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NPIC DATA SYSTEM
DATA AND CONTROL SEGMENT
ACQUISITION PHASE

VOLUME V
ALTERNATE CONFIGURATION ANALYSIS

STAT

24 February 1982

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Approved For Release 2007/06/18 : CIA-RDP84T00037R000400030001-4

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INTRODUCTION

We performed a rigorous analysis of an alternate vendor solution to our proposed generic D/C Segment architecture, carefully assessing the design, development, performance, and cost implications.

This volume reflects the results of a methodical assessment of implementing our proposal architecture with UNIVAC hardware and software products. This assessment was performed using the following approach:

a. Use our proposed generic D/C Segment architecture as the departure point for identifying an alternative vendor design;

b. Select the best choice of an alternate vendor, capable of meeting the technical and schedule objectives of the NDP;

c. Configure the alternate vendor's equipment in a manner which meets D/C Segment processing objectives, holding to our generic architecture characteristics in terms of design margins and switchability;

d. Perform a comprehensive assessment of the impacts of the alternate vendor solution to our proposed design, development plan, schedule, and projected performance;

e. Identify the risks associated with the alternate vendor solution; and

f. Estimate rough-order-of-magnitude deltas to the proposed cost of our preferred solution.

To implement this approach, we identified an independent project team. Their goal was to identify and analyze the best possible vendor alternative, with emphasis on satisfying D/C Segment functional, performance, and schedule objectives, while providing the most cost-effective solution. The following sections reflect the results of their analysis, including supporting justification and rationale.

HARDWARE CONFIGURATION

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Section 1

HARDWARE CONFIGURATION

The alternate configuration definition began with an analysis of our generic D/C Segment architecture characteristics.

The generic architecture which was selected for the D/C Segment reflects the results of extensive tradeoff analyses to determine the best solution to meet NDS processing requirements. The preferred solution is a distributed processing architecture, in which intelligent work stations off-load processing and data from the host processor, providing the user with improved system responsiveness. This architectural solution was considered fundamental to satisfying D/C Segment performance requirements and thus, became the starting point for selecting our preferred vendor design. Similarly, this same starting point is reflected here in the definition of an alternate vendor solution.

GENERIC D/C SEGMENT ARCHITECTURE -- As illustrated in Figure 1.0-1A, the host portion of the D/C Segment Architecture involves three host systems. Master Database (General) and the P&A functions are assigned to one host system. Exploitation and the C^2 functions are resident in the second host system. The third host system supports the Training, Test and Development activities as well as serving as a redundant system for the other two hosts. All DASD is switchable to any of the three host systems - ideally by an intelligent switch which allows for prestored switching patterns. There are at least three front-end-processors (FEP's) which have multi-host support and have access to any host system. The FEP interfaces to the Local Area Network (LAN).

ARCHITECTURAL HIGHLIGHTS -- Besides no single point of failure within the D/C Segment Configuration, there are three major architectural highlights. All functional database DASD is totally switchable via pre-stored switching configurations. Any functional host system may assume control over any portion or the entire functional database DASD. All host systems are supported by multiple front-end processors (FEP's). Each FEP supports all host systems. Figure 1.0-1B spotlights these capabilities.

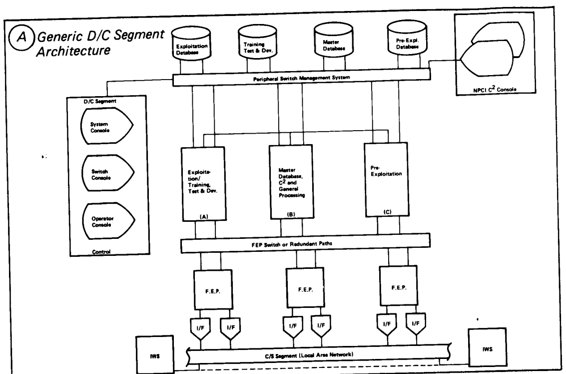
ARCHITECTURE CHARACTERISTICS -- Figure 1.0-1C lists the architectural characteristics which must be met in order to satisfy the NDS driving requirements. Careful analysis of these characteristics fall into three major categories: function identification, processing requirements, and availability requirements. These characteristics were used as the basis selecting the most suitable alternate configuration.

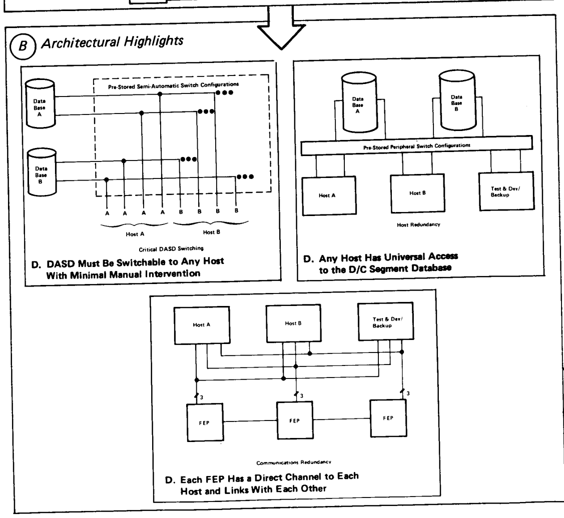
CONFIGURATION ITEM DEFINITIONS -- Our analysis focused on the Configuration Items as defined in our Design Specification. Some CI characteristics (Figure 1.0-1D) were relaxed somewhat so as not to be too restrictive. This allowed more vendors to be considered. Our analysis assumed our fundamental architecture was to be preserved. The alternate configuration analysis was limited to the central ADP facility elements of our design. Alternatives for The Integrated Work Station (IWS) design were considered in Vol. II, Sect. 5.8 of this proposal.

1.1 Vendor Selection

We selected UNIVAC for the alternate vendor solution, both because it is a vendor-compatible extension of today's system, and because the UNIVAC product line can be configured to satisfy our generic architecture.

While several vendors offer hardware and software products which could satisfy D/C Segment needs, we selected UNIVAC as the best vendor for our alternate solution. The primary rationale





(C) *Architectural Characteristics*

- Single or multiprocessors in the 8-14 MIP range (single processors should be redundant)
- Accessibility by any host processor to any functional database or segment.
- Redundant paths and units for all critical peripheral subsystems
- Redundant mainframe components (i.e., cache, backing storage and I/O)
- Command and Control which can be superimposed on a designated host processing system.
- Self diagnosis of hardware faults down to the field replaceable unit (FRU) is critical to reducing the average total mean-time-to-repair (MTTR). This must be considered as a necessary contributor to overall availability.
- Cache disk to optimize heavy I/O activity.
- The exploitation function will require 4 MIPS and four billion bytes of DASD
- A computational capability of 4.6 MIPS and one-half billion bytes of DASD is needed for pre-exploitation processing.
- A computational capability of one MIPS and approximately four billion bytes of DASD is needed for Training, Test and Development.

