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PRISM Systems
Glacier Executive Summary

At Exit from Phase 0

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4. Cheyenne Master Documentation Plan

5. Glacier Market and Product Requirements Document

6. Cheyenne Market and Product Requirements Document

7. Cheyenne and Glacier Sales Impact Statement

8. Glacier Alternatives and Feasibilies Statement

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10. Cheyenne and Glacier Manufacturing Impact Statement

11. Glacier Customer Services Impact and Requirements Document

12. Cheyenne Customer Services Impact and Requirements Document

13. PRISM Systems/ Cheyenne Executive Summary

Change History

Date	Issue #	Description
Oct 1987	0.1	PRISM Systems/ Glacier Preliminary Phase 0 Executive Summary
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1 Introduction

1.1 Scope of this Document

The Glacier Executive Summary presents an overview of the Glacier compute server system. The document is designed to give the reader a basic understanding of the products, primarily from a business point of view.

More detailed information on Glacier may be found in the following plans:

- Glacier Business Plan

- Glacier Master Documentation Plan

- Glacier Market and Product Requirements Document

- Glacier Alternatives and Feasibilies Statement

- Glacier Customer Services Impact and Requirements Document

- Cheyenne and Glacier Sales Impact Statement

- Cheyenne and Glacier Manufacturing Impact Statement

2 PRISM Strategy

2.1 Background

DIGITAL's VAX/VMS strategy is losing ground to the competition in several key areas:

- Minisupercomputers offer better performance and better price/performance than VAX systems

- Neither VAX nor VMS products compete effectively in the workstation market

- VMS does not provide adequate capabilities for commercial data processing

In order to counter these competitive advantages, as well as prepare for the computing needs of the next century, a new architecture has been designed — PRISM.

The PRISM architecture is a simplified machine architecture. It offers VAX datatype compatibility, vector capabilities, and an extended physical and virtual address space. 32-bit and 64-bit versions enable efficient implementation of systems in today's technologies, while maintaining the ability to meet all foreseeable application needs well beyond the year 2000.

2.2 PRISM Goals

PRISM meets the following strategic goals:

- Ensures DIGITAL's competitiveness for the next forty years

    - Handles today's 32-bit applications

    - Allows for easy application migration to 64 bits in the next decade

- Provides a new processor architecture that is significantly more cost-effective than the VAX architecture, with better performance

- Provides a new software architecture that enables DIGITAL to penetrate commercial, database, and transaction-processing markets, and to maintain existing technical markets

2.3 Short-Term Strategy

To ensure that current corporate revenues will not be impacted, PRISM will be introduced as an extension to the VAX family. The following short-term (three-to-five year) tactics allow a minimum level of interproduct competition and maximum revenue:

- Provide maximum compatibility with VAX systems

- Offer products which complement VAX products, such as **servers**

- Explore new market opportunities (for example, on-line transaction processing — OLTP)

- Build products for market niches where VAX is not competitive (for example, workstations)

2.4 Medium-Term Strategy

In the medium term (over the next ten years), a clear-cut product position for PRISM systems will emerge:

- PRISM systems will gain VMS functionality for compatibility

- PRISM systems will develop new software capabilities

- High-performance applications will migrate to PRISM

- Large address space (64-bit) applications will run only on PRISM

- High-performance workstations will be PRISM systems

- On-line transaction processing systems will be PRISM systems

- Database machines will be PRISM systems

VAX systems will evolve to meet new market needs:

- VAX systems will dominate the lower midrange (due in large part to a huge applications library)

- VAX products will be used for terminals and lower-performance workstations

- VAX systems (with PDP–11 help) will continue to support realtime

2.5 Long-Term Strategy

In the mid-to-late 1990s and beyond, PRISM and extended-PRISM systems will be the mainstream of DIGITAL's business and will serve all types of applications, from workstations and scientific/technical to commercial. PRISM software will be as specialized or general as needed for the tasks at hand, such as database applications or general timesharing.

3 Glacier Systems

Glacier is part of the PRISM short-term strategy discussed above. It is one of a pair of **server** products: Glacier, a compute server; and Cheyenne, a database server. In addition to these server products, there will also be a family of PRISM workstation products.

The Cheyenne system is summarized in a companion document, the PRISM Systems Cheyenne Executive Summary, and supported by a full set of individual plans. It will not be described further in this overview.

A separate set of plans also exists which describes the PRISM workstation products.

3.1   Glacier Compute Server

A server is a system that provides some service function, typically in a network. Servers are usually invisible to the users, providing hardware and software that is dedicated to specific tasks. An example is a file server, which services all file access requests for a group of workstations.

Compute servers provide high-performance computing for networked workstations or VAX systems. To a user at the workstation or VAX system, this computing capability seems to be part of the system he or she is using. Commands which take advantage of the higher-performance compute server are automatically dispatched and executed on the compute server and the results are returned to the user on the client system.

In many ways, a compute server is an extension of today's clusters. The compute server provides the shared disks and files of a cluster, and adds the ability to remotely apply computing resources to a problem.

A compute server provides increased performance in two dimensions:

- Provides higher single-processor performance

- Uses multiple processors on a single problem

Any system built with a PRISM CPU will provide more MIPS[+] or VUPs[*] than a similarly fabricated VAX system. PRISM systems, therefore, are a natural choice for compute servers that extend VAX computing capabilities.

