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MANAGEMENT PLAN
Networking Research in Front Ending and Intelligent Terminals

by
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Networking Research in Front Ending and Intelligent Terminals

MANAGEMENT PLAN

Prepared for the
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by the

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OVERVIEW

An experimental network front end (ENFE) and an intelligent terminal program are supported by contract DCA100-76-C-0088.

ENFE

The data and experience gained from this program will lead to the generation of specifications for a WWMCCS network front end. The ENFE program will construct prototype ENFE's and execute experiments with those prototypes. The ENFE research program is organized into two teams.

The first team will implement a prototype ENFE. The prototype ENFE will use a DEC PDP-11/70 computer running a UNIX general purpose operating system. UNIX will be modified to include software for the host to front end protocol (HFP). Measurement software will be added to UNIX to support HFP experiments.

The second team will be concerned with protocol issues. This team will complete the HFP specifications, generate Telnet protocol options for Honeywell VIP terminals, conduct off loading studies, and follow AUTODIN II protocol developments.

Individuals and small groups will be drawn from both of these teams to generate an experimental plan, a multi-host technical report, and a plan for research into alternative front end architectures.

There are some major risks associated with this program. The state-of-the-art in network communication is geared to machine/terminal interaction rather than machine/machine interaction. Front-ending a large computer with a generalized machine-to-machine protocol like HFP has never been attempted. Furthermore, UNIX is not designed to support high speed message switching. Given the state-of-the-art in HFP and the

architecture of UNIX, the prototype UNIX ENFE and HFP software are strictly experimental. The primary product of this program will be experience with the host front-ending problem.

Intelligent Terminal

The objective of the intelligent terminal program is to investigate the capabilities of intelligent terminals in a command and control environment. These investigations will lead to the development of state-of-the-art prototype intelligent terminals and eventually to the generation of procurement specifications.

Three prototype intelligent terminals will be developed. The first terminal will be an DEC LSI-11 intelligent terminal essentially identical to the existing CAC demonstration unit. A major effort will be made to repackage the terminal hardware to be more consistent with office environment use.

The second terminal will use a Honeywell Level-6 minicomputer. The Level-6 terminal will be packaged similarly to the LSI-11 terminal and will have similar memory size, speed, and secondary memory. The LSI-11 and Level-6 terminals will have slightly different operating systems but will be capable of running the identical application software programmed in the language C.

The use of the Level-6 was motivated by two factors: the feasibility of future competitive procurement and the technical limitations of the LSI-11. Current intelligent terminal efforts are DEC oriented. If this trend continues, DEC will have a commanding advantage in any eventual procurement. In order to improve the possibility of competitive procurement it is advisable to reduce our DEC dependence. Furthermore, the LSI-11 architecture has reached its peak. We are currently using maximum LSI-11 configurations. In particular we have

been hampered by the LSI-11 address space limitations and its lack of advanced hardware features such as dynamic linking and virtual memory. Of the available competitors to DEC, the Honeywell Level 6 machine offers the greatest architectural flexibility for a research project. Furthermore, Honeywell is willing to provide the support necessary to use a Level-6 in this research program. This support consists of supplying a DEC compatible C compiler and of insuring timely hardware delivery.

A third terminal will be delivered and will incorporate advanced features such as bulk memory and multiple displays. The hardware base for the third terminal will be decided in January 1977. At that time sufficient experience with the LSI-11 and Level-6 machines will have been gathered to permit an intelligent choice. In addition, the rate of development in the semi-conductor industry argues for delaying the decision as long as possible. The arrival of legitimate competitors to both DEC and Honeywell is possible.

Other tasks are to build application programming tools for the intelligent terminals and to generate documents for the application programmer. These documents will include a complete rework of the existing intelligent terminal software to add appropriate in-line comments. A basic research program will be conducted in the hardware, software, and human factors associated with intelligent terminals. Finally, manpower has been assigned to assist MITRE in the development of intelligent terminal demonstrations and experiments using the PWIN.