(D) *Configuration Item Definitions*

CI	Definition
Processor and Console Displays	Three host-processor systems with separate I/O processors, 16 MB memory, 2 consoles per system with CRT and hard copy for each console. Consoles must be able to assume each other's function.
Front-end processor (FEP)	Three to five processors with from one-half to 2 million bytes of real memory. Must support a bit synchronous network protocol, support multi-host connections and function as FEP, node and concentration simultaneously, if needed. 50K bytes per second throughput — aggregate.
Operating System DASD	No separate DASD required if suitable ap-approach is available.
General Support and Pre-exploitation Data Base	All DASD subsystems must have fully dual controllers equipped with at least two banks of cache memory-no-less than four Mbytes of each Disk units must be at least 600 megabytes with dual access capability. Transfer rate must be 1.5 megabytes or greater with a cache hit access time of no greater than four milli-seconds. Disk average access time should be no greater than 40 milliseconds.
Exploitation Data Base	Same performance characteristics as the General Support and Pre-exploitation data base. All database DASD must be fully accessible from each host.
Archive Subsystem	No separate subsystems shall be configured. Additional capability will be added to each host system. Units shall be 9 track, 6250 GCR with 200 inches per second tape speed.
Display Subsystem	Standard CRT clustered no more than 6 to controller.
High Speed Printer	At least one printer per host with printing speed of 1000 lines per minute or greater at 96 characters print font. Must be horizontal print mechanism — no drum printers. Print fonts should be interchangeable with the printer capable of informing the host as to which print font is loaded.
Interprocessor Communication Facility	May be a channel-to-channel, high speed serial (up to 50 megabits per second) or multiple links between hosts.
Integrated Work Station	Considered in Vol. II, Para. 5.8 (INS Design)
Remote Job Printing	Considered in Vol. II, Para. 5.8 (IWS Design)

Figure 1.0-1. Generic Architecture Requirements

for this selection was twofold: 1) the extensive UNIVAC product line, and its ability to provide the central processor and peripheral hardware to support our basic architectural assumptions; and 2) the reduction in software and data base conversion effort which results from a UNIVAC selection. There were two considerations in the selection of UNIVAC:

a. The UNIVAC host processor product line does not include a processor which meets the execution rate requirement (10 MIPS) which is necessary to satisfy our generic architecture's physical partitioning of operational function into two host processors (plus one additional processor for maintenance, training, and backup). We were forced to expand our generic architecture to three host operational processors. Within each host processor, an additional CPU is configured for availability. Additionally, we were concerned with the life-cycle implications of not having a field-upgradable additional processing capability for the UNIVAC candidate processors.

b. The UNIVAC multi-processor architecture at the high end of the processor line, partitions the host into multiple 2 MIP processors, causing concern in partitioning the pre-exploitation (P&A) batch processing function into four parallel processes to meet the time requirement. The two factors to be considered were: 1) the additional software complexity to support this additional partitioning; and 2) the additional execution overhead and inherent delays in the additional portioning of the P&A function.

Both of these considerations were carefully examined, and we concluded that they result in less potential vertical host processor growth and increased P&A turnaround time than our preferred solution. We decided, however, that the UNIVAC products will meet the FOC requirements and do provide savings over other alternative vendors in terms of software conversion.

1.2 Alternate Configuration

After careful assessment of the UNIVAC product line, we have selected an 1100/84-based hardware configuration to meet D/C Segment processing objectives.

In deriving the UNIVAC hardware configuration, we examined the characteristics of each D/C Segment Configuration Item. Our objective was to identify the individual Univac hardware units which would satisfy these characteristics in the most cost-effective, state-of-the-art manner.

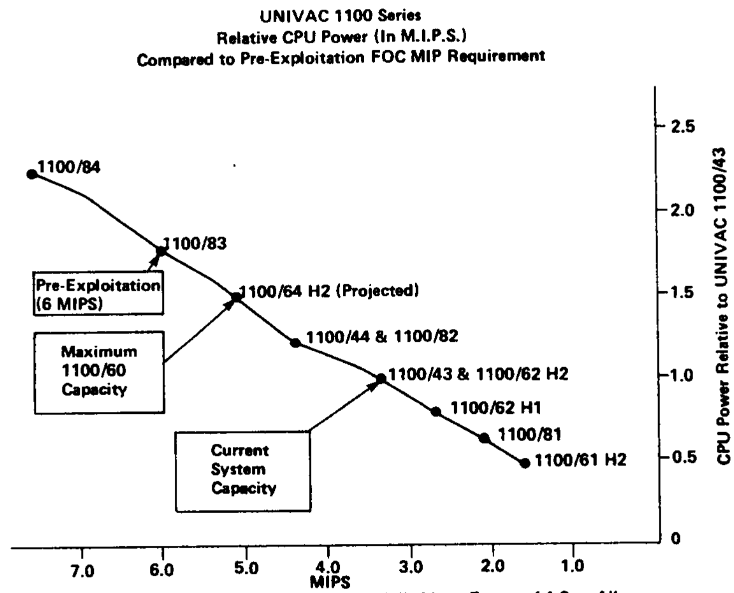
The hardware unit derivation for each CI is defined and justified in the following paragraphs.

PROCESSOR AND CONSOLE DISPLAY -- The first step in this CI definition process was to select the host processor which best satisfies the D/C Segment architecture objectives. Two candidate UNIVAC 1100 series processors were considered: 1) UNIVAC 1100/60; and 2) UNIVAC 1100/80.

Figure 1.2-1 shows the relative processing power in the various 1100 models and their corresponding MIP rates. The relative value of 1.0 is the current 1100/43 production system. The top end of the 1100 series cannot support the generic D/C Segment architecture, which reflects P&A and General Support functions in a single processor, requiring 10 MIPS of compute power. The alternative, then, is to partition the generic architecture function into additional hosts, so that the UNIVAC processor can be employed.

The first choice was to attempt to define an 1100/60-based configuration. The 1100/60 Series incorporates the latest technology, especially in the areas of availability and maintainability. The 1100/60 Extended Instruction Set is particularly well suited for this environment but is not object code compatible with the 1100/80 Series. Object code incompatibility would require only a minor conversion effort.

(A) The 1100/80 Is the Only 1100 Capable of Processing Pre-Exploitation With Margins.



*Projection Based On 1100/62 H2 Values Multiplied by a Factor of 1.8 to Allow for Memory Conflicts.

Reference: "Tracking the Elusive KOPS", Edward J. Lion; DATAMATION, November, 1980. pp 99-105.

(B) Performance and Compatability Dictated 1100/80 Selection.

Consideration	1100/60	1100/80
1. MIPS Per CPU	Line 1 — 1.2 Per CPU	2 — 2.2 CPU
2. Maximum Number of CPU's	Four	Four
3. Maximum MIPS	4-4.5 Per System	7.6-8.0 Per System
4. Redundant Instruction Execution	Yes	No
5. Fault Injection	Yes	No
6. Built In Hardware Monitor	Yes	No
7. Direct Fetch From Backing If Total Cache Failure Occurs Without Causing an O.S. Reboot	Yes	No
8. Self Diagnosis Down to the Field Replaceable Unit (FRU) Level	Yes	No
9. Extended Instruction Set for Character and Bit Manipulation	Yes	No

Figure 1.2-1. Univac 1100 Series Processor Characteristics

The total FOC pre-exploitation (P&A) requirement of 4.6 MIPS stresses the capabilities of a UNIVAC 1100/64. If the 1100/60 Series were selected, an 1100/64 system would be required to process the P&A workload alone. This would dictate an additional 1100/64 solely as back-up to the P&A system. Any additional growth in the P&A function would require distributing the function into multiple hosts. This would be a serious design impact. For this reason, the 1100/60-based configuration was rejected.

