EPICS COLLABORATION MEETING
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PAUL SCHERRER INSTITUTE
SWITZERLAND

LINUX AS A CONSOLE

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From the SLS Handbook (Chapter 8: Computing and Controls)

Software Architecture

Some of the primary criteria that must be considered are

- **Performance:** judged on real-time response as well as throughput considerations
- **Flexibility:** the ease with which it is possible to modify software, add new functionality and how well it can adapt to changing requirements
- **Scalability:** the ability for the system to grow in terms of
  - number of control points
  - number of nodes in the system
- **Robustness:** tolerance to errors from
  - users
  - software developers
  - hardware
  - software
- **Openness:**
  - the adherance to standards
  - the ability to interface easily (and without performance degradation) to other software packages (including commercial software)

From the SLS Handbook (Chapter 8: Computing and Controls)

Control Room

- The accelerators of the SLS complex will all be controlled from a single central control room. This control room will house the operator stations from which it will be possible to control all aspects of machine operation.
- Three consoles will be provided, in order to be able to carry out machine development in parallel with normal machine operation. Consoles will not be dedicated to one task or accelerator.
- All consoles will have the same facilities.
- There will be no specialized hardware or software installed on just one console.
- Consoles will each have three display monitors (multi-headed), sharing a mouse and keyboard to avoid .... one program window hidden under another.
- General program development will be discouraged in the control room.
- The control room will be equipped with a number of large fixed displays showing critical machine status and parameters. These will be mounted high on the front wall so that they can be viewed from any console.

Investment Costs

- CHF 159 million granted by the Swiss Federation during a four year construction period.
- Financing will be covered completely by resources included in the 1997 estimates and in the financial plans of the National Financial Administration and the ETH domain.
- The project will therefore not further burden the Swiss budget.

Operating Costs

- CHF 23 million annually will be financed from the start of operations out of the ordinary resources of PSI. These costs will be borne internally by PSI by reallocating funds.

The Choice of an Operating System
The Choice of a Control System

The criteria for both were much the same

- performance
- flexibility, scalibility
- robustness, openness

Some of the choices:

- Unix (AIX, Solaris, HP UX, IRIX, Digital Unix, Linux,...)
- Windows 95, 98, NT, ME, CE, 2000, XP,.....
- Mac OS
- OpenVMS

- LEP Control System (HP Unix)
- PS Cern (VMS Unix)
- SLAC (VMS Unix)
- APS (EPICS with Solaris)
- Jefferson (EPICS with HP Unix)

The control system / operating system had to be:

- Unix-like (to blend-in with the general user community)
- cheap (the SLS has a very tight budget)
- not require special hardware (see above!)
- not require special software (ditto)

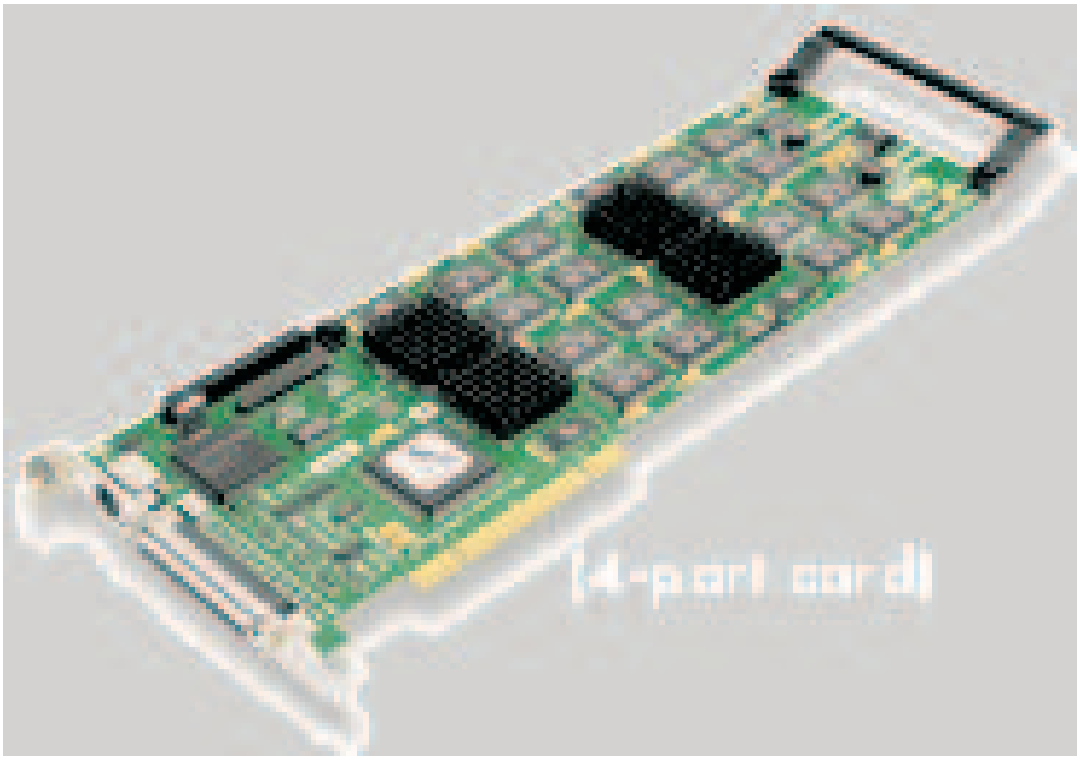
The decision:

Operating System	**Red Hat Linux 5.2**
Control System	**EPICS Release 3.13.0.beta 12**
Hardware	**Intel Pentium PCs**

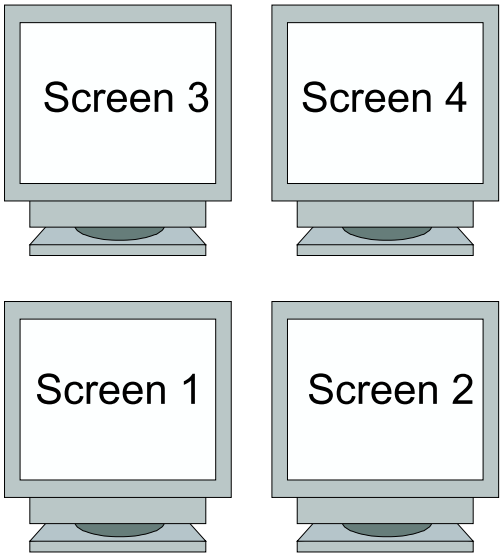
The Original SLS Console

4 computers each with

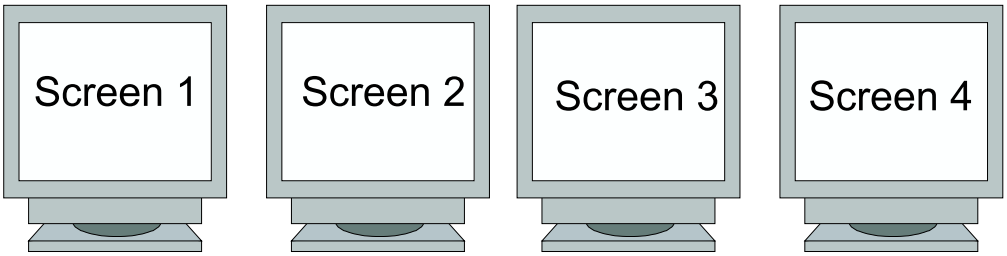
- Linux Red Hat 5.2
- 1 x 450 MHz Pentium III
- 512 Mb RAM
- 9 Gb SCSI disk
- 1 mouse
- 1 keyboard
- 4 single screens configured at 1280×1024 pixels (85 Hz refresh)
- X-server from Accelerated-X 5.0.3 from X_i Graphics
- 1 graphic card: single slot Jeronimo Pro 4x8Mb PCI



