

**Bad Homburg
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HP OpenVMS
Technical Update Days**



**Porting a real-time
database from Alpha
OpenVMS to Itanium 64**



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Introduction

The Challenge

- HP Integrity Developer Forum in Vienna, March 30/31. 2005
 - Goal: Transferring applications to Itanium 64
 - 50 participants in total
- My aim: Generate ABB's real-time database PRIMO-S for the Itanium
 - Originally the source was available for Alpha OpenVMS



About PRIMO·S

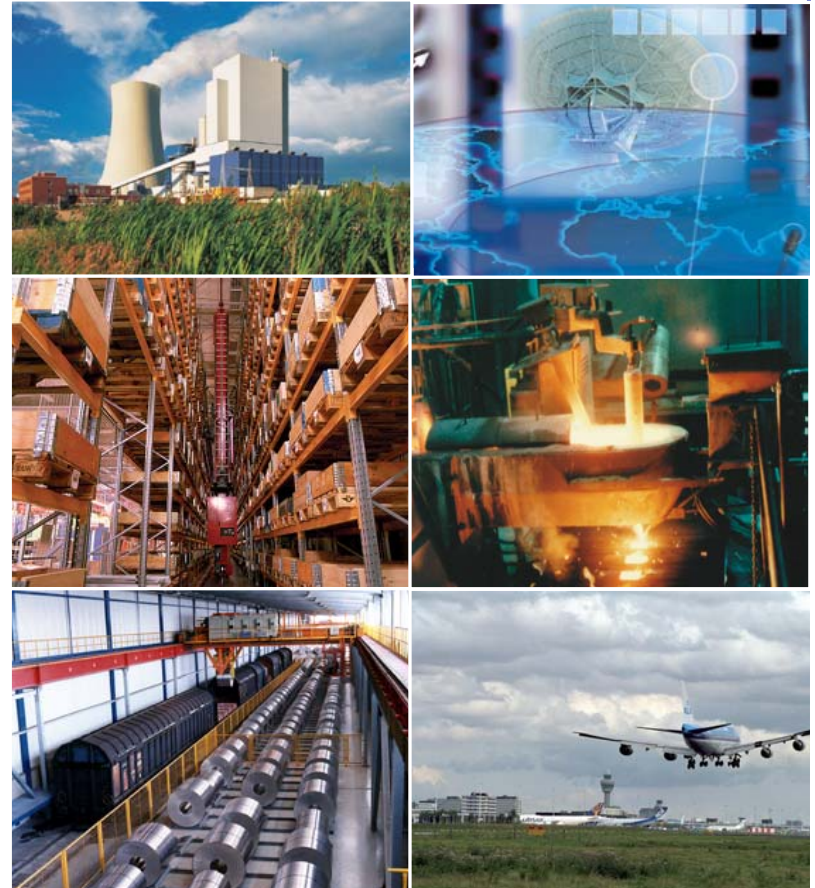
PRIMO-S – ABB's real-time database

- Established product
 - Has been used successfully for many years
 - Over 2,700 proven installations worldwide
- Compact, simple system
 - Little need for training
 - Installed and ready for use in just two minutes
 - Requires less than 5MB disk space under NT
- Available on a number of platforms
 - VMS (VAX, Alpha)
 - UNIX (HP-UX, Tru64, Linux, AIX, SunOS)
 - Windows (from NT 3.51 to 2003)
- Low price



The PRIMO-S Application Fields

- Power stations
- Rolling mills
- Continuous casting plants
- Manufacturing process control
- Cargo management
- Telecommunications
- Baggage and cargo handling systems
- Simulation systems
- Diagnosis Systems



ABB

PRIMO-S Highlights

- Performance
- Message Arrays
- Replication
- Logging
- Standards
- Code Generator



