CHEP'01 Review

H. Vogt, P.Wegner
Contributions: T. Schmidt, A. Gellrich, T. Naumann

History
Introduction
Plenary Program
Parallel Tracks
DESY Contributions
LHC / Grid
Commodity Hardware & Software
Data Handling & Storage
Data Acquisition
Simulation, Data Analysis, Visualization

Conclusions

History

International Conference on
Computing in High Energy (and Nuclear) Physics

18-month period (Europe, USA, World), history:

September 2001:	Beijing / P.R. China
February 2000:	Padova / Italy
October 1998:	Chicago / USA
April 1997:	Berlin / Germany
September 1995:	Rio de Janeiro / Brazil
April 1994:	San Francisco / USA
September 1992:	Annecy / France
March 1991:	Tsukuba / Japan
April 1990:	Santa Fe / USA
April 1989:	Oxford / Great Britain

Introduction

CHEP'01
3.-7. September 2001
Friendship Hotel
Beijing / P.R. China

Organized by IHEP of the Tsinghua University Beijing

Plenary Program

Monday (Future):

Status of Preparation for LHC Computing	***(M. Delfino / CERN)***
Geant4 toolkit: status & utilization	***(J. Apostolakis / CERN)***
Software Frameworks for HEP Data Analysis	***(V. Innocente / CERN)***
The LHC Experiments' Joint Controls Project (JCOP)	***(W.Salter / CERN)***

Tuesday (Running Systems):

The BARBAR Database: Challenges, Trends and Projections	***(J.Becla / SLAC)***
New data acquisition and data analysis system for the Belle experiment	***(R. Itoh / KEK)***
The CDF Computing and Analysis System: First Experience	***(S. Lammel / FNAL)***
The D0 Data Handling System	***(V. White / FNAL)***

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Plenary Program (cont.)

Wednesday (Grid):

Grid Technologies & Applications: Architecture & Achievements)	*(I. Foster / ANL)*
Review of the EU-DataGrid project	*(F. Gagliardi / CERN)*
US Grid Projects: PPDG nad iVDGL	*(R. P. Mount / SLAC)*
The Asia Pacific Grid (ApGRID) Project and HEP Application	*(S. Sekiguchi / AIST)*
Grid Computing with Grid Engine Juxta, and Jini	*(S. See / Sun Microsystems)*

Friday (Grid/Networks/Clusters/other fields):

Grid Computing at IBM	*(G. Wang / IBM)*
Present and Future Networks for HEPN	*(H. Newman / Caltec)*
From HEP Computing to Bio-Medical Research and Vice Versa: Technology Transfer and Application Results	*(M. G. Pia / INFN)*
Large Scale Cluster Computing Workshop	*(Alan Silverman / CERN)*
Virtual network computing environment - challenge to high performance computing	*GAO Wen (China academy of sciences)*
Conference Summaries	*(Session convenors)*

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Parallel Tracks

1. Commodity Hardware & Software (10)
2. Control Systems (9)
3. Data Analysis & Visualization (28)
4. Data Handling & Storage (27)
5. Simulation (8)
6. Information Systems & Multimedia (5)
7. Local & Wide Area Networking (10)
8. Software Methodologies & Tools (26)
9. Triggering & Data Acquisition (28)
10. Grid Computing (26)

Total (177)

Large number of talks especially from US speakers where canceled or held by other authors

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DESY Contributions

28 participants, 19 contributions, 14 talks, 5 posters

DESY Hamburg:

IT: C. Beyer (Printing), P. Fuhrmann (dCache), A. Gellrich (Linux)
K. Woller (Linux), K. Ohrenberg, B. Hellwig

IPP: J. Bürger (EDMS), L. Hagge, J. Kreuzkamp (AMS)

H1: U. Berthon (OO), G. Eckerlin (Control), R. Gerhards (OO Framework)
F. Niebergall

ZEUS: U. Behrens (DAQ), U. Fricke (Database), R. Mankel,
K. Wrona (Farms)

HERA-B: V. Amaral (Database)

TESLA: H. von der Schmitt (Tesla Computing)

DESY Zeuthen:

H. Leich (PITZ-Interlock), K.-H. Sulanke, H. Vogt,
P. Wegner (APEmille), T. Naumann (H1-Alignment),
J. Hernandez (Hera-B Farms), A. Spiridonov (Hera-B Reconstruction)

