DESY, September 16, 1995

Printing at DESY

Z. Jakubowski -ZDV-

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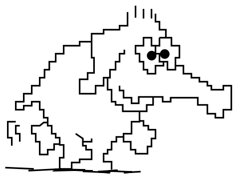


Prerequisites

- Full support on central computing facilities based on native commands.
- Support for both stand alone workstations and external laboratories.
- Meta command support – print command available on all systems.
- GUI to print command.

The following functionality should be provided:

- Job queuing
- Possibility to inspect job/printer status
- Possibility to cancel print jobs based on some kind authentication

Service should be stable and reliable and fit to local needs.

Printing in Various Operating Systems

Machine	System	Native Command	Other Command	Query Command	Cancel Command	Help Command
Apollo	BSD 4.3	lpr	lp	lpq	lprm	man lpr
Apollo	System V	lp	lpr	lpstat	cancel	man lp
DEC 5000	Ultrix	lpr	lp	lpq	lprm	man lpr
HP-9000	HP-UX	lp		lpstat	cancel	man lp
IBM	MVS	print	lprint,lpr	st	cancel	help print
Sun	SunOS4.x	lpr	lp	lpq	lprm	man lpr
Sun	SunOS5.x	lp	lpr	lpstat	cancel	man lpr
SGI	IRIX	lp		lpstat	cancel	man lp
		lpr		lpq	lprm	man lpr
Vax	VMS	print	lprint,lpr	show queue	delete	help print

The Project

Project name:

Distributed Printing

Man power:

1 + (1/3-1/2) persons

Persons involved:

Z. Jakubowski (1), G. Schroth (1/x)
P.K. Schilling, P.Sommer (IBM Software)
M. Kisielewski (1) ~1.5 years

Foundations

1. POSTSCRIPT **as standard printer language;**
2. UNIX **as an operating system;**
3. **TCP/IP as an underlaying network;**

UNIX Solutions: *lp* vs. *lpr*

	System V *lp*	BSD 4.3 *lpr*
networking	—	ground principle
options	free choice	fixed set
anonymization	necessary	not necessary
ownership	user	user@host
status,cancel	only local	built in
filtering	one filter	first&last host
adding printer	shutdown	“in flight”
maintenance	lp	root
maintenance	painful	painful

Supported Formats

Our attitude is:

Queue your print and we will try to do our best…

Th. Finnern

Data formats:

1. POSTSCRIPT ;
2. ASCII;
3. DVI (TEX meta-file);
4. GKS meta-file;
5. screen dump (xwd);
6. GIF;
7. CGM meta-files;
8. xroff input files;
9. HPGL-2;
10. compressed formats;

History

- A work on R2 Sys 5.3 based spooler was started by Th. Finnern and P. Nuguid;
- Start of the project—15 November 1991:
  Print spooler is the old Apollo DN3000 machine. In total 10 Kyocera PS-2000 printers are connected to Micom and fed through 3 multiplexed serial ports. The print speed was limited to about 1KB/s.
- Small stabilization of the print spooler software.
- Device tests—Spring 1992.
- DESY gives O.K. for a new printing infrastructure—August 92:
  All Kyocera printers get AX-5 network interfaces. 17 HP LaserJet IIISi printers connected via the JetDirect network interface should play a role of the "printing back bone". Apollo 425t/133 is supposed to take the role of the print spooler.
- Devices are delivered to DESY—November 92;
- New spooler machine Apollo 425/133—December 92;
- Installation January–February 93;
- Work on stabilization of the service, printer interfaces;
- Printer page accounting;
- Introduction of high resolution/high speed printers.
- Plotting at DESY—plot spooler design.

