Alpha, VAX and PDP-11 Virtualization

*An overview of CHARON products*

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Dogan Baser / Sep 2009
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• Legacy DEC systems
• Hardware virtualization
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• 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
IT applications are socio-technical systems

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
- Layered software
- Alpha OS

VAX/Alpha hardware platform

No changes

- Applications
- Layered software
- Alpha OS

CHARON-VAX or -AXP
Operating System
AMD or Intel

Hardware Replaced!
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, VAXElm, 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)

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.
## CHARON-VAX products on OpenVMS Integrity

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

(*) Depends on the CPU emulated
# CHARON-VAX products on Windows

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

(*) Depends on the CPU emulated
CHARON-VAX performance approximations

- CHARON-VAX/XM, XL, TB and VAXstation
  - On Intel or AMD: \( VUPS = \sim 5 \ldots 8 \times \text{CPU-freq} \) [GHz]

- CHARON-VAX/XM+, XK+, XL+ and VAXstation+
  - On old Intel CPUs: \( VUPS = \sim 19 \times \text{CPU-freq} \)
  - On AMD: \( VUPS = \sim 27 \times \text{CPU-freq} \)
  - On core2dual: \( VUPS = \sim 32 \times \text{CPU-freq} \)

- CHARON-VAX/66x0
  - On core2dual: \( VUPS \text{ per emulated CPU} = \sim 32-36 \times \text{CPU-freq} \)

- CHARON-VAX on OpenVMS Integrity
  - \( VUPS = \sim 34 \times \text{CPU-freq} \)
Relative VUPS performance comparison

- **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**
### CHARON-AXP products

<table>
<thead>
<tr>
<th>CHARON-AXP product</th>
<th>Alpha hardware model replaced</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHARON-AXP/ 3000</td>
<td>DEC3000/ 800, 3000/ 600, 3000/ 400</td>
</tr>
<tr>
<td>CHARON-AXP/ SMA</td>
<td>AlphaServer 2100/ 300, 2000/ 275, 1000/ 266 AlphaStation 200, 250</td>
</tr>
<tr>
<td>CHARON-AXP/ SMA+</td>
<td>AlphaServer 800, 1200, 4000, 4100, DMCC/ Flexor AlphaStation 500, 600, DPW, XP900, XP1000</td>
</tr>
<tr>
<td>CHARON-AXP/ 4100</td>
<td>AlphaServer 2000, 2100, 4000 or 4100</td>
</tr>
<tr>
<td>CHARON-AXP/ DS10</td>
<td>AlphaServer DS10, AlphaServer DS15</td>
</tr>
<tr>
<td>CHARON-AXP/ DS20</td>
<td>AlphaServer DS20, DS25</td>
</tr>
<tr>
<td>CHARON-AXP/ ES40</td>
<td>AlphaServer ES40</td>
</tr>
<tr>
<td>CHARON-AXP/ GS80</td>
<td>AlphaServer GS80, ES80</td>
</tr>
<tr>
<td>CHARON-AXP/ GS160</td>
<td>AlphaServer GS160, GS80</td>
</tr>
<tr>
<td>CHARON-AXPstation</td>
<td>AlphaStation 200, 250, 255</td>
</tr>
<tr>
<td>PersonalAlpha</td>
<td>Concept demo, freeware</td>
</tr>
</tbody>
</table>
PRESERVING YOUR SOFTWARE INVESTMENT ACROSS HARDWARE GENERATIONS!
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

• Tru64 and Layered Products transfer and support
  - From HP, as usual

• Oracle support
  - From Oracle Corp, as usual

* 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

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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Invenate GmbH, Hannover
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NST IT Design GmbH, Munich
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