Using parallel decomposition techniques, groups of processors can be dedicated to solving parts of a single problem simultaneously. Thus a large, multiprocessor PRISM compute server can offer greater computing capabilities and better price/performance to VAX systems, or even to a workstation with a single PRISM processor.

Glacier supports both VMS and ULTRIX software environments.

Glacier is available in March 1990.

3.2   Software

Two separate operating systems are provided for PRISM: UNIX (in the form of ULTRIX) and Mica.

Both operating systems support the DIGITAL Applications Integration Architecture (AIA). The AIA enables the largest number of proprietary applications to move transparently between VAX and PRISM systems that use VMS, Ultrix or Mica.

In addition, both operating systems support a common layered-product architecture that allows DIGITAL-designed compilers and utilities to run — with no changes — on both systems.

3.2.1   Ultrix

PRISM/ULTRIX is a world-class UNIX product that is tailored to PRISM workstations and PRISM compute servers. PRISM/ULTRIX supports the following key elements of DIGITAL's product strategy:

- DECwindows workstation windowing interface

- Applications Integration Architecture (to aid support of VAX) applications

- Local area system interconnection and diskless workstation support

- Common layered product architecture

+ Million Instructions Per Second
* VAX Units of Performance, or number of VAX–11/780 equivalents

PRISM/ULTRIX is a high-quality UNIX product that offers excellent reliability and performance. PRISM/ULTRIX capitalizes on DIGITAL's software investment in PRISM by sharing low-level operating-system components with Mica, which results in a much more robust system.

3.2.2 Mica

Mica is the base for DIGITAL's high value-added proprietary PRISM software. Mica is compatible with:

- VMS Compute-server software

- Cheyenne Database-server software

- On-line transaction-processing systems

- VMS-compatible general-purpose operating systems

- DIGITAL's Applications Integration Architecture (AIA)

Mica provides a flexible foundation for a wide variety of features, including:

- Object-based kernel

- Security

- Data sharing among applications

- Multithread processes

- High reliability and availability

- VMS compatibility library

- POSIX (UNIX) compatibility library

3.3 Hardware

Three PRISM processors are used to configure Glacier compute servers: Moraine, Rock and 64-bit PRISM systems.

3.3.1 Moraine

Moraine is a 32-bit, high-performance, multiprocessor PRISM system. It is the backbone of the server strategy, providing the hardware for the first Glacier compute server.

Moraine can have up to four processor modules and four memory modules. Each memory module is either 64 Mbytes or 256 Mbytes. The CPU modules contain a single scalar processor that is rated at 15 VUPs, combined with a vector processor that provides 48 double-precision or (96 single precision) peak MFLOPS~ .

Moraine contains one or two XMI card cages, which support the following XMI devices:

- XCA — XMI to cluster (CI) adaptor

- XNA — XMI to Ethernet (NI) adaptor

- Wildcat (HSX) — XMI disk and tape controller

~ Million FLoating point Operations Per Second

The system architecture of Moraine is shown in Figure 1. The nine-way CMOS-II crossbar provides connections for the processor modules, memory modules, and I/O card cages. Crossbar connection of processors and memory modules avoids the contention of multiple processors on a single system bus. Moraine is implemented with active crossbar components for improved memory performance.

Figure 1: Moraine System Architecture
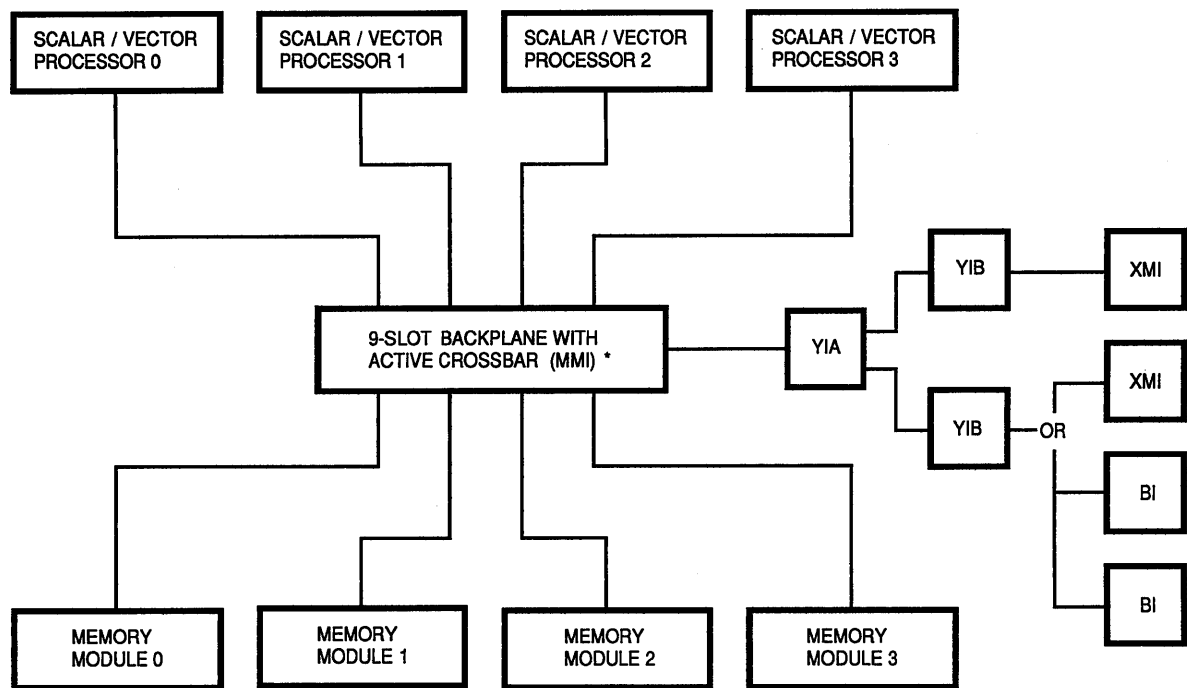
* MMI = Moraine Memory Interconnect