Next, an 1100/80-based configuration was examined. The 1100/84 CPU can support the P&A processing requirement, while retaining the required design margins. With an 1100/80-based configuration, three 1100/84 processors are required.

Finally, we considered a hybrid 1100/80 and 1100/60 solution. This approach was discarded because of the incompatibility of object code between the 1100/60 and 1100/80 would require the maintenance of two distinct software libraries. (The alternative to this would be to not make use of the expanded instruction set of the 1100/60, one of the primary reasons for having selected it).

After careful examination of these three alternatives, we selected the 1100/80-based configuration as the best alternative choice for the D/C Segment host processors. Figure 1.2-2 summarizes this choice in terms of functional allocation and projected loadings.

Function	Processor	Rationale
Exploitation/ Training, Test and Development	1100/84 (8 MIPS)	o Exploitation Requires 4 MIPS (2 CPUs) o Training, Test and Development Requires 1 MIP (1 CPU) o Availability Requires 2 MIPS (1 CPU)
General Processing/C^2	1100/84 (8 MIPS)	o General Processing Requires 4.6 MIPS (3 CPUs) o C^2 Negligible o Availability Requires 2 MIPS (1 CPU)
Pre-Exploitation	1100/84 (8 MIPS)	o Pre-Exploitation Requires 4.6 MIPS (3 CPUs) o Availability Requires 2 MIPS (1 CPU)

Figure 1.2-2. Univac Host Allocation Summary

The 1100/84 Processors have been configured for both performance and availability. Each configuration has:

a. 4 CPU's (3-workload, 1-availability)
b. 4 IOU's (3-workload, 1-availability)
c. 32K Storage Interface Unit (SIU) - Full 128K bytes cache for performance and redundancy.
d. 4 million words of Main Storage (MSU) - 32 megabytes.

The final configurations for the three 1100/84 processors are reflected in Figure 1.2-3. The detailed configuration layouts are reflected in Figure 1.2-3 and 1.2-4.

FRONT-END PROCESSOR -- Five DCP/40 Communication Processors have been configured as front-end processors. All front-end-processors (FEP's) have a full duplex, 36-bit channel connection to each host. Each FEP has a node link to each other and two high speed loadable line modules to support two Local Area Network (LAN) interface units. Each FEP is configured with 1.5

Detailed Alternate Configuration Schematic

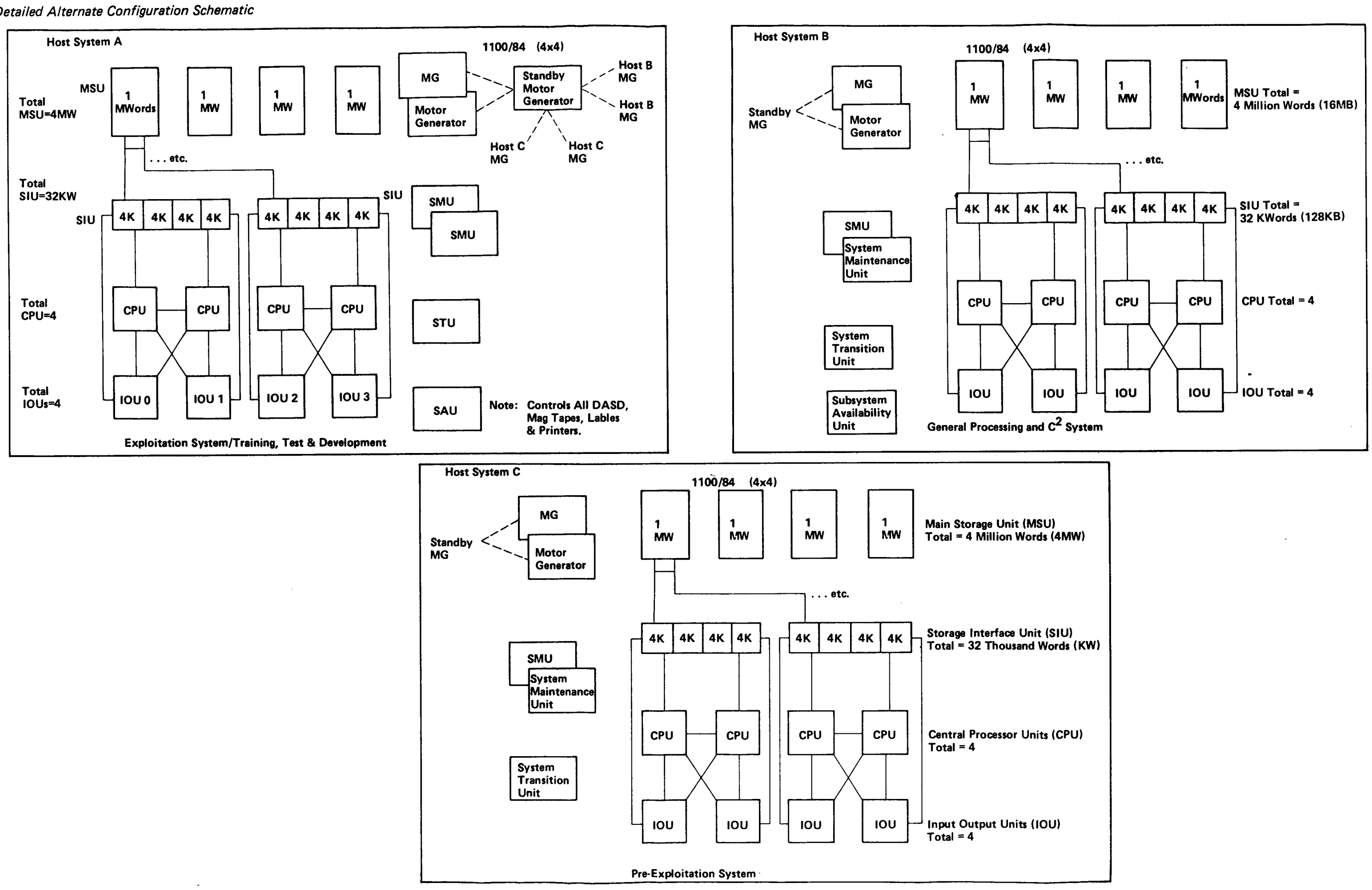
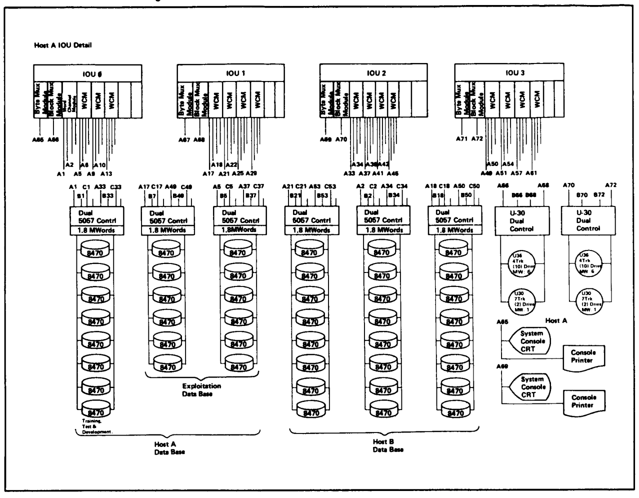
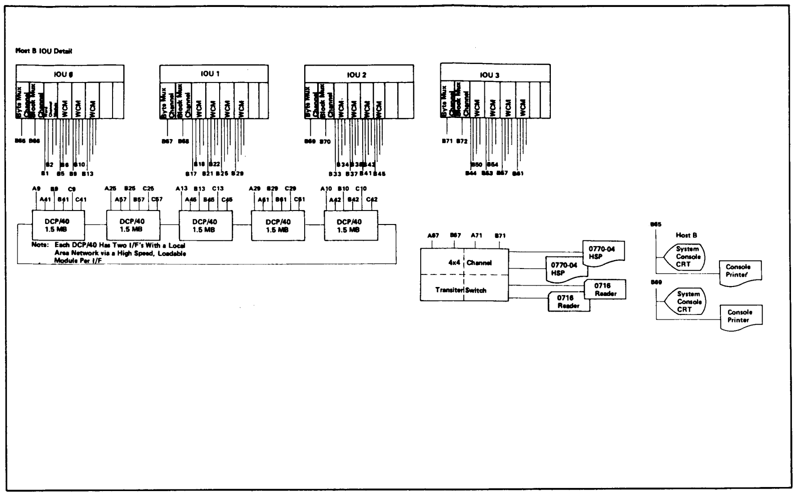


