# A New Low Level Processor for the DAFNE Control System

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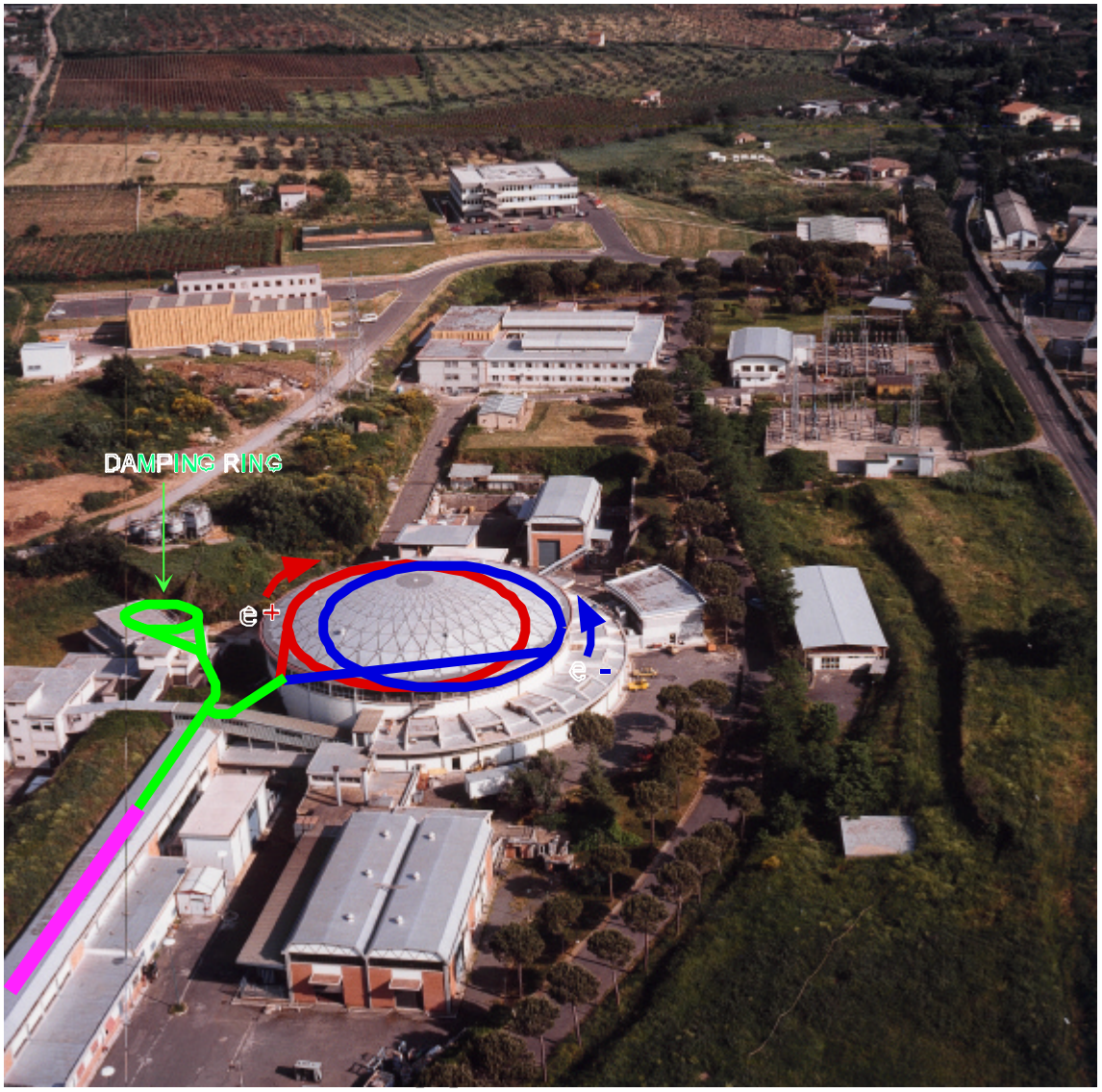
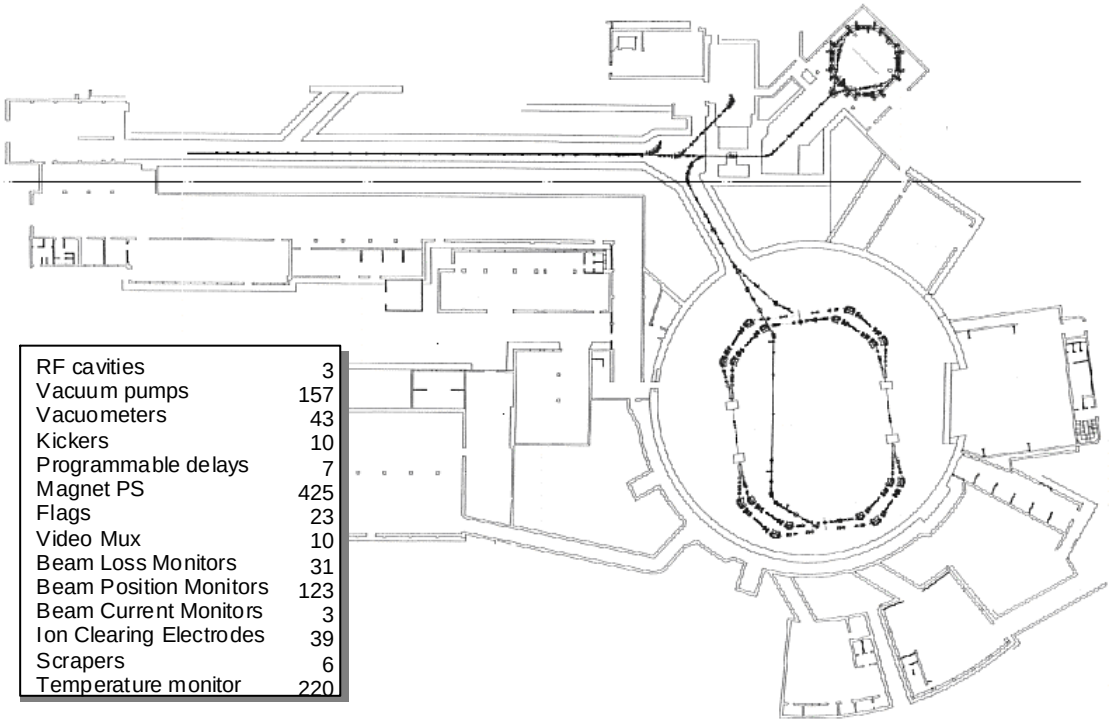
INFN-LNF Italy

# The DAFNE e+/e- ? -factory



# DAFNE layout



| | |
|---|---|
| RF cavities | 3 |
| Vacuum pumps | 157 |
| Vacuometers | 43 |
| Kickers | 10 |
| Programmable delays | 7 |
| Magnet PS | 425 |
| Flags | 23 |
| Video Mux | 10 |
| Beam Loss Monitors | 31 |
| Beam Position Monitors | 123 |
| Beam Current Monitors | 3 |
| Ion Clearing Electrodes | 39 |
| Scrapers | 6 |
| Temperature monitor | 220 |

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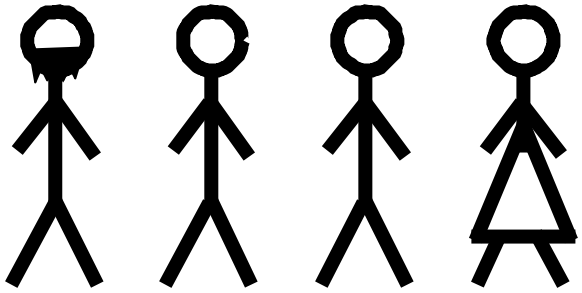
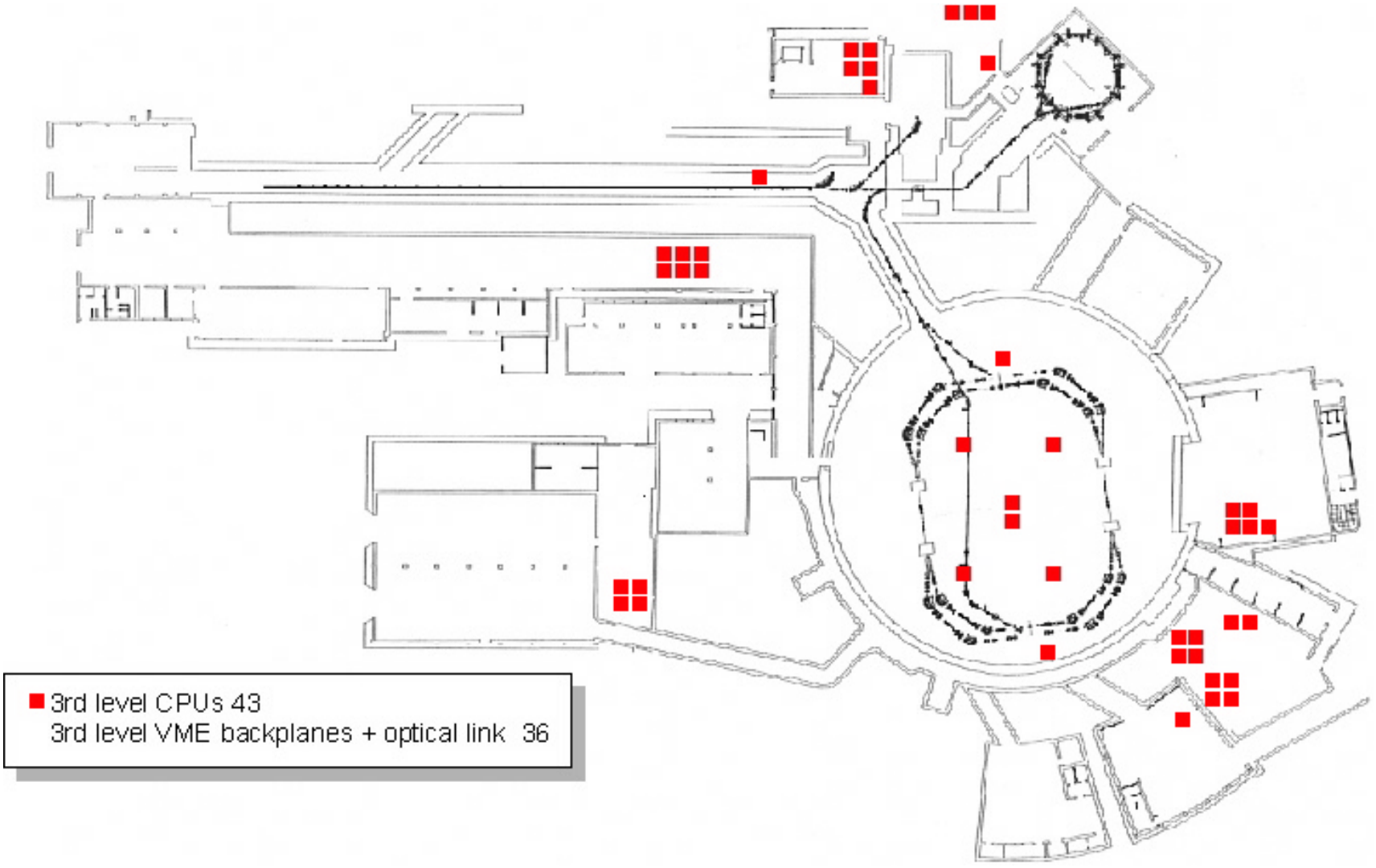
# Design statements



- Commercial technologies as  much as possible
- Easy development and maintenance
- Personal computers with native OS everywhere
- LabVIEW® as development environment for all the software
- Industrial VME bus for front-end interfaces

# 3rd level CPUs location



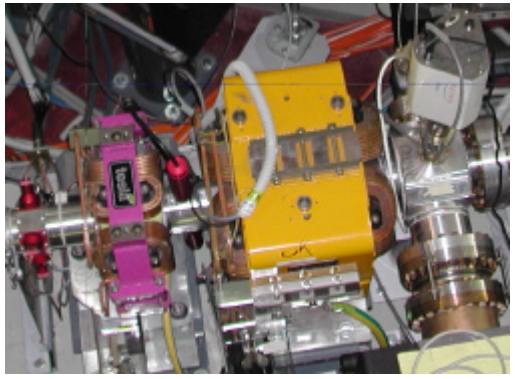
# Main operation in a control system

- Data taking
- Display
- Analysis
- Command execution

How to manage the data taking

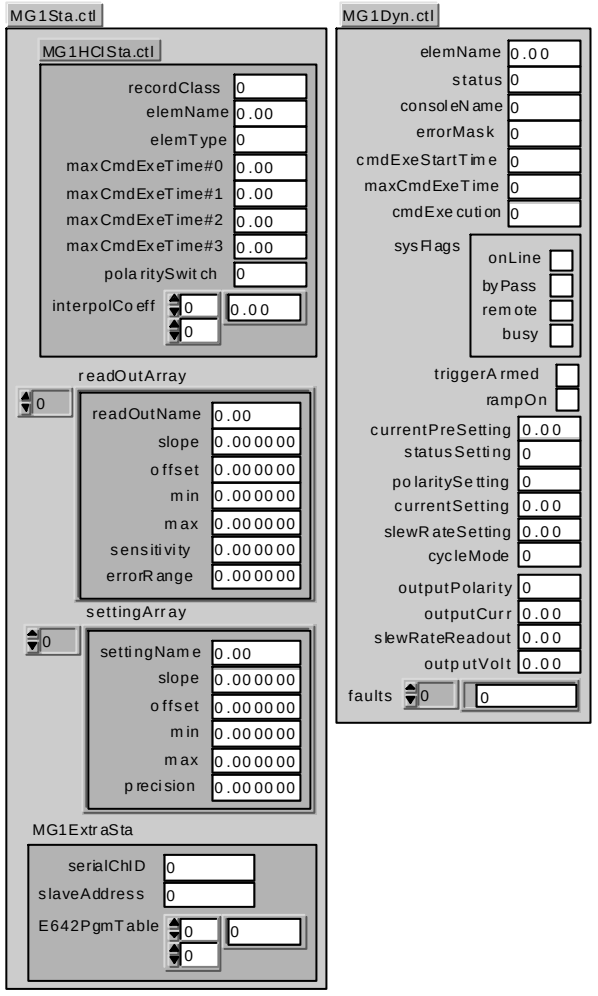
A simple way is the direct memory access