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Moraine is packaged in a single, air-cooled, 60-inch high, Class B cabinet. There is no provision for integral mass storage devices in the Moraine cabinet.

Moraine is available in March 1990.

3.3.2 Rock

Rock is similar in design to Moraine, but it is implemented with CMOS III. CMOS III PRISM processors provide 33% better performance than CMOS II (about 20 VUPs).

CPU modules may contain either two scalar processors or a scalar processor and a vector processor.

An entirely new design for the CMOS III scalar-vector module will provide a substantial improvement over Moraine's vector performance.

Rock is available in December 1990.

3.3.3 64-bit PRISM Processors

The PRISM architecture provides a 64-bit version for expanded addressing. 64-bit PRISM systems are implemented using CMOS IV or custom BiPolar in the early-to-mid 1990s. These processes provide the larger number of gates required by the 64-bit architecture, as well as an increase in performance. CPU modules may be either scalar-scalar or scalar-vector, similar to those in the Moraine and Rock products.

The impact of 64 bits on the software has been anticipated in the design of the operating system software. All that will be required is a simple recompilation of a user program. The impact on system software, however, may be more severe, so time has been allocated in the schedule to handle the conversion.

4 Market

The market for compute server products is technical and numerically-intensive. The primary competitors are the price/performance vendors: Sun, Apollo, Convex, and Alliant. They are followed closely by an even larger group of recent start-ups including MIPS, DANA and many others. The competition is very intense.

The Glacier compute server enhances DIGITAL's competitive position in the workstation and minisupercomputer markets by adding significant performance at competitive prices. Existing VAX users benefit by gaining performance while retaining VAX family compatibility.

4.1 Applications

The following applications, which have been identified as numerically-intensive, are typical compute-server applications:

*   Seismic analysis

*   Nuclear and general physics

*   Molecular dynamics

*   Graphics and image processing

*   Signal processing

*   Electrical simulation and layout

*   Investment banking

*   Econometric modeling

4.2 Market and Product Requirements

The following requirements are critical to success in the technical compute-server market:

*   Price/performance

*   Software development environment for FORTRAN, C, Ada and Pascal

*   Third-party applications

*   Seamless user environment

Other important requirements include:

* VAX compatibility

* Vector and multiprocessor capabilities

* Balanced memory and disk I/O bandwidth

* Third-party workstation client support

* Leading-edge availability, reliability, and serviceability

4.3 Market Size and Forecast

The near-supercomputer segment is divided into four pricebands, and include systems with average values greater than $75K and less than $2M. (Refer to Table 1.) Glacier systems will be shipped in all four pricebands between FY90 and FY95.

Table 1: Near-Super (Midrange Compute-Intensive MFLOPS) Market Size							
$M	FY87	FY90	FY91	FY92	FY93	FY94	FY95
$75K-$250K	30	180	270	380	500	630	770
$250K-$500K	80	440	670	940	1250	1580	1910
$500K-$1M	80	440	670	940	1250	1580	1910
$1M-$2M	120	280	340	390	440	490	530
TOTAL	310	1340	1950	2650	3440	4280	5120

The Glacier forecast assumes that DIGITAL vector processing systems are able to gain market share similar to that achieved by the VAX 11/785 or VAX 86XX in the technical market. Glacier is assumed to make up one-half of DIGITAL's share in the low-end near-supercomputer segment, and one-third of DIGITAL's share for systems in the high-end of the near-supercomputer segment.[1] (Refer to Figure 2.)

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[1] Low-end near-supercomputers cost between $75K and $500K; high-end near-supercomputers cost from $500K to $2M.