Figure 1.2-3. Univac Processor Configurations

Detailed Alternate Configuration Schematic





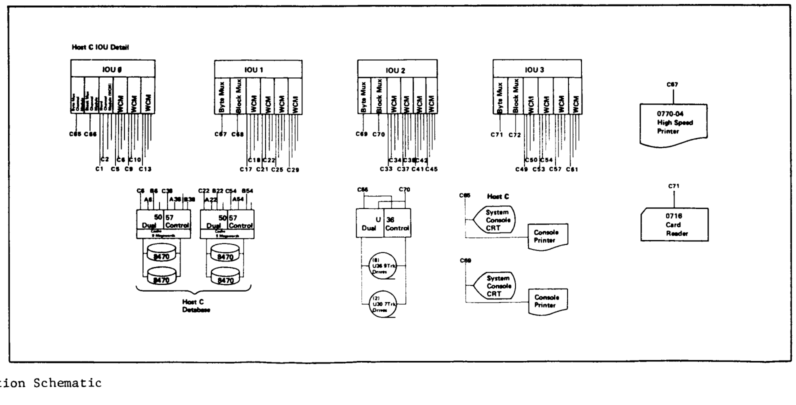


Figure 1.2-4. Detailed Alternate Configuration Schematic

million bytes of memory and will operate in primary mode under the TELCON Operating System. Four DCP/40's are required to handle the projected FOC communications traffic. The fifth processor provides the availability requirement.

SWITCH MANAGEMENT SYSTEM -- Switch management is a function of unsolicited operator keyins to the 1100 operating System and the manual activation of hardware transfer switches. Unit record equipment is switched via the byte channel transfer switch. DASD and other peripherals are redundantly configured from each system to each peripheral controller. Host system peripheral separation is maintained via console keyins. The Subsystem Availability Unit (SAU), along with optional transfer switches, may be used to hardware partition peripheral subsystems.

OPERATING SYSTEM DASD -- Operating system DASD requires no specialized devices or subsystems. However, we would recommend that the 1100 Executive and its non-resident segments be allocated to a solid state device in a 5057 cache disk memory. This would significantly improve operating system performance especially as system loading increases.

GENERAL SUPPORT AND PRE-EXPLOITATION DATA BASE -- The General Support DASD is shown in Figure 1.2-4 as the Host B database. The pre-exploitation DASD is illustrated at the bottom in Figure 1.2-4. Both database configurations use the 5057 Cache Disk subsystems. Each subsystem is configured with dual controllers and two banks of cache memory, totalling 1.8 million words or 8 megabytes. The disk units are 8470's with a storage capacity of over six hundred forty-five million bytes. The general database required 10 billion bytes (18 units), and is configured for 14 billion bytes (24 units) for availability. Pre-exploitation requires two units. Four have been configured.

EXPLOITATION DATABASE -- The exploitation database is shown in Figure 1.2-4. It consists of two dual controller subsystems with two banks of cache memory. As with the General Support and Pre-exploitation databases, all controllers have independent channels to each host system. The database requirement is for four billion bytes (eight units). Twelve units are configured to support availability. All DASD are configured with the dual access feature.

ARCHIVE SUBSYSTEM (MAGNETIC TAPE) -- Hosts A and B have full dual connections to the magnetic tape units as shown in Figure 1.2-4. Controllers and units can be migrated to either system as required. Controllers connect to the host systems via block multiplexor channels. Archiving will be done on the UNISERVO 36 drives. These are nine track units, dual density, supporting 1600 phase encoding or 6250 group coded recording. Twenty drives have been configured for Hosts A & B. Host C (Figure 1.2-4) will have eight drives of this type.

DISPLAY SUBSYSTEM -- The UNIVAC UTS-20 terminal was selected for the alternate configuration. Twenty-eight units were configured on five UTS-4020 controllers.

HIGH SPEED PRINTER -- Three high speed printers have been configured. Two are switchable between Hosts A and B. The third is dedicated to Host C. Printer back-up for Host C is via rollout to magnetic tape and printing on either Host A or B.

INTER-PROCESSOR COMMUNICATION FACILITY -- Each of the five DCP/40's is connected to each of the host systems via full duplex word channels. Host-to-host transfers will occur via the DCP/40's without entering the communications network.

IMPACTS

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Section 2
IMPACTS

The impacts to our preferred development approach lie primarily in two areas: 1) the additional design and development effort associated with the Communications Segment interface; and 2) the additional potential risk imposed by the unavailability of vertical growth in the host processors.

This section discusses five areas of impact to the preferred development approach:

a. Design -- A major consideration is the potential impact of upgrading the UNIVAC TELCON communication software to support the X.25 protocol. Also, the requirement to multi-task the pre-exploitation software into four threads, adds additional design complexity.

b. Development -- Several development impacts, both positive and negative surfaced. Positive impacts occur as a result of less software conversion. The additional development associated with the extensions to the TELCON software and a lower productivity factor associated with UNIVAC software development are the most significant negative impacts.

c. Schedule -- In order to ensure against schedule impact, more personnel resources will be required to meet SAP major milestones.

d. Performance -- Analysis reveals that the alternate configuration will support all performance requirements. The analysis has shown, however, that degradations in performance can be expected over the preferred solution.

e. Risk -- Several risk areas are addressed. The most serious risk, however, is the direct result of the lack of vertical growth potential for the alternate configuration.

