

Nothing Stops It.

The VAX and OpenVMS

looking back, looking ahead

HP OpenVMS

Celebrating 35 years of
rock solid performance.



12/13 November 2012

HP Amstelveen, Netherlands

Gerrit Woertman

Solution Architect and OpenVMS
Ambassador

Andy Goldstein

Andy.Goldstein@compaq.com

with thanks to Jesse Lipcon et al

In the Beginning

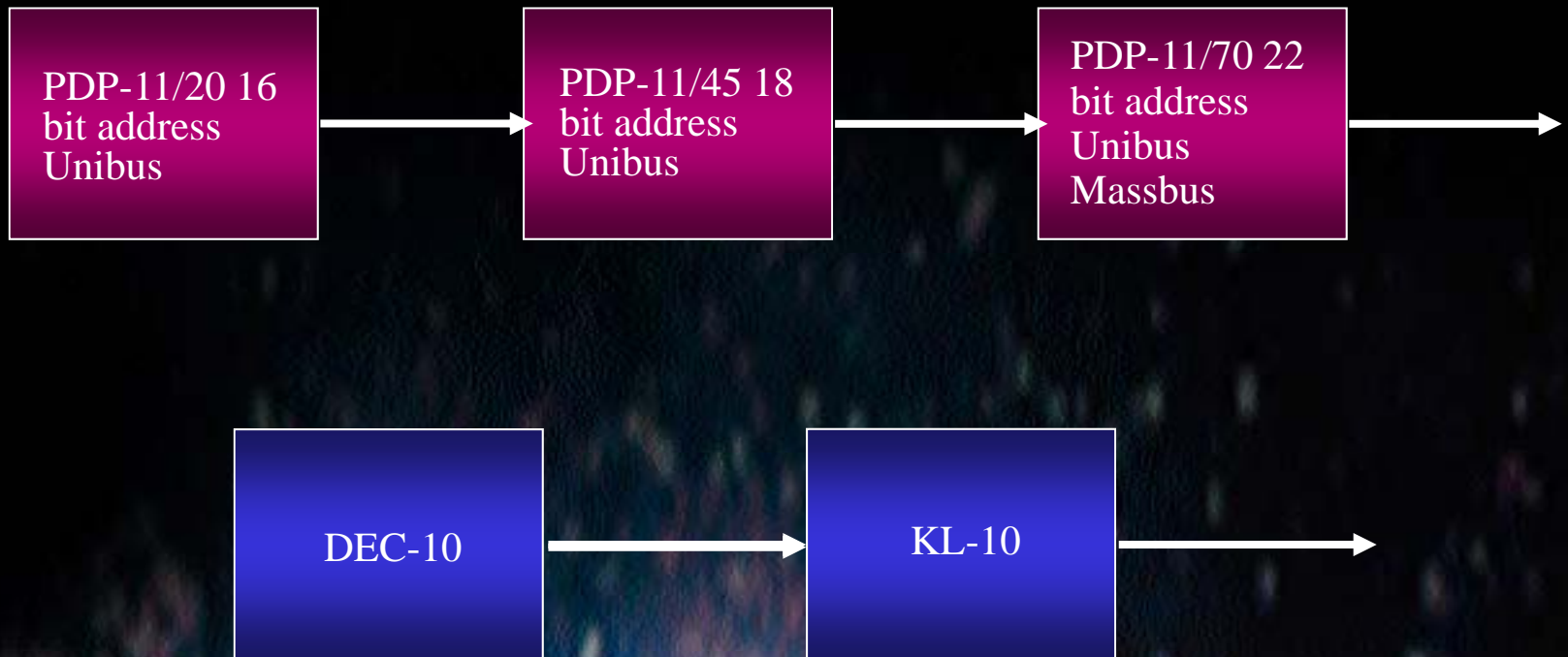
**Confining Software Environment, Limited
Scaleability, Incompatible Systems**



- ◆ **PDP-11 Popularity**
- ◆ **16-bit Architecture**
- ◆ **Architecture Limitations**
- ◆ **1974: Should we build a 32-bit PDP-11?**

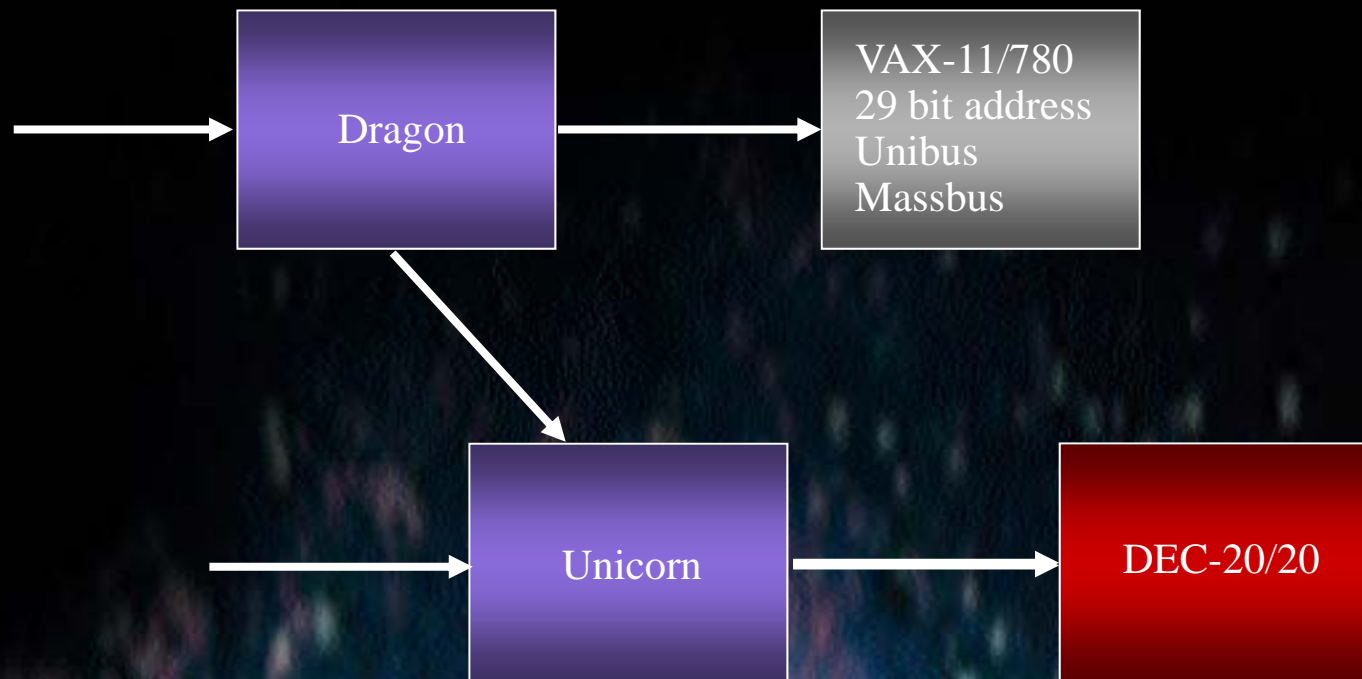
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Genealogy of the VAX