Figure 2: Near-supercomputers and Workstations Increasing Technical Market Share
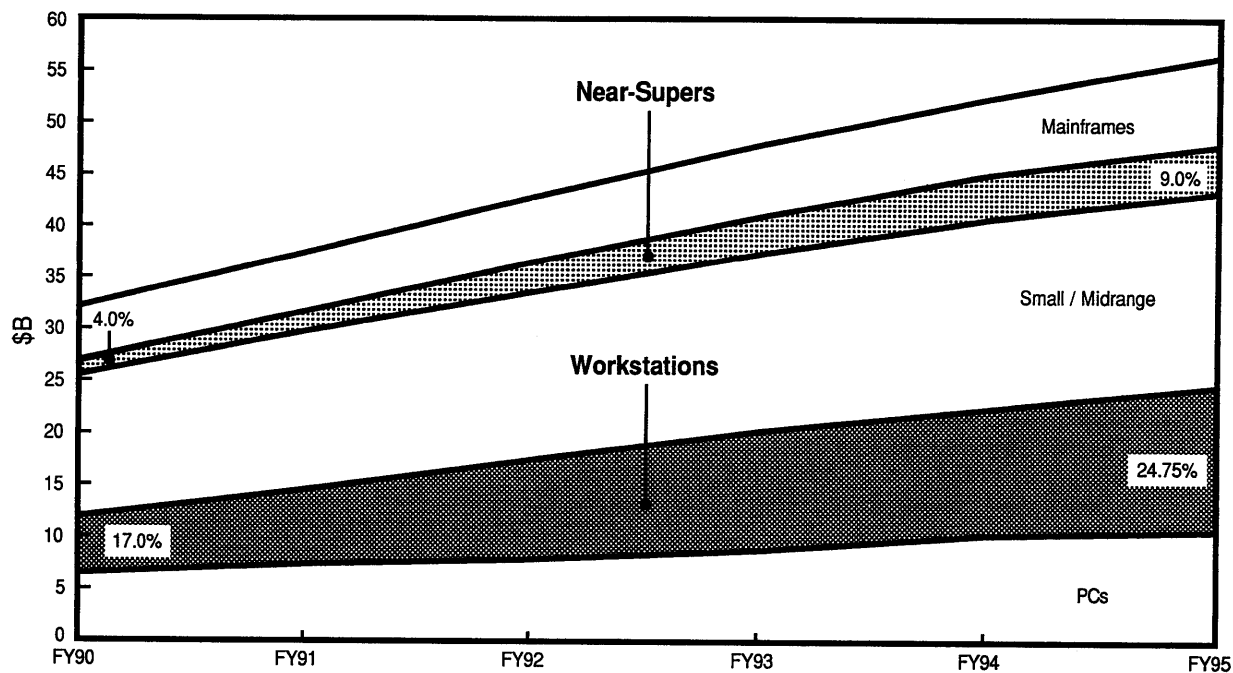
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The revenue forecast for Glacier systems is shown in Table 2.

Table 2: Glacier Revenue Forecast

	FY90	FY91	FY92	FY93	FY94	FY95
DIGITAL Share	3%	6%	32%	45%	34%	14%
Glacier % of Share:						
$75K-$500K	50%	50%	50%	50%	50%	50%
$500K-$2M	33%	33%	33%	33%	33%	33%
Glacier revenues ($M):	13	46	351	579	552	275

Unit ship forecasts for Glacier can be determined by dividing the revenue forecast by the average system value (ASV). The unit ship forecast for Glacier is shown in Table 3.

Table 3: Glacier Average System Value and Unit Forecast

	FY90	FY91	FY92	FY93	FY94	FY95
ASV	$419K	$319K	$330K[1]	$365K	$304K	$269K
Priceband Unit Fcst:	31	144	1063	1588	1818	1021

[1]ASV increases when Rock-based systems with more processors become a greater proportion of Glacier shipments.

5 Business Plan Summary

5.1 Business Objectives and Goals

The Glacier program has three major goals:

- By Q3 FY90, develop and ship the first mid-range implementation of the PRISM architecture, in support of DIGITAL's VAX and PRISM workstations strategy.

- Define and enhance a new style of distributed technical computing based on workstations and compute servers, in which the compute-server provides the following incremental resources:

  — Increased scalar performance

  — Vector capability

  — Symmetric multiprocessing

  — Large main memory

  — Mainframe I/O throughput and device connectivity

- Fully qualify, test, and debug the PRISM architecture and Mica software with Glacier before shipping the Cheyenne database server.

Glacier will meet these goals while

- Maintaining VAX *source code* compatibility

- Achieving a reasonable return on DIGITAL's investment

- Avoiding significant impingement of DIGITAL VAX sales

The following functional group goals support the program goals.

5.1.1 Software Goals

Mica goals support the Glacier and longer-term Cheyenne goals:

- Quality/robustness/reliability

- Seamless support of VMS clients

- Extensible, standard interface

- Performance

5.1.2 Hardware Goals

The Glacier hardware goals (in order of priority for Moraine) are:

- Quality design

- Schedule: FRS in Q3 FY90

- Cost: kernel transfer cost of $2K/VUP

- Performance: at least 15 VUPs and 48 MFLOPS double-precision peak MFLOPS per processor

- Reliability: 1 Year

- Availability: 99.5 %

PRISM/ULTRIX goals are TBD.

5.1.3 Manufacturing Goals

- Reliability: 1 year
- Availability: 99.5 %
- Time to market: FRS in Q3 FY90
- Cost: $2K/VUP in FY90
- *System* quality
- Customer satisfaction

5.1.4 Marketing Goals

Marketing's goals for Glacier are:

- Enhance DIGITAL's price/performance competitiveness in the technical market
- Introduce a new architecture and computing style with VAX and PRISM workstations and PRISM servers
- Leverage workstation revenues and market share
- Provide a DIGITAL alternative to compute servers and near-supercomputers

5.1.5 Sales Goals

Sales goals for Glacier are:

- Glacier revenues should not impinge on existing DIGITAL revenues
- Glacier should be clearly positioned as an evolution of the VAX architecture
- Glacier benchmarks should be available at FRS.

