Alpha, VAX and PDP-11 Virtualization

An overview of CHARON products

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Contents

- Stromasys SA

- Legacy DEC systems

- Hardware virtualization

- CHARON products overview

- Benefits

Stromasys SA

- Former European application migration department of Digital Equipment Corporation (DEC)

- Management buy-out in 1998 → Software Resources International SRI

- Renamed to Stromasys SA in 2008

- Headquarters in Geneva, Switzerland

- Focus on preserving software investments via

  – Hardware emulators (VAX, PDP-11, Alpha), and

  – Application source code migrations

- Sales and support channel worldwide

STROMASYS
VIRTUALIZATION TECHNOLOGIES

IT applications are socio-technical systems

Application software lifetime

System software lifetime

Hardware lifetime

time
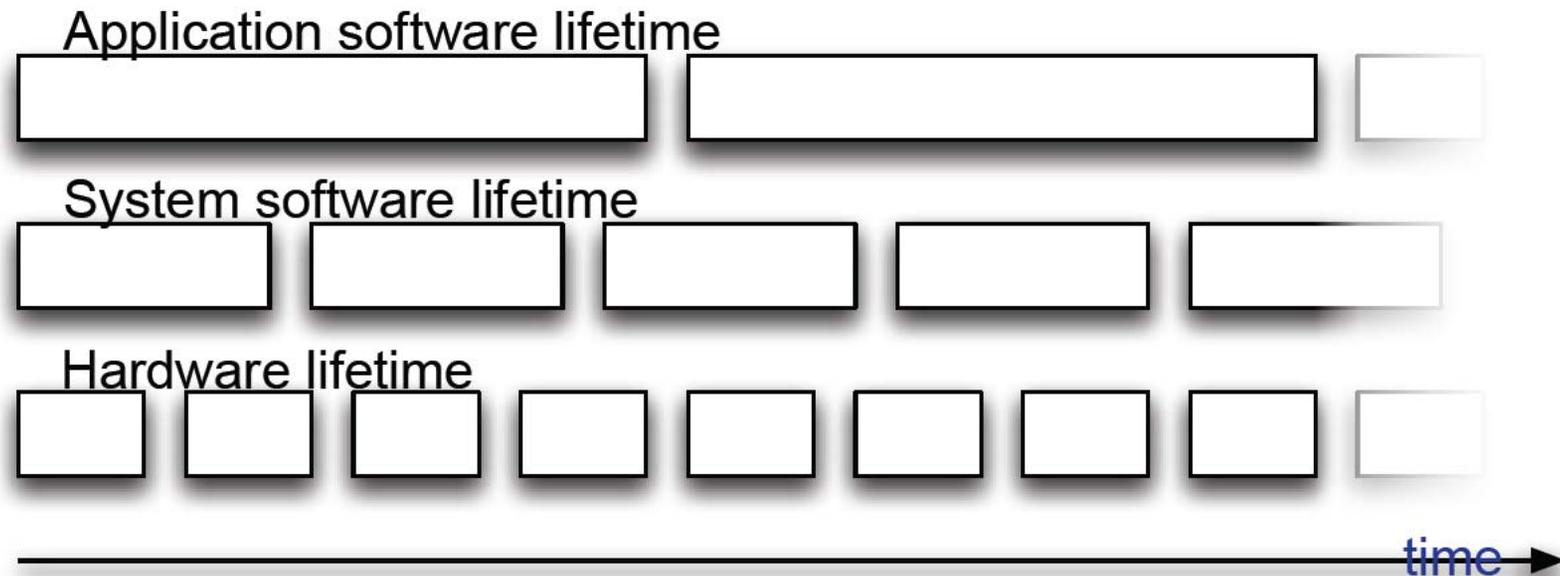
Source: Lehrbuch der Softwaretechnik; Balzert; Spektrum Akademischer Verlag, 1996

DEC computers
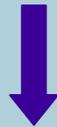
PDP → **Programmable Data Processor**
(PDP-11: 16 bit)

VAX → **Virtual Address eXtension**
(32 bit)

Alpha → **Extended VAX**
(64 bit)