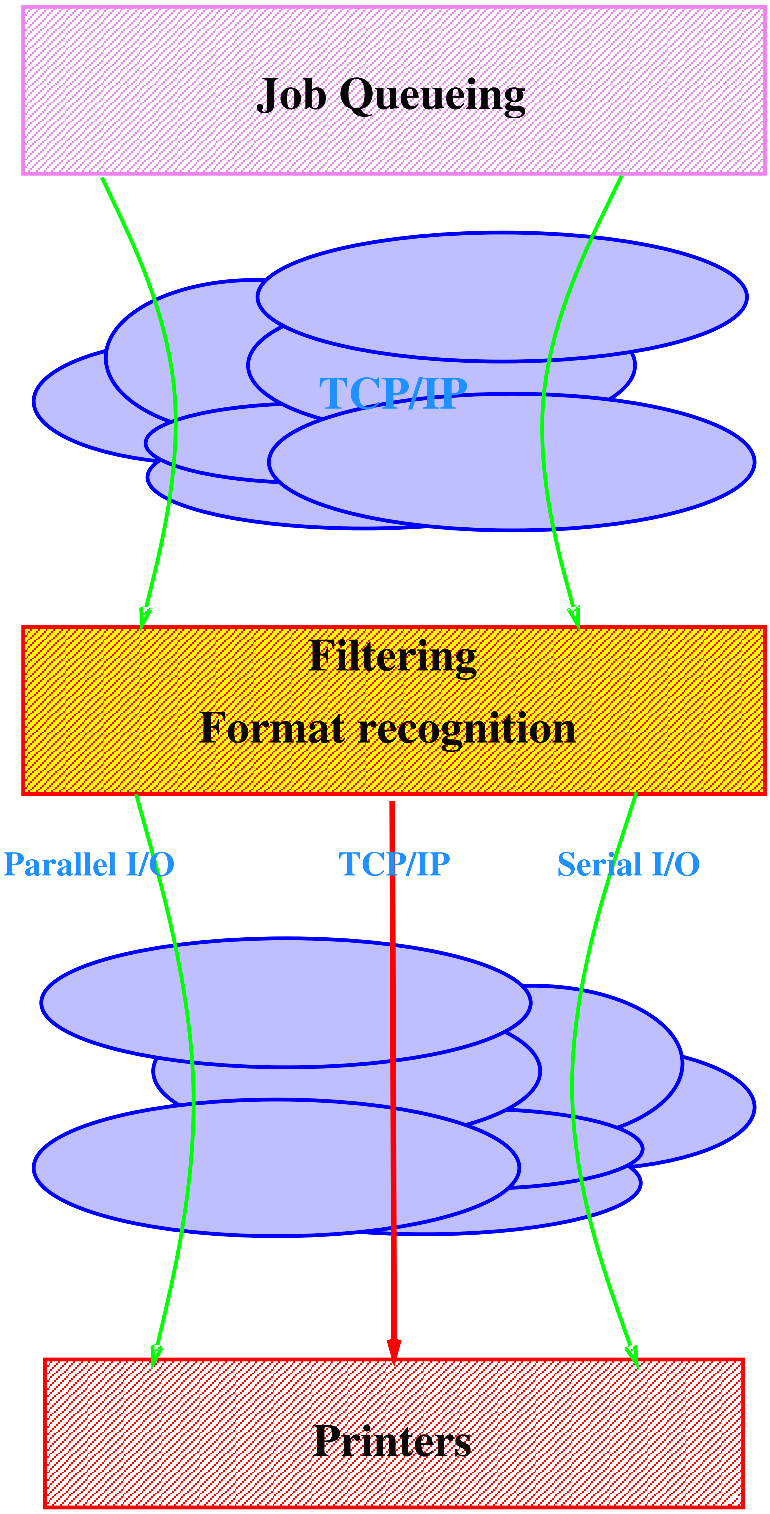
- Work on a backup print spooler lead to complete re-design of the spooler concept.
- The future.

Printers available at DESY Print Server

Printer (B&W)	Network Interface	Amount 93	Amount 94	Trend
HP LaserJet IIISi	HP JetDirect	20	20	$=$
HP LaserJet 4Si MX	HP JetDirect	3	7	$\nearrow$
HP LaserJet 4M(+)	HP JetDirect	2	15	$\nearrow$
Kyocera P2000	Axis AX–5	20	18	$\searrow$
QMS 800+	Axis AX–5	2	1	$\searrow$
QMS PS 2200	Direct on Sun	3	3	$=$
LaserWriter	Local-, EtherTalk	12	18	$\nearrow$
Printer (color)	**Network Interface**	**Amount 93**	**Amount 94**	**Trend**
Tek Phaser IISDX	Lantronix EPS1	2	2	$=$
Tek Phaser 200i	Lantronix EPS1	3	3	$=$
Tek Phaser IIPxi	Tek VB4511A	5	5	$=$
Tek Phaser IIPxi	Emulex Terminal Server	1	1	$=$
Tek Phaser 540	TeK	0	2	$\nearrow$
QMS PS2000	Axis AX–5	1	1	$=$
HP PaintJet	Axis AX–5	1	1	$=$

In 1993 we used ca. 22t of paper at DESY.
In 1994 we used ca. 18t of paper at DESY.