The following paragraphs discuss and provide justification for each of these impact assessments.

2.1 Design Impacts

Two areas of increased design complexity have been identified -- the software to support the Communications Segment interface and the partitioning of the P&A software to support a multi-thread design.

Each area of D/C Segment design was analyzed to assess the impact of the UNIVAC hardware configuration. The following discussions address each area, with emphasis on those areas which have the more significant impacts.

<u>HARDWARE DESIGN</u> -- As discussed in Section 1.2, the UNIVAC hardware products can be configured to support D/C Segment FOC processing requirements. The only significant variance from the preferred alternative hardware design is the requirement to provide an additional host processor in support of on-line operations (P&A and General Support must be split across two Hosts).

<u>COMMUNICATIONS DESIGN</u> -- The communications interface design for the alternate solution consists of five DCP/40's interconnected with each other. Each DCP/40 interfaces with the Local Area Network (LAN) via two 16 bit parallel high speed loadable modules and the associated channels.

<u>SOFTWARE DESIGN</u> -- Two major areas of software design impact have been identified:

a. The preferred solution dual-thread Pre-exploitation (P&A) software design will not meet the 25 minute execution time requirement;

b. The X.25 communications protocol is not supported by UNIVAC program products.

In order to perform the P&A function on the UNIVAC host and meet the turnaround time requirements, the preferred solution P&A software design must be modified. To meet the performance requirement, the software must be partitioned into four threads, to be executed in parallel on the four CPU's within each host processor. This change introduces an additional level of application software complexity into the P&A control design.

The X.25 communication protocol was chosen in our preferred solution as the best level 1-3 protocol for the NDS. In assessing the UNIVAC alternative, we found that UNIVAC does not support this protocol with its commercial software products. We still determined, however, that modification of the existing UNIVAC TELCON commercial communications software package to support X.25 was the most expeditious way of achieving the necessary communications interface. Our preferred approach to this, would be for UNIVAC to commit to support X.25 with their commercial TELCON package. The alternative to this would be for us to develop the required extensions to TELCON. Figure 2.1-1 summarizes the software design impacts for both the communications interface and P&A functions.

DATA BASE DESIGN -- Two Data Base Management Systems (DBMS) were identified which are supported by the UNIVAC configuration -- System 2000 and DMS 1100. Both can satisfy D/C Segment requirements. DMS 1100 was selected because of some reduction in the conversion effort, since it is the current DBMS. We did, however, have two concerns in this area:

a. The network structure of DMS 1100 imposes additional complexity on the NDS application software;

b. The use of the DMS 1100 Query Language (QLP) requires the user to have some knowledge of the data base structure.

Although these limitations do exist, we felt that the requirements for the D/C Segment were met in the most cost-effective manner with DMS 1100.

OPERATIONS/USER/IWS/INTERFACES/SECURITY DESIGN -- The remaining D/C Segment design areas remain virtually unchanged with the alternate vendor solution. The only change would be in the Operations design. The basic design remains unchanged, but the details of the computer operations, maintenance, and training would be altered to reflect the UNIVAC hardware man-machine interface and hardware maintenance implications.

2.2 Development Impacts

We rigorously estimated the software sizing and software development tool implications of the alternate vendor solution. Our conclusion is that the amount of software to be developed is approximately the same, but that degradations in software development productivity can be expected.

The development impacts associated with the alternate vendor solution can be localized to three areas:

a. Software Sizing Impact

b. Software Development Effort

c. Development and Test Laboratory Impact

The other D/C Segment development areas (e.g., Program Management, Systems Engineering) remain virtually unchanged with the alternate solution.

X.25 Compliance Is By Far the Most Significant Design Impact.

Design Impact Analysis

Impact/Task	Rationale	Complexity	Risk	Effort	Resultant Benefit	Negative Aspect
TELCON X.25 Compliance	Universal Heterogenous Host System Interface	High Level	• Vendor Supported: Low • Unsupported: High • May Not Be Universally Accepted	Extremely Labor Intensive	Non Vendor Specific Communications	• Expensive to Implement • Could Duplicate to Void a Current Vendor Product.
1.1 Analyze Current TELCON Designs	Understand Current Design Before Modification Can Be Considered.	High Level	Low	Labor Intensive	• Thorough Understanding of Current TELCON Design. • Knowledge of Most Effective Method to Integrate Design Changes.	• Front End Loads Project With Personnel, Costs. • Impact of Future Design Changes Unknown.
1.2 Develop New-Design Requirements	Integrate New Design Requirements With Existing Ones	High Level	High—Could Require Changes to Existing Design.	Labor Intensive	• Basic Guide for New Design Developments • Helps Avoid "Afterthoughts".	• Critical Timing Windows Are Often Not Visible At This Stage.
1.3 Design Extensions to Current X.25 Base	Bring Into X.25 Compliance	High Level	High—Difficult to Anticipate All Problem Areas.	Labor Intensive	• Provides X.25 Compliance Extensions While Retaining Basic Capabilities.	• Could Create Negative Effects On Other O.S. Software.
1.4 Test Design Extensions	Assure Compliance	Medium	• Nothing Tests As Effectively As the "LIVE" Environment. • Serious Design Problems Could Surface	Moderate	• Gives Some Measure of Confidence Prior to Transition to Production.	• Might Have to Return to the Design Stage and Start Over.
1.5 Maintenance	• Fix "Bugs". • Implement Extensions In New TELCON Releases.	High Level	• TELCON Internal Design May Be Changed. • TELCON and Extensions Become Incompatible.	Labor Intensive	• Identify and Correct "Bugs" in Design Extensions. • If TELCON Moves Towards Full X.25 Compliance, Extensions May Be Dropped.	• Not A "Pure" Vendor Product. • Migrations to New Levels Take Longer.
2.0 Pre-Exploitation Software						
2.1 Develop Activity Breakdown and Assignment Methodology	• Break Up Task Into Four Even Activities In Order to Fully Utilize Each CPU	Medium to High	• Load May Not Be Even. • Could Create Critical Timing Windows.	Labor Intensive Through Acceptance	• Will Use All CPU's • Processing Could Be As Low As 12 Minutes.	• If Format or Size of Input Data Changes, A Redesign May Be Required.
2.2 Must Keep Track of All Activities Spawned and Completed	• Must Assure That All Areas Have Been Analyzed.	Low to Medium	• Could Loose An Activity. • A Portion May Not Be Analyzed.	• Moderate Labor to Develop. • Thorough Testing Required.	• Will Assure Complete Processing of All Tasks.	• May Not Perform In A Balanced Mode. • Could Encounter A "Deadly Embrace", Especially As Regards the Database.
2.3 Activity Error-Status Analysis and Handling	• Dynamically Determine Problem and Recover. • Complete Task If At All Possible.	Medium to High	• Could Be Unrecoverable. • Portion of Data Unprocessed. • Might Hang the System.	• Moderate to Develop. • Intensive Checkout.	• Recover from Error Automatically and Process Task to Completion. • Minimum Or No Manual Intervention Required.	• Program Must Be Updated Each Time Status Codes Are Changed or Added.