# Object abstraction

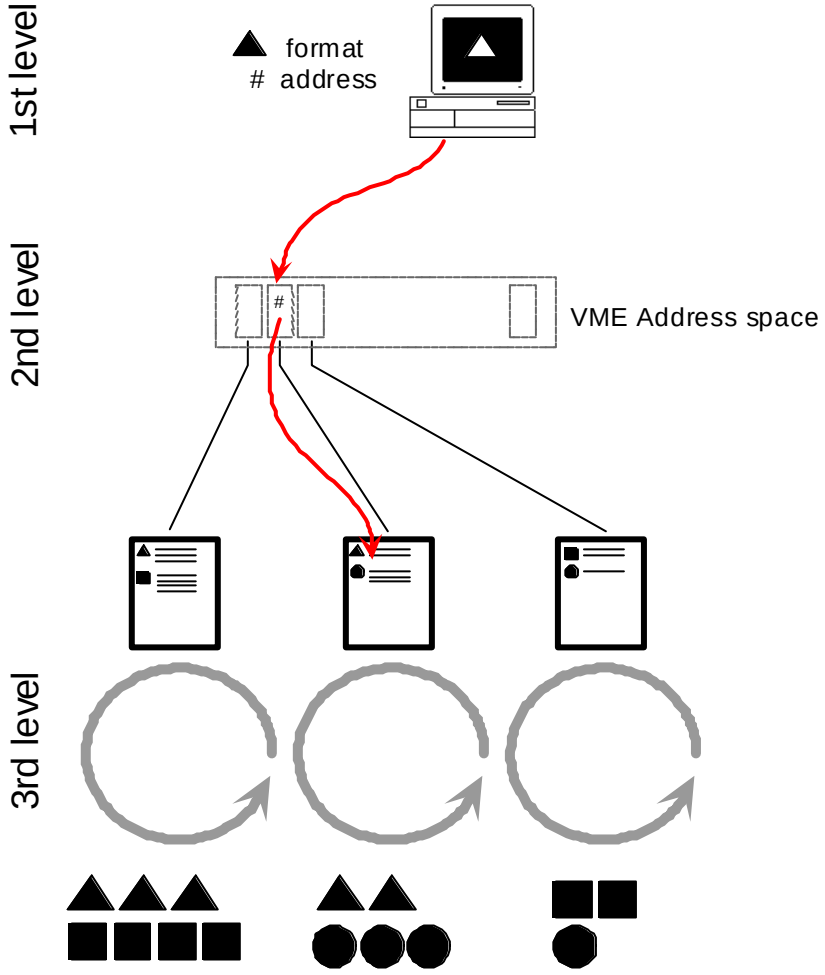


static variables (parameters)

dynamic variables

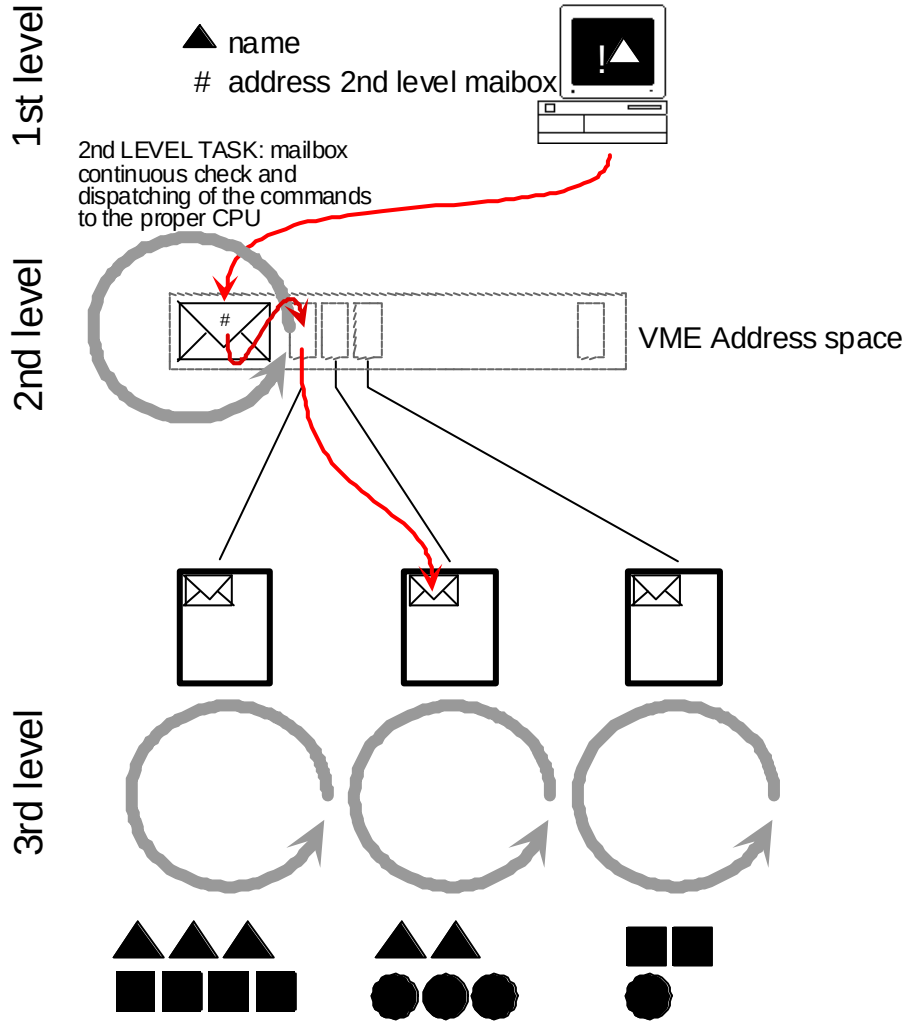


# Readout



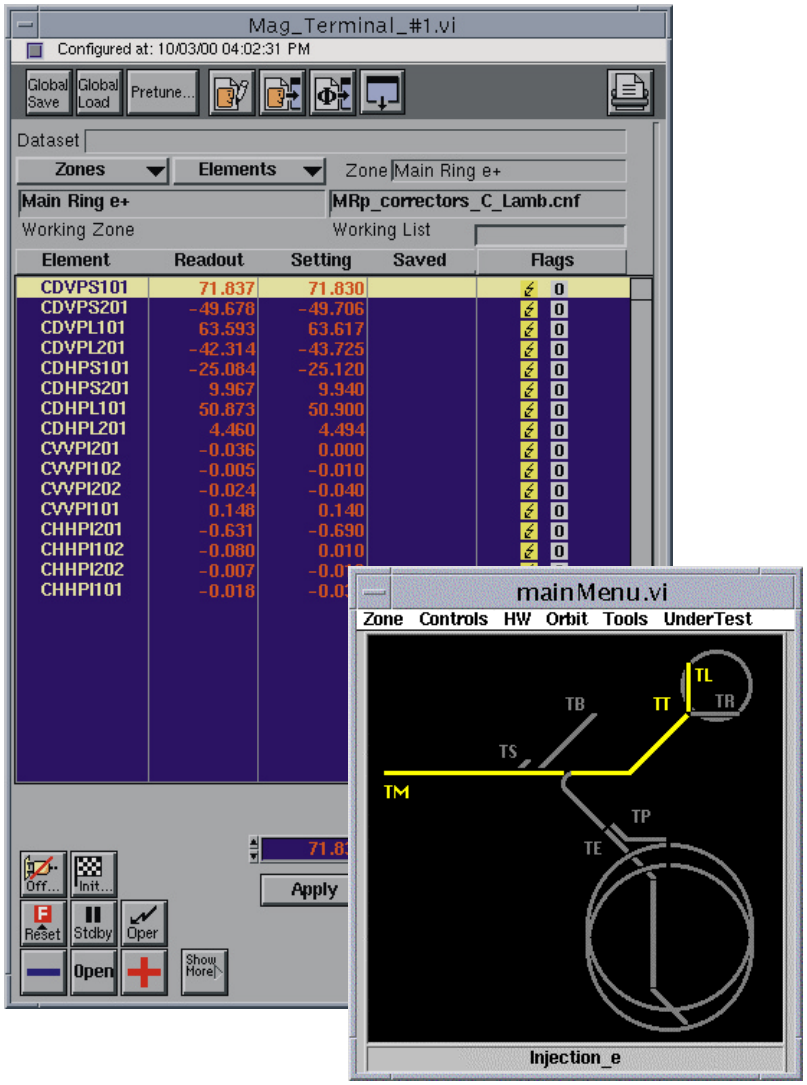

CONTROL TASK: elements continuous check and refresh of their representative records into the VME memory