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Genealogy (continued)



1975: STAR and STARLET goals

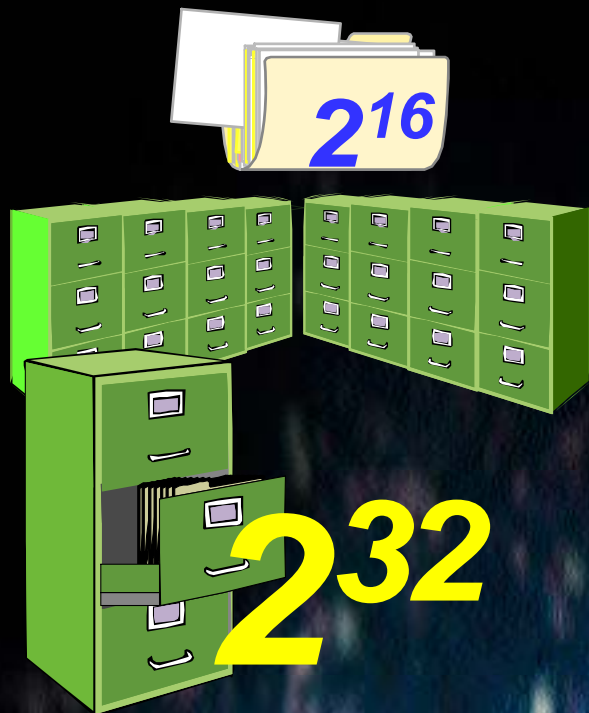
Beginning a 20 year tradition
of shattering barriers and breaking the rules



- ◆ April 1975: Gordon Bell says “Go”
- ◆ Integrated Hardware and Software Design
- ◆ Expand Addressing to 32 Bit
- ◆ Highly Scalable Architecture
- ◆ One System, Compatible Tools

Do The Math

2^{32} Is A Whole Lot More Than Two Times 2^{16}



- ◆ Eliminates Software “Overlays”
- ◆ Critical Software (e.g., RMS) Stays Resident
- ◆ Improved Performance
 - Programmer Efficiency
 - Program Execution

VAXA Committee

- ◆ **Gordon Bell**
- ◆ **Peter Conklin**
- ◆ **Dave Cutler**
- ◆ **Bill Demmer**
- ◆ **Tom Hastings**
- ◆ **Richie Lary**
- ◆ **Dave Rogers**
- ◆ **Steve Rothman**
- ◆ **Bill Strecker,
chief architect**

Early Development

- ◆ **Sept 1975 SRM Rev 1**
- ◆ **April 1976 April Task Force**
- ◆ **June-Aug Detailed software design**
- ◆ **Sept 1976 Hardware simulator and initial system kernel**
- ◆ **April 1977 DCL and file system**
- ◆ **June 1977 Breadboard and first VMS timesharing**

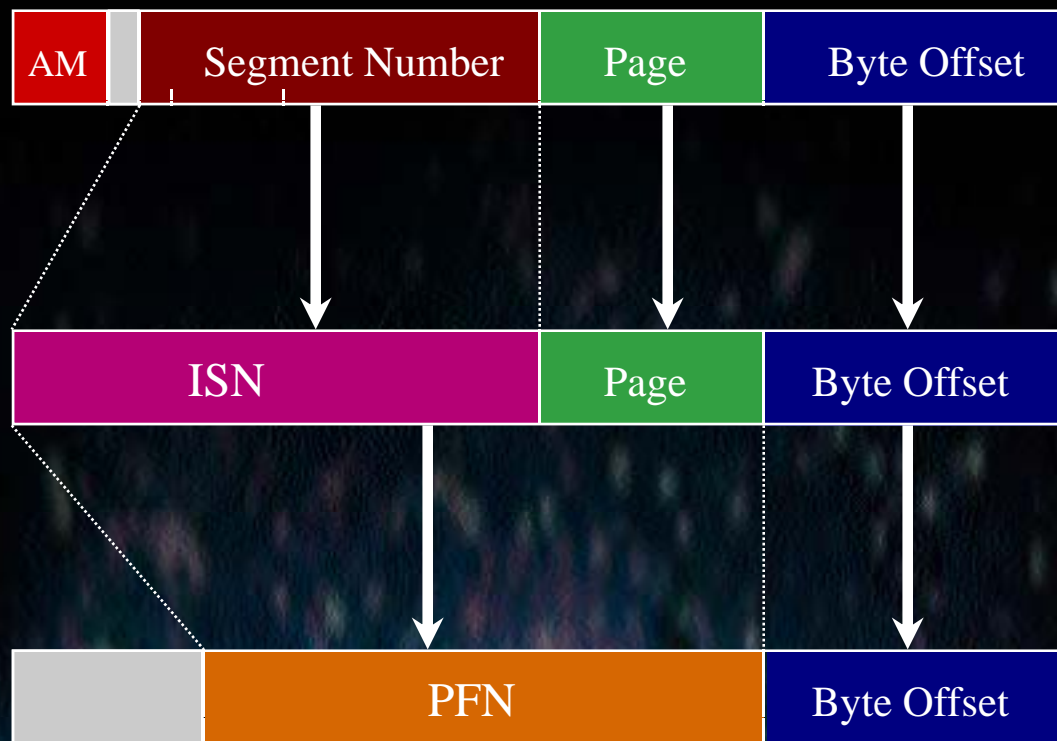
Initial VMS Design Team

By November, 1975...

