DSN Data Systems Software Methodology

C. K. Hung
Data Systems Section

This report presents a software methodology for JPL Deep Space Network (DSN) data systems software implementations through transfer and delivery. The DSN Data Systems Software Methodology is compatible with and depends on DSN software methodology and also incorporates the characteristics of real-time program development in a DSN environment. The DSN Data Systems software implementation consists of a series of six distinct phases: (a) planning and requirements, (b) design definition, (c) design and production, (d) combined subsystem testing, (e) acceptance test and transfer, (f) operation and maintenance. The unit (function) demonstration tests during the design and production phase will be planned early in the design definition phase. Each demonstration will serve as a significant milestone and will show an increased program capability. An Independent Group (IG) is responsible for verification and validation of the DSN Data Systems software during development phases.

The DSN Data Systems Software Methodology is being applied to all development software provided for or by the DSN Data Systems Section in Mark IV where there is a desire for reliability, maintainability, and usability within budget and schedule constraints.

I. Introduction

The Deep Space Network (DSN) Data Systems Software Methodology is to provide standard methods and policies for the orderly implementation and management of the DSN Data Systems software through transfer and delivery. The DSN Data Systems Software Methodology is compatible with and depends on DSN software methodology standards (Ref. 1), and also incorporates the characteristics of real-time program development in a DSN environment. The overview of the DSN Data Systems software development techniques are as follows:

(1) The DSN Data Systems software implementation plan is a series of six distinct phases:

(a) Planning and requirements

(b) Design definition

(c) Design and production

(d) Combined subsystem testing

(e) Acceptance test and transfer

(f) Operations and maintenance.

Before the acceptance testing phase, combined subsystem testing will be performed. The combined subsystem test phase will demonstrate that:

(a) That the program meets functional, performance, and interface requirements in its real-time environment and

(b) Proper concurrent operation of combined subsystems.

(2) The unit (function) demonstration tests during the design and production phase will be planned early in the design definition phase and will appear on the detailed Work Breakdown Structure (WBS). Each demonstration thus:

(a) Shows an increased program capability

(b) Proves module compatibility

(c) Serves as a significant milestone (quality and quantity)

(d) Produces test plans and procedures which often become a part of the Software Test and Transfer Document (STT).

(3) An Independent Group (IG) is responsible for verification and validation of the software during development phases.

II. Software Classification

The extent to which DSN Data Systems software methods and management policies are applied to the implementation of an individual software program is dependent upon the classification of that software into one of three software classes.

The individual software classes are defined as follows:

(1) Class 1–New operation software

(2) Class 2–Modified operation software (new functions added or major revisions) where implementation cost exceeds one-half man year or $25,000

(3) Class 3–Modified operation software (corrections or minor revisions) where implementation cost is less than one-half man year or $25,000.

Table 1 lists the implementation documentation requirements that are applicable to the three software classes.

III. Software Design and Development Process

A. Implementation Phases

This paragraph presents each phase of the software design and development process. It identifies all of the responsible people, their function and it relates to each phase of the process, the products that will be generated, and the monitoring, reviews, and control involved. Figure 1 summarizes the DSN Data System Software Management and Implementation Plan.

The phases of DSN Data Systems software implementation involve:

(1) Planning and requirements

(2) Design definition

(3) Design and production

(4) DSN Data Systems combined subsystem testing

(5) Acceptance test and transfer

(6) Operations and maintenance.

B. Program Language

Coding of the software design is performed using a standard high-level language approved for real-time and nonreal-time programs. The HAL/S language is a currently approved language used for all new minicomputer subsystem software development. The PL/M language is a currently approved language used for all Control and Computation Module (CCM) subsystem software/firmware.

The use of inherited code is not subject to the constraints and does not require a waiver to use an existing language.

C. Milestones

Based on the activities (major documents, design and test reviews) discussed in Paragraph III.A., eight major milestones are established which allow the overall software implementation project to be planned and its in-progress development to be monitored. The milestones, in order of occurrence, are as follows:

(1) Software Requirements Document (SRD) approved and DSN Level D review completed

(2) Project Data Flow and Interface Design Document (DFD) approved

(3) Software Definition Document (SDD), Preliminary Software Operator's Manual (PSOM), and Development Test Plan (DTP) approved and architectural design review (Level E) completed

(4) Final demonstration test review completed

(5) Combined Subsystem Test (CST) review and pre-acceptance test review completed. Combined Subsystem Test Plan and Test Procedure (CTT) approved

(6) Software Operator's Manual (SOM) approved

(7) Software Specification Document (SSD) approved

(8) Software Test and Transfer (STT) Document approved, Transfer Agreement signed, deliverable transferred to Operations.