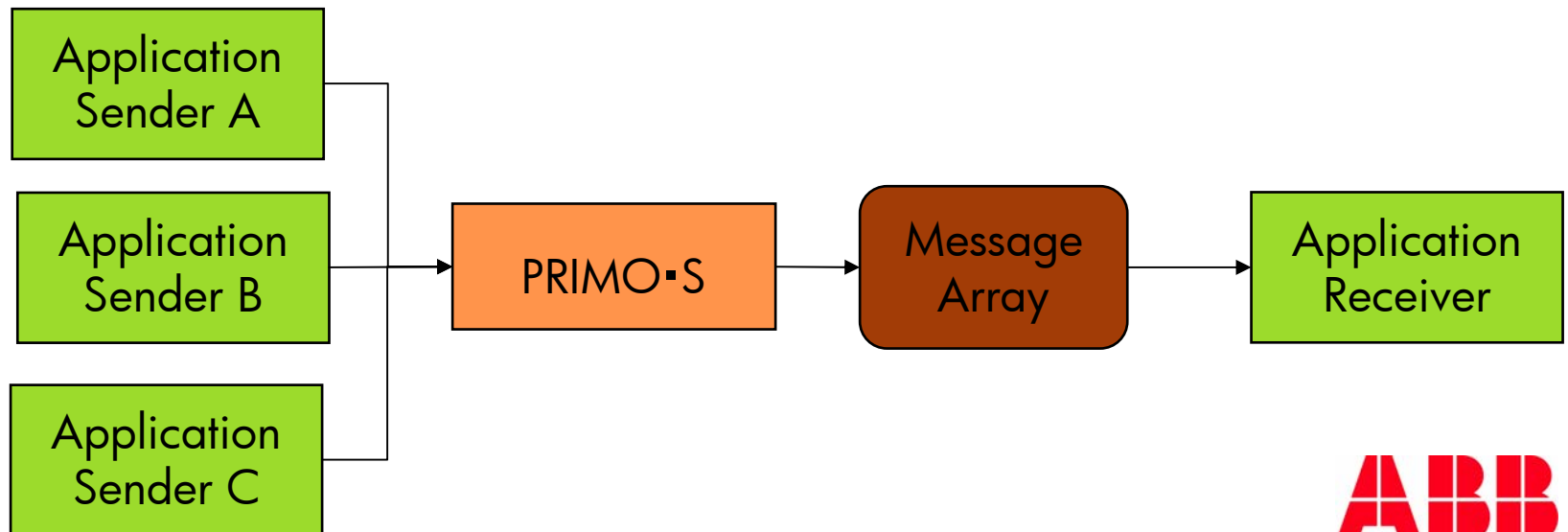
Performance

- PRIMO-S is very fast
 - More than 100,000 accesses per second
- Up to 35 times faster than conventional SQL data base
 - Measured by Institute in Cologne, Germany
- Data is accessed in memory
 - Global section on VMS
 - Memory mapped files on UNIX and Windows
- PRIMO-S itself is a shared image (DLL)
- Direct Access (via address) to data provided
 - For experienced user