High Risk ENFE Areas

11/70 delivery. The GFE 11/70 is scheduled for delivery in the third week of October. All schedules have been organized around this delivery date. It now appears possible that the 11/70 will be delivered in November or possibly later. An 11/70 delivery slippage will almost certainly cause a slippage in the ENFE program. The unavailability of the 11/70 will require the ENFE team to shift to the use of the CAC 11/45. The CAC 11/45 is a 24-hour service machine which is shared by many projects. The ENFE program requires large periods of dedicated usage for operating system reprogramming and debugging. Dedicated CAC 11/45 time can be arranged. However, the amount of dedicated time that can reasonably be expected is much less than needed. Hence an 11/70 delivery slippage will likely require additional funds and will certainly slow the program.

ABSI. The Asynchronous Bit Serial Interface (ABSI) between the 11/70 and the H6000 does not currently exist. We have a commitment from a vendor for delivery of an ABSI. The proposed ABSI will use an existing general purpose interface to an 11/70. It will also use the design for the MIT IOM interface on the MIT Multics machine. This should reduce the risk in generating a first time interface. However, there still is some possibility of slippage if the ABSI delivery or checkout take excessive time. If there is a gross failure to deliver a working ABSI, then serious schedule slips could ensue.

IMP 11/A. The IMP 11/A interfaces between the 11/70 and an ARPANET IMP. We have conflicting reports on the delivery of the IMP 11/A.

If delivery is delayed, an alternative strategy will be to use one of the existing IMP interfaces from one of the CAC machines. This will require a different device driver than for the IMP 11/A. The different device driver will not affect other ENFE software. However, there will be serious contention for the use of the IMP interface between the machine to which it is normally assigned and the 11/70. Furthermore, constant removal and replacement of the interface between two machines increases the jeopardy of the damage. The overall effect of a delay in IMP 11/A delivery will be a slowing of the integration of the ENFE software.

IMP port. An IMP requires one port inside the IMP for each host that will be interfaced to the IMP. The CAC IMP currently has two "local" ports. The position of the 11/70 in the CAC machine room will require a "distant" port. A third, distant port is on order. If the third port delivery is delayed, we plan to add driver circuitry to one of the local ports that will permit the port to operate over the required distance. This would impose a two week delay to generate the appropriate hardware.

VIP interface. The VIP interface is dependent upon a DEC DV11 synchronous interface. There are several unknowns associated with both the VIP and the DV11. The VIP is an idiosyncratic terminal. Our previous experience indicates that hardware performance cannot be predicted from written specifications. Furthermore, we have no experience with the DV11 interface. There is some possibility that it may not be appropriate to a VIP. Finally, UNIX is an inappropriate system for driving a VIP. It is not designed to handle a paged terminal. Schedules have been adjusted to accommodate a reasonable amount of uncertainty in this area. However, some possibility still exists for slippage that cannot be predicted until the work begins.

H6000 software specifications. The delivery of the H6000 software specifications was moved up two weeks in negotiations in an attempt to support CSC. Furthermore, the HFP specification on which the H6000 software specs will be based is not yet complete. Priority has been assigned to the generation of the H6000 software specifications. However, there is still some possibility of a two to eight weeks slip given the nature of the task and the status of the HFP specification.

High Risk Intelligent Terminal Areas

LSI-11 terminal delivery. The LSI-11 terminal is scheduled for delivery December 31, 1976 contingent upon hardware delivery. Our current best estimate of the availability of all components required for the LSI-11 terminal is January 17, 1977. As a result the delivery date of the LSI-11 terminal is moved to February 14, 1977.

Level-6 terminal. Given the financial constraints of this contract, our ability to generate a Level-6 terminal is heavily dependent upon Honeywell providing an appropriate software and hardware base. Verbal assurances have been given by Honeywell that this will be done, but no contractual arrangements have been completed. Should contractual arrangements fail, then we will be required to shift back to an LSI-11 terminal for the second terminal. This will not seriously impact schedules. However, our ability to do experiments with large address spaces and dynamic linking will be eliminated without the Level-6.