Figure 2.1-1. Software Design Impacts

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Changes in the software development area are driven by changes in the amount of new/modified software, the amount of converted software, and the productivity implications of the development tools which are available.

SOFTWARE SIZING IMPACT -- The impacts to CPCI sizing and to the amount of software conversion required are summarized in Figure 2.2-1. These impacts are presented in terms of deltas to the preferred solution sizing estimates. The net of the defined changes is that little change occurs in the total amount of software to be developed, while the bulk of the change occurs in the magnitude of the software conversion effort.

SOFTWARE EFFORT IMPACT -- The resulting sizing estimates must now be applied against: 1) the software development productivity rates which can be assumed for the alternate vendor effort, and 2) the additional effort required to perform the increased software conversion.

In determining the software development productivity rates to apply to the alternate solution, two factors must be considered:

a. Our experience in developing software without the benefit of our state-of-the-art development tools has shown that a decrease in software development productivity of approximately 10% can be expected. This position is borne out by studies of past [redacted] projects which included UNIVAC hosts. The inexperience of our programmers with UNIVAC hardware, operating systems, and program products will result in a decrease in productivity until familiarity with these items is gained. Our experience has shown that this reduction can initially be extremely high. Over the D/C Segment software development period (detail design, code, unit test) of approximately 24 months, an average decrease of 5% in productivity was assumed. While the 5% and 10% factors assumed above were derived from available experience data, it is acknowledged that the actual productivity factor is a sensitive variable that could range from a low of 5% to a high of 25%. This sensitivity should be borne in mind in subsequent cost and schedule impact assessments. In these assessments we have used the mid or 15% factor. Thus, while the amount of new and modified software to be developed has not significantly changed, the resulting software development effort required will increase by 456 man months because of the projected productivity degradation. STAT

b. The software conversion which is required in our preferred solution results in a development savings of 67 man months.

In summary, the total additional software development labor associated with the alternate vendor solution is approximately 389 man-months.

DEVELOPMENT AND TEST FACILITY IMPACT -- The alternate vendor solution would modify the computer installation schedule which was planned for the preferred approach. The factory requirement is defined as one 1100/84. This approach is the most cost-effective, and can be considered because of the partitioning capability of CPUs within the 1100/84. This approach does, however, limit the ability to do as much performance testing in the factory as with the preferred solution. In addition to the 1100/84, an [redacted] 4341 processor would be required for development documentation support. STAT

2.3 Schedule Impact

Although higher staffing levels are required to meet NDP milestone objectives, the alternate solution can be developed within current major milestone objectives.

The additional man-months of software development effort required for the alternate approach can be accommodated within major milestone objectives through increased staffing. Staffing

Development Changes	SLOC Delta	Complexity	BOC/IOC	Rationale
Host System Applic. Support CPCI				
– X.25 Comm. Upgrade	+10K	High	BOC	Interface to TELCON Software to Support X.25 Level 1-3 Protocol.
– C/S Interface for MSGs/ Cables	+3K	Med	BOC	
– IBM/UNIVAC Host Link	-10K	Med	BOC	This Software to Communicate Between Different Vendor Hosts for BOC is Not Required with the Alternate Approach.
Pre-Exploitation CPCI				
– P&A Scheduler	+12K	High	BOC	P&A Performance Requirement Exceeds UNIVAC Capability Unless a Four-Thread Design is Implemented. Additional Scheduler Complexity to Manage Four Parallel CPU Tasks.
Training, Test and Dev. CPCI				
– Tailoring of Tools	+6K	Med	BOC	Test Driver and CM Packages Tailoring. Needed to Adapt to UNIVAC. No Attempt Made to Convert Tools Except Where a Necessity, Productivity Loss Because of Unavailable Tools, but Considered Less than Conversion Cost/Additional Tailoring Development Risk.
DBM Applic. Support CPCI				
– Data Dictionary Enhance.	+5K	Low	BOC	Data Dictionary Upgrade to Decrease Manual Intervention
– Revival of Archive Data	+15K	Low	BOC	Revival is a Requirement Not Supported by DMS 1100
DBMS Conversion Software	-27K	Low	IOC	Special Software to Convert Data Base from UNIVAC to IBM Not Required with Alternate Vendor Solution.
Total	+14K			

Conversion Changes	SLOC Delta	BOC/IOC	Rationale
Auto. Tools Conversion	+80K	BOC	Test Driver and CM Packages must be Converted to Support Alternate Vendor Hardware.
Auto. Pre-Exploitation Conversion	-23K	BOC	This Conversion Effort was Required with Preferred Solution for BOC – Not Required if UNIVAC
Remaining Auto. Conversion	-225K	IOC	This Conversion Effort was Required with Preferred Solution for IOC – Not Required if UNIVAC
Total	-168K		

Figure 2.2-1. Software Development Impact Summary

requirements must be carefully planned for the SAP, in light of clearance lead time requirements. We feel that our personnel situation could accommodate the alternate approach. Thus, the D/C segment development Master Schedule (reflected in Volume III, Section 5, paragraph 5.1 of this proposal) remains unchanged.

The development and Test Laboratory schedule impact of the alternate vendor solution is reflected in Figure 2.3-1.

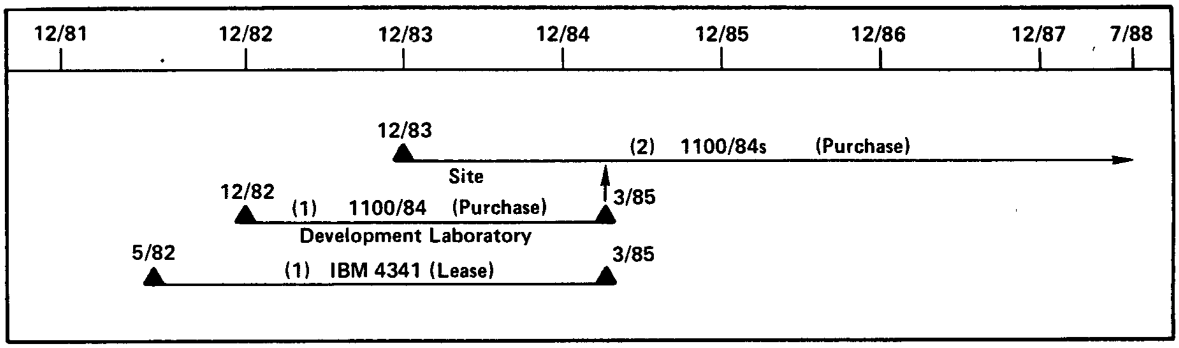


Figure 2.3-1. Alternate Equipment Installation Schedule

2.4 Performance Impacts

We have modeled the performance of the alternate UNIVAC configuration and have found that it can meet the D/C Segment performance requirements.

We modeled the UNIVAC configuration at the same detail level as the preferred solution. Analysis of the performance results indicates that the configuration provides satisfactory performance.