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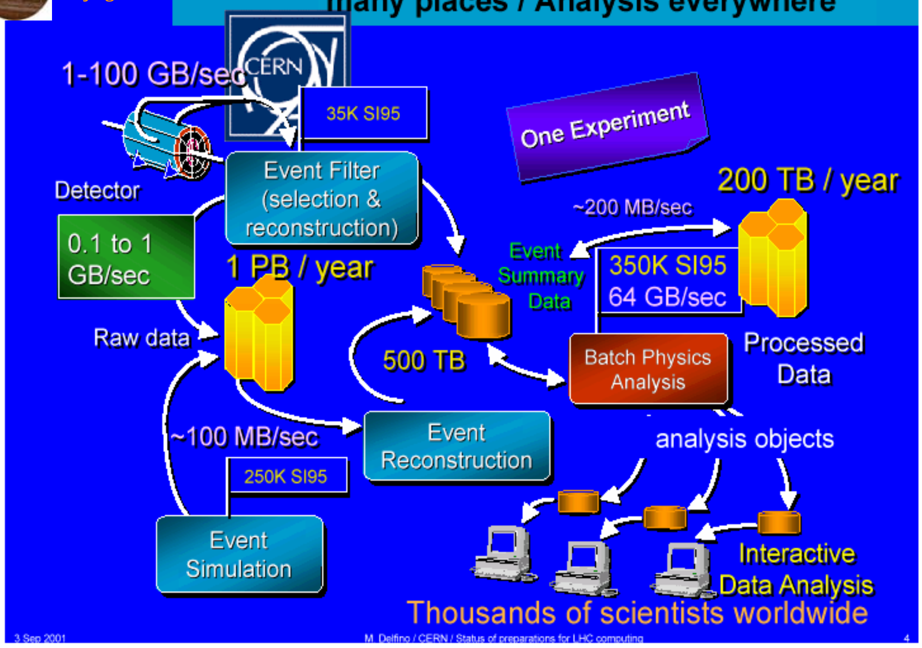
IT Division

Experiments at CERN / Simulation in many places / Analysis everywhere



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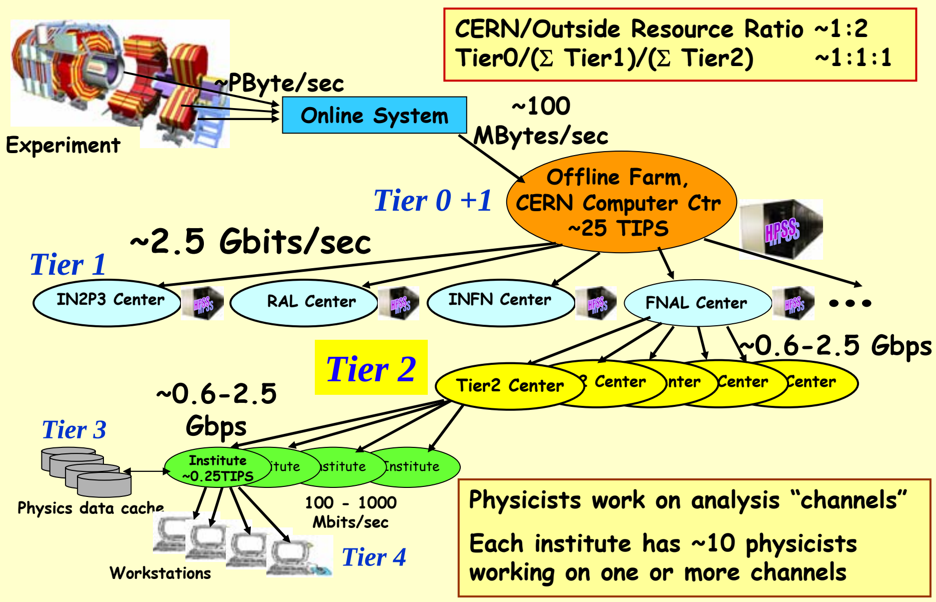
LHC -Data Grid Hierarchy 2005 (H. Newman)