Bulk memory. We have decided to go with a high risk technology for intelligent terminal bulk memory. Magnetic bubble memories have been selected due to their cost, size, and heat advantages. In particular, our current budget supports a maximum 256K byte memory if we work with conventional MOS technology. This same budget will support a one megabyte memory if we shift to bubble technology. At present bubble

technology is high risk in the sense of availability of sufficient components in sufficient time to develop the memory. Furthermore, the use of magnetic bubbles may require the development of a cache memory for the intelligent terminal. The thrust of technology is in the direction of magnetic bubbles for bulk memory purposes. The major risk is one of time. It presently appears that we have an even chance to produce a one magabyte memory based on bubble technology in the third intelligent terminal. However, the delivery of the bulk memory could slip several months into a follow-on contract.

WWMCCS Computer Time Requirements

One month of intermittent use of the Code 400 H6000 will be required to check out the ABSI. Check out is scheduled to begin March 1, 1977. If the 11/70 or ABSI delivery is delayed, the checkout could begin as late as July 1, 1977.

Tasks and milestones have been estimated to a one week resolution for internal project management. In addition, each task has been assigned to a specific individual. Typically, internal tasks vary from one to four weeks in duration for the ENFE program. Intelligent terminal tasks, other than documentation and construction tasks, are ongoing best-effort tasks of greater length.

Detailed internal tasks have been aggregated to correspond to the larger tasks specified in the contract technical statement of work. In some cases, detailed tasks were hard to uniquely assign to a single contract task. An example is the two two-week internal tasks which generate the software documentation standards. These two tasks are input to all software design and coding tasks on both the ENFE and intelligent terminal programs. In these cases, non-unique internal tasks are spread over multiple contract tasks.

The following tables list the contract tasks for the ENFE and intelligent terminal programs. The paragraph in the technical statement of work which defines the task is noted. The start and end dates of significant activity are noted. The estimate of man-months is noted. Critical external inputs to the task are also noted. These inputs are either GFE items, hardware which must be procured, or other DCA contractors with whom we will require extensive interaction to perform the task. Following each task table, is a table of contract specified milestones and internal milestones of interest to DCA. Following each milestone table is a figure charting tasks and milestones verus time.

ENFE Tasks

ference	Task	dates[2]	man-months[3]	external inputs
..1	Design & Assemble ENFE Hardware	10/11-11/15	3	11/70
..2.a1	11/70 Device Driver for ABSI	1/31- 4/18	3	ABSI
a2	H6000 Device Driver Specs	10/1 -10/25	1	HFP Specs
..2.b	IMP-11/A Device Driver	10/25-11/1	1	IMP-11/A
..2.c1	11/70 HFP Interpreter Module	11/8 - 3/14	6	11/70
c2	H6000 HFP Interpreter Specs	10/11-11/8	1	HFP Specs
c3	Performance Evaluation of UNIX HFP	3/14- 9/30	19	CSC
..2.d1	11/70 NCP	10/1 -11/29	5	11/70
d2	H6000 NCP Specs	10/11-11/8	1	HFP Specs
..2.e1	User and Server Telnet	11/1 - 1/31	4	
e2	H6000 Telnet Specs	10/1 -11/1	1	HFP Specs
e3	11/70 VIP Device Driver	4/4 - 6/6	3	VIP
e4	Design Telnet Options for VIPs	10/1 - 1/3	3	HFP Specs
e5	Implement Telnet Options for VIPs	5/23- 7/4	2	
..2.f	Access Control Mechanism	3/14- 4/4	1	
..2.g	Investigate Security Strategies	10/1 - 9/30	3	SDC
..2.h	Provide With-Host and Stand-Alone Modes	See II.B.2.c1 & d1		
..2.i1	Investigate Protocol Offloading	1/3 - 9/30	8	
i2	FTP Offloading Specs	8/1 - 8/29	2	
..2.j	Investigate Connection of Multiple Hosts	1/3 - 1/24	1	HFP Specs
..2.k	Tune UNIX	See II.B.2.c3		
..2.l	Implement 11/70 Measurement Tools	11/15- 3/14	5	11/70
..2.m	Develop Alternative Arch. Research Plan	2/28- 9/12	5	
..2.n	Develop ENFE Experiment Plan	11/15- 1/3	4	HFP Specs
			82 total	

Paragraph in Statement of Work which defines the task

Dates refer to significant activity. Minor support may occur outside the start and end dates indicated.