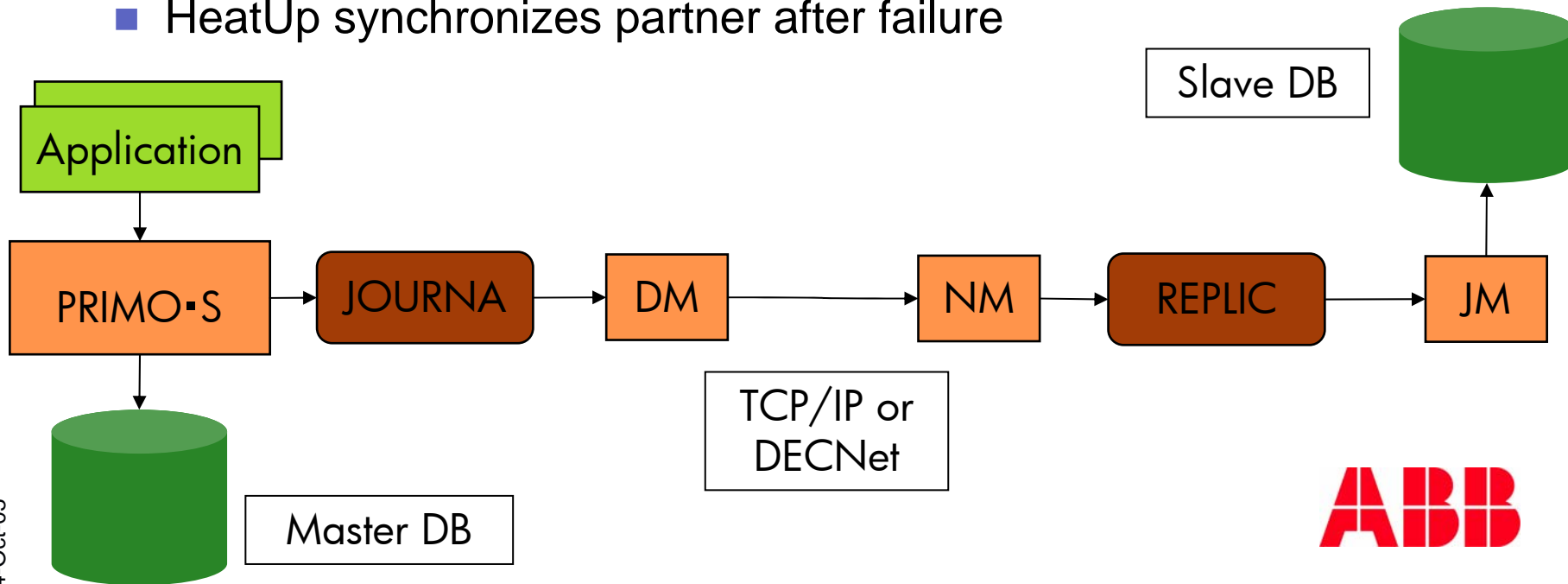
Message Arrays

- Has built-in inter-task communication
 - Technology called Message Arrays
 - Three times faster than VMS mailboxes
 - More than 100,000 send/receive per second
 - Powerful Message Monitor
 - Sender and receiver may be on a remote computer