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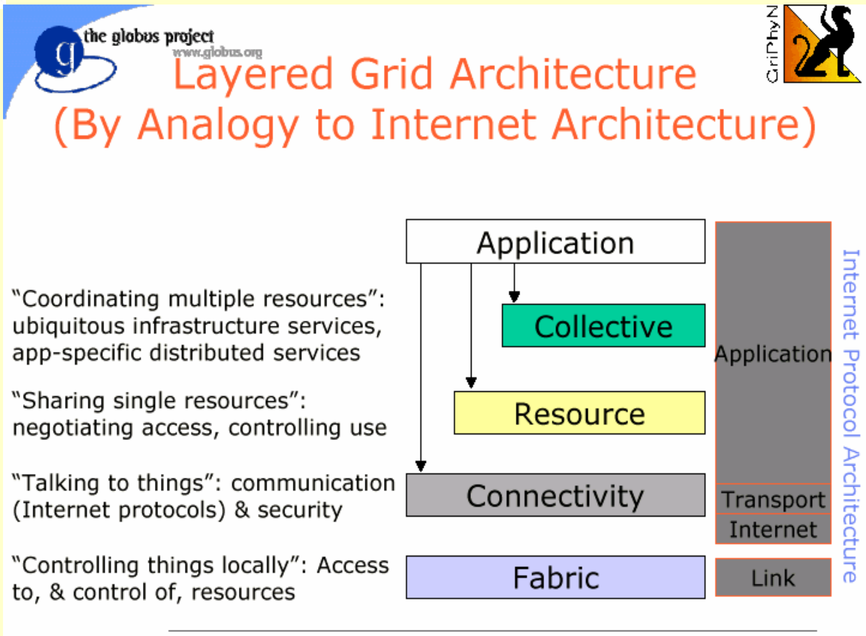
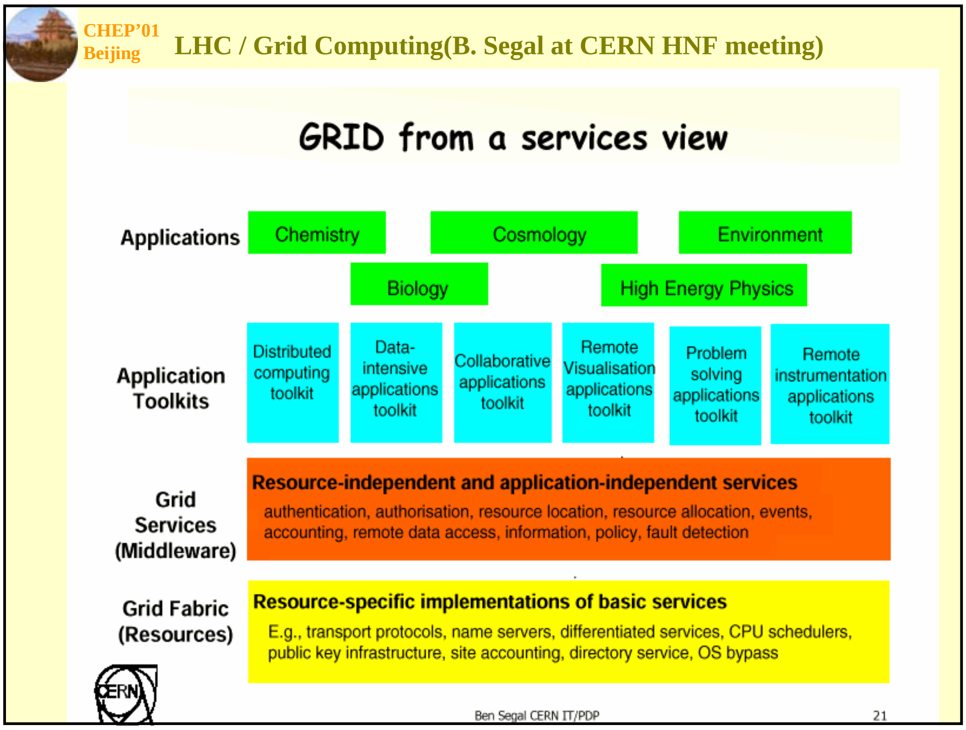
LHC / Grid Computing