PDP-11

- Sold by DEC between 1970 and 1997
- First real time process control computer in the industry sold in large quantities
- Several bus structures: UNIbus, Qbus, Massbus
- Cloned several times in the Eastern Block countries
  - SM-4, SM-1420, SM-1600, Elektronika BK-0010, DVK, UKNC (Soviet Union)
  - SM-4, SM-1420, IZOT-1016 (Bulgaria)
  - SM-1420 (East Germany)
  - Mera (Poland)
  - SM-4 (Hungary)
  - I-102 (Romenia)
- Several operating systems by DEC and others:
  - DOS/BATCH, IAS, P/OS, CAPS-11, RT-11, RSX-11, RSTS/E, Ultrix-11
  - ANDOS, MKDOS, MONECS, CSIDOS, TRIPOS, MUMPS, Unix V7, BSD, DEMOS (Soviet Union), TSX-Plus, Rumor (ABB)
- RSX-11: Real time process control OS with preemptive task scheduling

- If somebody is still using a PDP-11 today, it is because he could not migrate ➔ he is in great difficulties

VAX, a legend

- Introduced at October 25th, 1977
- Together with Virtual Memory System VMS or OpenVMS
- First commercially available 32 bit computer
- First installations in Carnegie Mellon University and CERN
- Made DEC the #2 computer manufacturer worldwide by 1982
- Nightmare of any other computer manufacturer between 1980- 90
- Shipped over 500,000 times worldwide
- USA DoD prohibited export into Eastern Block
- Cloned several times
- An entirely compatible family of computers with 100s of models
- Sold until 2000
- The operating system OpenVMS has outlived its host platform

Alpha AXP

- Introduced in 1992, end of life in 2007

- 64-bit RISC processor

- OpenVMS, Tru64 UNIX, Windows NT

- Gentoo Linux, Debian GNU/Linux, Slackware, Red Hat, Berkeley Software Distribution NetBSD, OpenBSD, FreeBSD

- Very large user community

DEC users, what now?

- Binary translation

- Native migration

- Virtualization

Binary translation

- From VAX to ALPHA: Using OMSVA

- From ALPHA to Itanium: Using OMSAI

- Both delivered by Stromasys to HP, freeware

- Fastest and most inexpensive solution

- Does not need the source code

- However, some serious limitations apply, such as the availability of older languages on the target platform

- User-mode applications, only

- Does not allow for future enhancements on target platform

- VAX to Itanium needs two steps

- Will impact performance

- Not all applications are binary translatable

Native migration to a new platform

- Produces native application on the target platform

- Almost every application can be migrated

- Partial redesign during migration allows for replacing the programming language, middleware, user interface and design

- Further development and maintenance on target platform

- May give a performance boost

- However, will take long to implement

- Presents some risks (time, functionality, QA, re-certification)