# Commands dispatching

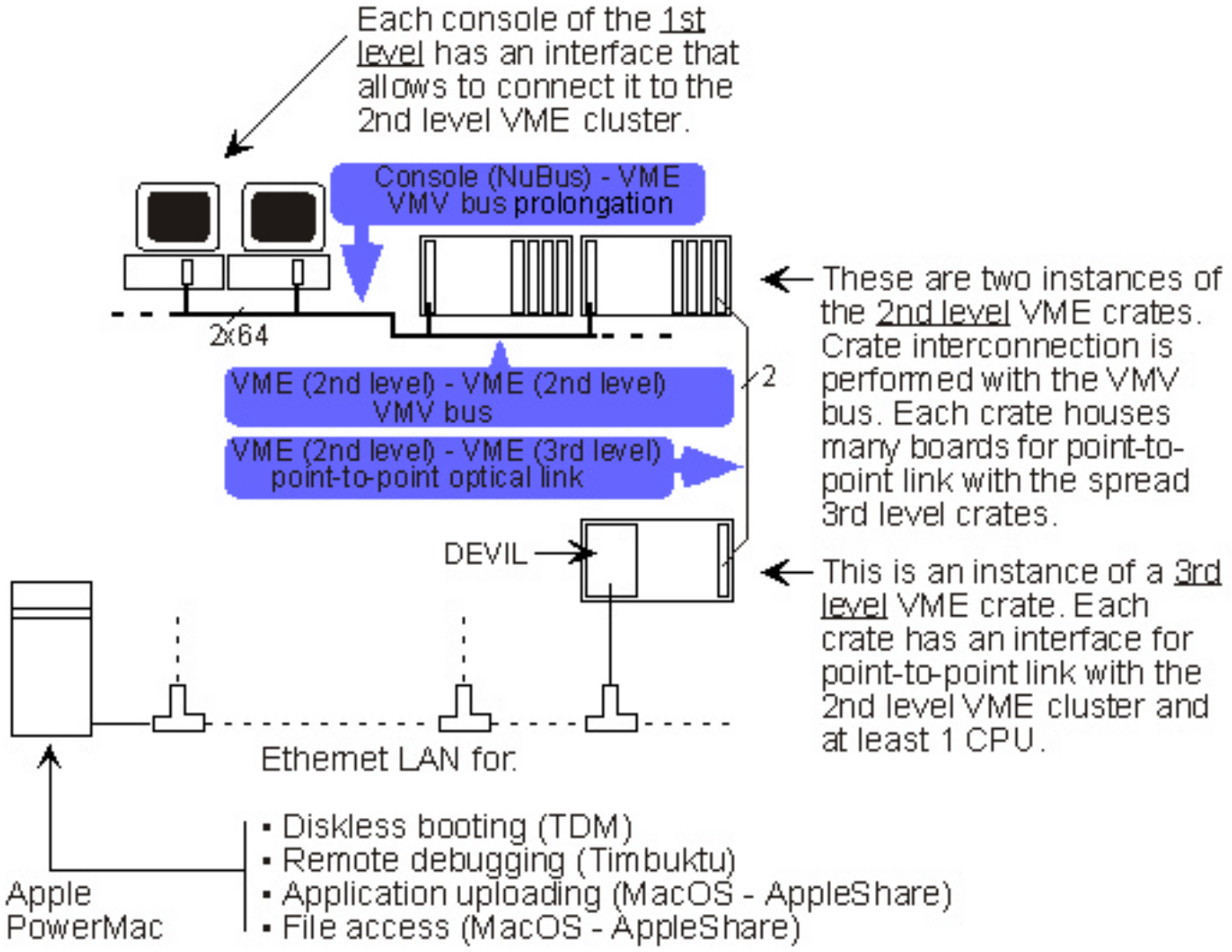



command reception and execution on the element

# Object operation

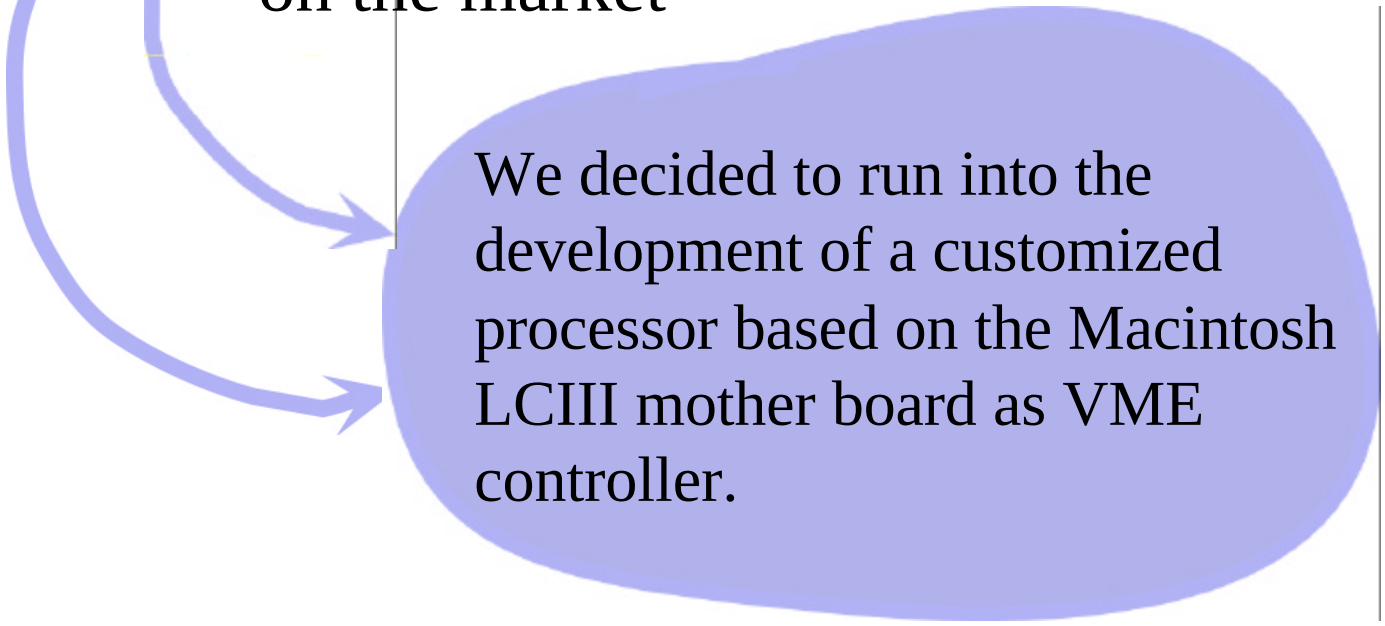


# System I implementation



# How to match the design statements with the available SW & HW at that time

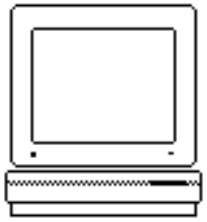
- LabVIEW® was available only for Macintosh
- No VME controller based on Macintosh present on the market



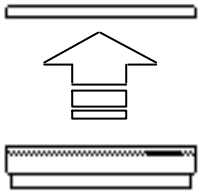
- The result was the DEVIL (DEvice for Virtual Instrument at Low level) a full operative Macintosh 68030 computer joint to an interface performing all the VME System Controller functions

# DEVIL DEvice for Virtual Instrument at Low level

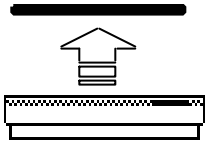
- CPU 68030 @25 MHz + math co-processor 68882
- 4 Mbyte VME RAM + Macintosh RAM (4-32 Mbyte)
- Ethernet 10 base t
- triple port memory (VME - VSB - Mac)
- ARBITER / NO ARBITER



Take a Mac LCIII

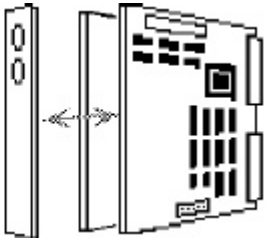


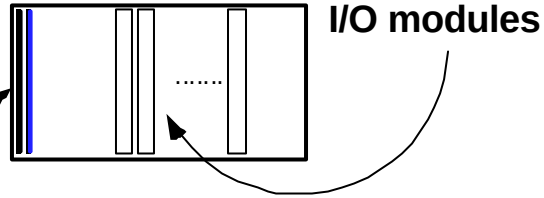
Open it and...



take the logic board

Join the board to a proper interface

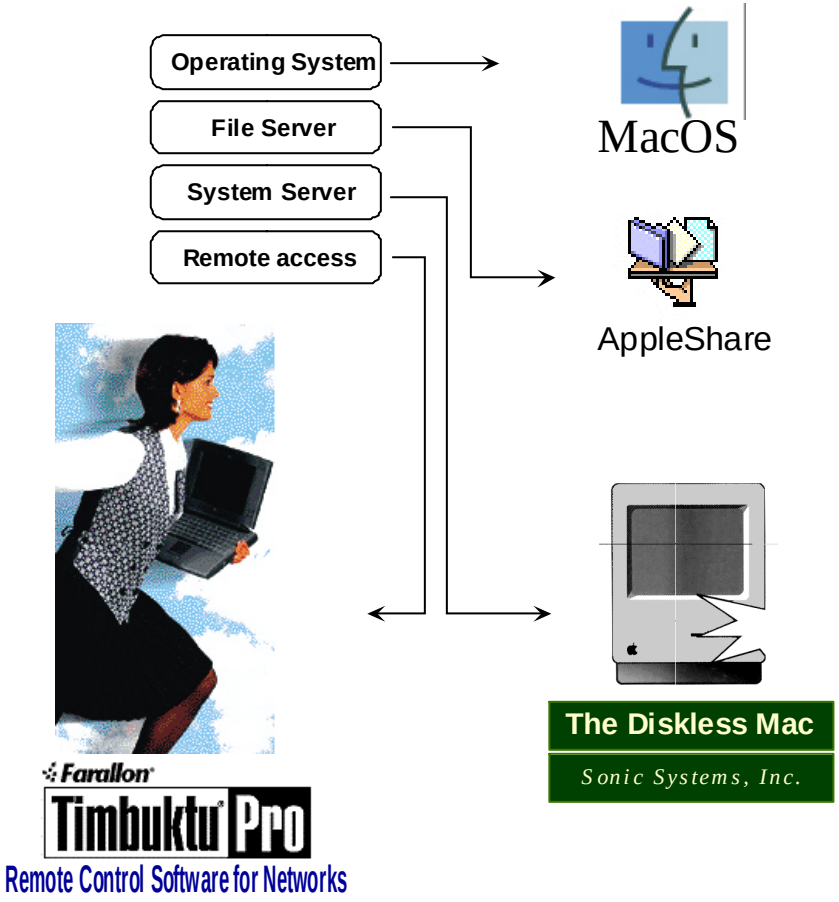




I/O modules

Put the DEVIL into a VME crate a peripheral CPU

# How to manage a wide PC ensemble with OTS products (our choice at that time)



The system VERSION I main peculiarities were:

- **true** memory mapping of the central virtual memory into the consoles internal address space
- **uniform** hardware and OS (Macintosh at any level)
- **full** accomplishment of the design statements

1st level

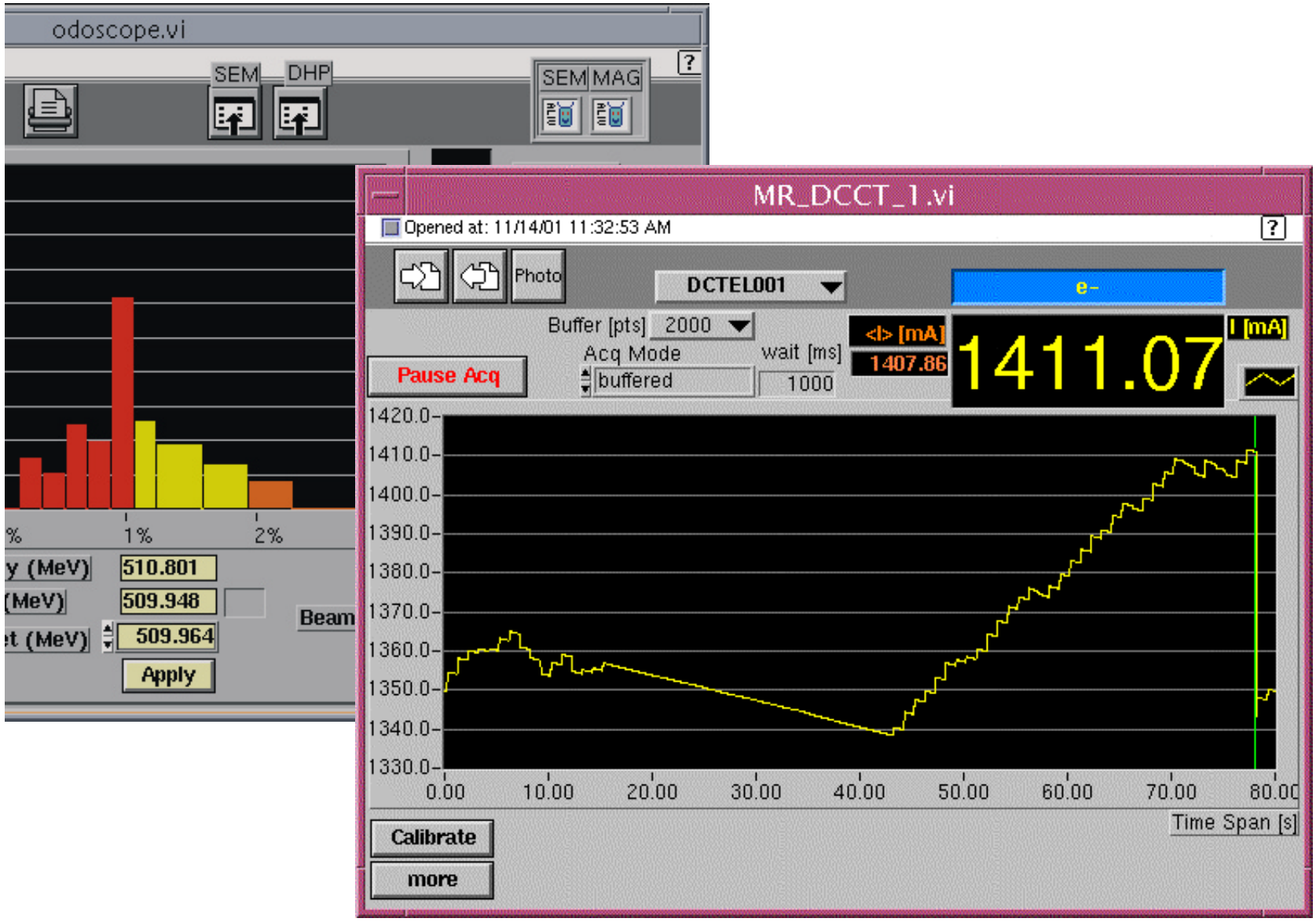
MacOS

2nd level

MacOS

3rd level

MacOS


odoscope.vi
SEM
DHP
SEM MAG
%
1%
2%
y (MeV)
510.801
(MeV)
509.948
t (MeV)
509.964
Apply
Beam
MR_DCCT_1.vi
Opened at: 11/14/01 11:32:53 AM
Photo
DCTEL001
e-
Buffer [pts]
2000
Acq Mode
buffered
wait [ms]
1000
Pause Acq
<I> [mA]
1407.86
1411.07
I [mA]
1420.0
1410.0
1400.0
1390.0
1380.0
1370.0
1360.0
1350.0
1340.0
1330.0
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Time Span [s]
Calibrate
more