D. Reviews

Technical reviews are required to assess the technical quality and progress of the development during DSN Data Systems Section software implementation process. Reviews are held at the end of each implementation phase. These reviews are of two types: DSN Data Systems Section internal reviews and DSN formal review. The DSN formal reviews are described in Ref. 1.

The reviews, in order of occurrence, are as described in the paragraphs which follow.

1. **DSN subsystem function design review (Level D).** The DSN formal Level D review for each subsystem's software and the common software shall be held at the end of software planning and requirements phase.

2. **Peer design review.** The peer design review shall be held after the DSN formal Level D review, at the end of design definition phase, to allow for corrective action and before the DSN formal subsystem detail design (Level E) review. The DSN Data Systems peer design review procedure is shown in Figure 2. The peer design review criteria shall include:

(1) Requirement traceability

(2) Architectural design

(3) Man/machine interface

(4) Testing factors

(5) Management information

(6) Hardware and software development systems

The detailed review form is shown in Ref. 1. Members of the peer design teams shall consist of the following:

(1) Software Manager (Chairman)

(2) Independent Group representative

(3) Data flow and interface engineer

(4) Combined subsystem testing engineer

(5) Senior software engineer

Also, the DSN subsystem engineer and operational representative participate in the peer review.

3. **DSN subsystem detail design review (Level E).** The DSN formal Level E review for each subsystem's software and the common software shall be held after the subsystem peer design review and before substantially entering the design and production phase.

4. **Unit (function) demonstration test review.** The unit (function) demonstration test review for each subsystem and the common software is held at the end of each demonstration test during the design and production phase.

The technical group supervisor shall be responsible for calling the meeting and for assuring resolution of all open items. Members of review teams shall include the Software Manager and the cognizant development engineer and his/her staff. The Independent Group common software engineer may also participate, if required. The review focuses primarily on:

(1) Performance against design. The review

(a) Systematically lists all program parameters such as data queue, Input/Output (I/O) queues, buffer pool (released buffer), etc.

(b) Creates boundary conditions for these parameters and systematically checks that all cases are performed properly against design.

(2) Functional performance against functional requirement. The review

(a) Systematically lists all program parameters and system parameters such as 1200-bit-per-second line, error polynomial, etc.

(b) Creates boundary conditions for these parameters with test driver/other programs and checks systematically that all cases are performed properly.

(3) Tests (creates) all possible hardware failures and their error recoveries. Also tests all peak load where all interrupt signals occur simultaneously.

5. **Final demonstration test review.** The final demonstration test review (section internal) shall be held at the end of the design and production phase.

6. **Combined subsystem test review.** The combined subsystem test review (section internal) shall be held at the end of the DSN Data Systems combined subsystem testing phase.

7. **DSN subsystem transfer to operations review (Level F).** This formal DSN review is optional and is held normally only for subsystem transfers.

E. Documentation

Documentation is a baselined product of each of the software implementation phases, and is produced concurrently with the design and other implementation activities conducted in each phase. Typical outlines for documentation are shown in Refs. 1, 2, and 3. Table 2 summarizes the documents and their responsibility.

F. Quality Control

The Independent Group shall assure the traceability of software requirements through architectural design, design and production, integration combined subsystem test, and transfer. The Independent Group conducts and observes the pre-acceptance test and combined subsystem tests, and is a signatory to test reports.

Before completion of the transfer of the software from implementation to operations, DSN Quality Assurance (QA) certifies the status of the SSD (including the code). Detailed DSN QA requirements and procedures are contained in Ref. 1.

G. Configuration Management

All documentation and software products are maintained under configuration control by Software Production Management and Control (SPMC). SPMC provides security, integrity, and controlled access to material within its custody and enforces configuration management practices.