METHODOLOGY -- Figure 2.4-1A shows the methodology used to study configuration performance. A detailed queueing model of the alternate configuration was built. The performance was then evaluated under the FOC driving workload using RESQ2. RESQ2 is a discrete event simulation tool which is used for computer system performance evaluation. Since the level of detail was the same as for the preferred solution, a direct comparison of performance can be made.

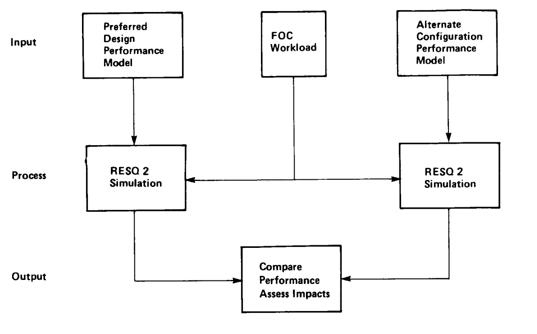
MODEL DEFINITION -- The detailed performance model was developed to evaluate the stated UNIVAC design. The derivation of that model is presented in detail in Volume II, Appendix A4 (Technical Proposal, Segment Design and Analysis Report) of this proposal. The key parameters of the model are provided in Figure 2.4-1B.

Since the hardware configuration for the alternative is different from the preferred configuration, the hardware topology and performance parameters in the model have been changed to accurately portray the alternate case. The definitions of software modules, lengths, memory requirements, and I/O activity are identical in both configurations. The one exception is the data base management system (DBMS) employed. In the preferred configuration, the DBMS is MODEL 204, whereas in the alternate configuration the DBMS is DMS 1100. Analysis of the performance of MODEL 204 has indicated that it can provide database services in the D/C Segment environment with fewer I/O accesses than DMS 1100. This is primarily due to differences in internal organization and capability. Accordingly, the preferred configuration is estimated to require only 80% of the I/O accesses required by the alternate configuration for those functions which reference the database.

On the other hand, the UNIVAC configuration offloads some of the operating system I/O services from the central processor to the I/O processing unit. This offload is estimated to be 15% of the overall pathlength, thus providing additional processing reserve in the central processor. Also, Predict and Assign is run as a multiple thread process using four processors in the UNIVAC configuration.

Ⓐ METHODOLOGY

Comparative Performance of Preferred and Alternate Configurations Modeled and Evaluated.



Ⓑ MODEL

The Performance Models of the Two Configurations Contain Numerous Hardware, Software and Data Base Parameters.

Work Station

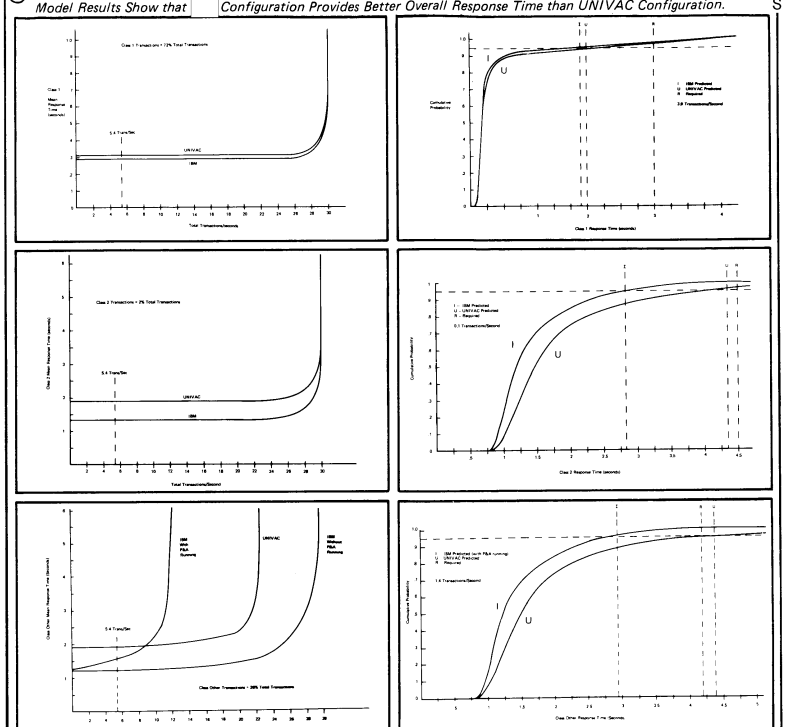
Screen Fill Rate	56K Bits/Sec
CPU Speed	0.25 MIPS
Mean Disk Seek Time	41.7 msec
Disk Latency Time	8.3 msec
Disk Transfer Rate	573K bytes/sec
Transaction Path Length	25K instructions

Central Processors

	IBM CONFIGURATION		UNIVAC CONFIGURATION
	3033	3081	1100/84
CPU Speed	4.8 MIPS	2 x 4.6 MIPS	4 x 1.9 MIPS
DASD Seek & Latency Times	17.9 msec	17.9 msec	21.8 msec
DASD Data Transfer Rate	3M bytes/sec	3M bytes/sec	280K words/sec
Transaction Path Lengths			
Class 2, Other	1170K instructions	1170K instructions	1240K instructions
Class 1 Download	1170K instructions		1240K instructions
DASD Accesses			
Class 2, Other	24.4	24.4	30.6
Class 1 Download	35.2		44
PeA, MTF Update (13% TD, 87% NTD)			
Pathlength		3.28×10^9 instructions	3.28×10^9 instructions
DASD Accesses		51300	51300
Batch Queries			
Path Length		20M instructions	20M instructions
DASD Accesses		151	151
FEP Speed	1.1 MIPS	1.1 MIPS	1.1 MIPS
Communications Bandwidth	56K bits/sec	56K bits/sec	56K bits/sec

Ⓒ RESULTS

Model Results Show that [redacted] Configuration Provides Better Overall Response Time than UNIVAC Configuration. STAT



	UNIVAC	IBM
P&A + MPF Update Time Time Dominant Non Time Dominant Number of Threads	 1.2 minutes 7.7 minutes 4	 1.4 minutes 9.2 minutes 2
Mean Transaction Response Times Class 1 Class 2 Class Other	 0.31 sec 1.9 sec 1.9 sec	 0.29 sec 1.35 sec 1.3 sec w/o P&A 1.6 sec w/ P&A
Single Thread P&A Time Dominant Non Time Dominant	 4.7 minutes 30.6 minutes	 2.8 minutes 18.3 minutes

Figure 2.4-1. Alternate Configuration Performance Assessment Summary

RESULTS -- The transaction classes which were considered include:

a. Class 1 - NPIC internal critical mission transactions requiring D/C Segment internal data;

b. Class 2 - NPIC internal generalized queries for D/C Segment data;

c. Class Other - NPIC internal and remote support functions/services transactions requiring D/C Segment data; NPIC external interactive queries for D/C Segment data.

Figure 2.4-1C shows transaction loading curves and response time probability curves for Class 1, 2, and Other transactions for the preferred and alternate configurations. The majority of Class 1 transactions are handled locally by the IWS. Thus, the overall response time is almost independent of the configuration choice. The configuration performs well with considerable reserve capacity, the 56K bits/second communications channel being the limiting component. Overall responsiveness is only slightly less than the preferred solution.