Man-months are estimates to the nearest man-month. All tasks estimated to take less than one man-month are rounded up to one man-month.

ENFE Milestones

Date		Milestone
11/15	*	1. DRAFT H6000 Software Specs
11/30	*	2. FINAL H6000 Software Specs
12/15	*	3. DRAFT ENFE Functional Description
12/20		4. HFP line protocol completed
1/15	*	5. FINAL ENFE Functional Description
1/30	*	6. Multi-Host Technical Report
1/31		7. HFP process server completed
3/1		8. Ready to debug ABSI on H6000
3/14		9. HFP channel level complete
		10. All HFP designed coded and documented
4/4		11. Minimal access control complete
4/18		12. ABSI tests complete - H6000 tests possible
5/1	*	13. DRAFT ENFE Experiment Plan
5/15	*	14. FINAL ENFE Experiment Plan
6/6		15. VIP handler complete
7/1	*	16. DRAFT ENFE Software Functional Description
7/18		17. All required software operational
9/1	*	18. FINAL ENFE Software Functional Description
9/15	*	19. DRAFT Alternative Architecture Research Plan
9/30	*	20. FINAL Alternative Architecture Research Plan
	*	21. UNIX/ENFE Experimental Performance Report
	*	22. FTP Off-Loading Report
	*	23. ENFE Nassi-Schneidermann Charts
	*	24. ENFE Listings and Object Code
	*	25. ENFE Final Report