The SRD, SDD, SSD, SOM, and STT are subject (ultimately) to DSN configuration management. The TRA, DTP, PSOM, DFD, CTT, and SMP are DSN Data Systems Section project documents, and are subject to DSN Data Systems Section change control only.

1. **Section (internal) change control.** The TRA, DTP, PSOM, DFD, CTT, and SMP are maintained under DSN Data Systems Section configuration control in SPMC files, and are updated whenever a change request is approved. All change requests need to be justified and need to be accompanied by the modified change pages reflecting the change at the same or lower level or detail as was included in the original approved document.

2. **DSN change control.** The SRD and SDD are not maintained beyond program transfer to operations. The SSD, SOM, and STT are separate as-built documents delivered along with the completed program and are maintained throughout the operational life of the program. Therefore, the SSD, SOM, and STT are subject to DSN change control procedures.

Detailed DSN Configuration Management requirements and procedures are contained in Ref. 1.

3. **Waiver.** Deviations from the Software Management plan may appear in the SRD or through the waiver procedure. All approved waivers shall be formally documented by the SPMC.

H. Methodology and Tool Utilization

There are two main categories of computers used operationally and for software development support:

(1) minicomputers

(2) CCM-based microprocessors. Minicomputer applications are intended to be developed on Intel MDS systems and/or a CCM-based Development Work Station (DWS). The development tool summary is shown in Table 3.

IV. DSN Data Systems Mark IV Software Implementation

Over the last several years (1978-1980), the DSN Data Systems Ground Communication Group has employed software development techniques such as unit (function) demo tests, combined subsystem testing, etc., for developing reliable realtime software for the Ground Communication Facility (GCF)-Network Operation Control Center (NOCC) Reconfiguration Project (Ref. 4 and 5).

The DSN Data Systems Section is playing a major role in the implementation of the Network Consolidation Project (NCP) (Ref. 6 and 7). (Referred to in this paper as the Mark IVA Implementation Project.) This software methodology applies to all development software in Mark IVA provided for, or by, the DSN Data Systems Section in the Mark IVA era where there is a desire for reliability, maintainability, and usability within budget and schedule constraints.

As of mid-July 1982, all DSN Data Systems computer programs are in the architecture design phase or the design and production phase. Table 4 contains the software classifications for Mark IVA Interim software. Table 5 contains the software classification for the Mark IVA final software.

The status of the DSN Data System software implementation for the NCP will be described in a subsequent issue of the TDA Progress Report.

References

1. "*Standard Practices for the Implementation of Computer Software*," JPL 78-53, Jet Propulsion Laboratory, Pasadena, California, September 1, 1978.
2. "*Preparation Guide for Class B Software Specification Documents*," JPL 79-56, Jet Propulsion Laboratory, Pasadena, California, October 1, 1979.
3. Robert C. Tausworthe, *Standardized Development of Computer Software*, Part 1 (1976), Part 2 (1978), JPL SP-43-29, Jet Propulsion Laboratory, Pasadena, California.
4. Bremner, D. S., and Hung, C. K., "Ground Communication Facility and Network Operations Control Center Reconfiguration," *The Telecommunications and Data Acquisition Progress Report 42-58*, pp. 108-109, Jet Propulsion Laboratory, Pasadena, California, August 15, 1980.
5. McClure, J. P., "GCF-NOCC Reconfiguration," *The Deep Space Network Progress Report 42-55*, pp. 86-89, Jet Propulsion Laboratory, Pasadena, California, February 1980.
6. Gatz, E. C., "Network Consolidation Program System Design," *The Telecommunications and Data Acquisition Progress Report 42-63*, pp. 150-153, Jet Propulsion Laboratory, Pasadena, California, June 15, 1981.
7. Yeater, M. L., and Herrman, D. T., "Network Consolidation Program," *The Telecommunications and Data Acquisition Progress Report 42-65*, pp. 19-24, Jet Propulsion Laboratory, Pasadena, California, October 1981.
8. Robert C. Tausworthe, "*Deep Space Network Software Cost Estimation Model*," JPL 81-7, Jet Propulsion Laboratory, Pasadena, California, April 15, 1981.