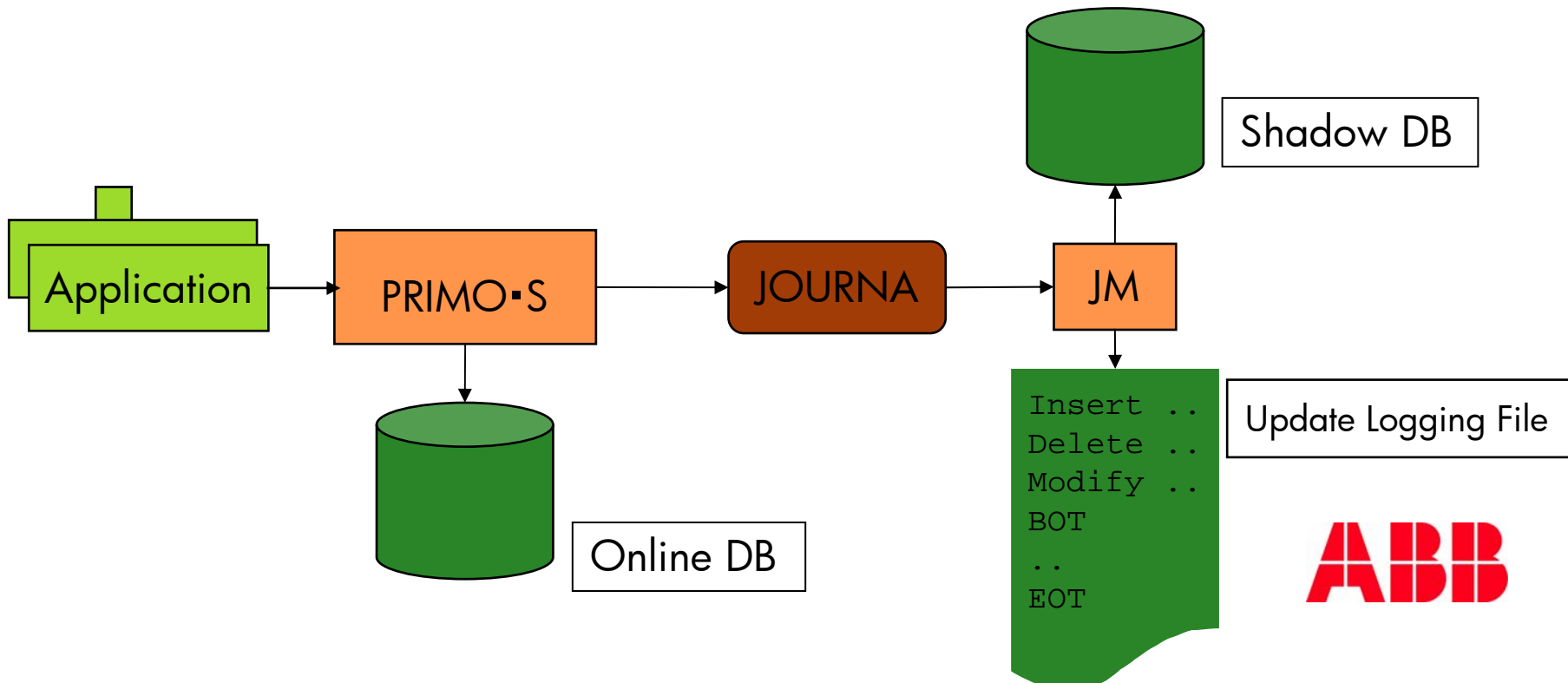
Replication

- Master/Slave principle to replicate data to partner host (may be foreign SQL db)
 - Replicates update event-driven
 - Several thousand per second
 - Signals errors by callback to user
 - HeatUp synchronizes partner after failure



Logging

- No data loss in failure situations
 - Recovery uses Shadow DB and Update Logging File
 - Logging may be local or remote, single or multiple
- Synchronization on-line of partner host after failure (HeatUp)



Standards

- **RPC – Remote Procedure Call**
 - Access remote PRIMO-S data base, e.g. from Client Windows to server HP-UX
 - Handles automatically
 - Little/big endian conversion
 - Different floating point formats
 - Very thin client: RPC DLL on Windows only 80 KB
- **SQL**
- **ODBC – Open Data Base Connectivity**
 - Access (foreign) server db from Windows
 - Use MS Access, Excel or Visual Basic as client



Code Generator

- Translate provided SQL statement into library routine
 - No more low level data base access programming
 - User heavily in many projects like STATOIL
 - Generates optionally test frames for generated code

```
C:> psvpcg "select isbnno, author from books where author=?"
psv_l_retcode pcg_sel( int          search_first /* in */
                    , Books_author_type  author_eql /* in */
                    , Books_isbnno_type *isbnno     /* out */
                    , Books_author_type  author     /* out */)
{
    psv_l_retcode      rtc;
    static psv_sql_handle  handle;
    static Books_author_type  my_author_eql;
    if (!handle)
    {
        rtc = psv_sql_prepare (&handle, "select isbnno, author from books where author=?");
        rtc = psv_sql_bind_param (handle, 1, my_author_eql, sizeof(Books_author_type));
    }
    rtc = psv_sql_fetch (handle);
    rtc = psv_sql_get_data (handle, 1, isbnno, sizeof(Books_isbnno_type));
    rtc = psv_sql_get_data (handle, 2, author, sizeof(Books_author_type));
    return rtc;
}
```