5.1.6 Service Goals

The Glacier service goals for a Moraine-based system are:

- Mean-Time-Between-Failure > 1 Year
- Availability > 99.5 %
- Mean-Time-To-Repair < 2 Hours
- 90% isolation to the Field Replaceable Unit (FRU) level
- Installation =< 8 Hours (Hardware) and 1 Hour (Software)

5.1.7 Financial Goals

The most often used financial metric for the evaluation of future products in DIGITAL is the internal rate of return (IRR). Glacier yields an IRR of 21.3% as compared to the corporate target rate of 30% for high-risk products. The 21.3% is based on a conservative financial approach and is heavily burdened with corporate overheads, specifically field selling and allocated engineering costs. Both have increased significantly over the past years. A more aggressive financial approach in the areas of pricing, field costs, and transfer cost assumptions would allow Glacier to meet or exceed its product goal of a 30% IRR.

Table 4 shows the current financial goals and base case financials for Glacier.

Table 4: Financial Goals (% of NOR)

	Goal	Base Case
Gross Margin	70.0%	63.6%
Profit Before Tax	17.0%	11.0%
Internal Rate of Return	30.0%	21.3%

These goals represent the high-end of the range for the majority of DIGITAL's systems today. The conservative base case reflected in the business plan does not currently meet these goals. There are four significant areas that impact Glacier's profitability and return on investment.

1. Aggressive pricing of the Glacier products has resulted in an average system markup of 4.5 times cost. Currently, the external service processor is included in the kernel transfer cost. The cost for this optional item will be excluded from future financial analysis resulting in a positive impact on profitability.

2. Volumes are based on a percentage of market revenue penetration. The market addressed by Glacier products was deliberately limited by positioning these systems as servers to minimize the impact on VAX system sales.

3. Engineering development costs for Glacier and Cheyenne products currently include the total costs for development of the PRISM architecture and Mica operating system.

4. Field selling costs in this analysis are 40% of Net Operating Revenue. This cost has a significant impact on operating profit.

The Mid-Range Systems Product Business Unit (PBU) financial goals for Glacier are as follows:

- Gross Margin = 70% of Net Operating Revenue in Initial System Sales (ISS) Analysis

- Profit Before Tax = 17% of NOR (ISS)

- Internal Rate of Return > 30%

5.2 Transfer Costs

FY91 transfer cost estimates for Moraine and Rock systems are shown in Table 5:

Table 5: FY91 Moraine and Rock Transfer Costs

	Typical MBytes	Moraine	Rock
Uniprocessor S/V kernel	64	$44.4K	$55.8K
Dual processor S/V kernel	128	$58.3K	$69.7K
Quad processor S/V kernel	192	$87.6K	$99.0K
Octo processor S/V kernel	256	-	$167.7K

5.3 Competition

The major competition for Glacier will be high-end workstation servers from Sun, and near-supercomputer systems from vendors such as Alliant and Convex.

Sun will compete by pushing standards such as UNIX and NFS and quoting aggressive price /performance on the order of $3,000 to $4,000 per MIP. Alliant and Convex will offer scalar and vector performance together with balanced memory and I/O subsystems; in essence, providing single-job throughput for prices between $17,000 and $20,000 per VUP.

Glacier is more similar in design and hardware functionality to a Convex or Alliant near-supercomputer than to the typical Sun workstation server. Scalar and vector multiprocessing, a 64- to 256-Mbyte memory system, and a full I/O subsystem put Glacier into the near-super system class. However, Glacier's positioning as a compute server without local logins results in the perception that it is less general-purpose than the Convex or Alliant UNIX-based systems.

Glacier FY90 pricing of $15,000 per VUP is therefore used in this plan.

5.4 Geographic Distribution

Steady-state shipments to the United States are assumed to be 60% of revenues, with Europe at 30%, and GIA 10%.

5.5 Substitution/Replacement Positioning

Product managers for Aquarius, Argonaut, and Rigel submitted estimates of the proportion of Glacier revenues which they could capture if Moraine and Rock did not exist:

- Rigel — would capture 10% of Moraine-based system sales in FY90, FY91, and FY92 if Glacier did not exist

- Argonaut — would capture 10% of Moraine-based and Rock-based system sales in FY92 and 5% in FY93 if Glacier did not exist

- Aquarius — "No impingement"

The upgrade revenue forecast is also affected by these nonincremental units. The nonincremental revenues associated with the Glacier forecast are shown in Table 6.

Table 6: Glacier Non-Incremental Revenues ($M)						
	FY90	FY91	FY92	FY93	FY94	FY95
Rigel	1.3	3.5	26.8	-	-	-
Argonaut	-	-	28.7	28.8	-	-
Aquarius	-	-	-	-	-	-
Upgrades	-	.1	1.5	15.4	44.0	62.7
TOTAL	1.3	3.6	56.9	44.2	44.0	62.7

5.6   Risks and Dependencies

Figure 3:   Risks and Dependencies

	TECHNOLOGY	MANUFACTURING	SERVICE	MARKET	PRODUCT	SALES
RISK ASSESSMENT	5	3	3	4	3	3
MAJOR DEPENDENCY	CMOS TAB PACKAGING (HPTP)	UNIPROCESSOR TRANSFER COST AND STAGE I PROCESS	COURSE DEVELOPMENT	THIRD PARTY APPLICATIONS SW	VECTOR AND SMP PERFORMANCE	SALES TRAINING