Table 1. Software classifications

Document	Product for each program	Software classifications		
		Class 1	Class 2*	Class 3*
SRD	Software Requirements Document	Yes	Yes**	Yes**
SDD	Software Definition Document	Yes	Yes	Yes***
PSOM	Preliminary Software Operator's Manual	Yes	Yes (Redline SOM)	Yes (Redline SOM)
DTP	Development Test Plan	Yes	Yes	Yes
SOM	Software Operator's Manual	Yes	Yes	Yes
SSD	Software Specification Document	Yes	Yes	Yes
STT	Software Test and Transfer Document	Yes	Yes	Yes
TRA	Test Requirements Analysis Report	Yes	If critical	No

*Existing Documents updated for Changes
**ECR + Softcost (Ref. 8) = SRD on Changes
***ECO + WBS = SDD on Changes

Table 2. Documentation

Phase	Document	Responsibility	Approved By	Review By
1	SRD	CDE	DSN Line Mgrs (810-13) S/W Mgr (Concur)	IG
2	SDD	CDE	DSN Line Mgrs (810-13) S/W Mgr (Concur)	IG
2	Prelim. SOM	CDE	Supervisor, S/W Mgr	IG
2	DTP	CDE	Supervisor, S/W Mgr	IG
3, 4	SOM	CDE	DSN Line Mgrs (810-13)	S/W Mgr IG
3, 4	SSD	CDE	DSN Line Mgrs (810-13)	
3, 4, 5	STT	CDE	DSN Line Mgrs (810-13)	IG
1, 2	DFD	Data Flow and Interfaces Eng	Subsystem Eng Mgr Section Mgr	S/W Mgr, CDEs IG/CST Eng
2, 3, 4	CTT	CST Eng	Integration Mgr Section Mgr	S/W Mgr IG, TGSs, CDEs
1, 2, 3	TRA	IG	CST Eng, Integration Mgr Subsystem Eng Mgr	S/W Mgr CDEs
1	SMP	S/W Mgr	Section Mgr	TGSs, CDEs, Cost Eng Integration Mgr

Table 3. Development Tool Summary

Tool	Phases	Utilization	
Cost model	1	CDE/Supervisor ;	Scheduling
Word processor	1, 2, 3, 4, 5	CDE, SPMC ;	Documentation
Work Breakdown Structure (WBS)	2, 3, 4, 5	CDE/Supervisor ;	Scheduling and milestones
Program Design Language (PDL)	2*, 3, 4, 5	CDE, SPMC. QA ;	Documentation
HAL/S	3, 4, 5	CDE ;	Modcomp high-order language
PL/M	3, 4, 5	CDE ;	CCM S/W/firmware language
Development Version Control System (DVCS)	3, 4, 5	CDE, SPMC, QA ;	Version control
Multiple terminal for software code	3, 4, 5	CDE/Implementer ;	Code development
Anomaly Report System (ARS)	3, 4, 5	CDE, COE, IG ;	Anomaly Reporting System
Source Editor (SED)	3, 4, 5	CDE/Implementer ;	Modcomp Source Editor
Assembler*	3, 4, 5	CDE/Implementer ;	Modcomp language
Test generator*	3, 4, 5	CDE/Implementer ;	Debugger

*Option

Table 4. Software classification for Mark IVA interim software

Subsystem	Program	S/W classification	Code estimates (X 1000 lines)
Command	Deep Space Station (DSS) Command Modulator Assembly (CMA) firmware	1	1.6
	DSS Command Processor Assembly (CPA)	2	4.4
	Network Operation Control Center (NOCC) Command Real-Time Monitor (NCD)	2	0.2
Telemetry	DSS Telemetry Processor Assembly (DTM)	2	3.2
	NOCC Telemetry Real-Time Monitor (NTM)	2	0.12
NOCC Display	NOCC Display Subsystem (NDS)	2	2.4
	Video Assembly Processor (VAP)	2	0.3
Common Software	NOCC Common Software	2	5.6