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* Contract Deliverable

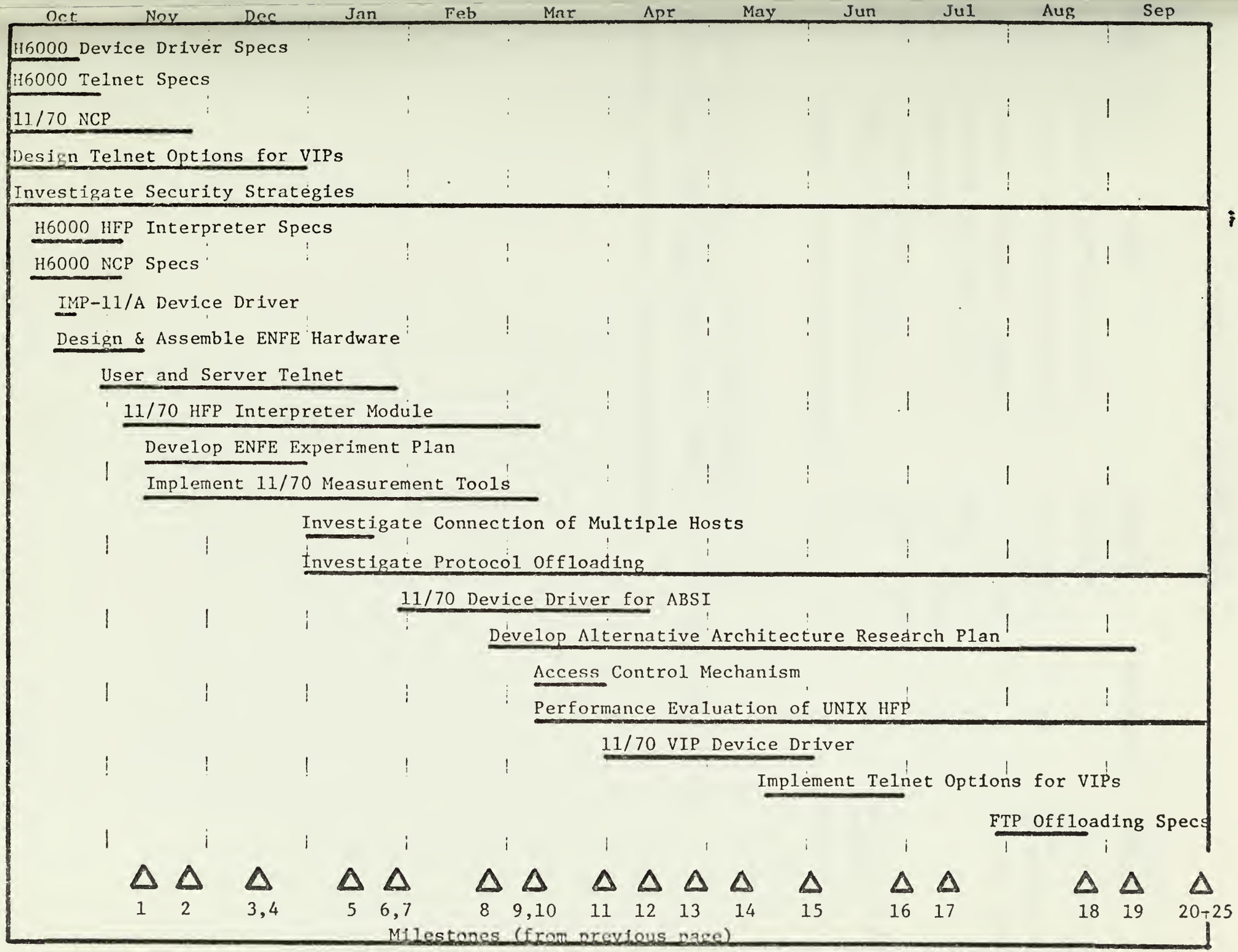

Figure 1

ENFE Tasks and Milestones for FY 1977

Intelligent Terminal Tasks

rence	Task	dates[2]	man-months[3]	external inputs
.1a	Design & Assemble Terminal 1	10/ 2/14	3	LSI-11 hardware
1b	Design & Assemble Terminal 2	11/1 - 4/4	3	Level 6 hardware&software
1c	Design & Assemble Terminal 3	1/3 - 9/30	3	terminal hardware
.2	Develop Application Tools	10/1- 9/30	17	
.3a	User Manual	11/22- 9/30	4	
3b	Utility Documentation	10/25- 9/30	4	
.4	Research into Capabilities	10/1 - 9/30	33	memory and display hardware
.5	Assist in Demos and Experiments	10/1 - 9/30	7	Mitre

Paragraph in Statement of Work which defines the task

Dates refer to significant activity. Minor support may occur outside the start and end dates indicated.

Man-months are estimates to the nearest man-month.

Intelligent Terminal Milestones

Date		Milestone
11/22		1. LSI-11 hardware drawings complete
12/31	*	2. Initial LSI-11 Software delivery
	*	3. Preliminary User Manual
1/3		4. Level-6 terminal design complete
1/17		5. LSI-11 components available
1/31		6. DRAFT LSI-11 Maintenance Manual
		7. Level-6 components available
2/14	*	8. LSI-11 terminal delivered
		9. FINAL LSI-11 Maintenance Manual
3/21		10. Level-6 terminal ready for CAC use
		11. DRAFT Level-6 Maintenance Manual
		12. Level-6 operating system usable
6/30	*	13. Level-6 terminal delivered
7/5		14. Advanced Terminal ready for CAC use
		15. Bubble memory laboratory model works
8/30	*	16. DRAFT Software Functional Description
	*	17. DRAFT User Manual
9/30	*	18. FINAL Software Functional Description
	*	19. FINAL User Manual
	*	20. Advanced Terminal delivered
	*	21. Intelligent Terminal Nassi-Schneidermann charts
	*	22. Intelligent Terminal listings and code
	*	23. Final Research Report