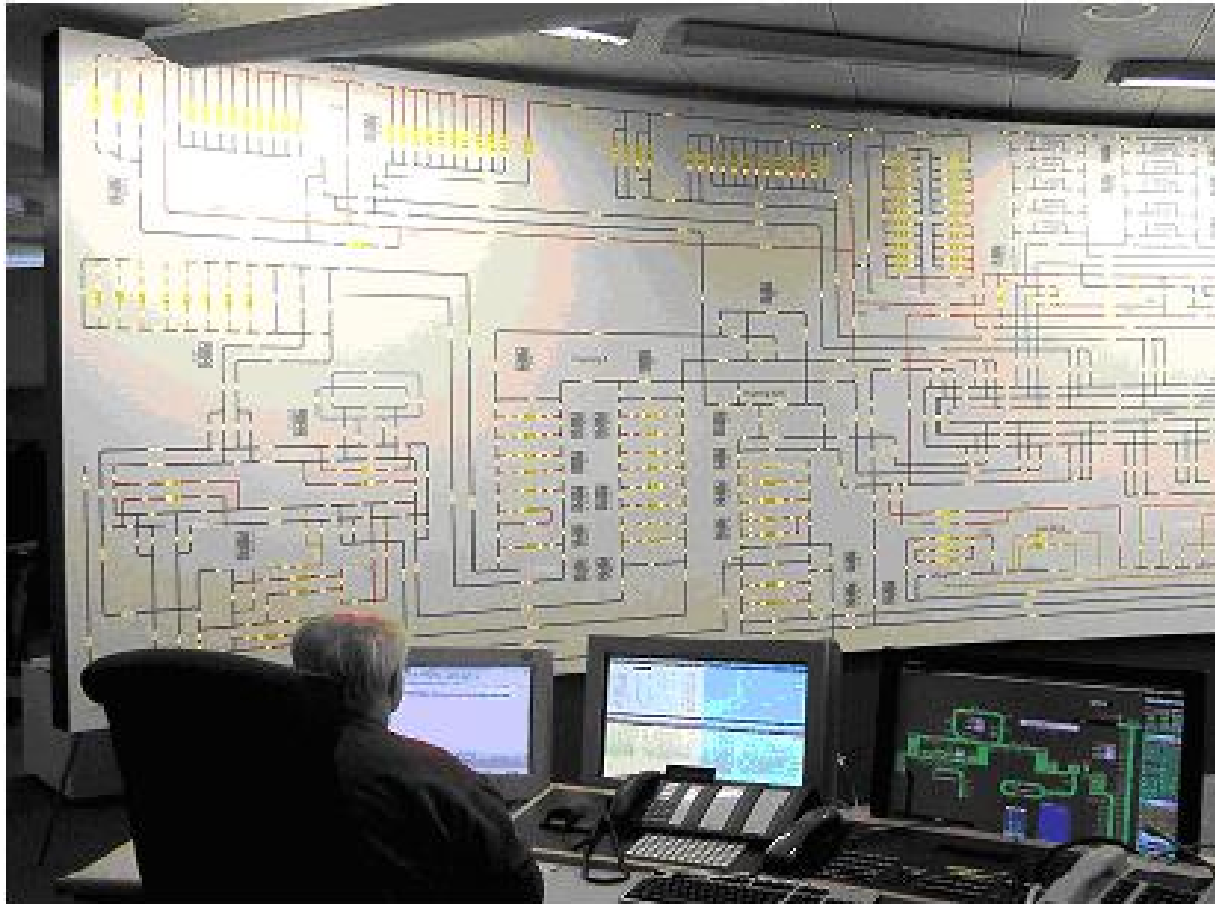
PRIMO-S Reference - FRAPORT

- Frankfurt Airport
 - Baggage Handling System called GFA (google for it)
 - Up to 100,000 pieces of luggage per day
 - 4 times 2 Alphas (each pair in a cluster)
 - Replace fault tolerant VAX with PRIMO-S redundancy concept Replication
 - 45 minutes guaranteed transfer time between flights
- Reasons for PRIMO-S
 - Performance
 - Replication for fast switch over in failure case



PRIMO-S Reference - FRAPORT

- Frankfurt Airport – Control room



Picture: FRAPORT



PRIMO-S Reference - STATOIL

- STATOIL - Snøwhit
 - Norwegian company the builds a huge liquefaction plant at the Arctic Circle close to Hammerfest
 - See www.statoil.com
 - PRIMO-S used in emulation system for the target plant and also for training of operators
 - Simulates 25 controllers in one PC
- Reasons for using PRIMO-S
 - Performance
 - Message Arrays for inter-task communication
 - Direct Access to data to fulfill extreme performance requirements