	CUSTOMER SERVICES	ENGINEERING	SUPPORT	BUSINESS	OTHER (EXPLAIN)
RISK ASSESSMENT	3	4	4	4	5
MAJOR DEPENDENCY	FIELD EXPERTISE AT FRS	DISTRIBUTED FILE SYSTEM; COMPILERS; CROSSBAR	SW BENCHMARKING AND SALES SUPPORT	PRICING	CORPORATE WORKSTATION STRATEGY; ULTRIX

RANK: 1=LOW, 5=HIGH

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6 Financial Summary

6.1 Financials: Summary

The objective of this system-level financial analysis is to evaluate whether or not engineering goals for the Glacier program will provide the corporation with a financially viable product. The analysis covers the entire expected life of the Glacier products, and represents a system view which includes peripheral add-on and service business and initial invoice sales.

For purposes of this analysis, two sets of business plans are presented: a fully loaded financial analysis as well as an incremental analysis. Table 7 outlines the key financial metrics for the fully loaded analysis. The incremental analysis is discussed in Section 6.2.2.

Table 7: Glacier Lifetime Base Case

	Fully Loaded	% of NOR
Number of Units	5665	
Net Operating Revenue	$ 3307M	100.0%
Gross Margin	$ 2027M	61.3%
Profit Before Tax	$ 602M	18.2%
Profit After Tax (Rate = 35%)	$ 392M	11.8%
Internal Rate of Return	21.3%	

In preparing this analysis, DECwest Finance adopted a very conservative approach. While these products are heavily burdened with corporate overheads which are reflected in the profit after tax, it is important to note that Glacier products show a healthy gross margin of 61.3% of NOR for the fully loaded analysis.

Despite the fact that the Glacier IRR does not meet the corporate target rate for high-risk products, there is a key strategic reason for recommending continuance of the program. DIGITAL needs the PRISM architecture (and products based on that architecture) in order to remain competitive into the next decade. This is because VAX systems do not compete effectively in the minisupercomputer or workstation markets, and because VMS does not provide adequate capabilities for commercial data processing.

6.2   Financials: One-Page Business Plan

6.2.1   Fully-Loaded Analysis

Figure 4:   Glacier Fully Loaded Business Plan

VOLUME & PROFITABILITY:	($ MILLIONS)	INITIAL SYSTEM SALES (ISS)								LIFETIME TOTALS			
		ALL PRIOR YEARS	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	ALL FUTURE YEARS	ISS	ADD-ONS	SVC	GRAND TOTAL
	UNITS SHIPPED (#)	-	31	144	1063	1588	1818	1021	-	5665			
	MLP $ M	-	15.5	57.9	443.0	787.4	872.2	609.1	-	2785.0	793.2		3578.2
	NOR $ M	-	12.7	47.3	362.4	644.1	713.5	498.2	-	2278.1	693.3	336.0	3307.4
	GROSS MARGIN % NOR	-	14.0	55.5	66.4	66.0	62.4	63.7	-	63.6	67.4	32.8	61.3
	OPERATING PROFIT: ($)	<62.0>	<44.8>	<16.7>	62.2	120.7	110.6	81.1	-	251.1	266.8	84.4	602.3
	OPERATING PROFIT: (% NOR)	-	-	-	17.2	18.7	15.5	16.3	-	11.0	38.5	25.1	18.2
	AFTER TAX ROA %		-	-	28.5	25.2	18.0	15.9					
	IRR %									12.1			21.3

TOTAL

ENGINEERING EXPENSE:	SYSTEMS DIRECT SPENDING	18.2	13.1	7.9	4.2	3.7	3.5	3.6	-	54.2
	SYSTEMS INDIRECT SPENDING	7.6	5.5	3.3	1.8	1.6	1.5	1.5	-	22.8
	TOTAL SYSTEMS SPENDING	25.8	18.6	11.2	6.0	5.3	5.0	5.1	-	77.0
	COMPONENT/ ALLOCATED SPENDING	29.3	22.5	12.4	21.7	24.0	23.0	13.2	-	146.2
	TOTAL ENGINEERING SPENDING	55.1	41.1	23.6	27.7	29.3	28.0	18.3	-	223.2
	MANUFACTURING EXPENSE (NPSU)	6.5	5.1	3.4	-	-	-	-	-	15.0
	CAPITAL EXPENDITURES	7.0	3.6	2.6	-	-	-	-	-	13.2
NET ASSET INVEST:	INVENTORY	-	4.5	32.4	50.3	67.8	38.5	-	-	
	RECEIVABLES	-	1.7	13.3	106.0	177.2	197.9	139.5	-	
	OTHER (NET)	5.4	9.6	24.2	142.0	235.6	257.1	174.8	-	
	TOTAL	5.4	15.8	69.9	298.3	480.6	493.5	314.3	-	

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6.2.2 Incremental Analysis

This incremental analysis provides an estimate of the Glacier products net financial impact to the corporation after accounting for the substitution/replacement impact on existing or proposed products shipping in the same timeframe.

To determine the substitution/replacement effect, product managers representing Aquarius, Argonaut, and Rigel products were polled. They were asked to estimate the loss in projected volumes /revenues that their products would experience due to the presence of Glacier products. The replies indicated no impingement on Aquarius systems, 10% impingement on Rigel by Moraine in FY90 - FY92, and 10% impingement on Argonaut by Moraine and Rock in FY92, decreasing to 5% in FY93.