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LHC / Grid Computing(B. Segal at CERN HNF meeting)
GRID from a services view
Applications
Chemistry
Cosmology
Environment
Biology
High Energy Physics
Application Toolkits
Distributed computing toolkit
Data-intensive applications toolkit
Collaborative applications toolkit
Remote Visualisation applications toolkit
Problem solving applications toolkit
Remote instrumentation applications toolkit
Grid Services (Middleware)
Resource-independent and application-independent services
authentication, authorisation, resource location, resource allocation, events, accounting, remote data access, information, policy, fault detection
Grid Fabric (Resources)
Resource-specific implementations of basic services
E.g., transport protocols, name servers, differentiated services, CPU schedulers, public key infrastructure, site accounting, directory service, OS bypass
CERN
Ben Segal CERN IT/PDP
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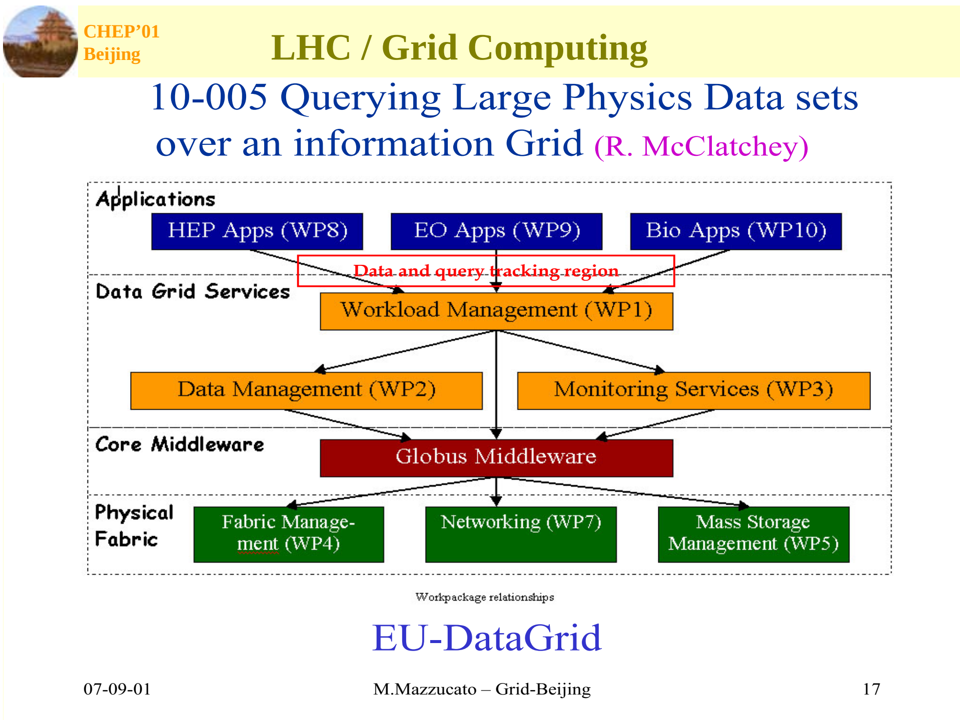
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LHC / Grid Computing
10-005 Querying Large Physics Data sets over an information Grid (R. McClatchey)
Applications
HEP Apps (WP8)
EO Apps (WP9)
Bio Apps (WP10)
Data and query tracking region
Data Grid Services
Workload Management (WP1)
Data Management (WP2)
Monitoring Services (WP3)
Core Middleware
Globus Middleware
Physical Fabric
Fabric Management (WP4)
Networking (WP7)
Mass Storage Management (WP5)
Workpackage relationships
EU-DataGrid
07-09-01
M.Mazzucato – Grid-Beijing
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LHC / Grid Computing

Goal:
... Grid is (also) the attempt to develop a new world-wide "standard engine" to provide transparent access to resources (computing, storage, network….) for coordinated problem solving by dynamical Virtual Organizations.

Implementation:
Globus, Avaki (commercialized former Legion project)

Projects:
EU Data Grid (CERN + others, 9.8 M Euros EU funding over 3 years)
Grid Physics Network (GriPhyN)
Particle Physics Data Grid (PPDG, $ 11 M, US DOE, over 4 years)
International Virtual Data Grid Laboratory (iVDGL, $ 15 M, US NSF, over 5 years)

... and many many others

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Cluster Computing

HEP wide: More and more (Linux) PC clusters are replacing large SMP and MPP 'mainframes' for offline simulation and analysis
Challenge: automatic management and support, no common tools, side dependent solutions
CERN: Batch farm, about 800 nodes, dual PII/PIII up to 800 MHz, dedicated and shared subfarms controlled managed via LSF (Load Sharing Facility),
Goal : One big shared batch farm with optimal resource scheduling
Only DESY is officially supporting Linux on desktops.
Red Hat – basic distribution (except DESY – SuSE)

Many online farms in HEP experiments:
CDF, D0, RHIC, H1, ZEUS, HERA-B, HERMES, BaBar
LHC: CMS, ATLAS, ALICE – Testfarms O(100), O(1000) planned from 2005/2006