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* Contract deliverable

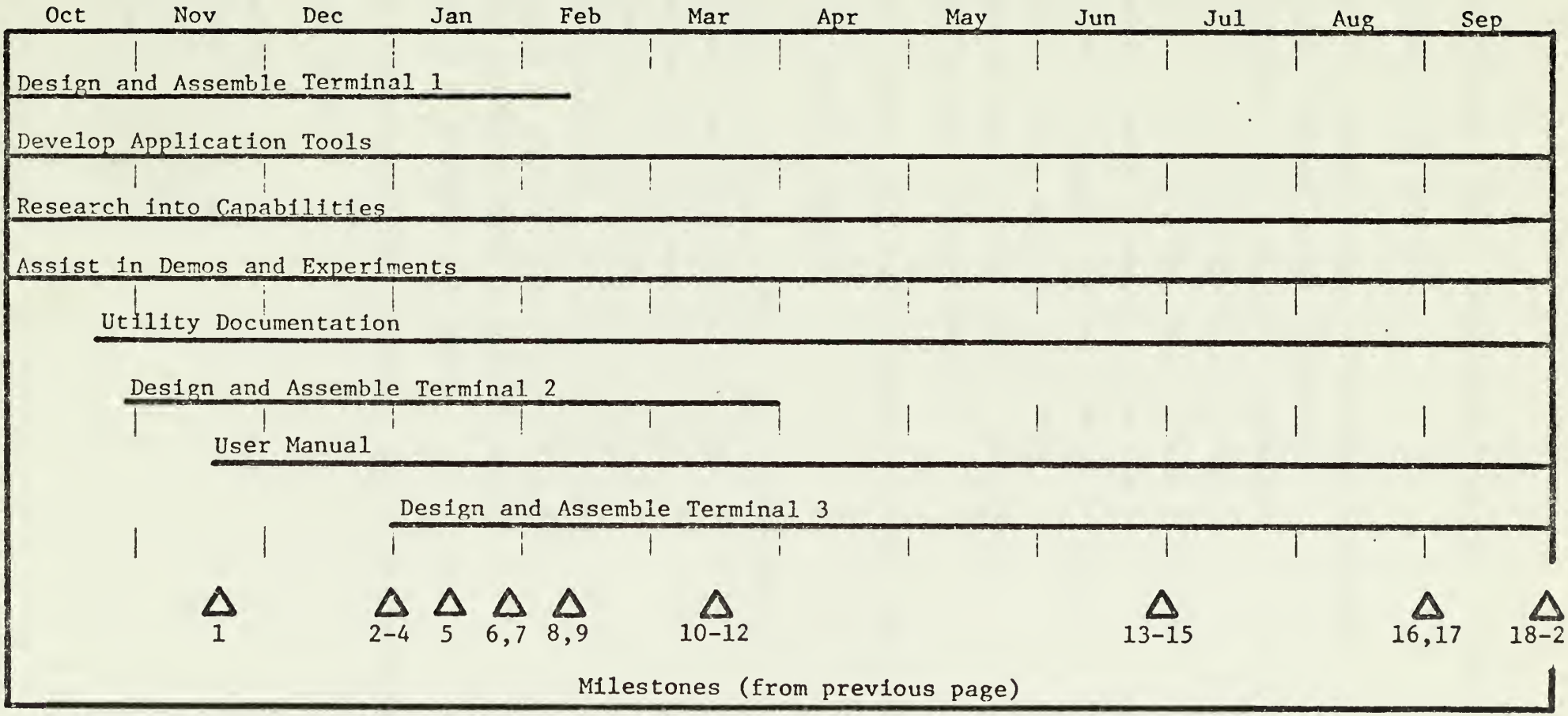

Figure 2

Intelligent Terminal Tasks and Milestones for FY 1977

STAFFING

The following staff are assigned full time to this contract for the duration of the contract.

Peter A. Alsberg, Research Associate Professor
James F. Bailey, Research Engineer
Deborah S. Brown, Research Programmer
John D. Day, Research Systems Analyst
Gary R. Grossman, Principal Research Programmer
David C. Healy, Research Systems Analyst
Steven F. Holmgren, Senior Research Programmer
Paul B. Jones, Research Programmer
John R. Mullen, Senior Research Programmer
Jaap K. Spek, Research Engineer

The following staff are assigned on a full time basis for a portion of the contract period.

Geneva G. Belford, Research Associate Professor
Steve R. Bunch, Research Programmer
Enrique Grapa, Research Associate
Richard H. Howe, Research Associate
Elizabeth Kasprzycki, Research Associate
Daniel E. Putnam, Research Systems Analyst
Paul Schwartz, Research Systems Analyst
Daniel L. Slotnick, Professor

The following graduate students are assigned to this contract on a part-time basis.

Andrew N. Fu
Robert B. Kolstad
Daniel J. Kopetzky
David A. Willcox