- Source code needed

HW virtualization, the principle

Applications

Layered software

VAX/Alpha OS

No changes →

VAX/Alpha hardware platform

Hardware Replaced! →

CHARON-VAX or -AXP

Operating System

Host computer

HW virtualization, the principle

Applications		**Applications**
Layered software	**No changes** →	**Layered software**
Alpha OS		**Alpha OS**
		CHARON-VAX or -AXP
VAX/Alpha hardware platform	**Hardware Replaced!** →	**Operating System**
		AMD or Intel
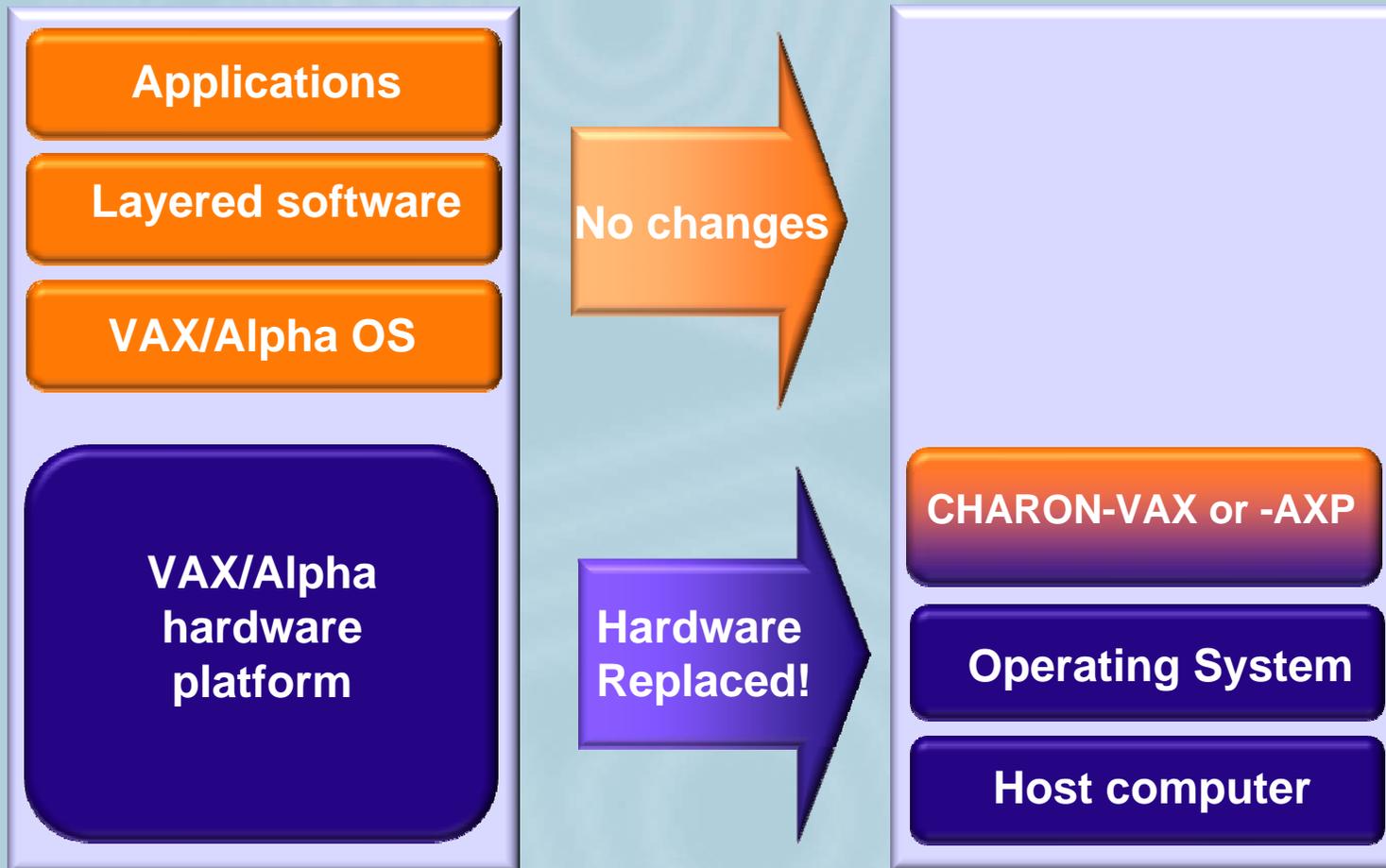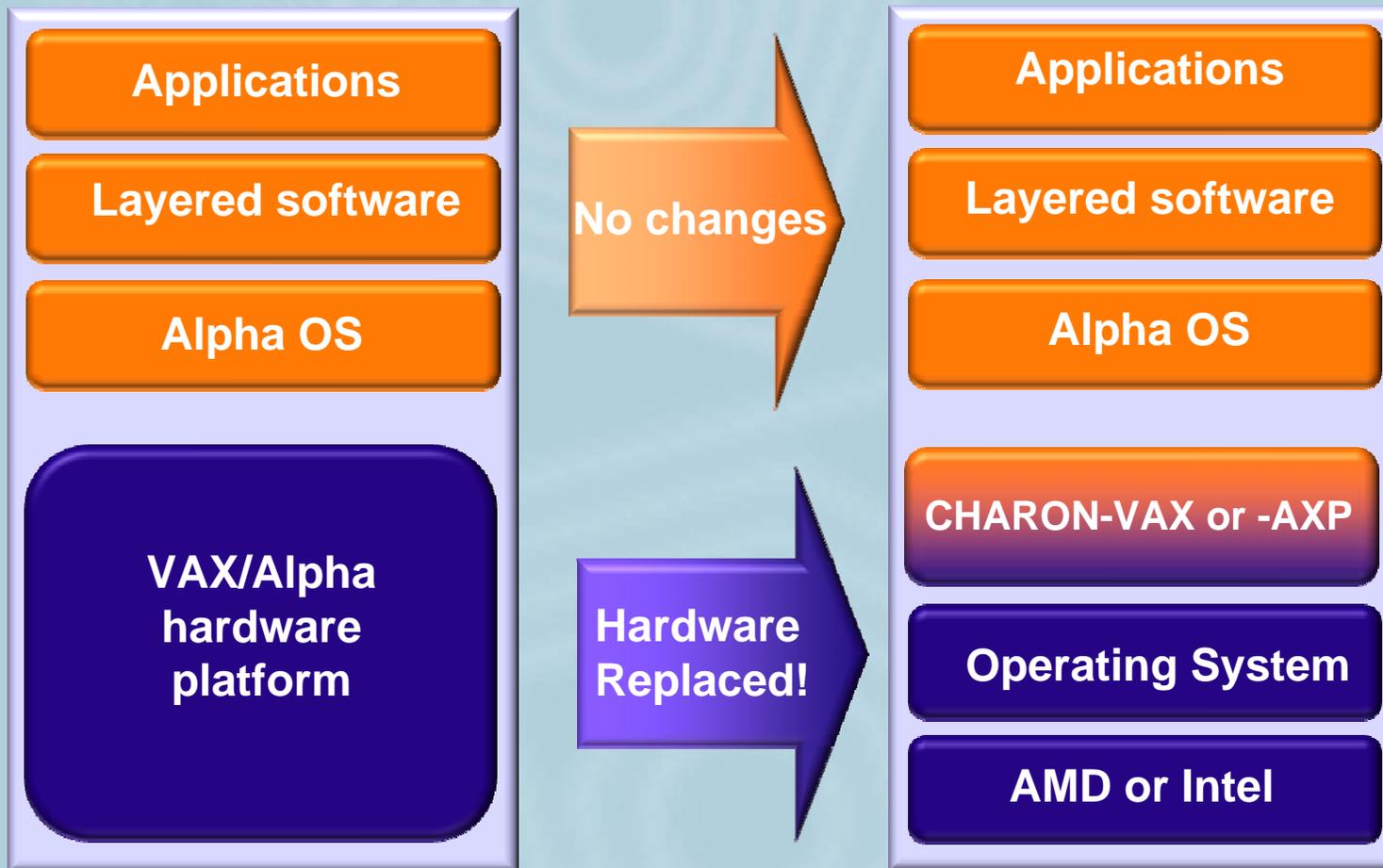
Virtualization