- ◆ Dave Cutler,
project leader
- ◆ Andy Goldstein
- ◆ Roger Gourd,
manager
- ◆ Roger Heinen
- ◆ Dick Hustvedt
- ◆ Hank Levy
- ◆ Peter Lipman
- ◆ Trev Porter

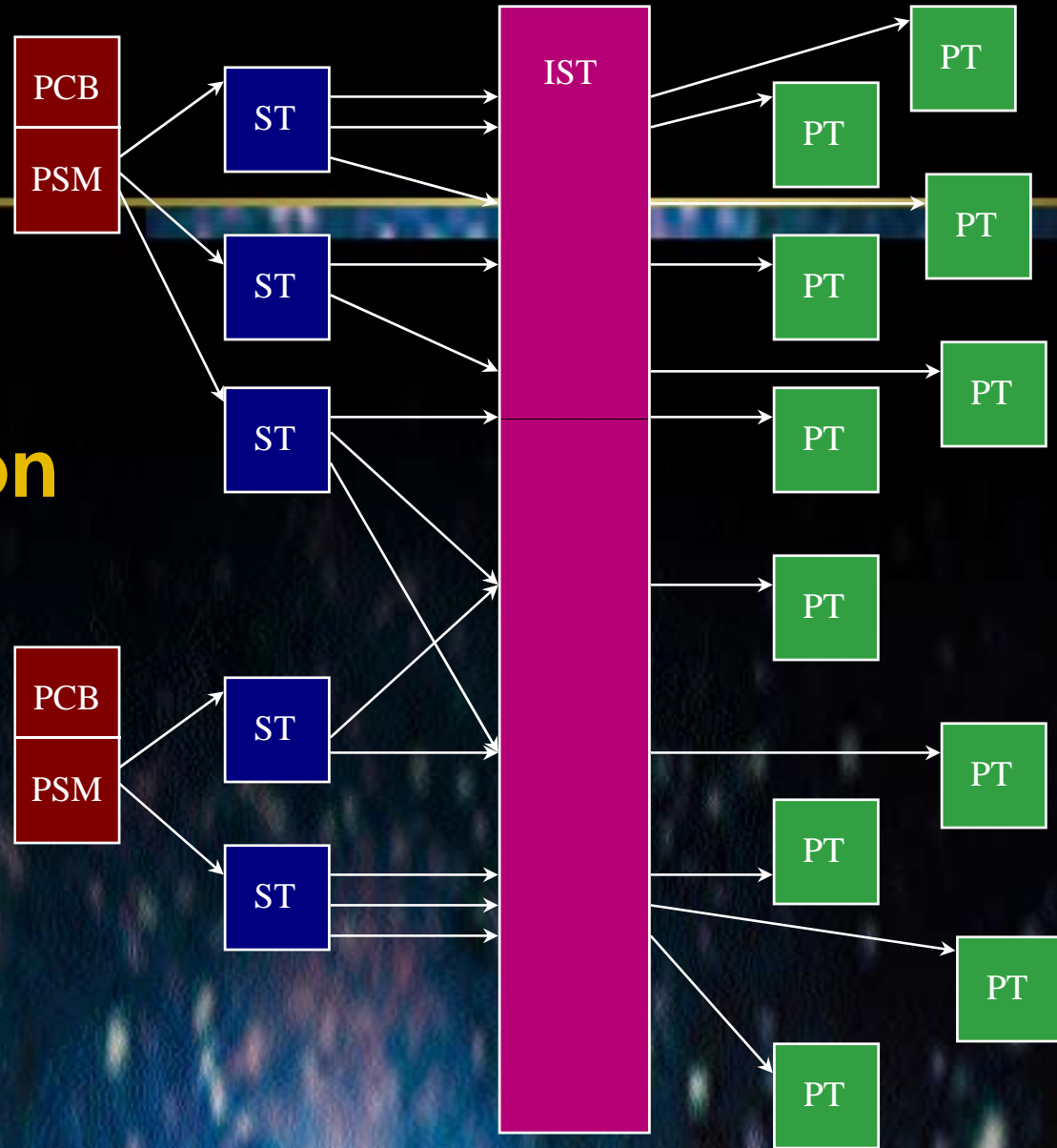
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SRM V1 Memory Management



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Address Translation



Early Development

- ◆ **Sept 1975 SRM Rev 1**
- ◆ **April 1976 April Task Force**
- ◆ **June-Aug Detailed software design**
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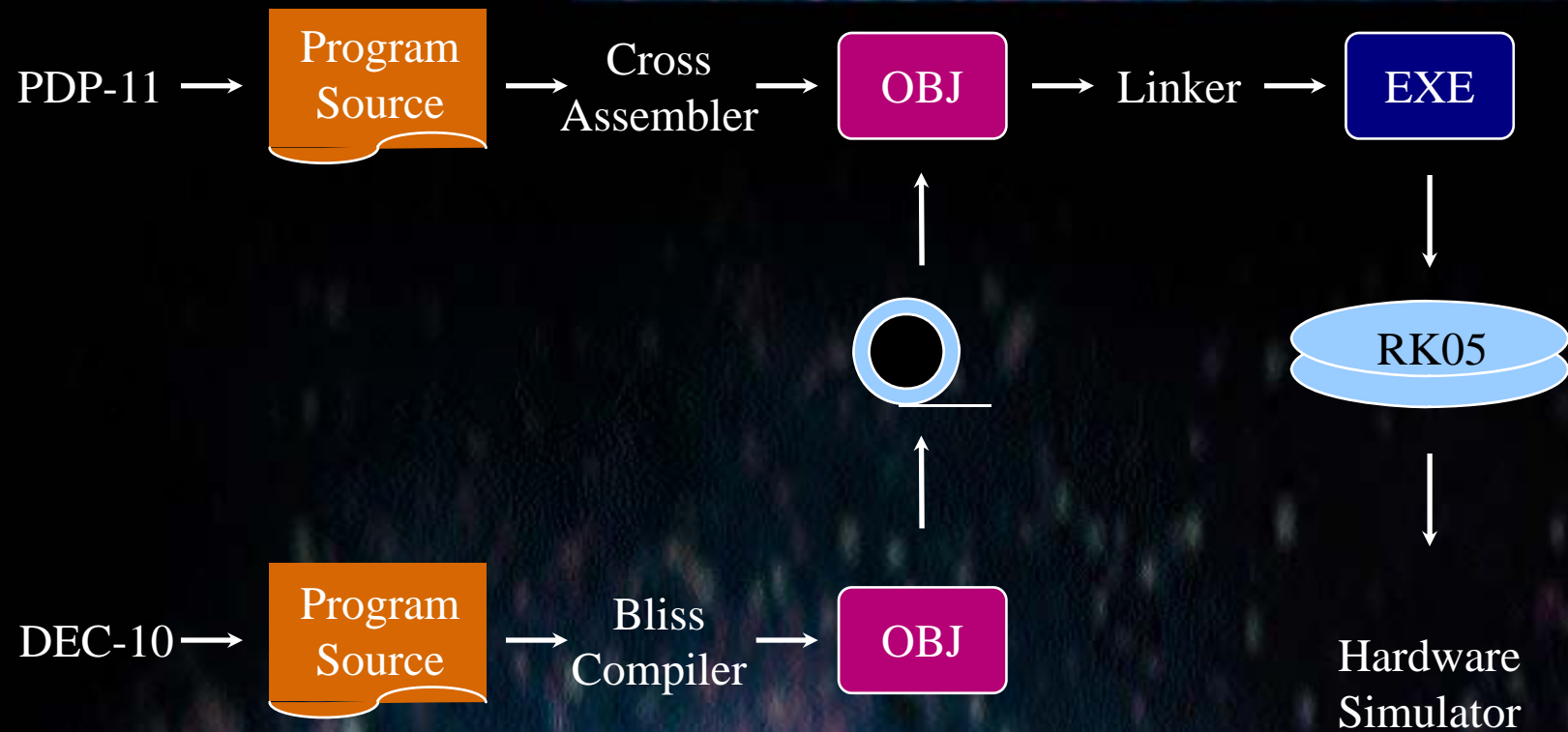
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780 Prototype Power On