Table 5. Software classification for Mark IVA final software

Subsystem	Program	S/W classification	Code estimates (X 1000 lines)
Command	Deep Space Communications Complex (DSCC) Command Processor Assembly (CPA)	2	0.8
	Network Operations Control Center (NOCC) Command Real-Time Monitor (NCD)	2	2.0
Test Support	DSCC Test Support Assembly (TSA)	1	31.7
	NOCC Test and Support Assembly (NTS)	2	12.0
Antenna Mechanical	DSCC Antenna Pointing Assembly (APA)	1	25.5
	DSCC Antenna Control Subassembly (ACS)	1	12.0
Tracking	DSCC Metric Data Assembly (MDA)	2	21.0
	NOCC Network Tracking Assembly (NTK)	2	25.0
Radio Science	DSCC Occultation Data Assembly (ODA)	2	16.1
Monitor and Control	DSCC Complex Monitor and Control (CMC)	1	40.0
	DSCC Link Monitor and Control (LMC)	1	35.0
	NOCC Monitor and Control (NMC)	1	20.0
Telemetry	DSCC Telemetry Processor Assembly (DTM)	2	20.0
	NOCC Telemetry Real-Time Monitor (NTM)	2	25.1
Ground Communication Facility	DSCC Area Routing Assembly (ARA)	1	22.0
	Central Communication Terminal (CCT) Error Correction and Switching Assembly (ECS)	2	12.0
	CCT Data Record Generator Assembly (DRG)	2	8.0
	CCT Central Communication Monitor (CCM)	2	7.2
	NOCC Network Communication Equipment (NCE)	3	8.0
Display	NOCC Display Subsystem (NDS)	2	0.3
	NOCC Video Assembly Processor (VAP)	2	0.3
Network Support	Star and VAX Interface Adapter (SVIA)	1	0.5
	Network Support Subsystem (NSS) Control Input/Output	1	10.0
	NSS Sequence of Events (SOE)	1	14.0
	NSS Standard and Limit (S&L)	1	16.0
	NSS System Performance Record (SPR)	1	16.0
Common Software	Functional Independent Data Module (FIDM), IEEE 488, STAR and FTS handler	1	4.0
	Local Area Network (LAN) RS-232 device handler for microprocess	1	0.8