- Does not need the source code

- Replaces old HW by modern HW

- No significant migration efforts. Upgrades immediately, quickly, simply

- Inexpensive

- No risk

- Reduces computer footprint, energy consumption and cooling significantly

- Preserves current investments

  - Keeps current applications and data
  - Keeps current business processes, no impact on day-to-day operations
  - No re-training, no re-staffing, **no re-certification**

- Increases performance

CHARON characteristics

Operating System independent:

- Runs VMS, VAXEln, Tru64 UNIX, Ultrix, NetBSD, etc

- No special host system or VAX/Alpha Operating System drivers

Full hardware compatibility:

- Tested with diagnostics and architecture tests (AXE)

- No VAX/Alpha binary code changes

- No VAX/Alpha application source code required

- Supports NI clustering, shared disk clustering, shadowing, striping

- DECnet, Ethernet, TCP/IP, LAT…

Why virtualization

- Hardware is end-of-life

- Service costs have increased significantly

- Operational costs (e.g. energy consumption) are excessive

- Application rewriting and recertification may be expensive & risky

- Experts and/or application source code not always available

- Automatic binary conversion to OpenVMS/IPF does not always work

- Market expects modern platforms

- Tru64 Unix

Virtual systems with VMware ESX (same platform virtualization)

Same system architecture

VM

Application	Application
Operating System	Operating System

ESX Server

Hardware

VM

Same system architecture
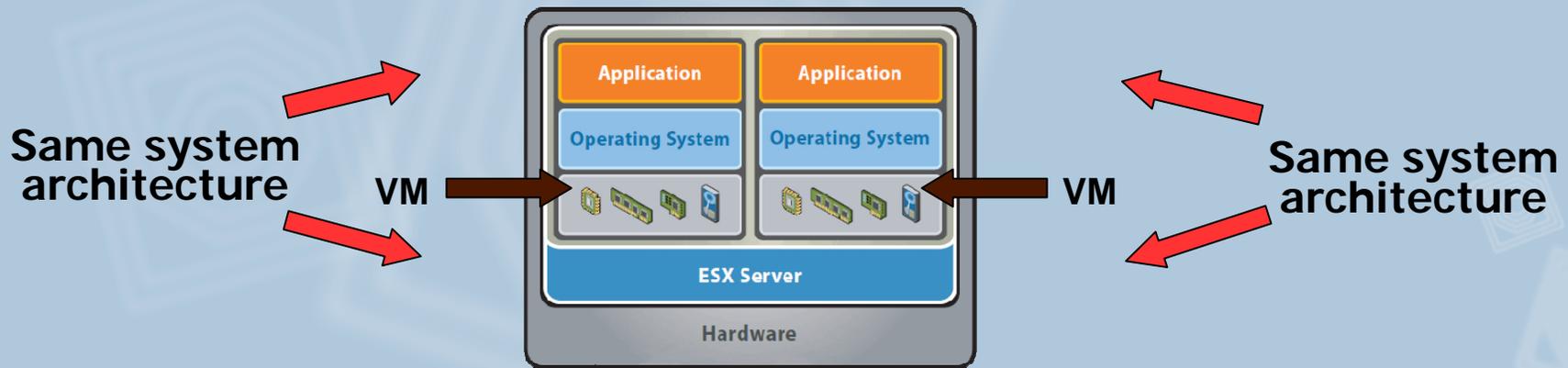
In this environment, the Virtual Machines have the same architecture and instruction set as the hardware host system

Virtual legacy systems with **CHARON** (**cross-platform virtualization**)

In this environment, the Virtual Machines have a (very) different architecture and instruction set from the host.

Applications
Layered Software
VAX/Alpha OS
Virtual VAX / Alpha Hardware Virtualization
Host Computer

Different System Architecture
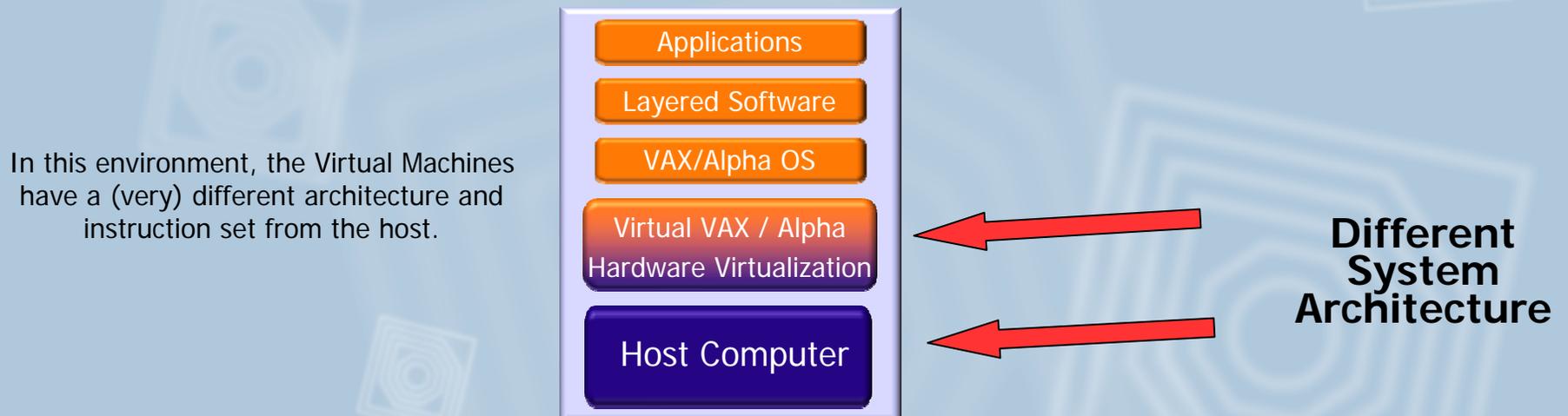
CHARON-VAX products on OpenVMS Integrity

Product	Platform	Earliest VMS version supported	Emulated Memory Size	May replace
CHARON-VAX/3198 for OpenVMS Integrity	OpenVMS V8.2	5.5-2h4	512 MB	VAX3100 -80, -85, -90, -95, -96, -98 VAX4000 -96, -98
CHARON-VAX/4705 for OpenVMS Integrity	OpenVMS V8.2	5.5-2h4	512 MB	VAX4000 -300 ,-400, -500, -600, -700, -705
CHARON-VAX/6610 Plus for OpenVMS Integrity	OpenVMS V8.2	5.5-2h4	1 GB	Large SMP VAXes with single CPU
CHARON-VAX/6620 Plus for OpenVMS Integrity	OpenVMS V8.2	5.5-2h4	3 GB	Large SMP VAXes with two CPUs
CHARON-VAX/6630 Plus for OpenVMS Integrity	OpenVMS V8.2	5.5-2h4	3 GB	Large SMP VAXes with three CPUs