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Program Development and Testing



Timesharing on the Prototype

- ◆ **Prototype 780, 1MB memory**
 - 2 RP06 + RK07
- ◆ **VT52s in the offices**
- ◆ **Self-supporting**
 - System builds
 - Bliss Compiler
 - “Eat our own dog food”

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1977 1978 1979 1980 1981 1982...

**Announcement of DIGITAL's
32-bit Computing System**



- ◆ **October 25, 1977**
- ◆ **VAX-11/780**
- ◆ **VMS V1.0 Announced**

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October 1977 Announcement



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V1.0 Development Team



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1977 **1978 1979** 1980 1981 1982...



- ◆ VMS V1.0 Shipped
- ◆ DECnet Phase II
- ◆ FORTRAN IV
- ◆ Up to 64 MB Memory

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An Unprecedented Platform

Multiple Evolutionary Paths, One Direction

- ◆ Multi-Board to Single Chip
- ◆ Ultimate CISC to RISC Processor Architecture



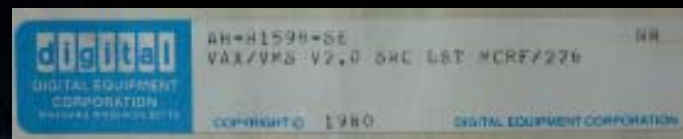
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1977 1978 1979 **1980** 1981 1982...

Low-Cost, High-Performance Networking -- Built Right In!



- ◆ DECnet Phase III
- ◆ VMS V2.0
- ◆ New Programming Tools
- ◆ Ethernet Products
- ◆ VAX-11/750



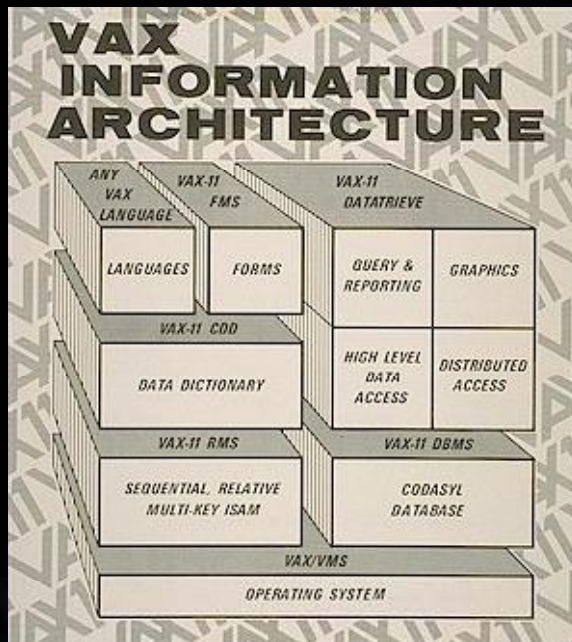
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V2.0 Development Team



1977 1978 1979 1980 **1981** 1982...

**32-Bit Addressing + Integrated Software
Tools = Development Productivity**



- ◆ VAX Information Architecture
- ◆ Common Data Dictionary
- ◆ RMS and VAX-11 DBMS
- ◆ Datatrieve
- ◆ CALLable From Any VMS Programming Language

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1977 1978 1979 1980 1981 **1982...**

A Long History of Growing Up -- And Down!

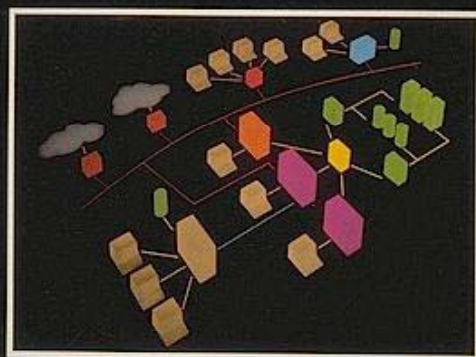


- ◆ **VAX-11/730**
- ◆ **VMS V3.0**
- ◆ **RA60 and RA81 Disk Drives**
- ◆ **Digital Storage Architecture**
- ◆ **ALL-IN-1**

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1983 1984 1985 1986 1987 1988...

**VAXclusters -- 24 x 365 Computing
Leadership, Then and Now!**



VAXcluster
Technical Summary

digital

- ◆ **VAXcluster Technology**
- ◆ **16 Node Star Architecture**
- ◆ **CI Connectivity**
- ◆ **HSC50**
- ◆ **DECnet Phase IV**
- ◆ **VAX-11/725**

Nothing Stops It.

