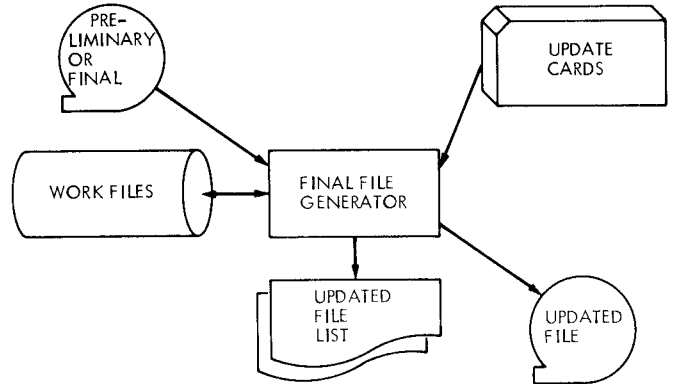


Fig. 4. Preliminary or final file update

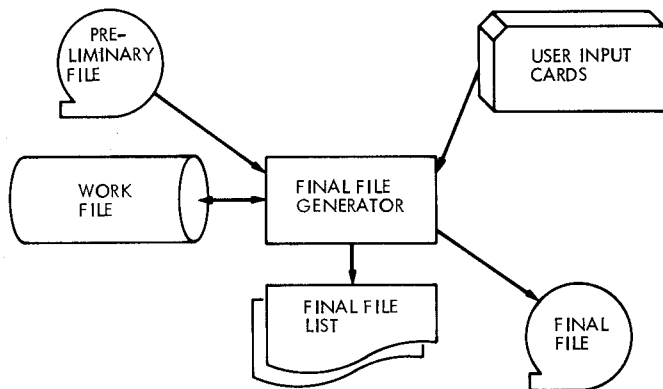


Fig. 3. Final file generation

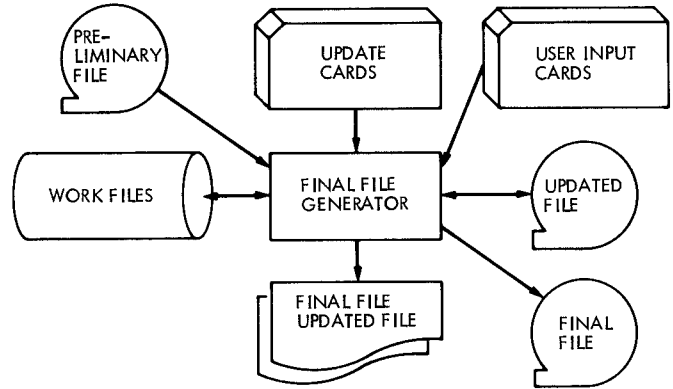


Fig. 5. Preliminary file update and final file generation

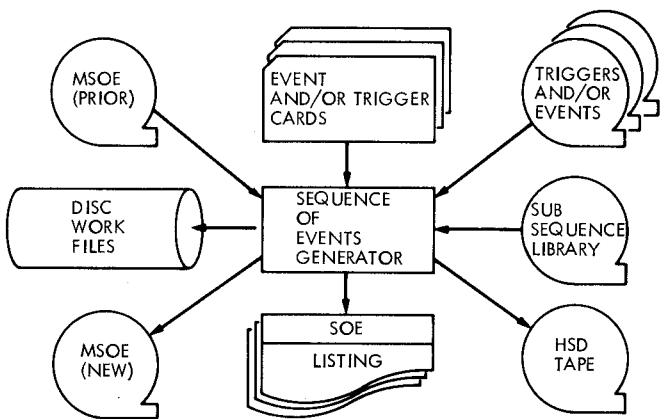


Fig. 6. Sequence of events generation

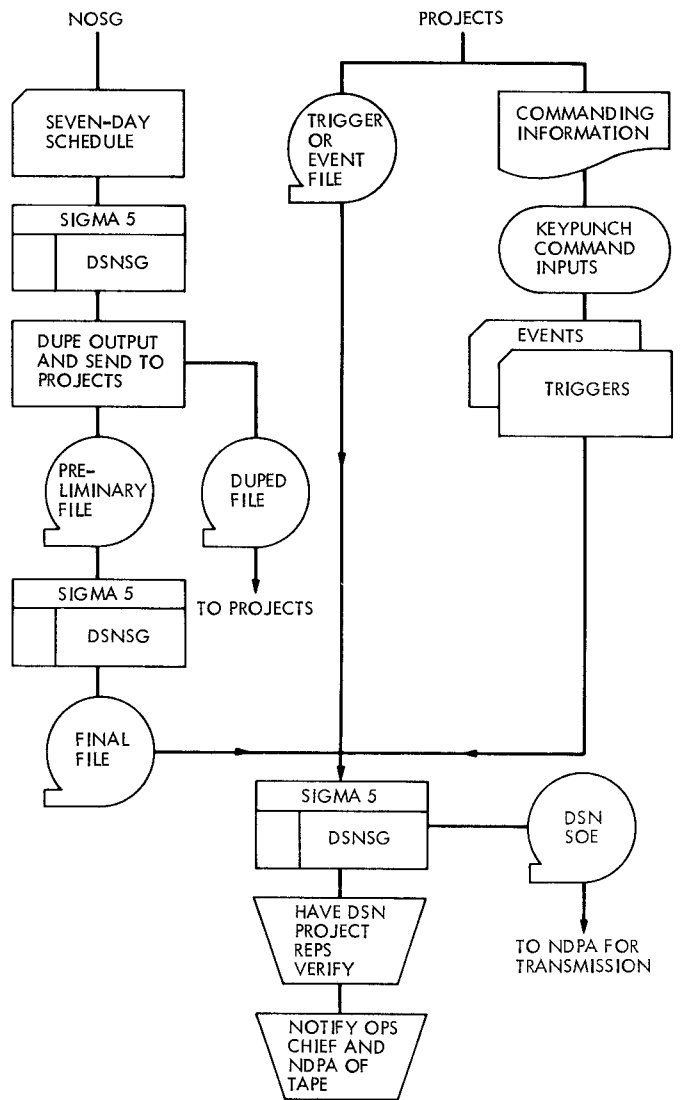


Fig. 7. System flow (overview) of normal SOE generation