Physically the screens were



But logically the screens were



We had a

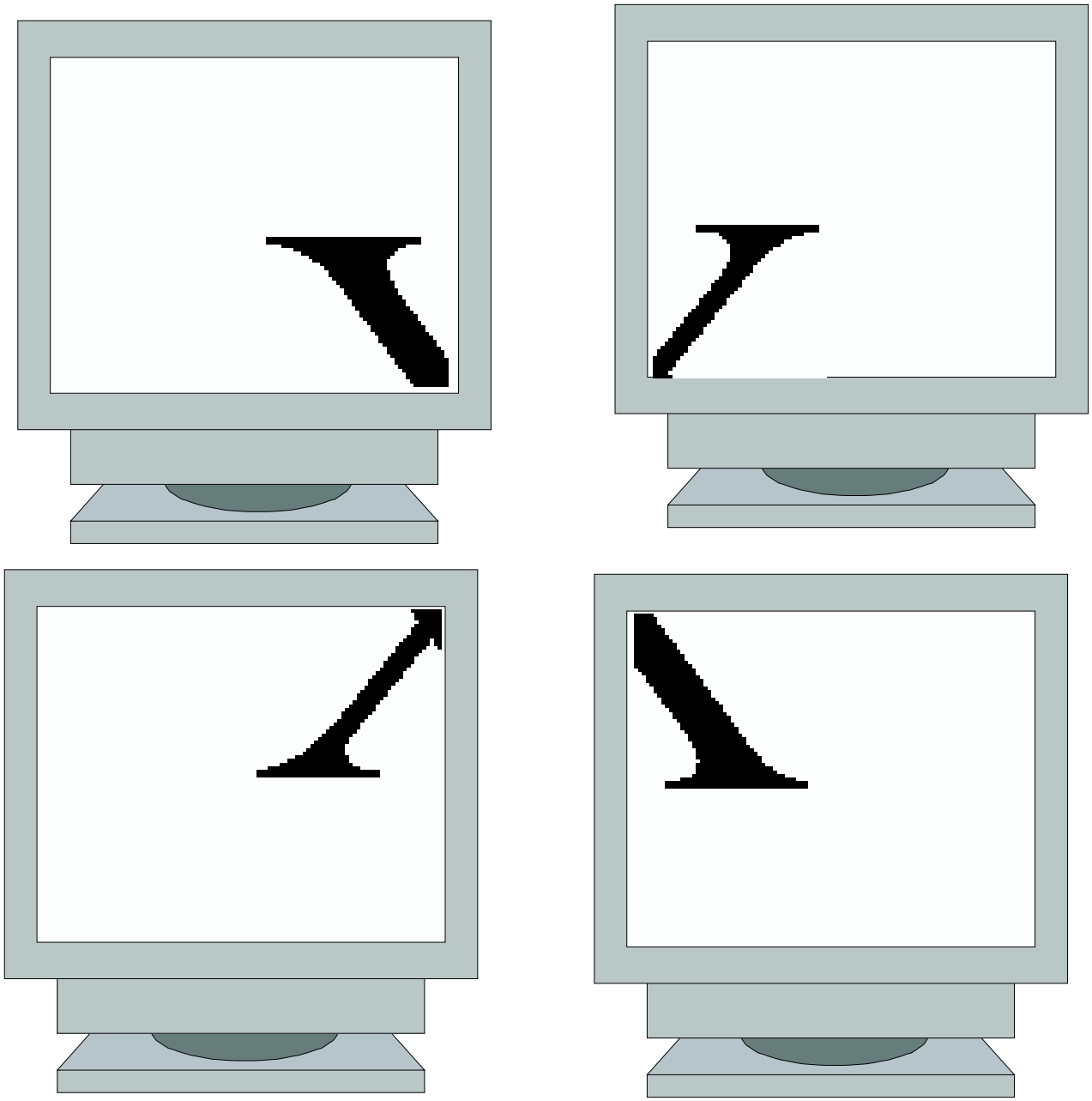
- good resolution (1280×1024) and a
- good refresh rate (85 Hz) and
- applications could be started from any screen

But ...

- Each screen was “stand-alone”
- Applications once started could not be moved to another screen
- Navigation with the mouse was confusing
- There was some “latency” when many (20+) windows were open

And then along came XFree86 Version 4 ....

Now we could have **Xinerama** mode !!



X-Server Benchmark Tests

A series of comparison calculations was first performed. Tasks to be addressed included:

- The Accelerated-X server 5.0.3 vs. the XFree86 4.0.1 server with (private) patch
- The Appian Jeronimo Pro card vs. multiple Matrox cards
- A single CPU system vs. a dual-CPU system

For each available combination of hardware, a constant X performance test (version 1.5) was performed. This test was first executed on an idle machine, and then repeated on a fully-loaded computer. The various configurations are shown below. The patch used in the XFree86 4.0.1 test was specific to the cases involving the Jeronimo Pro card. This patch has already found its way into the 4.0.2 official XFree release.

Hardware

- 1 Appian Jeronimo Pro 4x8Mb (PCI)
- 3 Matrox G200 PCI 8 Mb SDRAM
- 1 Matrox G400 AGP 16 Mb SDRAM
- Single CPU 450 MHz Pentium III processor with 512 Mb RAM
- Dual CPU 500 MHz Pentium III processor with 512 Mb RAM
- Red Hat LINUX 6.2

X-server

- Accelerated-X 5.0.3
- XFree86 4.0.1 with patch

CPU intensive test

The computer was loaded with a simple repetitive task.