1983 **1984** 1985 1986 1987 1988...

**A Solid and Stable Production System -- For
Business and Engineering!**



- ◆ VMS V4.0
- ◆ VAX Rdb/VMS
- ◆ VAX-11/785
- ◆ VAX 8600
- ◆ VAXstation I
- ◆ MicroVAX I

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1983 1984 **1985** 1986 1987 1988...

All That Power -- On a Single Chip!



- ◆ **VMS V4.2**
- ◆ **VAX11 ACMS**
- ◆ **MicroVAX Chip**
- ◆ **MicroVAX II**
- ◆ **VAXstation II/GPX**

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1983 1984 1985 **1986** 1987 1988...

VAXcluster Power, Implemented Using Cost-Effective LAN Technology!

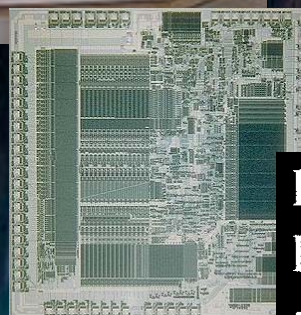


- ◆ VMS V4.5
- ◆ VAX 8800
- ◆ Local Area VAXclusters

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1983 1984 1985 1986 **1987** 1988...

“When You Care Enough to Steal The Very Best!”



- ◆ VAXstation 2000
- ◆ MicroVAX 2000
- ◆ CVAX Chip...
When You Care Enough to Steal the Very Best!
- ◆ MicroVAX 3500 and 3600

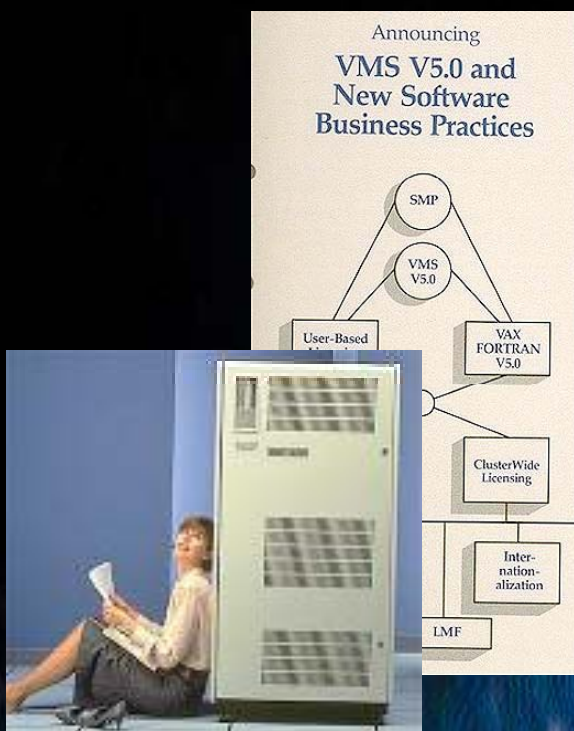
ВАКС
Когда вы заботите доволно
воровать настоящий лучший

VAX
When you care enough to steal the very best

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1983 1984 1985 1986 1987 **1988...**

**High-Speed Internal Bus + Tightly Coupled SMP =
High Performance!**

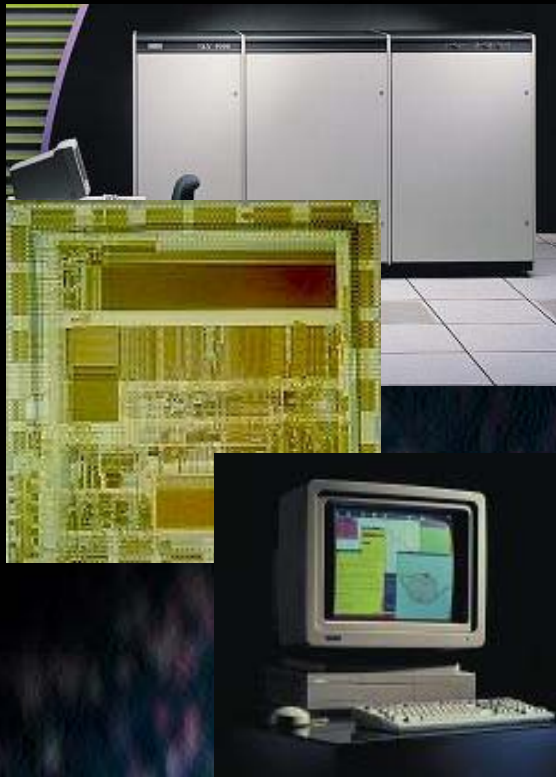


- ◆ VAX 6000
- ◆ VMS V5.0
- ◆ Symmetric Multiprocessing
- ◆ VAX 6200

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1989 1990 1991 1992 1993 1994...

Increasing Power and Expandability



- ◆ VMS V5.1 and V5.2
- ◆ VAXstation 3100
- ◆ MicroVAX 3100
- ◆ VAX 6300
- ◆ Rigel Chip Set
- ◆ VAX 4000-300
- ◆ VAX 6000

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1989 **1990** 1991 1992 1993 1994...

**Proprietary Power -- Plus the Flexibility of
Open Interfaces and Networking**



- ◆ **VMS V5.4**
- ◆ **VAXft 3000**
- ◆ **Mariah Chip Set**
- ◆ **VAX 6500**

1989 1990 **1991** 1992 1993 1994...

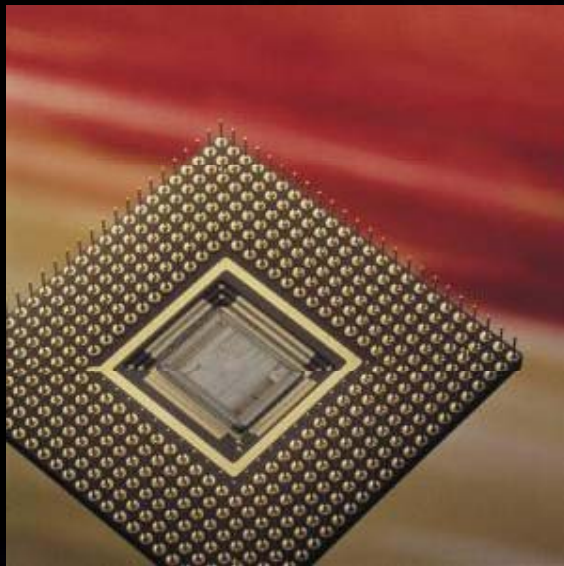
**Digital and Microsoft Unite to Promote
OpenVMS in Client/Server Networks**



- ◆ **OpenVMS Name Change Announced**
- ◆ **OpenVMS V5.5**
- ◆ **Digital-Microsoft Alliance Promotes PATHWORKS**
- ◆ **DECnet Phase V**
- ◆ **NVAX Chip**

1989 1990 1991 **1992** 1993 1994...