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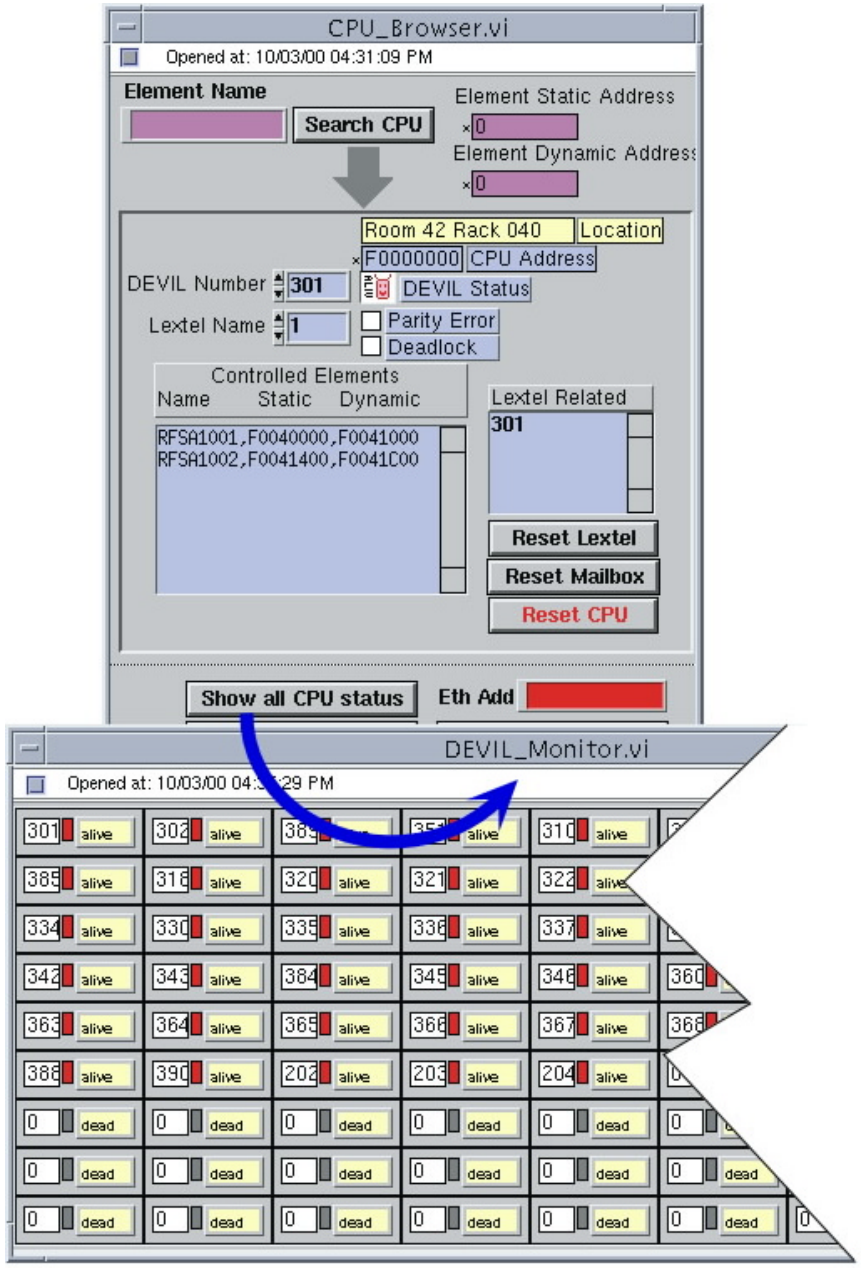
CPU_Browser.vi
Opened at: 10/03/00 04:31:09 PM
Element Name
Search CPU
Element Static Address
0
Element Dynamic Address
0
Room 42 Rack 040
Location
F0000000
CPU Address
DEVIL Number
301
DEVIL Status
Lextel Name
1
Parity Error
Deadlock
Controlled Elements
Name Static Dynamic
RFSA1001,F0040000,F0041000
RFSA1002,F0041400,F0041C00
Lextel Related
301
Reset Lextel
Reset Mailbox
Reset CPU
Show all CPU status
Eth Add
DEVIL_Monitor.vi
Opened at: 10/03/00 04:
alive
dead

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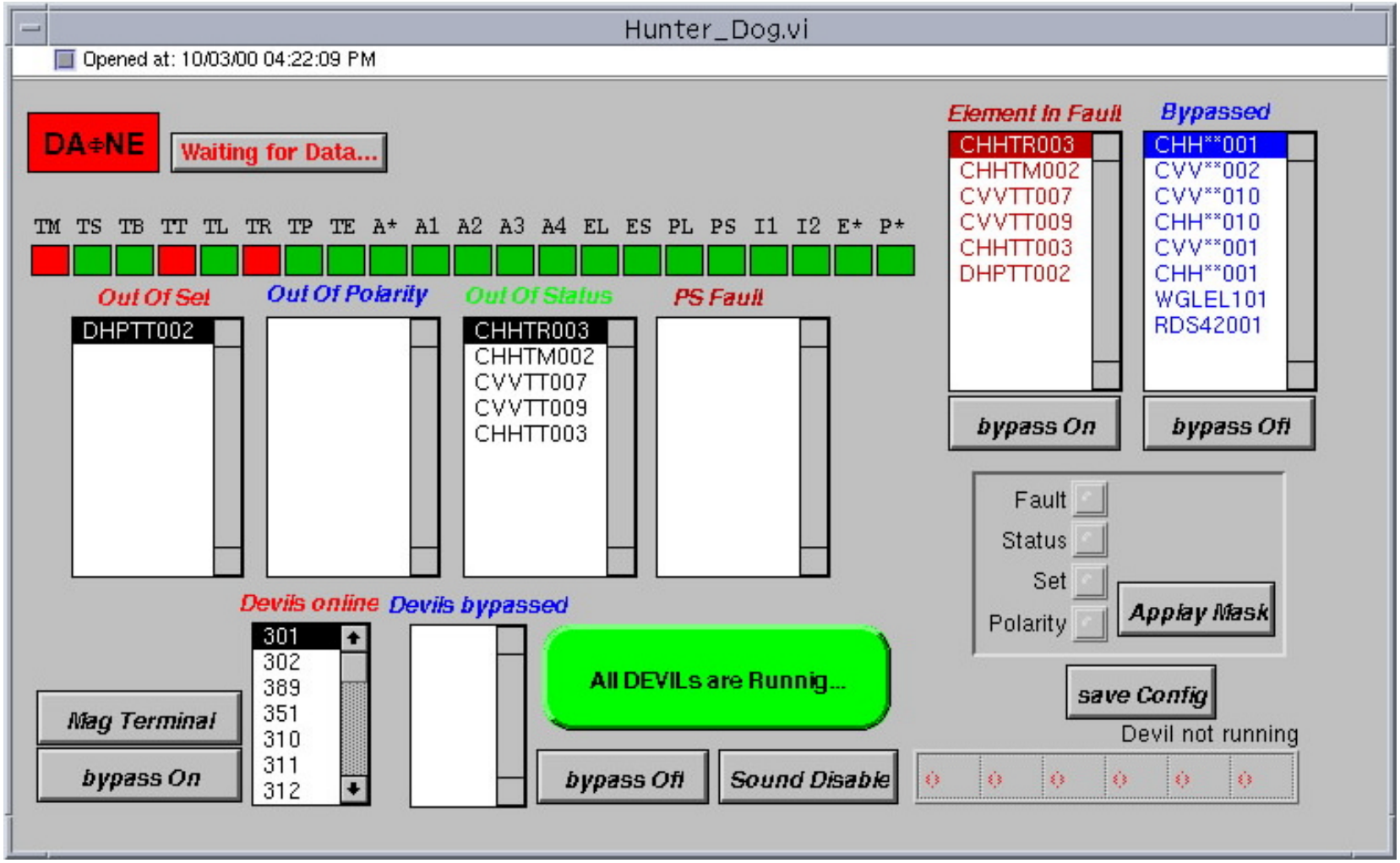
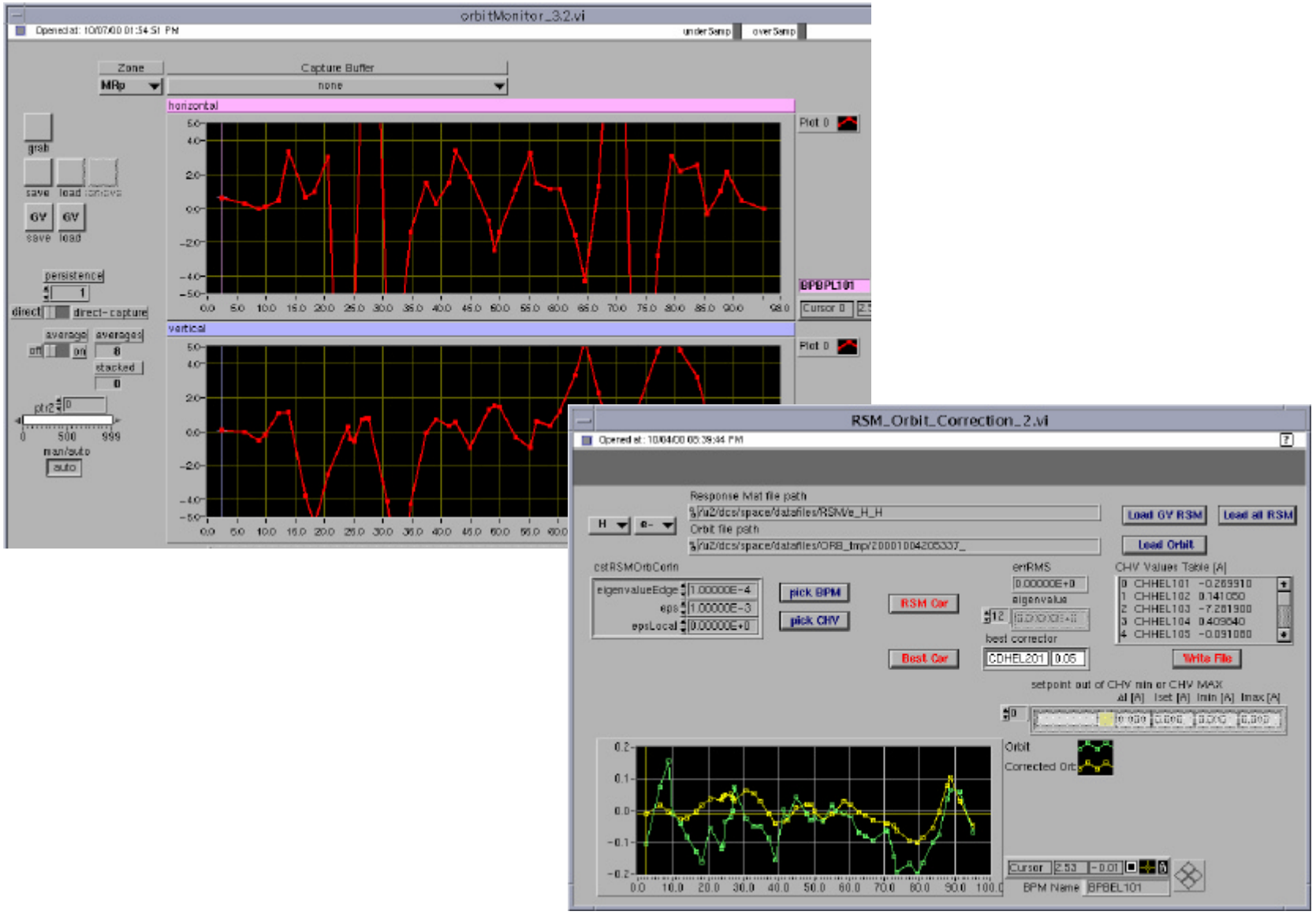

Hunter_Dog.vi
Opened at: 10/03/00 04:22:09 PM
DA⊕NE
Waiting for Data...
TM TS TB TT TL TR TP TE A* A1 A2 A3 A4 EL ES PL PS I1 I2 E* P*
Out Of Set
DHPTT002
Out Of Polarity
Out Of Status
CHHTR003
CHHTM002
CVVTT007
CVVTT009
CHHTT003
PS Fault
Element In Fault
CHHTR003
CHHTM002
CVVTT007
CVVTT009
CHHTT003
DHPTT002
Bypassed
CHH**001
CVV**002
CVV**010
CHH**010
CVV**001
CHH**001
WGLEL101
RDS42001
bypass On
bypass Ofl
Fault
Status
Set
Polarity
Applay Mask
save Config
Devil not running
Devils online
Devils bypassed
301
302
389
351
310
311
312
All DEVILs are Runnig...
Mag Terminal
bypass On
bypass Ofl
Sound Disable


orbitMonitor_3.2.vi
Zone
MRp
Capture Buffer
none
horizontal
vertical
grab
save
load
GV
persistence
direct
direct-capture
average
averages
stacked
man/auto
auto
Plot 0
BPBPL101
Cursor 0
RSM_Orbit_Correction_2.vi
Response Mat file path
Orbit file path
Load GV RSM
Load all RSM
Load Orbit
eigenvalueEdge
eps
epsLocal
pick BPM
pick CHV
RSM Cor
Best Cor
eigenvalue
best corrector
CDHEL201
0.05
CHV Values Table [A]
Write File
setpoint out of CHV min or CHV MAX
Orbit
Corrected Orbit
Cursor
BPM Name
BPBEL101