These percentages were translated into an adjusted shipment forecast for the incremental analysis. Additionally, component and allocated engineering costs were reduced proportionately. Other metrics that were similarly adjusted in this analysis were add-on total MLP, upgrade units, service revenue, and service expense. All costs calculated as a percentage of NOR or MLP were automatically adjusted in the model as a result of the reduced units.

The resulting financial measures for Glacier products show reduced returns to DIGITAL compared with the fully loaded analysis. Table 8 compares the key metrics.

Table 8: Glacier Fully Loaded and Incremental Lifetime Summary

	Fully Loaded	% of NOR	Incremental	% of NOR
Number of Units	5665		5404	
Net Operating Revenue	$ 3307M	100%	$ 3051M	100%
Gross Margin	$ 2027M	61.3%	$ 1846M	60.5%
Profit Before Tax	$ 602M	18.2%	$ 531M	17.4%
Profit After Tax (Rate = 35%)	$ 392M	11.8%	$ 345M	11.3%
Internal Rate of Return	21.3%		20.2%	

Figure 5: Incremental Business Plan

($ MILLIONS)	INITIAL SYSTEM SALES (ISS)								LIFETIME TOTALS			
	ALL PRIOR YEARS	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	ALL FUTURE YEARS	ISS	ADD-ONS	SVC	GRAND TOTAL
UNITS SHIPPED (#)	-	28	133	895	1509	1818	1021	-	5404	✕	✕	✕
MLP $ M	-	14.0	53.4	373.4	733.4	818.5	532.3	-	2524.9	750.9	✕	3275.8
NOR $ M	-	11.4	43.7	305.5	599.9	669.5	435.5	-	2065.4	656.3	329.4	3051.0
GROSS MARGIN % NOR	-	9.7	54.9	66.4	65.7	61.3	61.8	-	62.7	67.4	33.1	60.5
OPERATING PROFIT: ($)	<65.9>	<42.4>	<16.4>	51.7	110.0	95.9	61.5	-	194.3	252.8	83.6	530.7
OPERATING PROFIT: (% NOR)	-	-	-	16.9	18.3	14.3	14.1	-	9.4	38.5	25.4	17.4
AFTER TAX ROA %	✕	-	-	27.2	25.2	16.6	13.1	✕	✕	✕	✕	✕
IRR %	✕	✕	✕	✕	✕	✕	✕	✕	9.9	✕		20.2

(Row labels left margin: VOLUME & PROFITABILITY:)

									TOTAL
SYSTEMS DIRECT SPENDING	18.2	13.1	7.9	4.2	3.7	3.5	3.6	-	54.2
SYSTEMS INDIRECT SPENDING	7.6	5.5	3.3	1.8	1.6	1.5	1.5	-	22.8
TOTAL SYSTEMS SPENDING	25.8	18.6	11.2	6.0	5.3	5.0	5.1	-	77.0
COMPONENT/ ALLOCATED SPENDING	29.3	19.9	11.3	18.1	22.8	23.0	13.2	-	137.7
TOTAL ENGINEERING SPENDING	55.1	38.5	22.5	24.1	28.1	28.0	18.3	-	214.7
MANUFACTURING EXPENSE (NPSU)	6.5	5.1	3.4	-	-	-	-	-	15.0
CAPITAL EXPENDITURES	7.0	3.6	2.6	-	-	-	-	-	13.2

(Row labels left margin: ENGINEERING EXPENSE:)

INVENTORY	-	4.2	27.2	47.8	67.3	37.6	-	-	
RECEIVABLES	-	1.5	12.3	89.3	165.9	188.7	126.5	-	
OTHER (NET)	5.4	9.3	22.9	120.6	220.3	243.4	155.2	-	
TOTAL	5.4	15.0	62.4	257.7	453.5	469.7	281.7	-	

(Row labels left margin: NET ASSET INVEST:)

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7 Schedule

Glacier System Phase	Date of Exit from Phase (CY)
0 (Strategy & Requirements)	Dec 1987
1 (Planning)	Jul 1988
2 (Implementation)	Sep 1989
3 (Qualification)	Mar 1990
4 (Production and Support)	TBD
5 (Retirement)	TBD

Glacier System Milestones	Moraine Date	Rock Date
Power and Packaging Proto Complete	Oct 1988	Oct 1989
Backplane and Crossbar Proto Complete	Jan 1989	Oct 1989
I/O and Memory Module Build Complete	Jan 1989	Jul 1989
Microprocessor Chip Available in CMOS III		Aug 1989
Processor Module Build Complete		Nov 1989
Scalar/Vector Module Build Complete	Feb 1989	Feb 1990
Start Qualification Testing	Apr 1989	Jan 1990
Complete Qualification Testing	Jan 1990	Oct 1990
Start Field Test	Sep 1989	Jun 1990
Complete Field Test	Mar 1990	Dec 1990
FRS	Mar 1990	Dec 1990

8 Functional Plans

The following sections summarize the functional plans submitted by Marketing, Sales, CSSE, Manufacturing, and Documentation.