Shattering Barriers - Again - With 64-Bit Computing!



- ◆ **Alpha 64-Bit Processor Architecture**
- ◆ **VAX 7000**
- ◆ **First Release of OpenVMS AXP V1.0 for Alpha**

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1989 1990 1991 **1992** 1993 1994...

Breaking the rules again: “You can’t port OpenVMS. It’s written in assembler!”

- ◆ **The macro compiler**
 - a language is a language...
- ◆ **Binary translation**
 - and so is machine code!

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1989 1990 1991 1992 **1993** 1994...

Worldwide Initiative for Client/Server Computing



- ◆ OpenVMS AXP V1.5
- ◆ OpenVMS VAX V6.0
- ◆ Digital 2100 Alpha AXP Server
- ◆ Second Generation of Alpha AXP Servers and Workstations

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1989 1990 1991 1992 1993 **1994...**

OpenVMS VAX and OpenVMS Alpha Meet

- ◆ **OpenVMS VAX V6.1**
- ◆ **OpenVMS Alpha V6.1**
- ◆ **DIGITAL 2100 Alpha AXP Server**



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1995 1996 1997 1998 1999 2000...

OpenVMS V7.0 - breaking the rules yet again



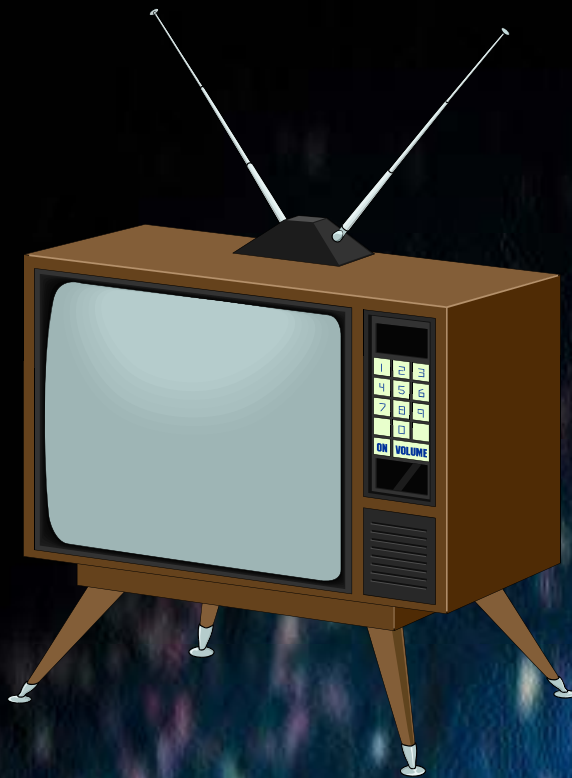
- ◆ **OpenVMS VAX V7.0**
- ◆ **OpenVMS Alpha V7.0 with 64-Bit, VLM/VLDB Support**
- ◆ **Affinity Wave 1**
- ◆ **The Biggest Release of OpenVMS Since V5.0**



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1995 1996 1997 1998 1999 2000...

Do The Math -- Again!



- ◆ **VAX and VMS 32-Bit Addressing Capability...**
- ◆ **Q: If VAX 32-Bit Addressing Equates to 20 Minutes of TV, What Size Multimedia Can 64-Bit Manage?**

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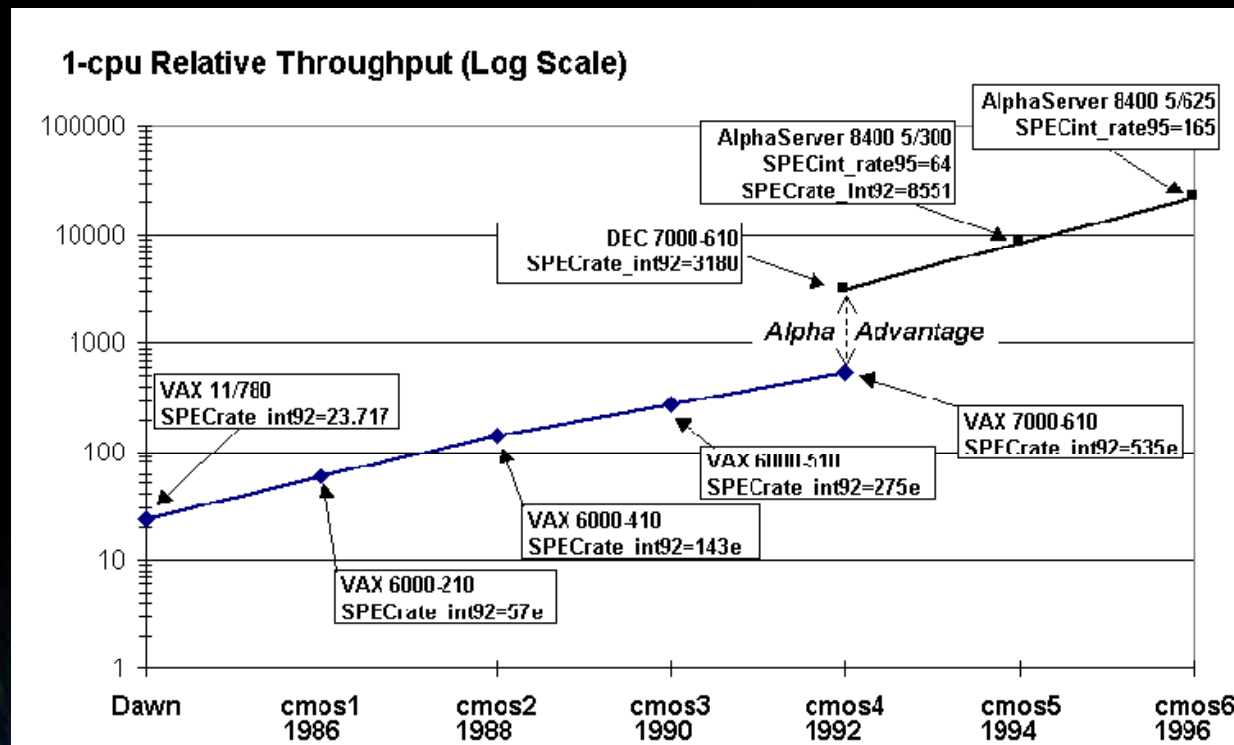
1995 1996 1997 1998 1999 2000...