Schematic View of DESY Print Service



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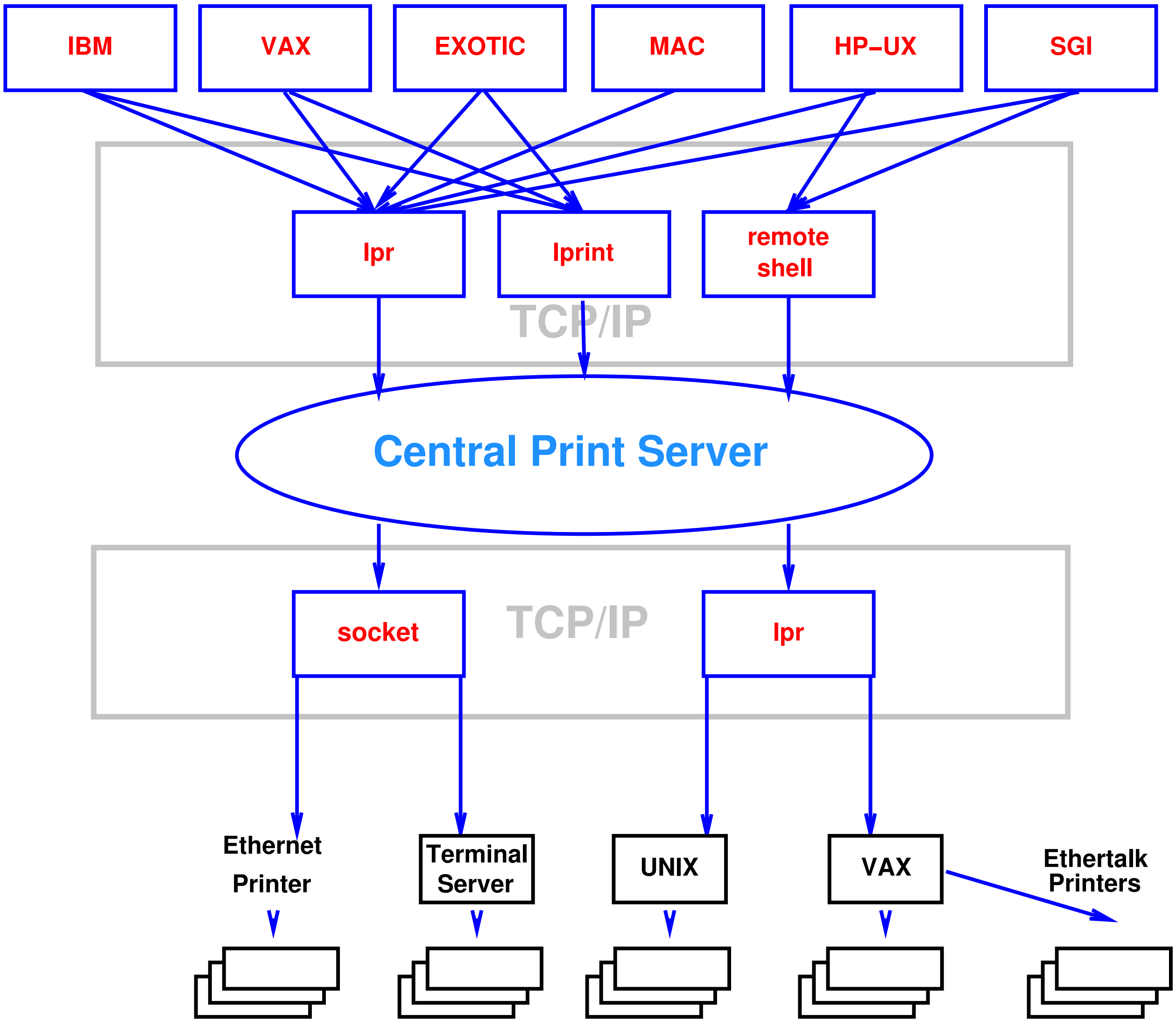