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Cluster Computing

Report on FNAL Cluster Workshop (by invitation, May 2000) :
Review of tools with regard to PC clusters
"Administration is far from simple and poses increasing problems as cluster sizes scale" (A. Silverman, CERN)
Quote of the week - "a cluster is a great error amplifier"
(Chuck Boeheim, SLAC)
DESY underrepresented, usage of cfengine, grid engine ... not mentioned

Lattice QCD farm at FNAL:
2000: 80 PCs, Dual PIII 600 MHz, Myrinet
(Replacement for ACPMAPS cluster)
2002: 256 nodes P4(XEON) 2 GHz(?), Myrinet2000
2004: 1000 nodes, 1 Tflop expected, extension to 10 Tflops planned
(deployment of about 200 nodes/year)

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Mass Storage

Who's Using What

"Experiment"	Event DB	Metadata DB	Mass Storage System
Alice	Root	MySQL	Castor
AMS	Root	Oracle	
Atlas	Objectivity	MySQL	Castor
BaBar	Objectivity	Objectivity	HPSS
BES	Root	Oracle	----
CDF	Root	Oracle	DIM
CMS	Objectivity	Objectivity	Enstore, HPSS → Castor
COMPASS	CDR	Objectivity	Castor
D0	Flat Files	Oracle	SAM+Enstore, HPSS, etc
JLAB-located	various	various	JASMine
KEK-located	various	various	HPSS
KLOE	YBOS	YBOS+DB2	ADSM+Local
LHCb	Root	In Progress	Castor
Star	Root	MySQL	HPSS
ZEUS	Objectivity	Objectivity	OSM → EuroStore

CHEP 2001 Data Handling & Storage Summary 9

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Mass Storage

RAIT (Reliable Array of Inexpensive Tapes)

- Parity tapes to data stripes
- US DOE/ASCI project, talk by Storage Technology Corporation(STK)
- Test setup: 80 MB/sec sustained,
- 1 FiberChannel Interface striped out to 8 drives
- Goal: 8 GB/sec by striping 12 RAIT systems together

dCache

- Joint project: DESY-IT, FERMI CD_INTEGRATED SYSTEMS)
- "Generic tool for caching, storing and easily accessing huge amounts of data, distributed among a large set of heterogeneous caching nodes"
- Single name space (pnfs)
- Hot Spot Spreading
- OSM interface

Disk storage is the biggest cost risk for LHC computing

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DAQ

More than 31 contributions …

3x ATLAS,LHC, CERN
3x CMS,LHC, CERN
2x ALICE,LHC, CERN
1x nTOF,PS, CERN
3x DZERO,Tevatron, Fermilab
2x CDF,Tevatron, Fermilab
1x BeTeV,Tevatron, Fermilab
1x H1,HERA, DESY
1x HERA-B,HERA, DESY
1x Zeus,HERA, DESY
1x AMANDA, (DESY)
1x ANTARES, (CEA)
1x ARGO, YBJ-HACRL
1x BaBar, PEP-II, SLAC
1x BES III, BEPC-II, IHEP Beijing
1x CLEO, CESR
1x FLNP, IBR-2, JINR
1x ISTRA+, IHEP Protvino
1x PHENIX, RHIC, BNL
1x SND2000, VEPP-2000, IHEP Novosibirsk
…

9x CERN
6x Fermilab
4x DESY

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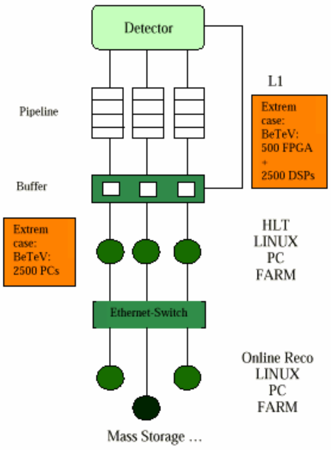
DAQ

Main topic: High Rate Systems …

Typical solution: pipelined readout + hardware filter + software filter (PC farm)

Examples:



Existing:	Future:
HERA-B 500000 Channels	ATLAS 100000000 Channels
10 MHz, 90 GB/s	40 MHz x 25 Events
Hardware Filter: 10 MHz, 10 GB/s	Hardware Filter: 75 KHz, O(200) GB/s
240 PCs L2 Software Filter (RoI): 50 KHz, 250 MB/s	400 PCs: L2 Software Filter: O(1 KHz), O(4 GB/s)
L3 Software Filter (Full Data) 500 Hz, 250 MB/s	200 PCs Software Event Filter: O(100 Hz), O(4 GB/s)
L4 Software Online Reco 50 Hz, 6MB/s	
2.4 MB/s to Mass Storage	200 MB/s to Mass Storage