- ◆ **AlphaServer and OpenVMS
64-Bit Addressing Capability**
- ◆ **A: Every TV Show Ever Shown
Since 1948!**

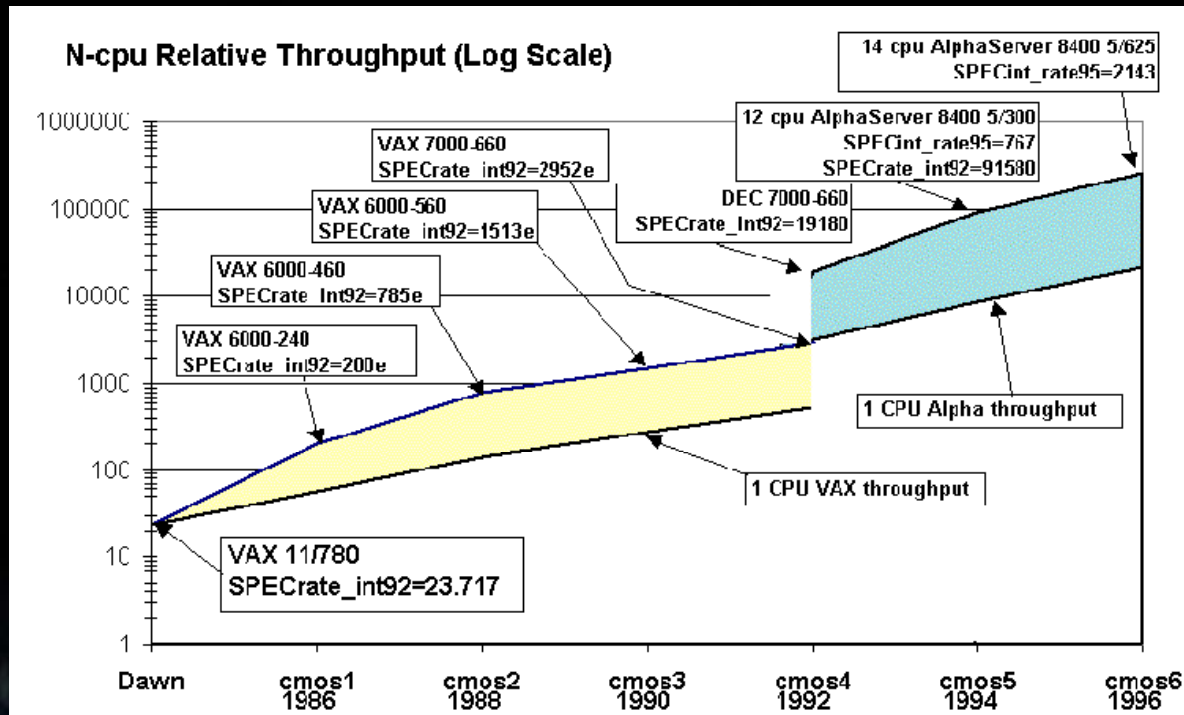
Evolution of Compute Power

Orders of Magnitude Increased Performance



The SMP Multiplier

Even more power through multiprocessing



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Industry Leading Technology

Mission-Critical Commercial Leadership



- ◆ #1 in Healthcare Industry
- ◆ 90% of the World's CPU Chips
- ◆ 66% of the World's Funds Transfers
- ◆ Dominance in Gaming/Lottery Industry
- ◆ Critical defense applications

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1998 1999 **2000** 2001 2002 2003...

The Next Generation...*Here Now!*

The GalaxyTM Software Architecture
for
OpenVMS

Digital Equipment Corporation



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1998 1999 2000 **2001** 2002 2003...



Coming soon...*Intel Inside!*

- ◆ **Breaking the rules yet again:**

What about all the special Alpha features that support OpenVMS?

– It's all software!



Itanium™ comes to OpenVMS Clusters

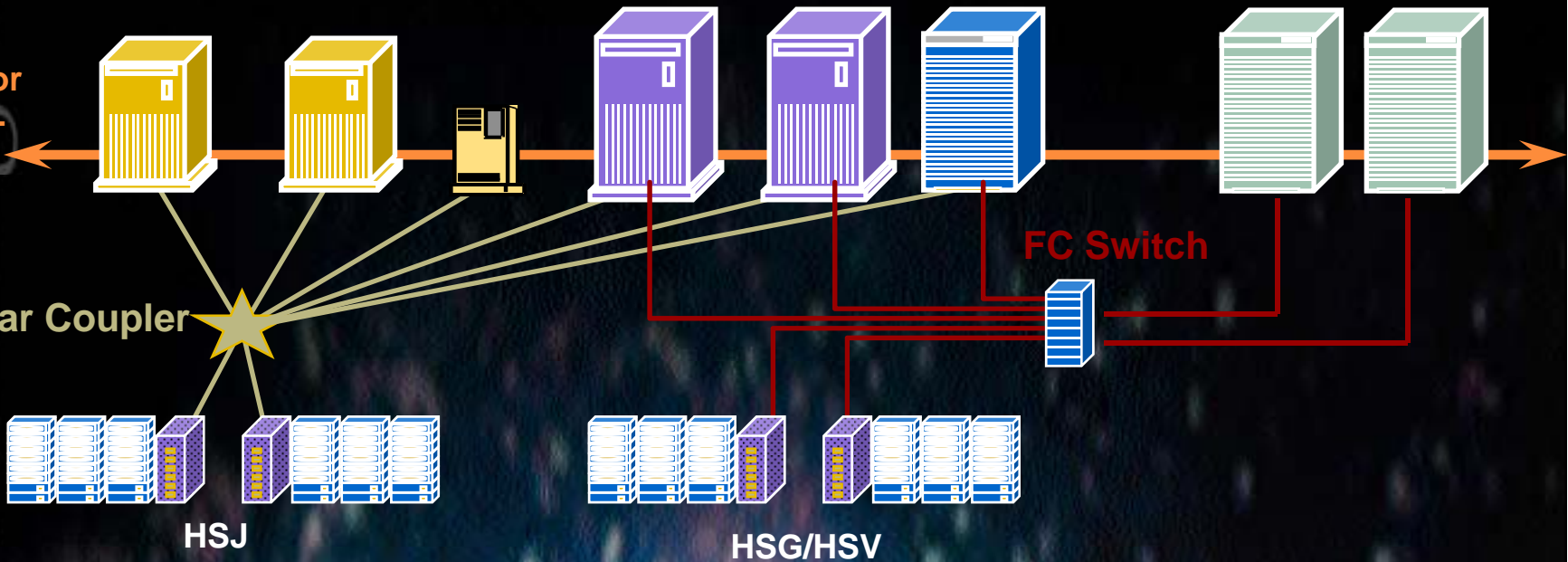
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OpenVMS VAX