Figure 1.1: Spooler configuration in 1993

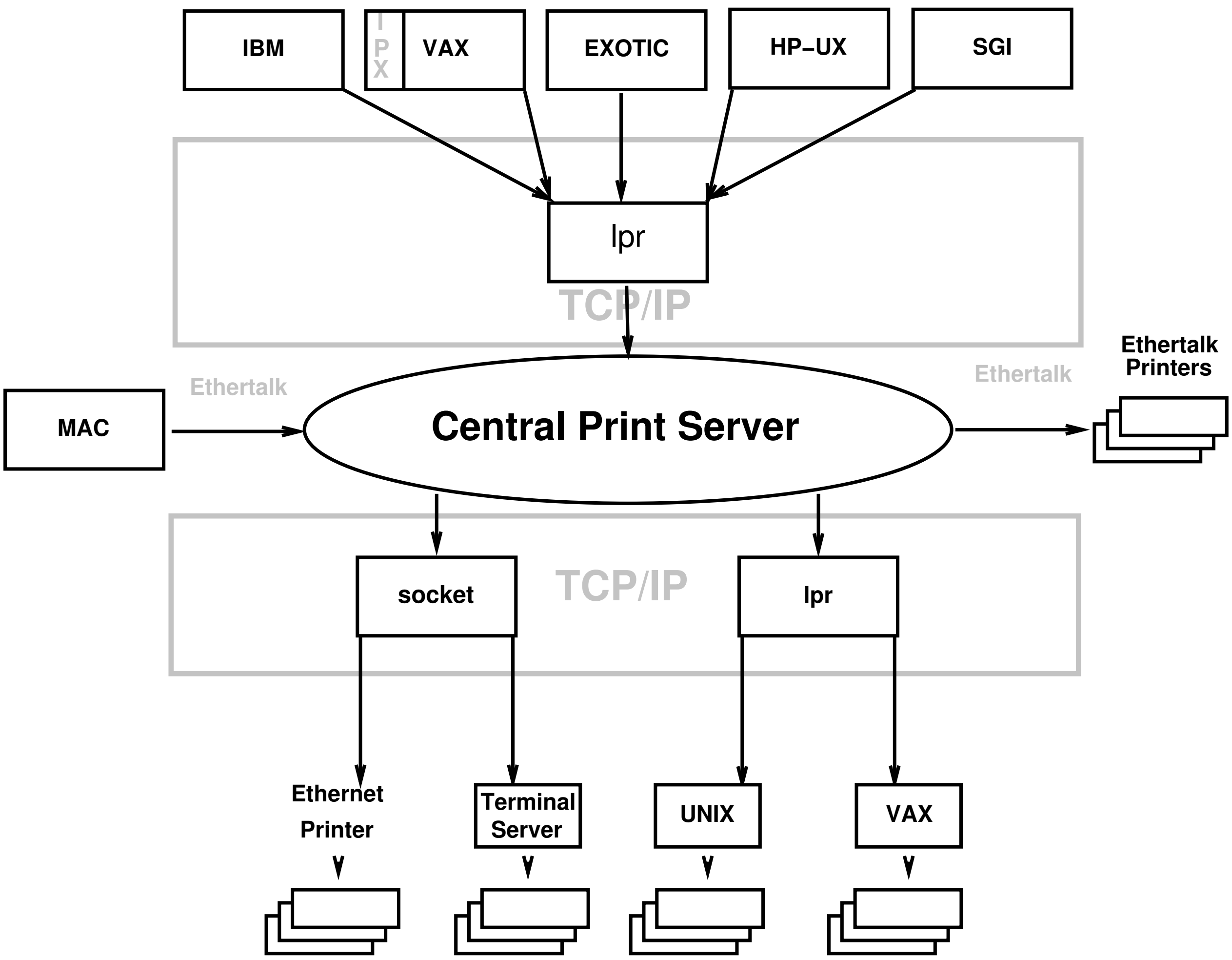


Figure 1.2: Spooler configuration in 1995

Print commands

- Stand-alone workstation support based on `slpr`, `slpq`, `slprm` suite. It is simply non-queuing `lpr` client implementation.
- BSD-like system support including printer stripping: SGI, Apollo, SUN.
- SYSV-like system support based on filters using `slpr`: HP, SUN, Apollo.
- VMS support via Multinet BSD print queues.
- IBM support via lpr (IBM implementation) and lpr exit routine of the external writer (in preparation).