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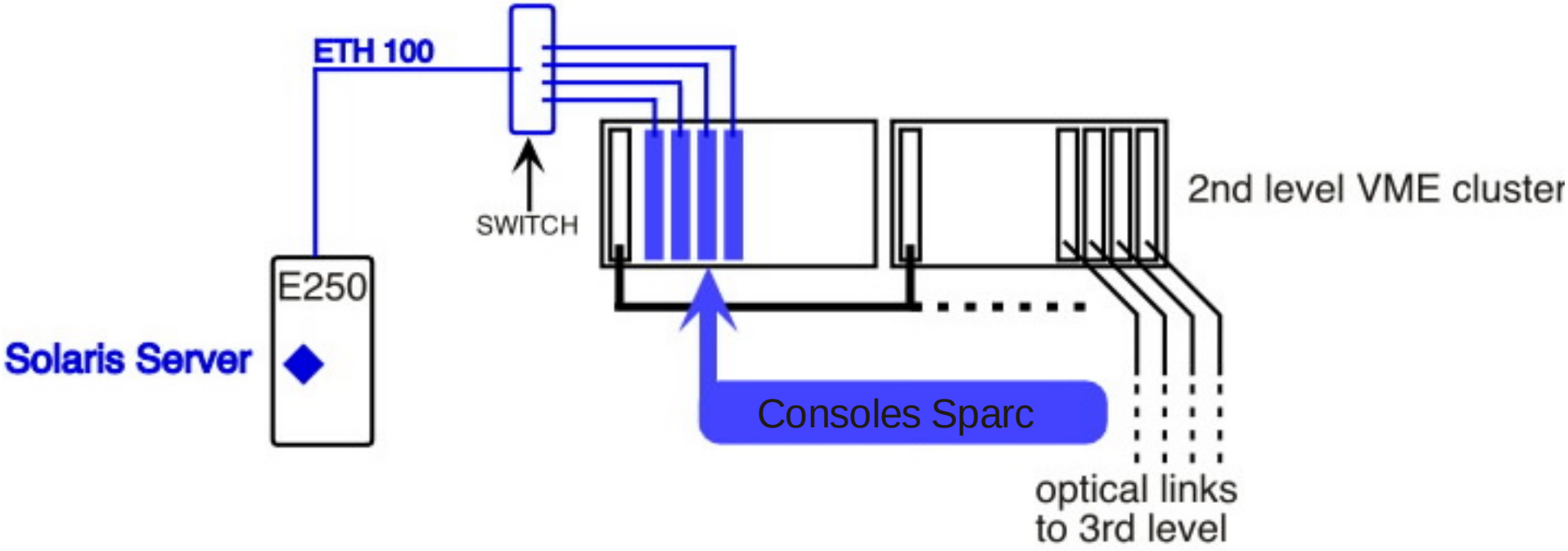
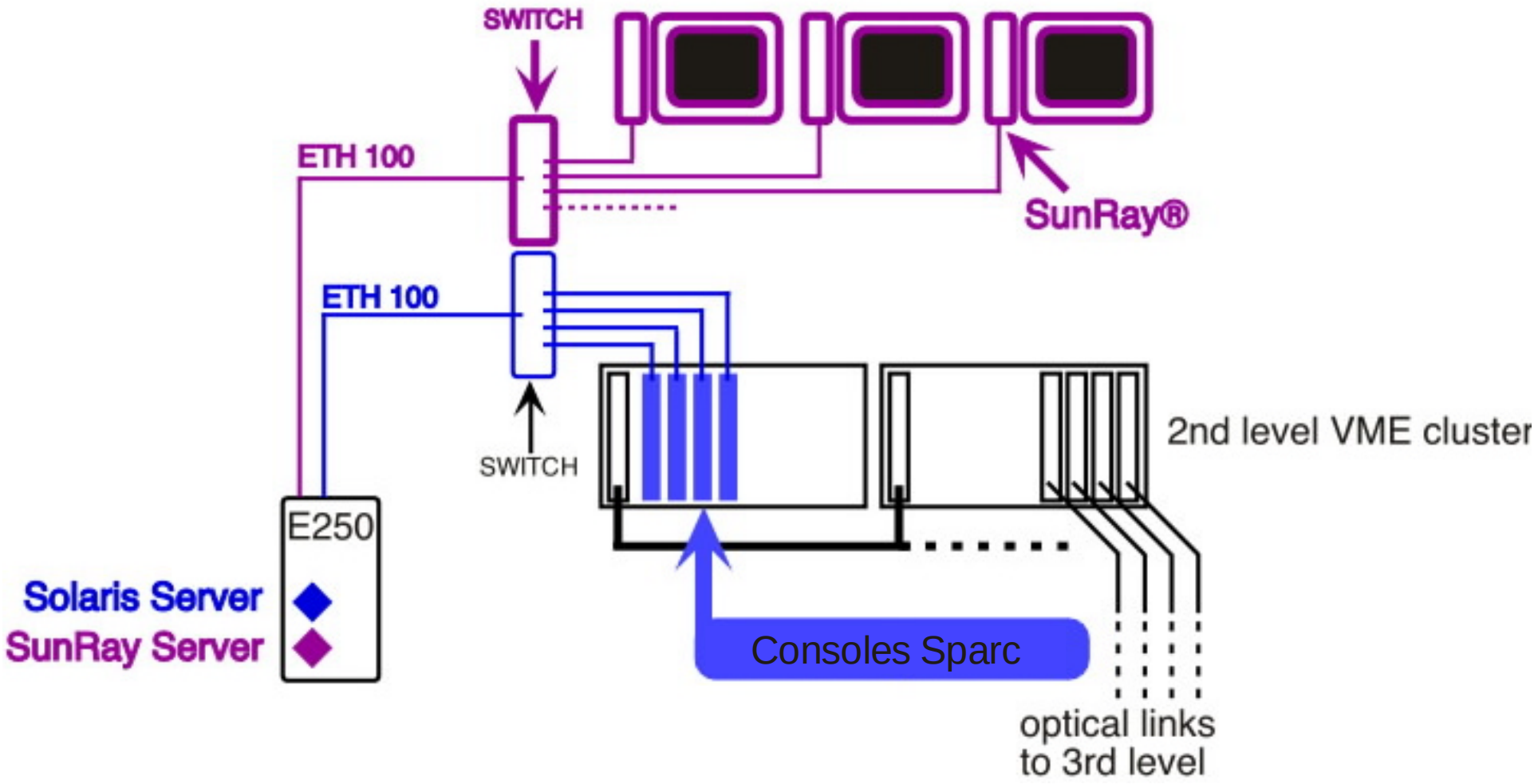
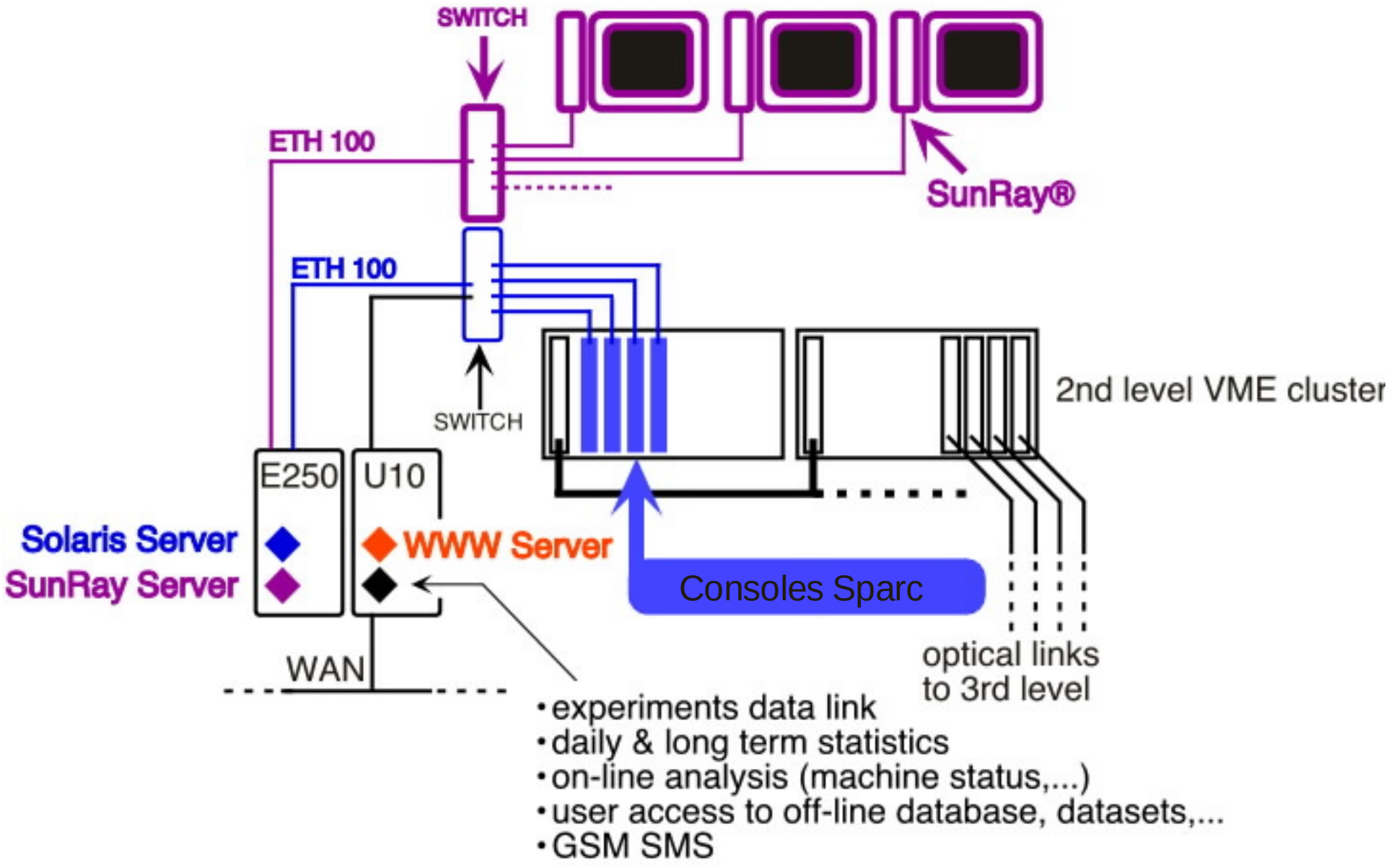
# System II

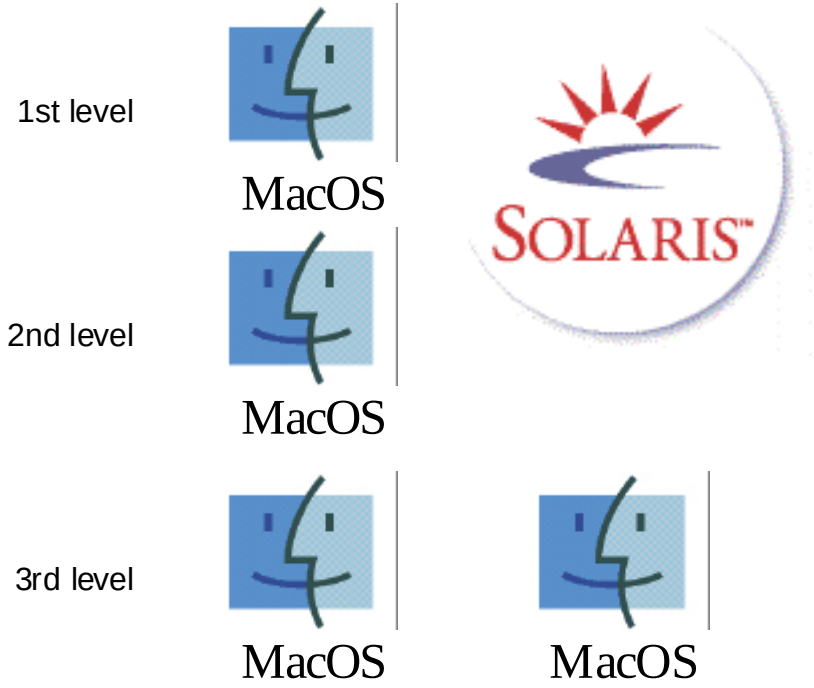

ETH 100
SWITCH
E250
Solaris Server
2nd level VME cluster
Consoles Sparc
optical links
to 3rd level

# System II


SWITCH
ETH 100
SunRay®
ETH 100
SWITCH
2nd level VME cluster
E250
Solaris Server
SunRay Server
Consoles Sparc
optical links
to 3rd level

# System II


SWITCH
ETH 100
SunRay®
ETH 100
SWITCH
2nd level VME cluster
E250
U10
Solaris Server
SunRay Server
WWW Server
Consoles Sparc
WAN
optical links
to 3rd level
•experiments data link
•daily & long term statistics
•on-line analysis (machine status,...)
•user access to off-line database, datasets,...
•GSM SMS

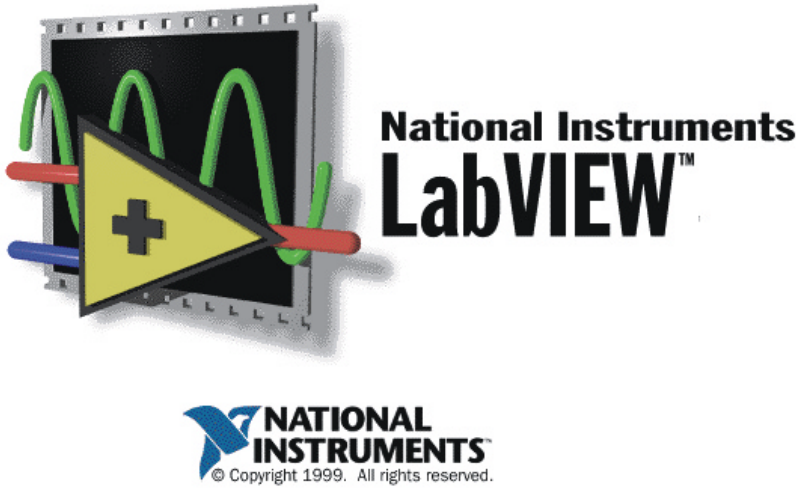

1st level
MacOS
SOLARIS
2nd level
MacOS
3rd level
MacOS
MacOS

# Why to upgrade something which is working?

The upgrade of 3rd level layer of CPUs become essential for more than one reason.