OpenVMS Alpha

OpenVMS Itanium™

LAN for Host-to-Host Comm.



CI Storage

Fibre Channel Storage

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1998 1999 2000 **2001 2002 2003...**

Where Do You Want to Go - *Tomorrow?*

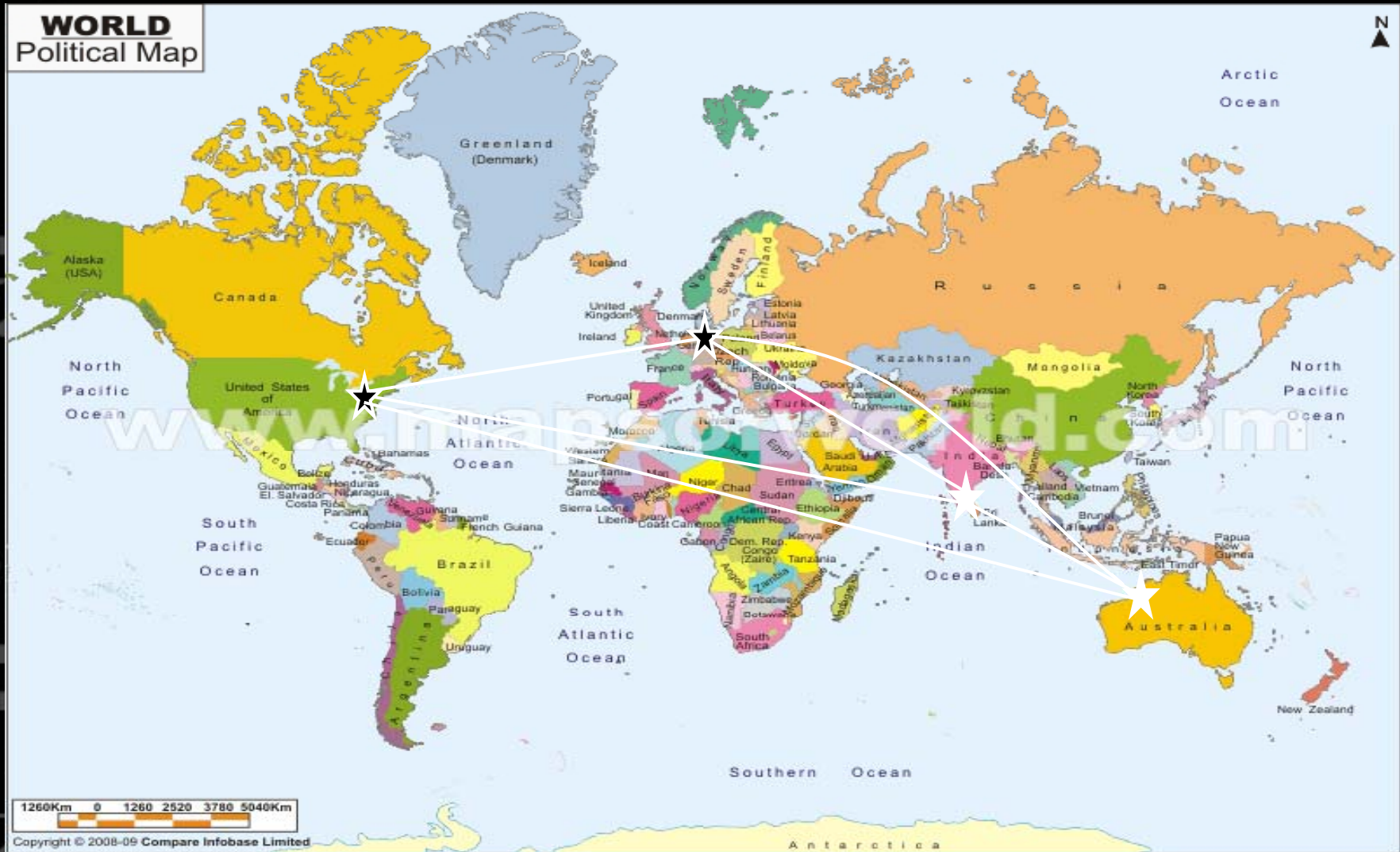
- ◆ A First Class Commercial Machine
- ◆ For Unlimited High-end Computing
- ◆ On OpenVMS!



VMS 8.4: cluster using IPCI

- ◆ 3 nodes in HP, India
- ◆ 1 node in HP, USA
- ◆ 1 node in HP Germany , 1 node in HP Australia
- ◆ 1 HPVM guest node
- ◆ Distance between Bangalore facilities <50 miles
(PEdriver Latency same as Ping Latency , approx 4ms)
- ◆ Distance between India and US - 8000 miles (Latency approx 350ms)

IPCI Cluster



Additional info

- ◆ <http://research.microsoft.com/en-us/um/people/gbell/digital/timeline/software.htm>
- ◆ <http://research.microsoft.com/en-us/um/people/gbell/Digital/DECMuseum.htm>
- ◆ http://research.microsoft.com/en-us/um/people/gbell/Digital/Bell_Retrospective_PDP11_paper_c1998.htm
- ◆ <http://www.bejaardecomputers.nl/index.html>
- ◆

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Additional info

- ◆ [Computer History_chron.pdf](#)