8.1 Marketing

The following requirements are critical to success in the technical compute server market:

- Price/performance
- Software development environment for FORTRAN, C, and Ada
- Third-party applications
- Seamless user environment

Other important requirements include:

- VAX compatibility
- Vector and multiprocessing capabilities
- Balanced memory and disk I/O bandwidth
- Heterogeneous workstation client support
- Leading-edge availability, reliability, and serviceability

Availability, reliability, and serviceability are not the most important requirements for the first compute server product, but are important to the Moraine effort as a start on features required in Rock to support the Cheyenne program.

Glacier should support VMS workstations with Mica and ULTRIX workstations with PRISM/ULTRIX at FRS. Mica would gain greater acceptance in the DIGITAL customer base with ULTRIX workstation support, and tremendous competitive advantages with client support of Sun and Apollo workstations. ULTRIX and Sun/Apollo client support should be priorities in Mica Version 2.

8.2 Sales

The sales impact statement stresses the need to properly position Glacier in relation to the VAX family in general and Rigel, Aquarius, Aridus, and Argonaut in particular. PRISM systems should complement and enhance VAX systems, providing incremental revenue to the existing VAX revenue stream. PRISM systems should be portrayed as evolving from the VAX architecture.

Sales education in vector processing, symmetric multiprocessing, and database and compute server technology is required six months prior to announcement.

Benchmark data characterizing Glacier and Cheyenne performance is needed four months before announcement.

Multiyear sales goals for PRISM systems may be required as incentives to the sales force.

8.3 Customer Services

PRISM is a new architecture that exploits higher performance markets for DIGITAL. PRISM will encompass a family of hardware products and a common operating system. A compute server for technical markets, Glacier, will have its First Revenue Ship (FRS) in Q3 FY90. Mica is the operating system for Glacier and other PRISM products. PRISM/ULTRIX will also run on these products. The database product, Cheyenne, will follow Glacier.

This summary focuses on technical product requirements and contains only brief product and business descriptions. Other documents are more detailed.

The next three sections summarize the service impact, base product metrics, and risks and concerns from the Customer Services Impact and Requirements Statement.

8.3.1 Summary of Service Impacts and Requirements

Integrated Service Delivery is required for Glacier. Warranty is one year, and includes installation and remedial services for hardware and software. The business goals are 50% margins for the new product components, and a 40% margin for the system, which includes configurations of peripheral devices.

Field support must be trained for the new architecture and product base. Costs for training will be higher than for VAX. Symptom Directed Diagnosis [SDD] will be implemented. A high level of error detection will reduce support labor by providing good field replaceable unit [FRU] isolation. Good error detection also reduces logistics costs by minimizing the no-problem-found rates at Module Repair Centers [MRCs] and parts used per fault.

8.3.2 Summary of Service Base Product Metrics

The following table lists goals for Glacier:

Table 9: Goals for Glacier

Hardware	Software
Availability greater than 99.9%	Crash rate [MTBCr] less than once every two quarters
Reliability [MTBF] greater than 1.5 years	Boot time less than two minutes
Repair time [MTTR] less than one hour	On-line diagnostics, back-ups, updates, and reconfigurations
Installation less than eight hours	Installation less than one hour
High levels of error detection and FRU isolation	Comprehensive error and event logging
	Shadowing and checkpointing

8.3.3 Summary of Service Risks and Concerns

Schedule pressures should not affect new-product testing. The CMOS technology requires surface mount processes and a High Performance Tape Package (HPTP)] with Tab Automated Bonding [TAB]; these are new processes to DIGITAL. While Symptom Directed Diagnosis is conceptually understood, it has not yet been implemented within DIGITAL. PRISM/ULTRIX is not as robust a software system as VMS or Mica, and does not allow the same diagnostic strategies as planned for Mica. Finally, Field Service needs to change its current business and administrative functions to allow for new services, interfaces, and reporting/tracking systems.

8.4 Manufacturing

The following summary outlines the manufacturing goals for Moraine and Rock, as well as the current risks and issues for manufacturing.

8.4.1 Goals

The following are the Moraine and Rock manufacturing goals:

- Develop and implement a manufacturing process which will meet the program goals for performance, reliability, and availability

- Maximize *system* quality

- Minimize cost while meeting the program goals

- Reduce the normal time between product conception and FRS by 20%

- Improve problem-free installations to 99% by the 200th Moraine ship and 150th Rock ship

8.4.2 Risks/Issues

The following risks and issues have been identified:

- Moraine and/or Rock require new components or processes:
  - CMOS-III technology
  - Surface-mount technology
  - High Performance Tape Packaging
  - 4-MBit memory chips

- Database server reliability requirements and the high clock cycles of Moraine/Rock require enhanced test and verification methodologies.

- Design data information flows from DECwest to MBUwest are unproven.

- MBUwest would like to gain experience with a few configurations before shipping a large variety of systems.

- Kanata is concerned about parts sources and the process implications of active backplane components.

8.5 Documentation

Traditionally, DIGITAL products include a software documentation set and a hardware documentation set. Because of the availability and maintainability requirements of the Glacier system, this division is no longer appropriate. A *systems* approach to the documentation is needed. Consequently, the documentation set for this product is divided as follows:

- A customer documentation set, with end-user, programmer, and system management information.

- A support documentation set for DIGITAL personnel who need to provide support for the Glacier system.

The main task of the DECwest Publications group, therefore, is to produce a documentation set covering all of the required customer and support information.