(*) Depends on the CPU emulated

CHARON-VAX products on Windows

Product	Platform	Earliest VMS version supported	Emulated Memory Size
CHARON-VAX/XM for Windows	Windows 2003 or XP	4.5 (*)	128 MB (*)
CHARON-VAX/XM *Plus* for Windows	Windows 2003 or XP	4.5 (*)	128 MB (*)
CHARON-VAX/XK *Plus* for Windows	Windows 2003 or XP	5.5-2	256 MB
CHARON-VAX/XL for Windows	Windows 2003 or XP	5.5-2	512 MB
CHARON-VAX/XL *Plus* for Windows	Windows 2003 or XP	5.5-2	512 MB
CHARON-VAX/6610 *Plus* for Windows	Windows 2003 or XP	5.5-2	1 GB
CHARON-VAX/6620 *Plus* for Windows	Windows 2003 or XP	5.5-2	2 GB
CHARON-VAX/6630 *Plus* for Windows	Windows 2003 or XP	5.5-2	2 (3) GB
CHARON-VAX/6660 *Plus* for Windows	Windows 2003 or XP	5.5-2	2 (3) GB
CHARON-VAXstation for Windows	Windows 2003 or XP	4.6	32, 64 or 128 MB
CHARON-TB for Windows	Windows 2003 or XP	4.5 (*)	512 MB (*)

(*) **Depends on the CPU emulated**

CHARON-VAX performance approximations

- **CHARON-VAX/XM, XL, TB and VAXstation**
- On Intel or AMD: VUPS = ~5…8 * CPU-freq [GHz]

- **CHARON-VAX/XM+, XK+, XL+ and VAXstation+**
- On old Intel CPUs: VUPS = ~19 * CPU-freq
- On AMD: VUPS = ~27 * CPU-freq
- On core2dual: VUPS = ~32 * CPU-freq

- **CHARON-VAX/66x0**
- On core2dual: VUPS per emulated CPU = ~32-36 * CPU-freq

- **CHARON-VAX on OpenVMS Integrity**
- VUPS = ~34 * CPU-freq

Relative VUPS performance comparison

Legend:
- VAX 11/780
- VAX 4000-500A
- VAX 3100-98
- VAX 7000-710
- VAX 7000-740
- VAX 7000-760
- VAX 7000-860
- CH-VAX/XM on dual-CPU P4, 3.4 GHz
- CH-VAX/XM+ on dual-CPU P4, 3.4 GHz
- CH-VAX/XL+ on dual-CPU Xeon, 3.0 GHz
- CH-VAX/XL+ on dual-CPU AMD 250, 2.4 GHz
- CH-VAX/6610+ on DL585 2P/2C AMD 850 CPUs, 2.4 GHz
- CH-VAX/6620+ on DL585 4P/4C AMD 850 CPUs, 2.4 GHz
- CH-VAX/6630+ on DL585 2P/4C AMD 880 CPUs, 2.4 GHz
- CH-VAX/6660+ on DL580 4P/8C core2dual, 3.3 GHz

Y-axis: 0, 100, 200, 300, 400, 500, 600, 700, 800

X-axis label: **CPU model - VUPs**

CHARON-AXP products

CHARON-AXP product	Alpha hardware model replaced
CHARON-AXP/3000	DEC3000/800, 3000/600, 3000/400
CHARON-AXP/SMA	AlphaServer 2100/300, 2000/275, 1000/266 AlphaStation 200, 250
CHARON-AXP/SMA+	AlphaServer 800, 1200, 4000, 4100, DMCC/Flexor AlphaStation 500, 600, DPW, XP900, XP1000
CHARON-AXP/4100	AlphaServer 2000, 2100, 4000 or 4100
CHARON-AXP/DS10	AlphaServer DS10, AlphaServer DS15
CHARON-AXP/DS20	AlphaServer DS20, DS25
CHARON-AXP/ES40	AlphaServer ES40
CHARON-AXP/GS80	AlphaServer GS80, ES80
CHARON-AXP/GS160	AlphaServer GS160, GS80
CHARON-AXPstation	AlphaStation 200, 250, 255
PersonalAlpha	Concept demo, freeware