The job looked like this:

```
#!/bin/bash
 while true
 do
   echo "2^50000/1.99^50000" | bc &
   echo "2^50000/1.99^50000" | bc &
   echo "2^50000/1.99^50000" | bc &
   echo "2^50000/1.99^50000" | bc &
   echo "2^50000/1.99^50000" | bc
 done
```

X11 test

A short X11 performance test (version 1.5) was performed and the timings recorded.

The job looked like this:

```
#!/bin/bash
#
\rm slsxtest.log
date > slsxtest.log
x11perf -srect1 1> slsxtest.log
date >> slsxtest.log
```

Results

For each of the aforementioned configurations timing calculations were executed. The results (in seconds) are tabulated below.

1x450 MHz PIII	Accelerated-X	XFree86			
	Jeronimo Pro	Jeronimo Pro		4 x Matrox	
512 Mb RAM	4 singles	4 singles	2x2 Xinerama	4 singles	2x2 Xinerama
no CPU load	10239	10212	10284	10826	11540
full CPU load	14757 100%	15057 102%	15627 **106%**	17202 117%	20786 **141%**
MEDM BPM test with full CPU load	4 sessions 1 session/screen 2 screens OK slow	4 sessions 1 session/screen 2 screens OK slow	4 sessions 1 session/screen — none updated	4 sessions 1 session/screen 3 screens OK 3 updated	4 sessions 1 session/screen 3 screens OK —

2x500 MHz PIII	Accelerated-X	XFree86			
	Jeronimo Pro	Jeronimo Pro		4 x Matrox	
512 Mb RAM	4 singles	4 singles	2x2 Xinerama	4 singles	2x2 Xinerama
no CPU load	10615	10250	10190	10665	11528
full CPU load	13643 100%	12809 94%	12910 **95%**	14441 106%	15235 **112%**
MEDM BPM test with full CPU load	4 sessions 1 session/screen — —	4 sessions 1 session/screen 4 screens OK —	4 sessions 1 session/screen 4 screens OK slow to start	4 sessions 1 session/screen 3 screens OK 1 not updated	4 sessions 1 session/screen 4 screens OK slow to start

Conclusions I

From the above results, we can deduce the following conclusions

- **In single-screen mode:**
  - Both X-servers, (Accelerated-X and XFree86 4.0.1), deliver approximately the same performance, irrespective of whether multiple Matrox cards or a single Jeronimo Pro quadro card were used.
  - In each case, the multiple Matrox solution was slower than the corresponding Jeronimo Pro solution.
- **In Xinerama mode:** (one logical screen displayed over 4 physical screens)
  - The Accelerated-X server did not support Xinerama mode.
  - For the multiple Matrox solution, Xinerama mode resulted in a **time penalty of 5% to 20%** compared with the single screen mode option.
  - For the Jeromino Pro solution, Xinerama mode resulted in a **time penalty of 1% to 4%** compared with the single screen mode option.
  - **However the multiple Matrox solution in Xinerama mode was 20-35% slower than the corresponding Jeronimo Pro solution.**

To this end the Jeronimo Pro solution appeared to be the preferred solution and was therefore implemented in the Control Room. The card also supported video.

But ...

under “real working conditions” other considerations came into play.

- The graphics driver glint_drv.o for the Jeronimo Pro card at present only supports a refresh rate of 60 Hz at 1280 $\times$ 1024 pixels.
- A refresh rate of 75 Hz was obtained at a screen resolution of 1152 x 870, but the Operators didn’t like this either. In a future release of the XFree86 software, this deficiency will be removed.