PRIMO-S Reference - STATOIL

- Snøwhit – Hammerfest - Melkøya



Picture: STATOIL



PRIMO-S Reference - STATOIL

- Melkøya



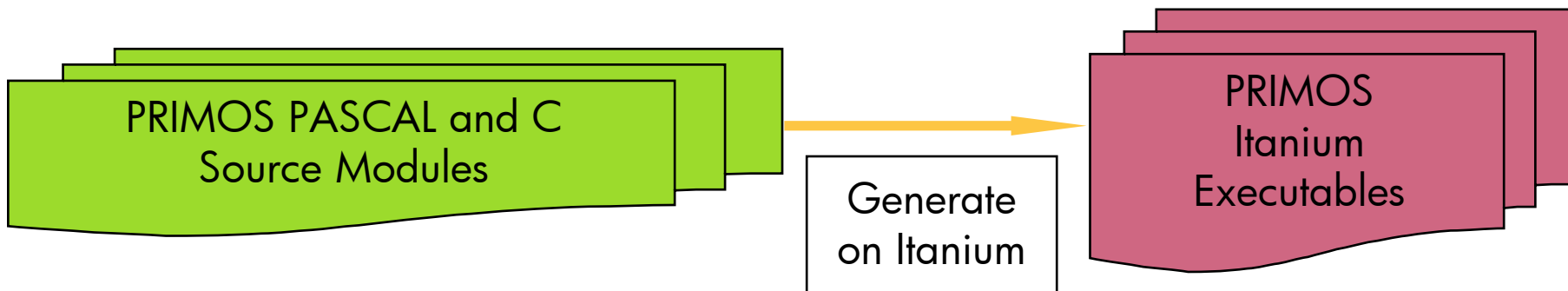
Picture: STATOIL



Preparing the Port

Dimension of Port

- 281 source modules to compile
 - Mostly written in Pascal
 - 66 in C
 - 3 in Macro-32 (VAX Macro!)
- 325,000 lines of code
- 49 Executables to be generated



The Porting Concept

- 2 Man Weeks effort in advance
- Aim: Identical generation as on Alpha
- Use in preparation exactly the sources as on target
- Use Zip/Unzip for Alpha and IA64 from Internet
- Read everything on Internet about Migration to Itanium
- Write paper how to proceed (2 pages)

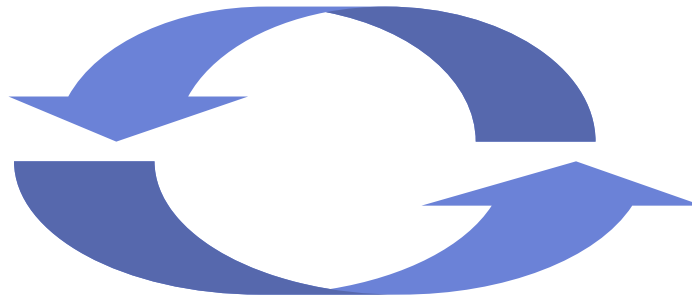
TODO List in Vienna

- Generate VMS user
- Install UNZIP
- Get all sources from CD
- ...



The Port Preparation Cycle (PPC)

- Collect all sources in single ZIP file (about 26MB)
 - Burn this ZIP on a CD, together with unzip
 - Create clean Alpha environment on empty disk
 - Mount CD and unzip source ZIP file into clean environment
 - Generate PRIMO-S in this environment
 - Run Simple Installation Test with generated EXEs
-
- About 10 serious problems identified and fixed:
 - Forgotten files
 - 'Dead' Objects
 - References to system environment files



”Challenging” Starting Conditions

- My Alpha was old (from 1995)
- VMS was old: V6.2 /target:8.2
- The UCX (TCPIP) was old 4.2/5.5
- The Pascal compiler was old: 5.7/5.9
- The C compiler was old: 6.0/7.1
- We support so far only one true 64 bit platform: TRU64



Positive Starting Conditions

- Intensive preparation
- We have porting experience
 - From pdp 11 to VAX
 - From VAX to many UNIX system
 - From VAX to Alpha
 - From Alpha to Windows
- PRIMO-S compiled on 15 different platform
- Programming Culture:
 - No warnings allowed
 - No dirty tricks
- PRIMO-S had never problems with VMS versions



Vienna

March 30, 2005

High noon

First Impressions on IDF, Vienna

- IDF environment extremely pleasant
- Immediate personal relationship to 'my' Itanium
 - Insert my source CD .. suspense
- Itanium OpenVMS feels 100% as Alpha OpenVMS
- No problems with UNZIP for IA64
- Certain pressure since ABB colleagues are waiting for my port result ..
- Start the engines ..