PHASES ITEM	SOFTWARE PLANNING AND REQUIREMENTS	SOFTWARE DESIGN DEFINITION (ARCHITECTURAL DESIGN PHASE)	SOFTWARE DESIGN AND PRODUCTION	SECTION 338 COMBINED SUBSYSTEM TESTING	ACCEPTANCE TEST AND TRANSFER TO OPERATION	OPERATION AND MAINTENANCE	REMARKS
MAJOR ACTIVITY BY COGNIZANT DEVELOPMENT ENGINEER (CDE)/IMPLEMENTORS	● GENERATE SRD ● REQ. FOR S/W ● INHERITED PGM CONSIDERATIONS ● COST MODEL - CLASS C WBS IN MADNET DATA BASE ● REVIEW	● GENERATE SDD, PRELIM SOM AND DTP ● FUNCTIONS OF EACH PGM AND DATA STRUCTURE ● ARCHITECTURAL DESIGN AND ORDER OF DEV. ● MAN/MACHINE INTERFACE ● DATA FLOW AND INTERFACE (INTERNAL AND EXTERNAL) DESIGN ● UNIT (FUNCTION) DEMO TEST PLAN AND H/W EQUIPMENTS NEED DATES ● CLASS B WBS ● REVIEW	● DETAIL DESIGN, CODING AND TESTING ● UNIT (FUNCTION) DEMO TESTS - PROVE DEMO OF INCREASING PGM FUNCTION CAPABILITY ● FINAL DEMO TEST AND REVIEW ● ANOMALIES → WBS ● GENERATING FINAL PRELIM. SOM, SSD, STT ● REVIEW AND DISTRIBUTE SOM, SSD, STT	● SUPPORT CST EGR AND IG FOR TESTING ● DEMONSTRATE PROGRAM MEETS SRD AND DFD IN REAL TIME ENVIRONMENT ● DEMONSTRATE PROPER CONCURRENT OPERATION OF COMBINED SUBSYSTEMS ● FIX ANOMALIES - STT, CTT ● REVISE STT, SOM, SSD ● SUBMIT PRELIM. SSD & PGM TO QA ● ANOMALIES →WBS, ARS	● RESPONSIBLE FOR THE OVERALL ACCEPTANCE TEST PROCESS AT DSS 11 ● SUPPORT CDE FOR ACCEPTANCE TESTING, SPT AND SOAK TESTS ● FIX ANOMALIES AND REVISED STT ● TRANSFER ● SUBMIT REVISED SSD & PGM TO QA ● ANOMALIES - ARS, WBS	● REMOVE LIENS ● ANOMALIES - ARS	1. SENIOR S/W EGR FROM EACH TECHNICAL GROUP WILL ADVISE ON V&V DURING PLANNING AND REQUIREMENTS PHASE AND DESIGN DEFINITION PHASE
MAJOR ACTIVITY INDEPENDENT GROUP (IG)	● VERIFY AND VALIDATE S/W REQUIREMENTS AGAINST FRD/FDD ● INITIATE A TEST REQ. ANALYSIS REPORT (TRA) ● PARTICIPATE IN REVIEW FUNCTIONS AND INTERFACE WITH CDEs IN FORMAL SCHEDULED MEETINGS. THE TGSs SHOULD SCHEDULE THESE MEETINGS	● EVALUATE ADEQUACY OF S/W ARCHITECTURE DESIGN TO MEET ALLOCATED REQUIREMENTS ● PREPARE AND ISSUE FIRST DRAFT OF TRA REPORT ● PARTICIPATE IN REVIEW FUNCTIONS	● COMPLETE THE TRA AND SUPPORT CST EGR IN PREPARING CTT ● REVIEW PRELIM. CTT AND STT TO ENSURE THEY MEET FUNCTIONAL REQUIREMENTS ● OBSERVE DEMO TESTS AND REVIEW TEST RESULTS ● PARTICIPATE IN REVIEW FUNCTIONS	● CONDUCT THE PRE-ACCEPTANCE TEST IN ACCORDANCE WITH STT AT 338 LAB, SIF/CTA 21 OR DSS 11 ● SUPPORT CST EGR FOR CST ● ANOMALIES → ARS	● MONITOR AND SUPPORT S/W ACCEPTANCE TEST FOR COMFORMANCE WITH STT ● EVALUATE CONFORMITY OF TEST RESULTS WITH TRA		2. SENIOR S/W ENGINEERS WILL SERVE AS TECHNICAL ADVISOR FOR SECTION S/W DEVELOPMENT DURING IMPLEMENTATION PHASES
MAJOR ACTIVITY BY COMBINED SUBSYSTEM TEST ENGINEER	● ESTABLISH THE TEST PHILOSOPHY FOR H/W AND S/W	● INITIATE COMBINED SUBSYSTEM TEST PLAN AND TEST PROCEDURE (CTT)	● GENERATING OF CTT	● CONDUCTING THE CST IN ACCORDANCE WITH THE CTT AT SECTION LAB, SIF/CTA21 OR DSS 11 ● REVISED CTT ● ANOMALIES	● ENSURE CONSISTENCY/INTEGRITY OF COMBINED SUBSYSTEMS		3. CDE CONDUCTS ACCEPTANCE TEST
MAJOR ACTIVITY BY DATA FLOW AND INTERFACES ENGINEER	● PREPARE AND ISSUE PRELIM. DFD ● COORDINATE INTERFACES	● GENERATE DFD ● ENSURE CONSISTENCY/INTEGRITY OF END-TO-END DATA FLOW FOR ALL DSN SYSTEMS	● ENSURE CONSISTENCY/INTEGRITY OF END-TO-END DATA FLOW FOR ALL DSN SYSTEMS	● ENSURE CONSISTENCY/INTEGRITY OF END-TO-END DATA FLOW FOR ALL DSN SYSTEMS	● ENSURE CONSISTENCY/INTEGRITY OF END-TO-END DATA FLOW FOR ALL DSN SYSTEMS		