Class 2 transactions are significantly more responsive on the preferred configuration with 1.35 seconds mean response time versus 1.9 seconds for the alternate. Again there is ample reserve capacity, with the 56K bits/second communications again being the limiting components. The UNIVAC configuration is very close to exceeding the .95 probability time.

The Class Other transactions include classes 3, 3A, and 6. The most stringent time requirement is 4.2 seconds for Class 3A under peak load. The modeling analysis showed that the alternate configuration response is slightly above this level, using the current design assumptions (Figure 2.4-C5). Considering the model assumptions which are inherent in these results, and the design flexibility which would exist in the implementation, we feel that the .95 cummulative probability response requirement can be met.

Both time dominant and non time dominant Predict and Assign complete well within the required times of 10 and 25 minutes, respectively. P&A is run as a double thread on the preferred solution, and as a quadruple thread on the alternate configuration.

SUMMARY -- In conclusion, the alternate configuration meets all FOC performance requirements. The reserve performance margins, however, are less than for the preferred solution in all categories.

2.5 Risk

We examined and assessed the risk associated with the alternate configuration in each impact area. Our conclusion is that, although no individual area has unmanageable risk, the overall risk is greater than with the preferred solution.

In assessing the risk associated with the alternate vendor solution, we considered four major D/C Segment elements which we felt an assessment should be made:

a. Database Software

b. Applications Software

c. ADPE Configurations

d. Communications Interface

Figure 2.5-1 reflects the results of our analysis.

We identified the primary items of risk to be:

a. ADPE growth potential, and the fact that no up-gradable processor is available for vertical expansion; instead expansion would have to be horizontal (more host processors), providing significant performance impact to time dominant processes such as P&A;

b. Communications interface, and the fact that no commercially available software package satisfies X.25 protocol; the risk associated with modifying the TELCON software to support X.25 is deemed as high.

Although each of these items was identified as high risk, we feel that with proper risk management they can be contained to meet the NDP milestones. Of greater concern is the life-cycle risk potential which has been identified.

D/C Segment Element \ Risk Area	Tech/Performance	Schedule	Cost	Growth
Database Software	• DMS 110 path length 20% greater than preferred DBMS Risk Factor: Medium	• Additional staffing required for file redesign • Thorough knowledge of DMS 1100 internals before Database design starts Risk Factor: Medium	• More effort required to design DMS 1100 database • More software required to interface with DBMS (i.e. data dictionary, archiving retrieval) Risk Factor: Medium	• File intricacy and record placement may require database redesign Risk Factor: Medium
Applications Software	• Unexpected delays or deadlocks due to complexities of DMS-1100 • P&A must be designed for four thread processing-may not be evenly balanced Risk Factor: Low	• In depth knowledge of DMS 1100 as opposed to normal COBOL programming skills for preferred DBMS. • Longer lead times and more intensive up-front knowledge required Risk Factor: Low	• More effort and staffing required to implement the same capabilities Risk Factor: Low	• When hardware performance reaches maximum, functions may have to be distributed across multiple host processor systems. Heavy cost impacts will result. Risk Factor: High
ADP Configuration	• No equivalent to TPNS makes preproduction testing & checkout nebulous • Word channel module will not support full channel rates Risk Factor: Low	• Multi-banking makes program development and checkout much more complex Risk Factor: Low	• More hardware required for performance and availability Risk Factor: Med/Low	• No vertical growth possible. Growth will have to be horizontal. This will impact design. Risk Factor: High/Med
Communications Interface	• Heavy design development and cost impacts will result from the TELCON upgrade to X.25 compliance result Risk Factor: High	• Heavy front-end project research • No direct access to software development group Risk Factor: Med	• Research, design, development, checkout & documentation costs • Continuing maintenance at 10% of development costs Risk Factor: Med	• No significant growth risk has been identified Risk Factor: Low

Figure 2.5-1. Risk Analysis Summary

COST

Approved For Release 2007/06/18 : CIA-RDP84T00037R000400030001-4

3.0 Cost

We have quantified and substantiated the impacts of the alternate configuration in terms of cost deltas to our preferred solution.

We carefully reviewed each Government Work Breakdown Structure (GWBS) Level 2 cost that was estimated for the preferred solution, and assessed the impact to each cost category. With each assessment, we determined the positive or negative impact to our proposed cost, and provided the rationale to justify the estimate. The results of our assessment, for each Level 2 item. which is impacted is reflected in Figure 3.0-2. The cost difference through FOC is significant, and driven primarily by the difference in hardware purchase prices and the reduced productivity which is projected for the alternate configuration software implementation. Figure 3.0-1 reflects the cost deltas by fiscal year.

STAT

Figure 3.0-1. Alternate Configuration Fiscal Year Summary

STAT

Alternate Configuration Cost Analysis Summary

Cost Increase

Level 2 WBS Item		Comments
Program Management		• Purchase conversion services to convert 20 KSLOC's of Configuration Management tools software for use on UNIVAC system
System Engineering		• Additional system engineering effort to define/specify the P&A schedules software function/performance (23 man-months)
Software Development (BOC)		• More total new and modified code 352 (alt) vs 311 SLOC's • Lower development productivity • 213 (alt) vs 250 SLOC's/MM • Learning curve for programmers unfamiliar with UNIVAC systems
		• Purchase RPQ to upgrade UNIVAC commercial communications product (TELCON) to achieve X.25 compatability
		• Purchase training package from UNIVAC to train IBM programming staff. NOTE: This is a delta above UNIVAC training included in our primary bid.
Hardware Development—BOC, IOC, FOC		• Applies to Installation, Checkout & Test — BOC/IOC/FOC as well
ADPE Test and Verification BOC		• Higher purchase costs for alternate configuration • Purchase conversion service to convert 60 KSLOC's of test tool code (TPNS) for use on UNIVAC. NOTE: Tool does not exist for alternate
		• Integration testing of additional 41 KSLOC's new and modified code
Development and Test Facility		• Higher maintenance charges and software leases for alternate Configuration Development Lab
Operations & Maintenance BOC/IOC/FOC		• Higher commercial hardware and software maintenance costs over life of contract
Total Delta		

Cost Decrease

Software Development (BOC)		• Purchase conversion service to convert 23 KSLOC's (retained portion of Pre-Exploitation CPCI)
Software Development (IOC/FOC)		• File conversion code not required for DBMS conversion and associated application mods. (27 KSLOC's at 250 SLOC's/MM)
		• Purchase conversion service to convert 225 KSLOC's of retained code to run on Preferred System
Hardware DEU-BOC/IOC/FOC		• Applies to installation, checkout & test - BOC/IOC/FOC as well
Test and Verification BOC		• Integration testing of 23 KSLOC's of converted code (Pre-exploitation)
Test and Verification IOC/FOC		• Integration testing of 225 KSLOC's of converted code • Integration testing of an additional 27 KSLOC's of new and modified code
Total Delta		

Figure 3.0-2. ROM Cost Analysis Summary