'My' Itanium – ABB2



Hardworking in Vienna



Porting Results

- Successful generation at 12:05, 30.3.2005 in 8 minutes on IA64
 - *** PSV_GEN: End Kit Generation at 30-MAR-2005 12:05:46 (7:47 minutes)
- Successful Simple Installation Test in 2 minutes
- Deliver PRIMO-S Kit to ABB colleges at 16:00 on other ABB IA64 machine (ZIP size: 8 MB)
- 70 automatic tests (Kit Release Test) to 80 % successful
 - Differences in floating formats
 - Differences in IP addresses, host names
 - Timings



Some Performance Figures

- Compare 'old' Alpha to new Itanium

Activity	Alpha 3000/600	IA64 rx1620
Generation	49 min	8 min
Installation	8 min	2 min
Simple Installation Test	8 min	2 min
# Accesses per second	12,000	200,000
Release Test	4:14 hours	1:58 hours



Problems during Port

- IF ““PSV_ARCHI““.EQS. “Alpha“ ..
 - Architecture is „IA64“ on Itanium
 - DCL runs in wrong ELSE
 - Cheat with PSV_ARCHI == Alpha ...
- Different error codes and error messages
- Different floating formats

```
* FBI_DIFF: DIFFERENCES in CaseTest PSU/TSTUTYUSE.REF
*****
File SYS$SYSDEVICE:[PRIMOS.PSVKIT.SRC.PSU.TST]TSTUTYUSE.REF_I;2
 649      1 /      1 # 1.41280999999999989924504006921779364347 |
 650
*****
File SYS$SYSDEVICE:[PRIMOS.PSVKIT.SRC.PSU.TST.LOG]TSTUTYUSE.LOG_I;2
 649      1 /      1 # 1.41280999999999989924504006921779364300 |
 650
*****
* FBI_DIFF: END of DIFFERENCES in CaseTest PSU/TSTUTYUSE.REF
* VERIFY: Run post.com for CaseTest TSTUTYUSE
*** VERIFY: End kit_test for CaseTest PSU/TSTUTYUSE at 22:42:41
```



Compare midrange
Alpha with low end
Titanium

Comparison Alpha and Itanium

- Alpha ES45 and Itanium rx1620
- PRIMO-S Kit Installation in both cases ca. 2 minutes
- Data Access Times on both machines 5 microseconds (200,000 accesses per second)
- **Result:**
 - rx1620 performs like an ES45
- EXE on Itanium have about double size of EXE on Alpha



Today ..

The Situation Today (September 2005)

- 'My' Itanium arrived in Mannheim
- Integrated in ABB Intranet
- Rework Release Test to work in Itanium without differences
- Release Tests at 100 %
- No code change so far for Itanium
- Plan to release PRIMO-S on Itanium in November 2005



PRIMO-S Live Demo

- Generate a database
 - Table with 20,000 rows
 - With a 12-character key
- Fill it with dummy data
- Measure search time
 - search each key 200 times
 - measure the needed time
 - compute average access time
- Monitor database activities
 - 4,020,010 data base accesses
- Your expectations?



The PRIMO-S OpenVMS TUD Demo CD

- Contains full versions for
 - Itanium OpenVMS
 - Alpha OpenVMS
 - Windows
 - .. With certain restrictions in terms of sizes ..
- For each platform there is a README
 - .. With installation instructions
 - .. Startup hints to get it going
- There is full documentation in HTML format
- You get it for your business card ..



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