MAJOR ACTIVITY BY COMMON SOFTWARE ENGINEER	● IDENTIFY COMMON S/W ELEMENTS ● ESTABLISH AN IMPLEMENTATION PLAN FOR COMMON S/W AND ASSOCIATED WBS's ESTABLISH PRODUCTION PERSONNEL THROUGH TGSs	● COORDINATE PREPARATION OF FUNCTIONAL SPEC. OF NEW COMMON S/W ELEMENT ● PROVIDE "USER" DOCUMENTATION AND TRAINING AND SUPPORT SERVICE IN SPMC	● COORDINATE PRODUCTION OF COMMON S/W AND IS RESPONSIBLE FOR FUNCTIONAL TESTING	● COORDINATE PRODUCTION OF COMMON S/W AND IS RESPONSIBLE FOR FUNCTIONAL TESTING	● RESPONSIBLE FOR FUNCTIONAL TESTING		
MAJOR ACTIVITY BY SOFTWARE MANAGER	● GENERATE SOFTWARE MANAGEMENT PLAN (SMP) ● MONITOR AND MANAGE	● ASSURE PROPER INTER SUBSYSTEM COORDINATION IN SUPPORT OF SECTION INTERNAL/EXTERNAL S/W I/F TESTS, . . . ETC. ● MONITOR AND MANAGE	● MONITOR AND MANAGE (WBS, DEMO TESTS) ● COORDINATE H/W REQ. WITH H/W MGR ● RESOLVE TECHNICAL CONFLICTS	● REVIEW CTT ● MONITOR AND MANAGE	MONITOR AND MANAGE		
MAJOR DOCUMENTS FOR EACH PROGRAM	SOFTWARE REQUIREMENTS DOCUMENT SRD	SOFTWARE DEFINITION DOCUMENT SDD PRELIM SOFTWARE OPERATOR MANUAL PRELIM SOM DEVELOP TEST PLAN DTP	SOM PRELIM. SSD PRELIM. SOFTWARE SPECIFICATION DOCUMENT PRELIM STT	REVISED SOM REVISED SSD SOFTWARE TEST AND TRANSFER DOCUMENT REVISED STT	SOM SSD STT		4. SSD, SOM AND STT ARE UNDER DSN CHANGE CONTROL
MAJOR PROJECT DOCUMENTS FOR SECTION (338) SUBSYSTEMS	SOFTWARE MANAGEMENT PLAN SMP PROJECT DATA FLOW AND INTERFACES DESIGN DOCUMENT DFD PRELIM.	TEST REQUIREMENTS ANALYSIS TRA PRELIM. DFD	TRA COMBINED SUBSYSTEM TEST PLAN AND TEST PROCEDURE CTT PRELIM.	ANALYSIS REPORT CTT			5. TRA SMP DFD CTT } UNDER. INTERNAL CHANGE CONTROL
DESIGN REVIEWS ▲ DENOTES FORMAL △ DENOTES SECTION INFORMAL	DSN LEVEL D ▲ 810-10	LEVEL E PEER ▲ DSN ▲ TGSs	DEMO TEST REVIEW △- - - -△ GROUP INTERNAL CDE FINAL DEMO TEST REVIEW △ TGSs	CST REVIEW AND PRE-ACCEPTANCE TEST AND REVIEW △ CST ENG/I.G.	LEVEL F TRANSFER △ CDE		6. HARDWARE AVAILABILITY
ANOMALY REPORT	N/A	N/A	APPLICABLE (338) WBS	APPLICABLE (338) WBS	APPLICABLE (DSN)	● ANOMALIES REPORTED TO CDE APPLICABLE (DSN) ● CSE ANALYSIS & CATEGORIZATION	
MILESTONES	1. SRD APPROVED AND DSN LEVEL D REVIEW COMPLETED (CDE) ▽1	2. DFD APPROVED (DFE) 3. SDD, PRELIM. SOM, DTP APPROVED AND ARCHITECTURAL REVIEW COMPLETED (CDE, TGS) ▽2 ▽3	4. FINAL DEMO TESTS REVIEW COMPLETED (CDE, TGS) ▽4	5. CST REVIEW AND PRE-ACCEPTANCE TEST REVIEW COMPLETED, CCT APPROVED (CST ENG) ▽5	6. SOM APPROVED (CDE) 7. SSD APPROVED (CDE) 8. STT APPROVED: DELIVERABLES TO OPERATIONS (CDE) ▽6 ▽7 ▽8		
DEVELOPMENT TOOLS USED	● SPMC JACQUARD WORD PROCESSOR * ● COST MODEL - CLASS C WBS IN MADNET DATA BASE	● SPMC JACQUARD WORD PROCESSOR ● CLASS B WBS IN MADNET DATA BASE ● PDL FOR TOP-LEVEL DESIGN (OPTIONAL)	● PDL ● HAL/S ● PL/M ● DVCS ● 7870 ● WBS ● ARS ● SED ● JACQUARD WORD PROCESSOR ● ASSEMBLER (IF REQUIRED) ● STAR TEST GENERATOR	● PDL ● HAL/S ● PL/M ● DVCS ● 7870 ● WBS ● ARS ● SED ● JACQUARD WORD PROCESSOR ● ASSEMBLER (IF REQ) ● STAR TEST GENERATOR	● PDL ● HAL/S ● PL/M ● DVCS ● 7870 ● WBS ● ARS ● SED ● JACQUARD WORD PROCESSOR ● ASSEMBLER (IF REQ) ● STAR TEST GENERATOR	● DSN ARS	