If everything was done correctly printing from the inside of applications is granted automatically. For stand-alone workstations using slpr it is enough to alias slpr to lpr (even on user basis). Missing lp can be helped using small shell script like in HP-UX system.

Some more points:

- Software distribution, info for users: WWW. See:
  http://www.desy.de/dtg/printing/main.html
- Real GUI interface based on Tcl/Tk shell (in preparation);

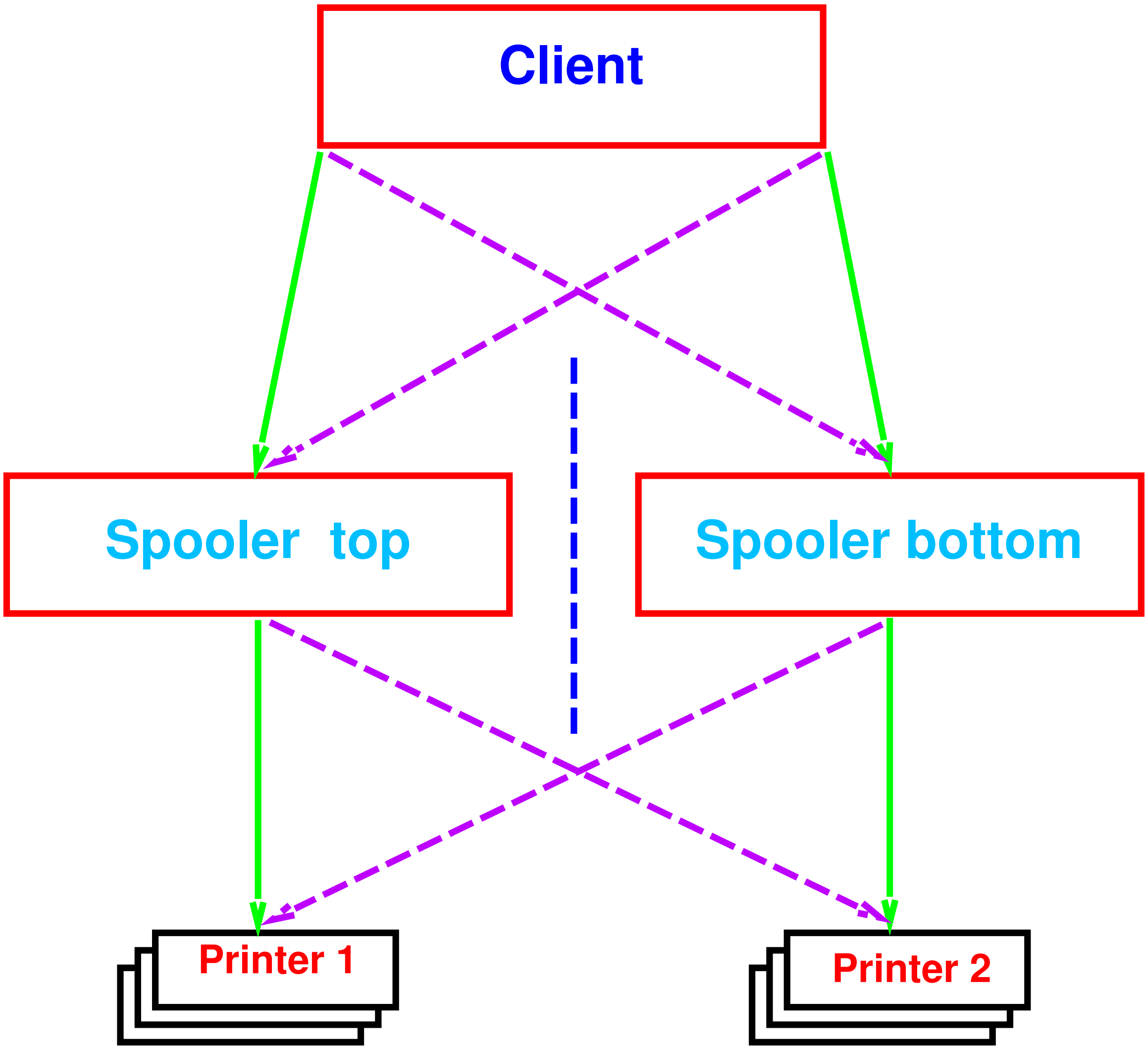
Problems with PostScript Printers

1. PostScript != PostScript
   - Incompatibility leaders PC generated graphics.
   - Vendor specific codes in user graphics.
   - PostScript level 1 and 2 incompatibilities.
2. variable size of the printable area;
3. incomplete files:
   - file quota on Vax;
   - stream vs record I/O problems;
   - files in EPS format–no showpage;
4. Long rendering and/or looping PostScript programs (printouts); There is no connection between rendering time and the file size.
5. Page accounting;
6. Relatively large internal buffer–think twice before you turn the printer off;

High availability concept

- **Print Spooler Hardware will be at least duplicated;**
- **Configuration of the Print Spooler will be mirrored. It means *every spooler machine is able to feed every printer*.**
- **Neighboring printers should be feed from *different machines*. You can call it "printer stripping".**
- **At client side:**
  Client will try to queue the job first on primary print spooling machine. In case of failure the secondary (n-th) print spooler is used. You can call this concept "active approach".

Concept is implemented. Using lp on HP or SGI you are using it automatically full capacity of our "high availability" concept.


Client
Spooler top
Spooler bottom
Printer 1
Printer 2

Print Spooler—The Target

- BSD based print spooler.
- Hardware Sun(s) SPARC 20/51 (just now 2 SPARC10 workstations).
- Print spooler(s) should connected to a network via FDDI.
- Service stability can be reached via “printer striping” and active approach on client side.
- Simple job flow.
- Authentication problems are gone.
- Unification of the hardware inside DESY and Zeuthen.
- Compatibility with Sys 5.4 that is supposed to be a new standard (?).