- we are running out of spare CPUs;
- the new LabVIEW version does not run on 68K processors;
- dealing with MacOS 7, the remote development and debugging is hard to do.

# Constrains!




- VME as front end bus

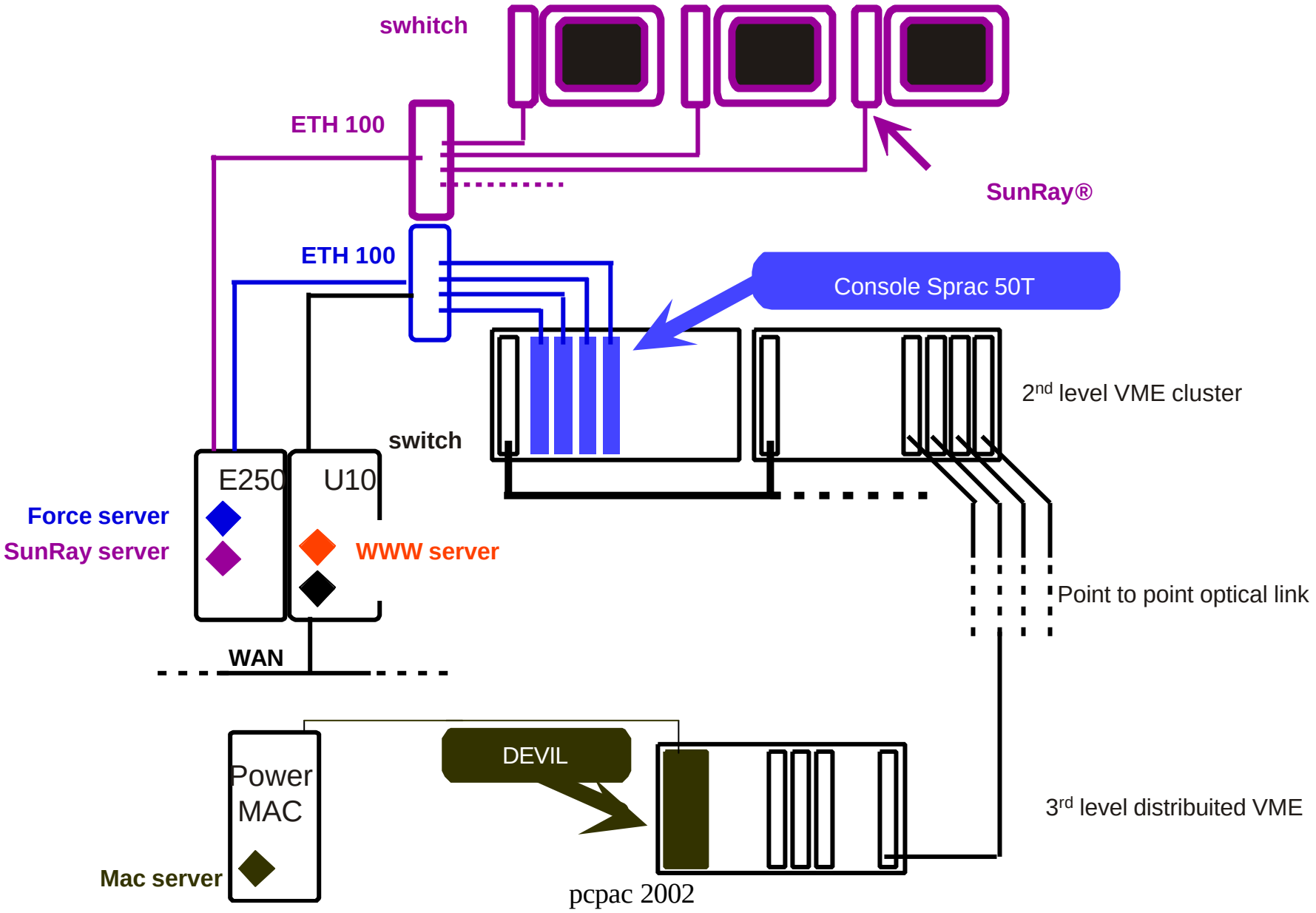
# The new CPU

On the base of our precedent experience we looked for a VME controller which could allow us to reuse all the existing LabVIEW software even onto a different platform.

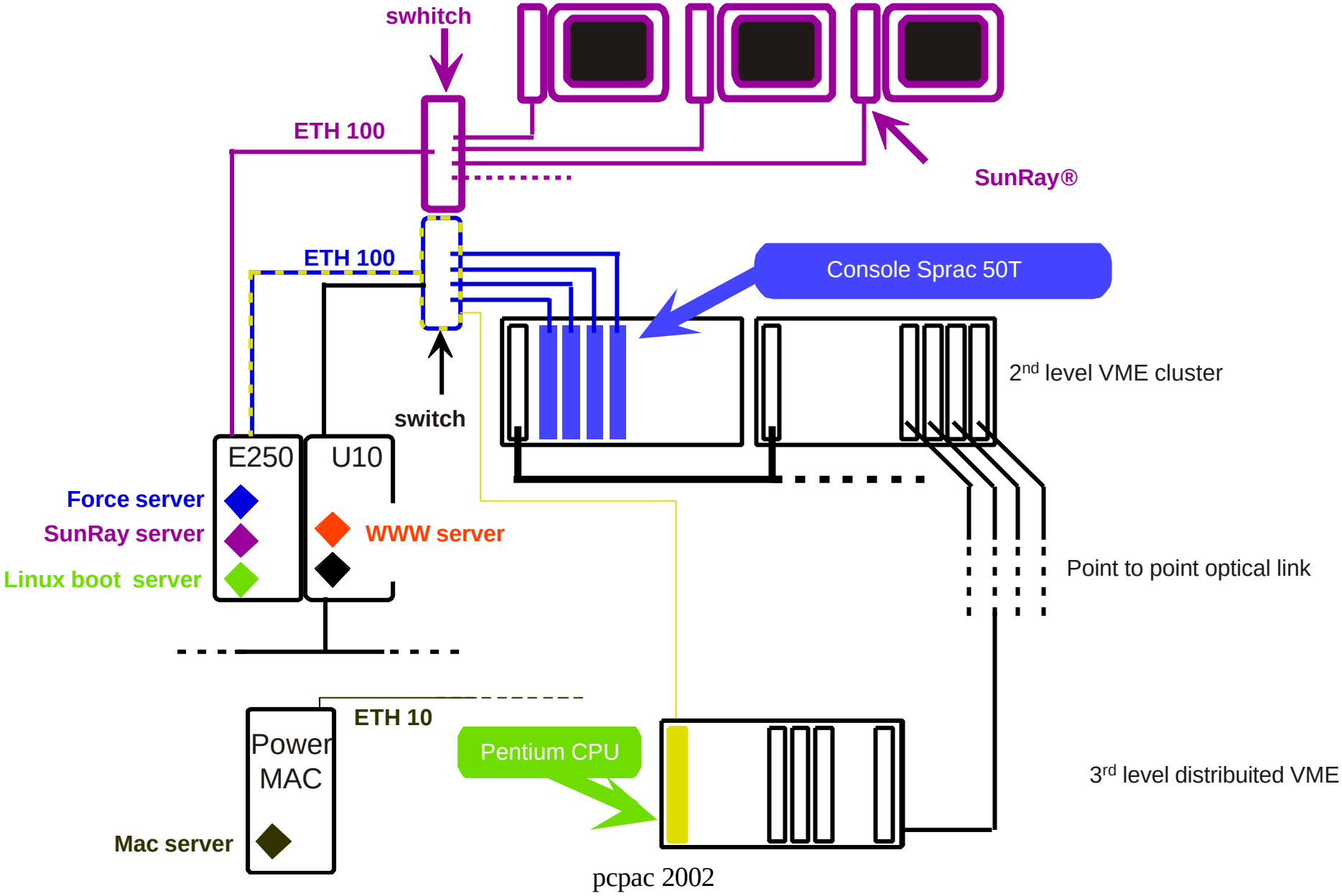
This led to choose a Pentium diskless board  with Linux OS, which match all the new requirements and still has a reasonable cost.

Nowadays we need to write the basic VME access routines and we plan to put the new 3rd level CPU on the control system at the beginning of 2003.

# System II


swhitch
ETH 100
SunRay®
ETH 100
Console Sprac 50T
2nd level VME cluster
switch
E250
U10
Force server
SunRay server
WWW server
Point to point optical link
WAN
Power
MAC
Mac server
DEVIL
3rd level distribuited VME
pcpac 2002

# System III

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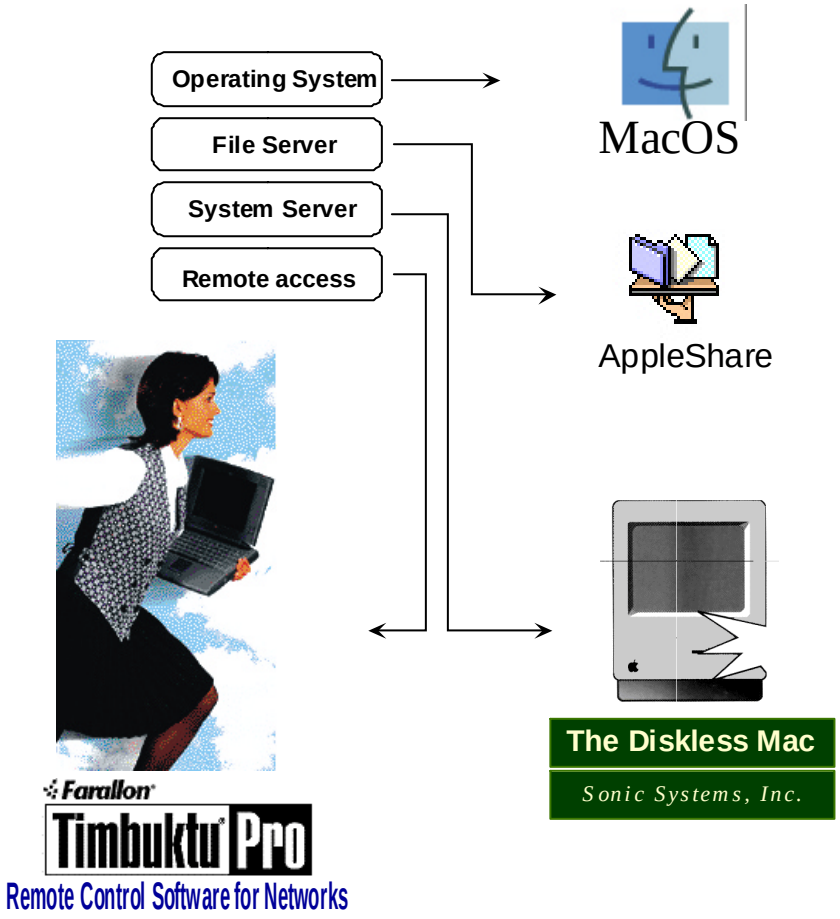
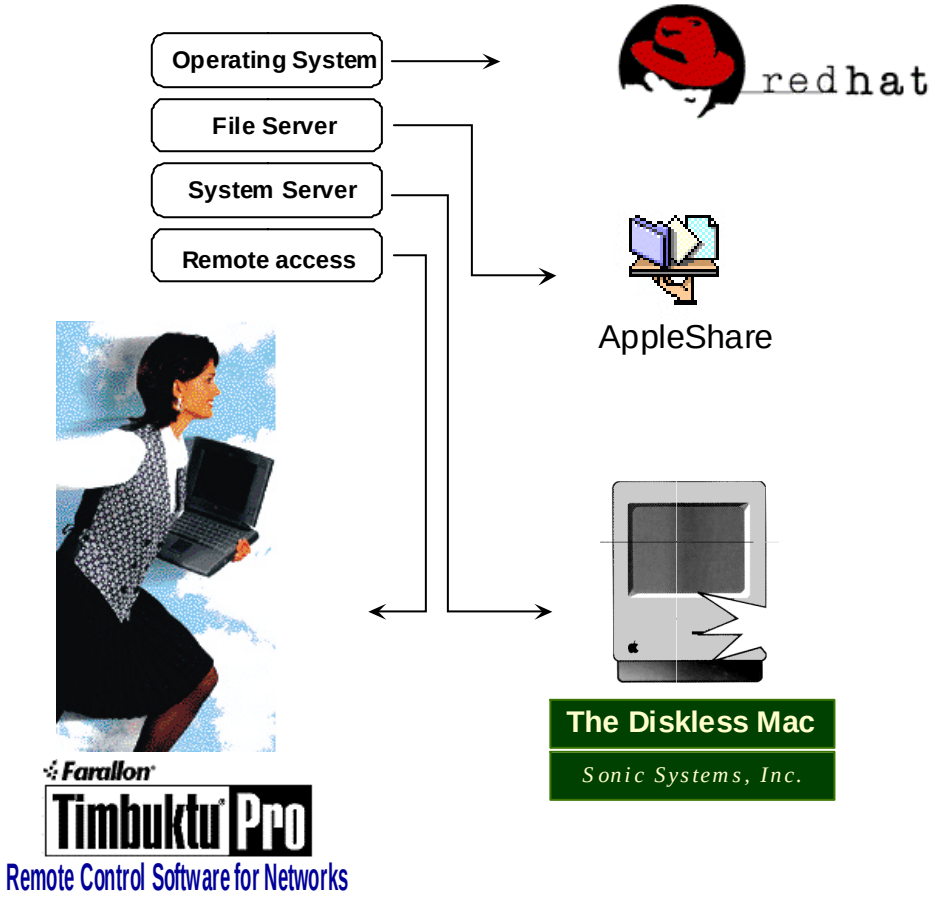
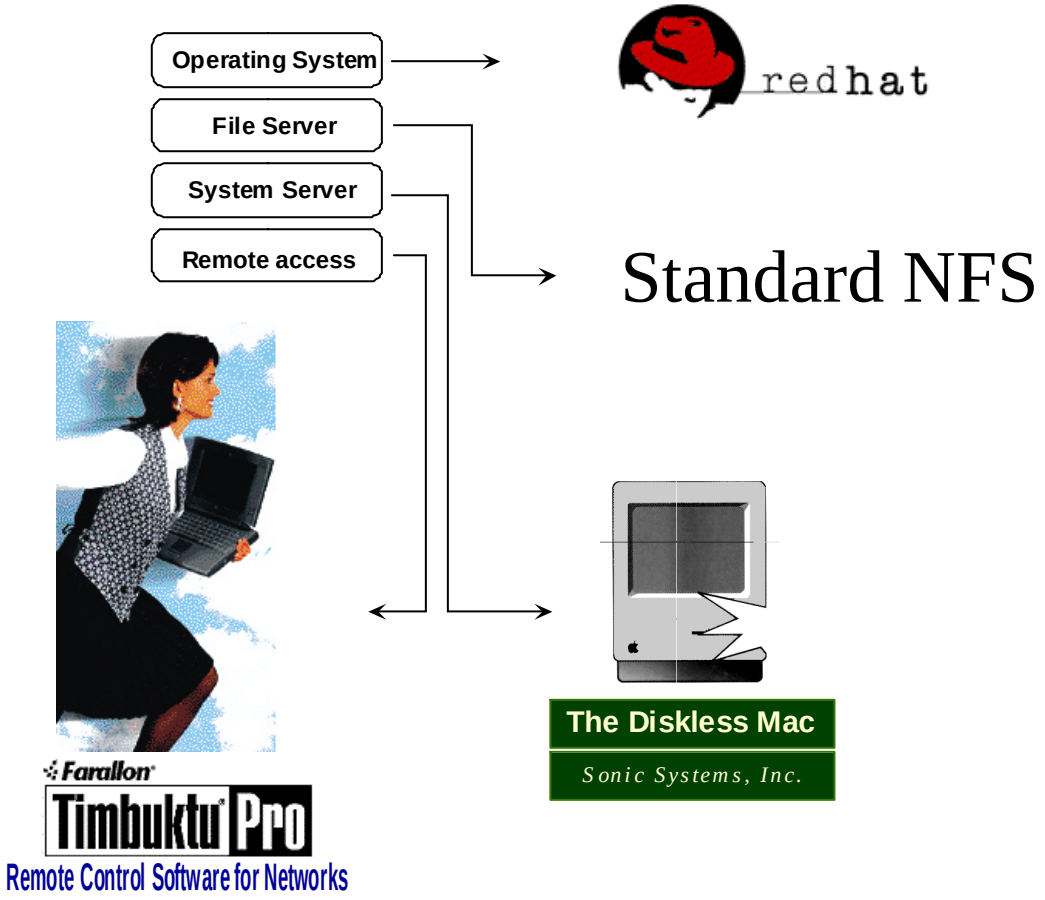
# What change