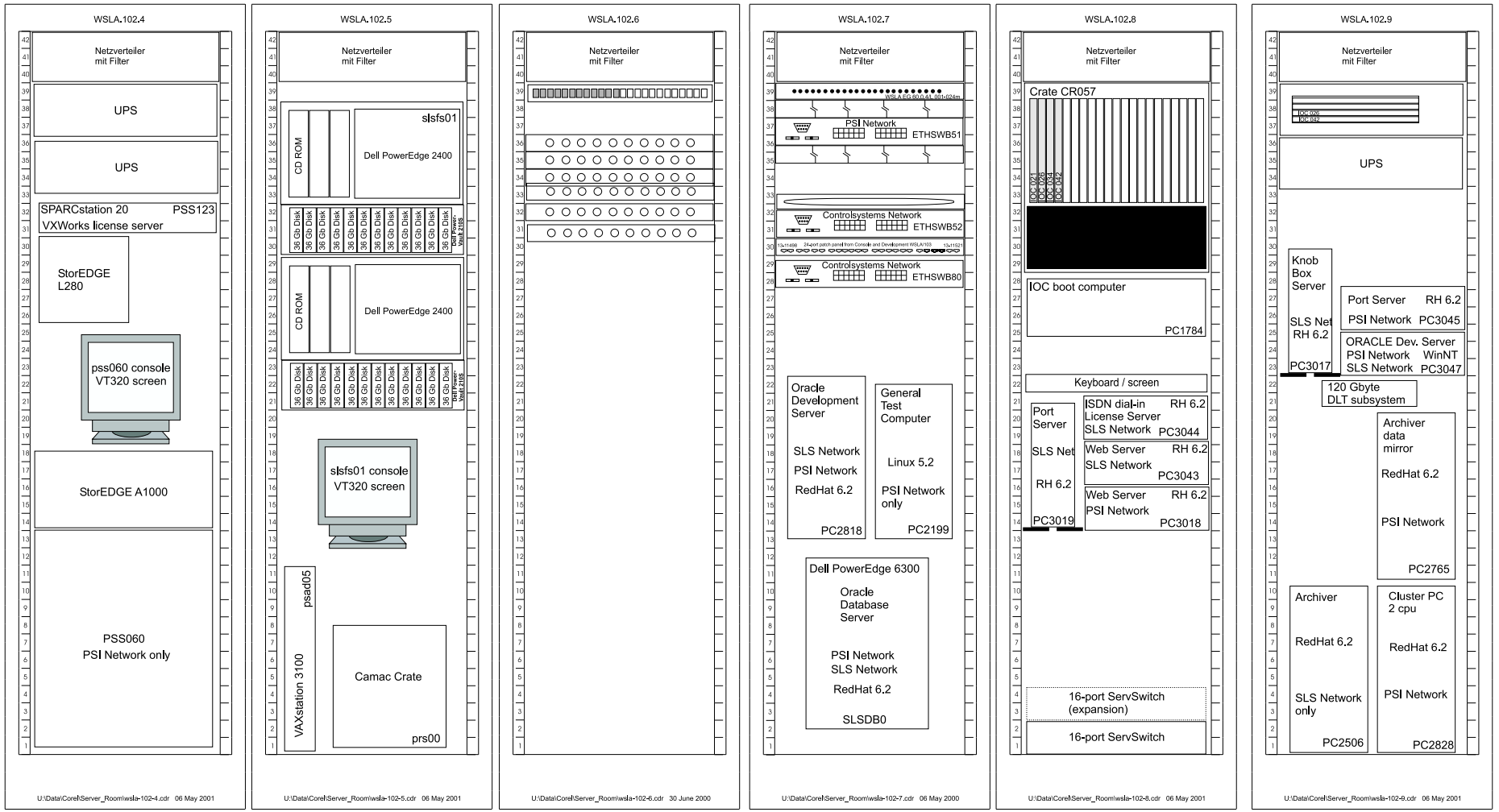
Conclusions II

So the Jeronimo Pro cards were replaced with multiple Matrox cards.

- At a screen resolution of 1280 $\times$ 1024 the Matrox cards gave an 85Hz refresh rate.
- If in the future a video signal needs to be displayed, other Matrox cards will be required.
- Or we await a future release of XFree86 4.x.x