- Database for administration of print spooler.

Call for a New Standard

To fulfill current requests it is enough to extend the *lpr* protocol by adding:

1. **Options should be transparent for a spooler designer. It should be the decision of the target host whether the options are correct.**
2. **All hosts in chain should be allowed to use filtering.**

The *lpr* protocol is the only one widely accepted and implemented by different vendors including computers from IBM, DEC, HP and it even runs on PC.

***lpr* as a lot of other standard UNIX programs like uses privileged port authentication. It is natural that the *lpr*-client runs as “setuid(0)” program.**

Printing at DESY–Theory & Real Life

1. UNIX administration.
2. Networking
   - name service;
   - BOOTP organization;
   - SNMP;
3. User support.
4. New techniques, new devices…
5. Work organization.
6. Installation, service and supplies.
7. Research.

Current Tasks

1. β-version of DESY Print Spooler is ready.
2. Cutting down color printing costs.
3. New services: FAX??
4. Streamlining:
   - Hardware standardization.
   - Printers from DESY shop?!
   - Direct contracts–supplies can be ordered directly from distributors.
5. Upgrades of the old printers/plotters.
6. High availability concept for the Print-Spooler.
7. “Plug and go” principle for printers.
8. Concepts leading to paper reduction.

Do we need printing in future?

Do we need paper as information carrier?

- Authentication problems.
- Do we need only information transfer?
- Are we prepared to take a challenge of rejecting the paper now?
- First attempts:
  - WWW with HTML—only information transfer?
  - Acrobat a hope to preserve aesthetic?
- Problems:
  - Information persistency
  - Hardware dependence
  - Hardware size and prices

Conclusions&Plans

- We succeed in:
  - selecting stable hardware;
  - constructing a stable transport layer;
  - selecting reasonable defaults;
  - supporting most of reasonable data formats.
- A lot of work has to go now in user manuals, GUI tools.
- Standard *desy_print* command.
- High Energy Physics standard spooler.
- The fact that we are able to take a load of today does not mean that we will be able to do it tomorrow.
- Paper-less office ??
- Software distribution.
- Printing is not computing?...