Operating System
File Server
System Server
Remote access
MacOS
AppleShare
The Diskless Mac
Sonic Systems, Inc.
Farallon
Timbuktu Pro
Remote Control Software for Networks

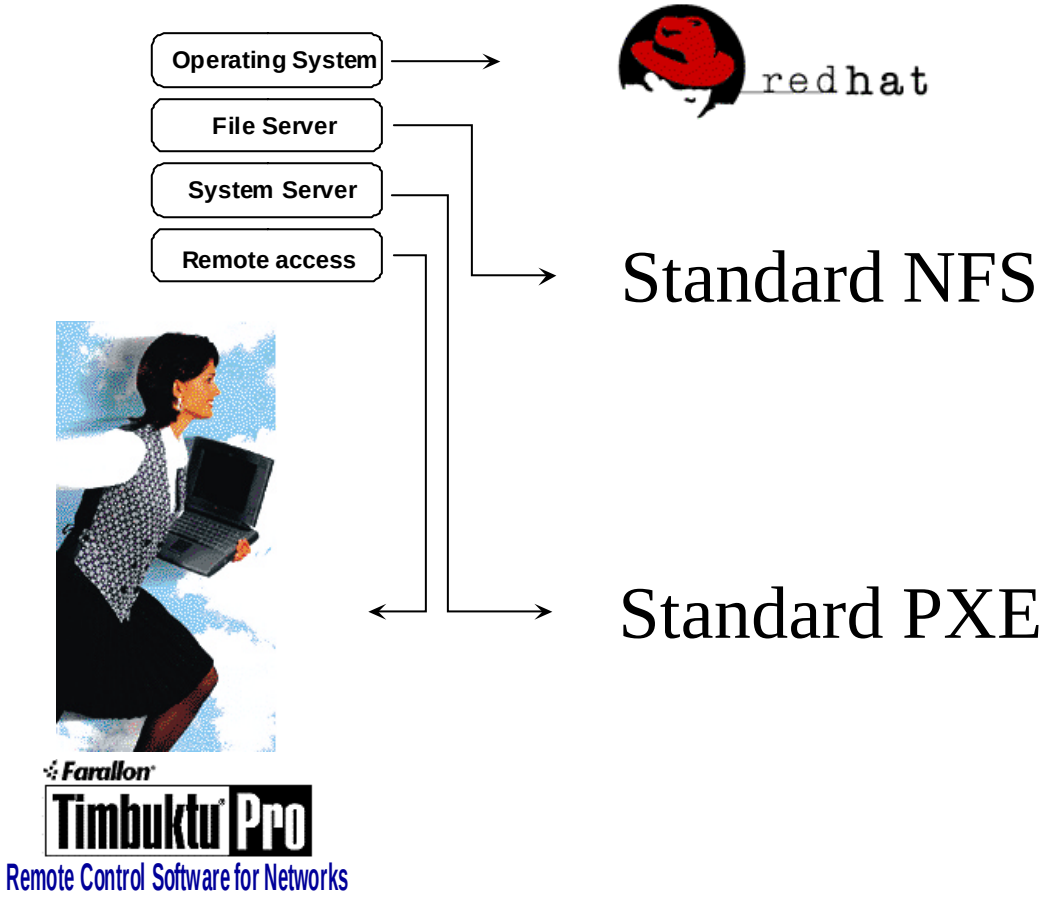
# What change


Operating System
File Server
System Server
Remote access
redhat
AppleShare
The Diskless Mac
Sonic Systems, Inc.
Farallon
Timbuktu Pro
Remote Control Software for Networks

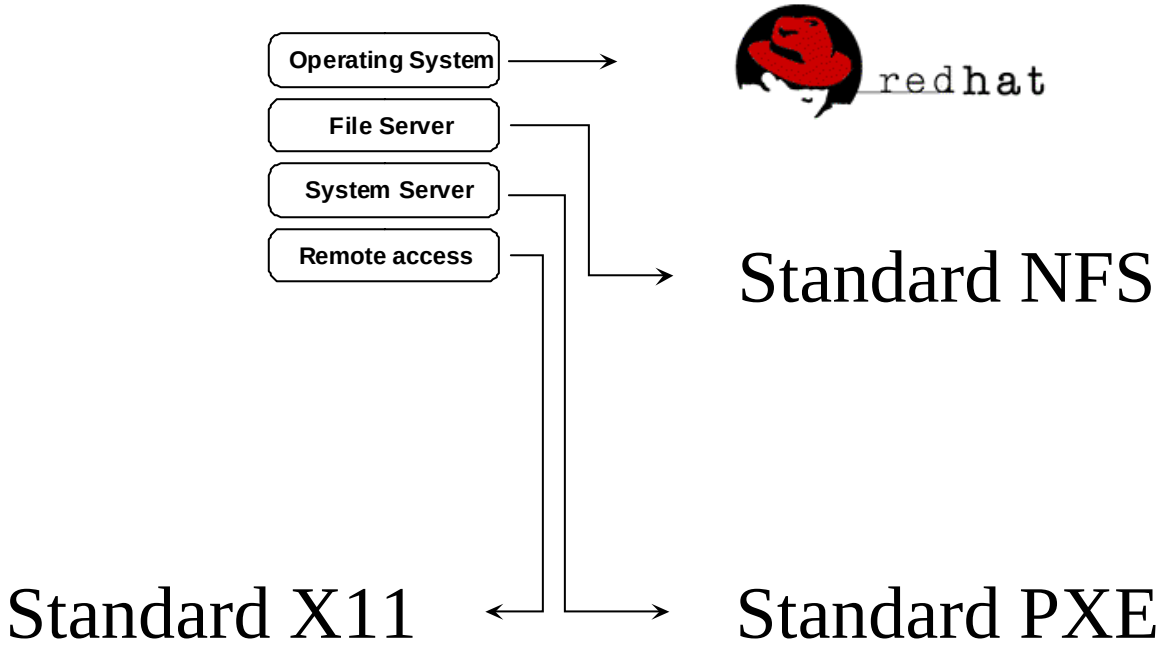
# What change

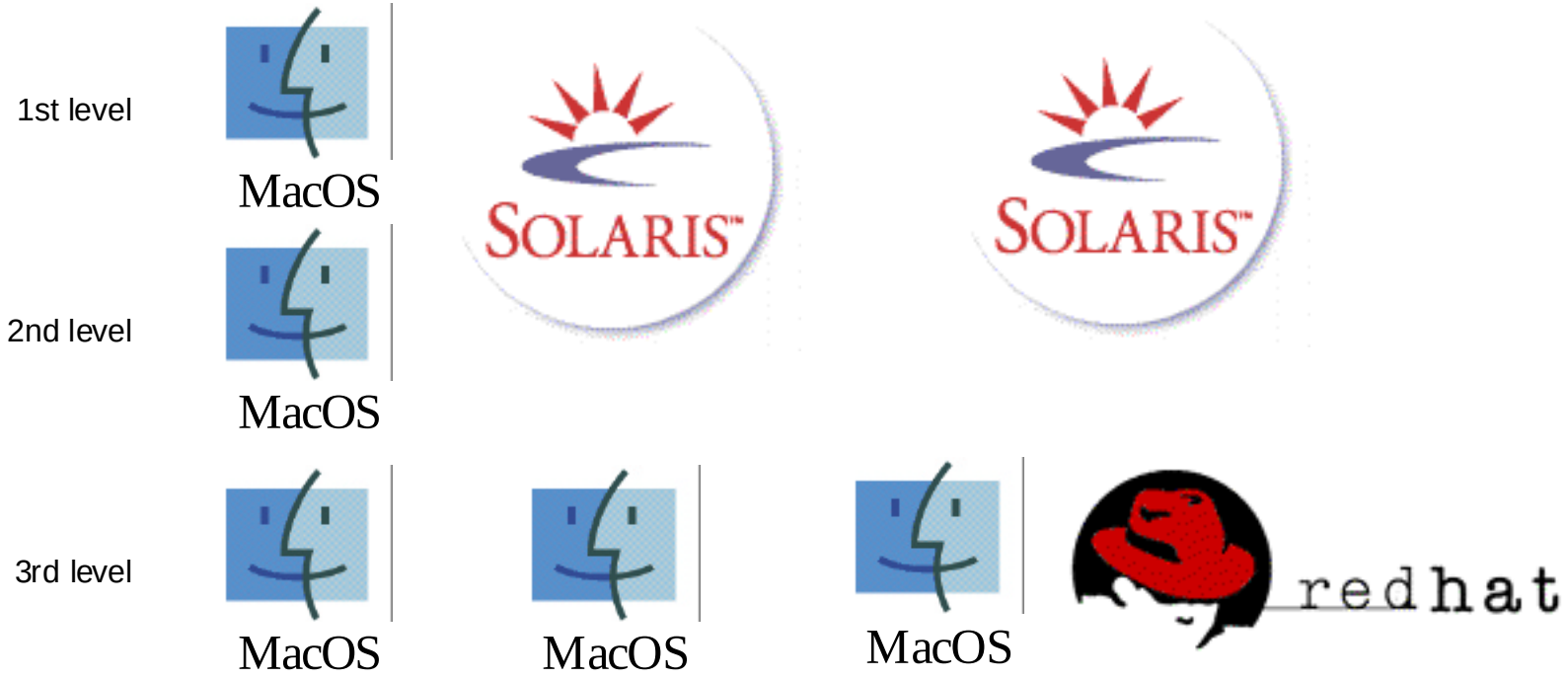

Operating System
File Server
System Server
Remote access
redhat
Standard NFS
The Diskless Mac
Sonic Systems, Inc.
Farallon
Timbuktu Pro
Remote Control Software for Networks