Home File System

File Server



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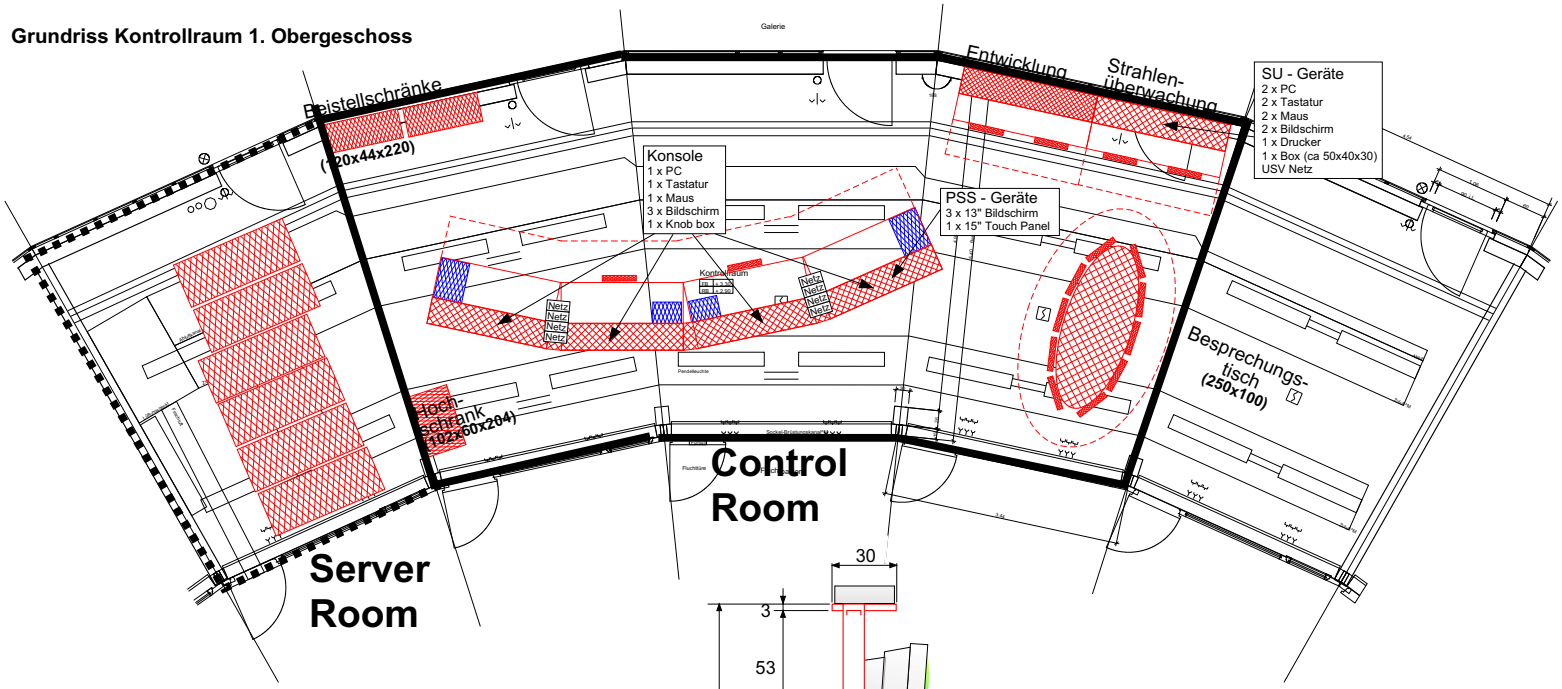
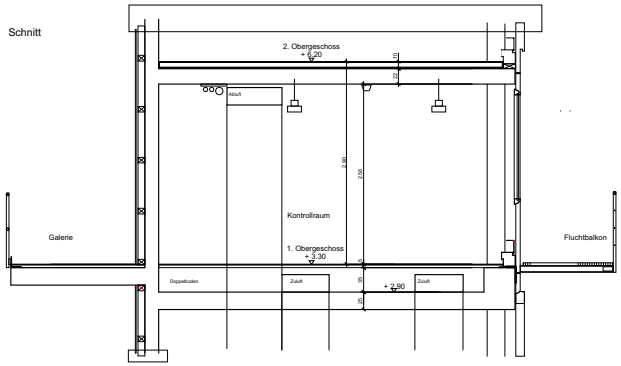
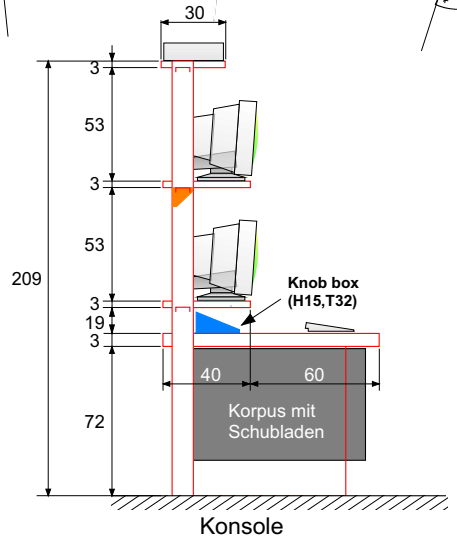
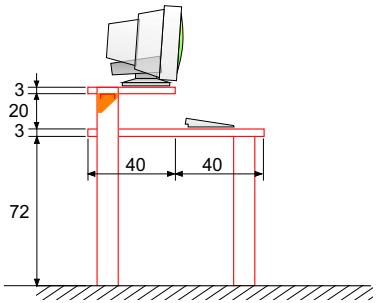
Grundriss Kontrollraum 1. Obergeschoss







Konsole



Entwicklung und
Strahlenüberwachung