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DAQ

Crucial component: Farm communication using Gigabit Ethernet, Myrinet …

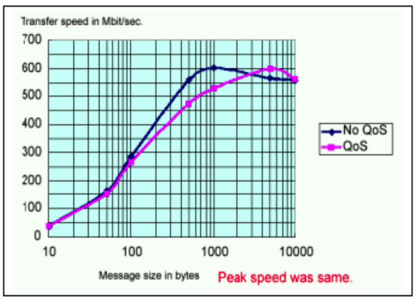
Example:
Quality of Service on Linux for the Atlas TDAQ Event Building Network:

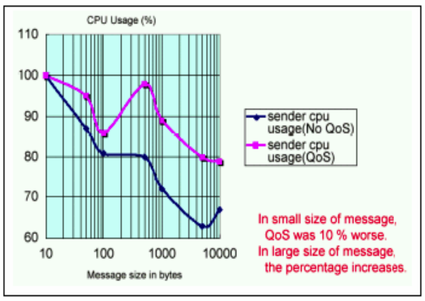
Testsetup: 4 Linux PCs with Gigabit Ethernet plus Gigabit Switch

→ QoS can eliminate packet loss on UDP/IP multicast transfer (upto 60% without QoS)

→ Transfer speed high inspite of QoS

→ CPU usage of QoS is small on the transfer





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DAQ

Readout/Run Control/Online Software…

Frequently used technologies:

OS	low level software	high level software	client-server/remote actions	GUI, histogramming, etc.	configuration	scripting (run control)
• VxWorks (realtime) • **LINUX** (dominating, since realtime typically not needed) • Solaris	C(++)	• **C++** • Java	CORBA • ILU, omniORB, MICO, … (C++) • jdk1.3 CORBA (Java)	**ROOT** (C++) AWT and JAS (Java)	• databases (Objectivity, mySQL) via JDBC • **XML**	(J)Python

Interesting: Tendency to use many different technologies in parallel:

Examples:
a) A Dataflow Meta-Computing Framework for Event Processing in H1
→ Linux PCs + C++ + Java + omniORB + jdk1.3 CORBA + ROOT + JAS + Python
b) On the Way to Mturity – The CLEO III Data Acquisition and Control System
→ VxWorks/Solaris/Windows NT CPUs + C++ + Java + VisiBroker CORBA + Objectivity

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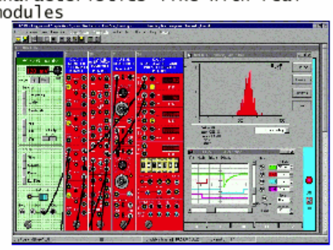
DAQ

Pleasant change to relax: Small systems and simple tools like …

TASS: Trigger and Acquisition System Simulator

- TASS reproduces in a realistic way commercial NIM, CAMAC and VME modules
- Access to any hardware and software characteristics like with real modules



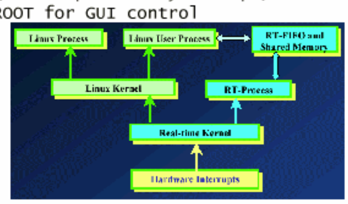
→ to help physicists developing trigger systems and students learning the fundamentals

TASS aims to be the 'bridge' joining the existing software packages in HEP
Detector/GEANT → DAQ/TASS → Analysis/PAW

RTLinux and ROOT for Data Acquisition in Small Experiments

Hardware:
- PC with ISA-to-CAMAC controller
- plus CAMAC crate etc.
- Interrupt requests are sent to PC using IRQ9

Software:
- RTLinux for hard real-time DAQ (interrupt latency < 15 μs)
- ROOT for GUI control



Offers:
- High DAQ speed
- A reliable and stable DAQ system
- Easy implementation of software design
- Low cost

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CHEP'01 URLs

CHEP01 home page:	http://www.ihep.ac.cn/~chep01/
EU Data Grid:	http://www.EU-DataGrid.org
Grid anatomy: http://www.globus.org/research/papers/anatomy.pdf	
IEEE task force on cluster computing:	http://www.ieeetfcc.org
Fermilab Large Cluster Workshop:	http://conferences.fnal.gov/lccws/
IGUANA Toolkit:	http://iguana.cern.ch
Java Analysis Studio:	http://www-sldnt.slac.stanford.edu/nld
Tass DAQ simulator	http://tass.roma1.infn.it/