# What change


Operating System
File Server
System Server
Remote access
redhat
Standard NFS
Standard PXE
Farallon
Timbuktu Pro
Remote Control Software for Networks

# What change

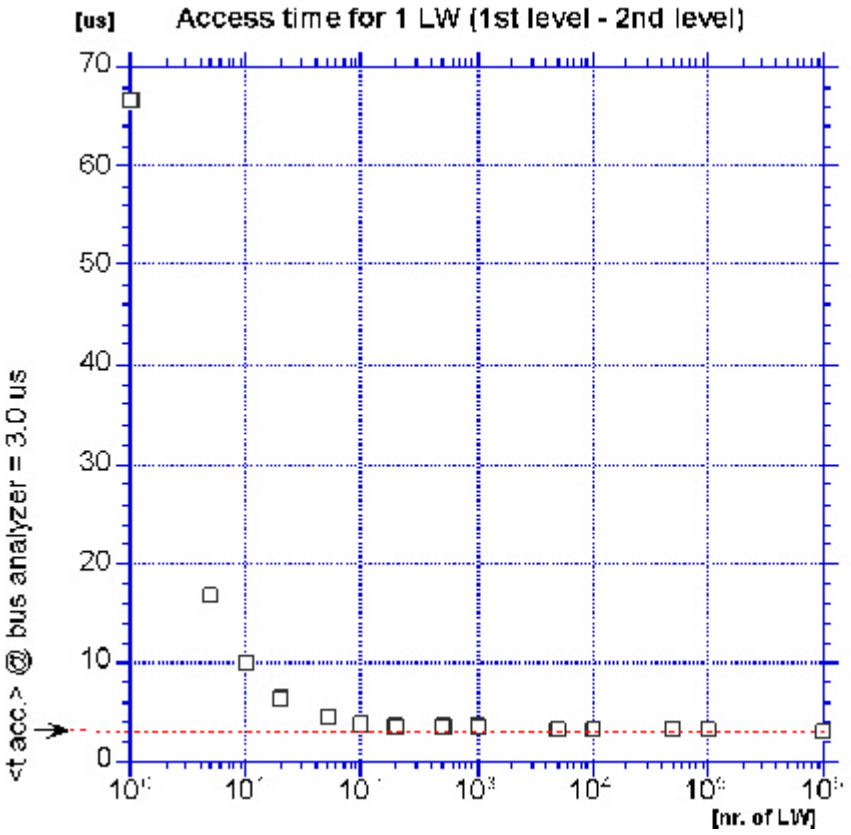

Operating System
File Server
System Server
Remote access
redhat
Standard NFS
Standard X11
Standard PXE

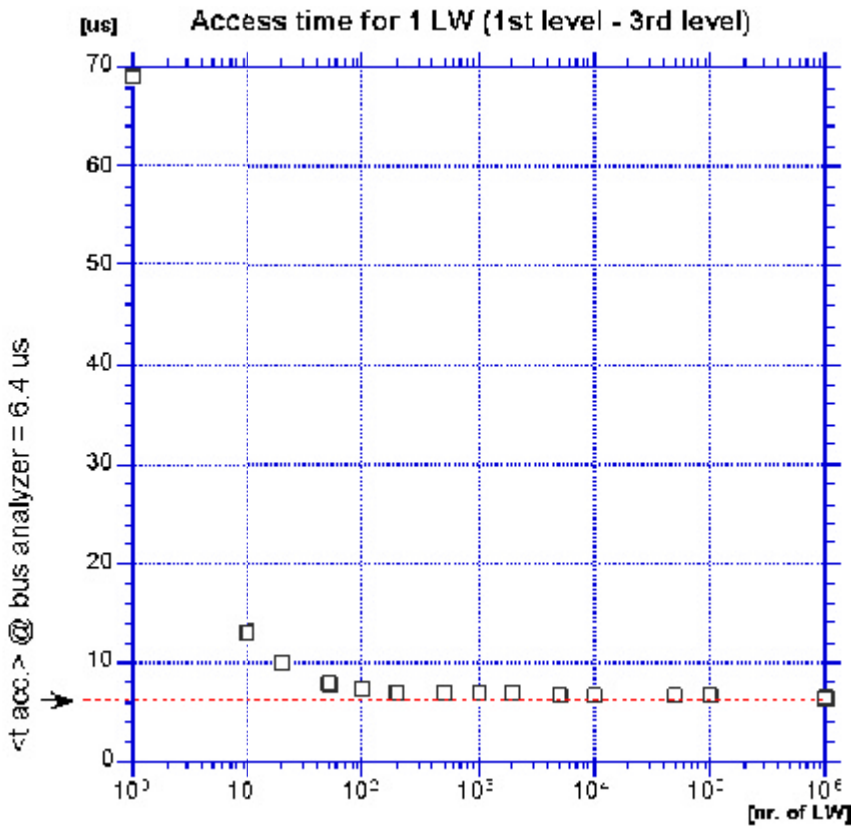

1st level
MacOS
SOLARIS
SOLARIS
2nd level
MacOS
3rd level
MacOS
MacOS
MacOS
redhat

# Conclusion

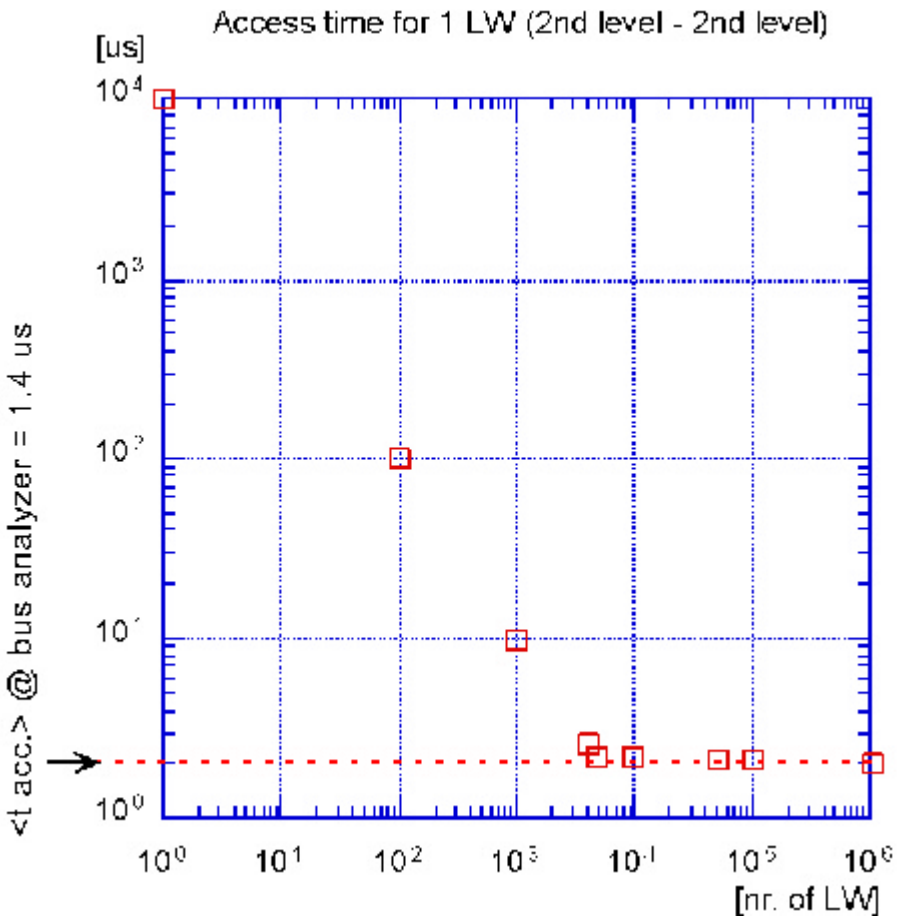
The choise of comercial software and direct memory access allow us to evolve the System through 3 different operating Systems and 5 major LabVIEW releases, standing smoothly these shocks. This has been possible thanks to the use of software written for personal computers with the characteristic of portability.

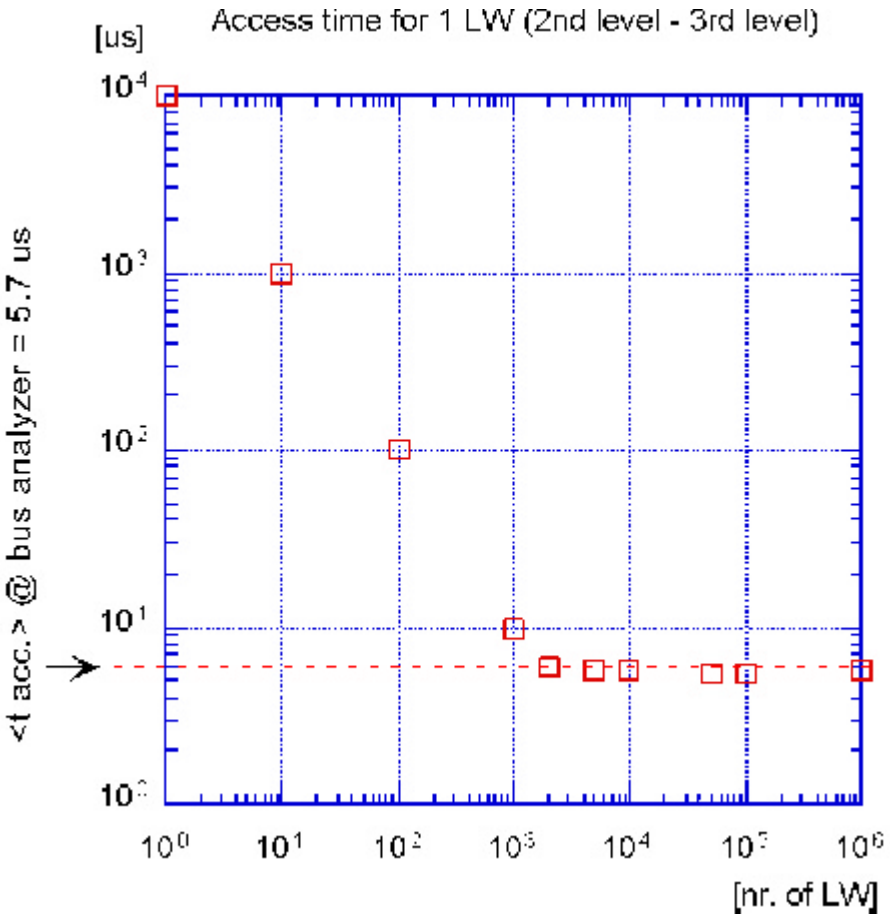
# Memory access time



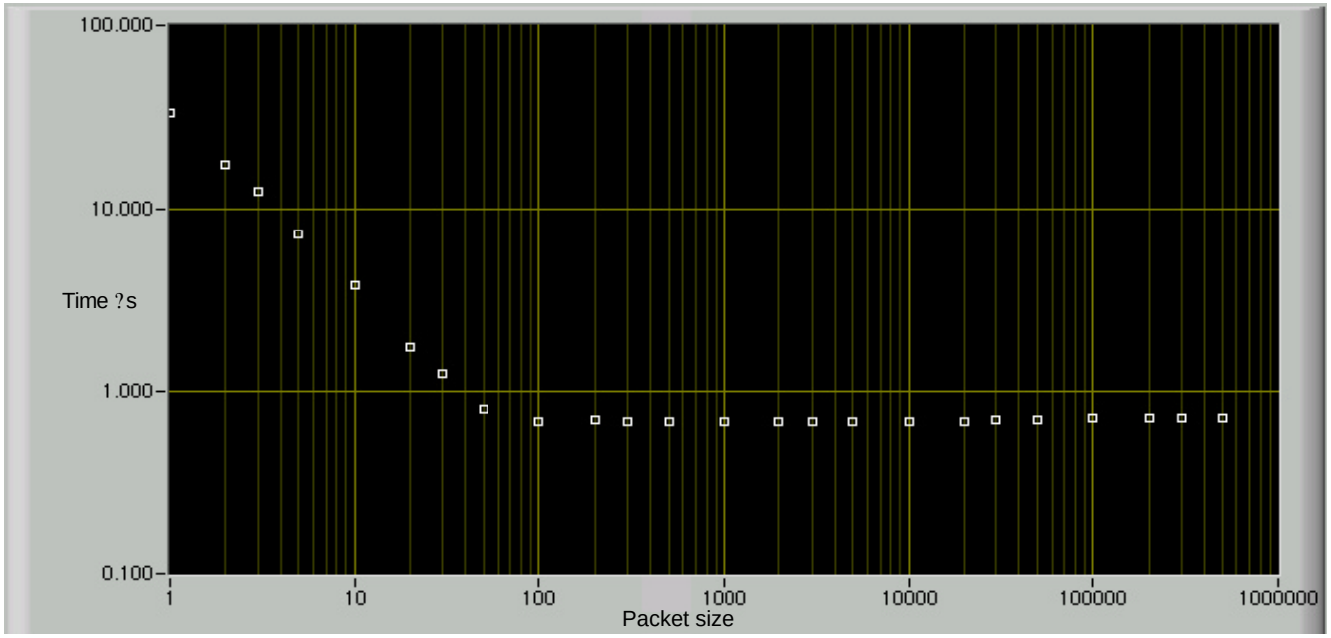



# Memory access time
# (with CPU 8VT)



# Memory access
# Linux CPU

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