CHARON licensing

INDIVIDUAL License

- A single instance of a product on one host system

MULTI-INSTANCE License

- One or multiple instances of a product on one host system

NETWORK License

- One or multiple instances of a product on multiple hosts in a network

For all license types

  – Unlimited license, or

  – Yearly license

Clustering

- **NI clusters**

- **Shared Disk Clustering**

  (e.g. MSA devices, EVA devices, etc…)

HP's transfer licenses and support

- CHARON product support
  - From Stromasys or a Stromasys-certified support organization
  - GOLD Support: 5 days / 8 hours
  - PLATINUM Support: 7 days / 24 hours*

- VMS and Layered Products transfer and support
  - From HP, as usual
  - http://h71000.www7.hp.com/openvms/sri-charon-vax-emulator.html

- Tru64 and Layered Products transfer and support
  - From HP, as usual
  - http://h30097.www3.hp.com/stromasys/stromasys-alpha-emulator-sw.html

- Oracle support
  - From Oracle Corp, as usual
  - http://www.oracle.com/technology/products/rdb/htdocs/rdb7/charon_vax.html

  * Subject to geographical availability

Benefits

- Replace old and expensive HW by modern HW

- Significantly reduce energy consumption

- Significantly reduce cost of ownership

- Preserve current investments
  - Keep current applications and data
  - Keep current business processes, no impact on day-to day operations
  - No re-training, no re-staffing, **no recertification**

- Extend on new platforms, create room for future growth

- Increase performance

- Scalable size and licensing conditions in line with client's needs

- Upgrade immediately, quickly, simply

- Reduce space needs significantly

Some CHARON users

- BT, US Dept. of Defense (Pentagon), many Navies, Air Forces and Armies, Contraves, Dresdner Bank, Bosch, CMC Electronics, GAFSA, Bank Morval, Ferrero, Ishida, Brittany Ferries, Robotek, Stahlwerk Bous, Alcatel, Lexmark, many hospitals in USA and Australia, many counties in USA, EDF, Warner Robbins, Ship Analytics, Vattenfall, Dow Chemical, Bell Group, Janssen Pharmaceutica, ProQuest Allison, many universities, AKZO Nobel, General Dynamics, Rolls Royce, GE, P&R, Vodaphone, Philip Morris, Philips, Jaguar, Opel, British Energy, Elvia, Teijin Dupont, Optus, IASCO, NAMSA, Corus steel, Samsung, Toshiba, ABB, Raytheon, **HP** eng and ops, EST Enerji, Nortel, Scania, VEBA, BREGA, Swedish Steel, Barco, **Oracle**, Agfa, Northrop Grumman, TRW, Airbus, Boeing, Lockheed, Voestalpine, Medisuisse, Migros PK, Spida, Vibro-Meter, Milano Railways, SBB/CFF, Hitachi, Nikon, Fujitsu, HSBC, EDS, Thales, Nokia, EADS, Ferrari, Ford, Fidelity … and many others

Some CHARON-AXP users

Europe
- ✓ Arma Suisse
- ✓ BCC
- ✓ BP
- ✓ Bundeswehr
- ✓ Commerzbank
- ✓ Degremont
- ✓ Eurofighter
- ✓ European Space Agency
- ✓ Fugro UK
- ✓ Huntsmann Chemicals
- ✓ Gallimard France
- ✓ GlaxoSmithKline Italy
- ✓ Kirchenrat Stuttgart
- ✓ Metalli Italy
- ✓ Oto Melara
- ✓ Philips Medical Systems
- ✓ Police Netherlands
- ✓ RAF UK
- ✓ Stockholm Public Transport
- ✓ Urano Germany

Global
- ✓ Nikon

Americas
- ✓ ACSSD
- ✓ Brooks Automation
- ✓ Bureau of Census
- ✓ Cargill
- ✓ Catalyst Paper
- ✓ Caterpillar
- ✓ Cedar Rapids Corn Mill
- ✓ Central de Valores Chili
- ✓ City of Oklahoma
- ✓ Fedex
- ✓ General Dynamics
- ✓ ITT
- ✓ Jefferson Parish Sherriff
- ✓ New Brunswick Power
- ✓ OSPI
- ✓ Penton
- ✓ RL Polk
- ✓ South Central Power

Australia/New Zealand
- ✓ ABC
- ✓ St. Vincents Hospitals
- ✓ Workcover
- ✓ Wyeth Pharmaceuticals

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