Fig. 1. DSN data systems software management and implementation

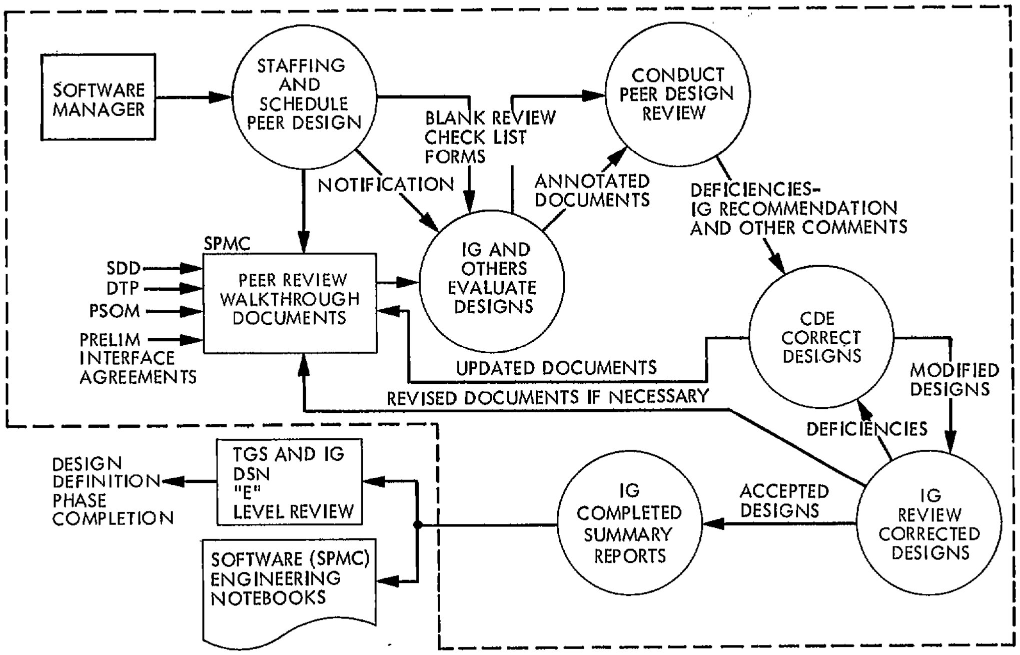
SOFTWARE MANAGER
STAFFING AND SCHEDULE PEER DESIGN
CONDUCT PEER DESIGN REVIEW
BLANK REVIEW CHECK LIST FORMS
NOTIFICATION
ANNOTATED DOCUMENTS
DEFICIENCIES-
IG RECOMMENDATION AND OTHER COMMENTS
SPMC
SDD
DTP
PSOM
PRELIM INTERFACE AGREEMENTS
PEER REVIEW WALKTHROUGH DOCUMENTS
IG AND OTHERS EVALUATE DESIGNS
CDE CORRECT DESIGNS
UPDATED DOCUMENTS
MODIFIED DESIGNS
REVISED DOCUMENTS IF NECESSARY
DEFICIENCIES
DESIGN DEFINITION PHASE COMPLETION
TGS AND IG DSN "E" LEVEL REVIEW
SOFTWARE (SPMC) ENGINEERING NOTEBOOKS
IG COMPLETED SUMMARY REPORTS
ACCEPTED DESIGNS
IG REVIEW CORRECTED DESIGNS

Fig. 2. DSN data systems peer design review procedure