

il calcolo nella fisica delle particelle elementari

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Istituto Nazionale di Fisica Nucleare

INFN

finanzia e coordina
la ricerca in fisica
delle particelle
elementari in Italia



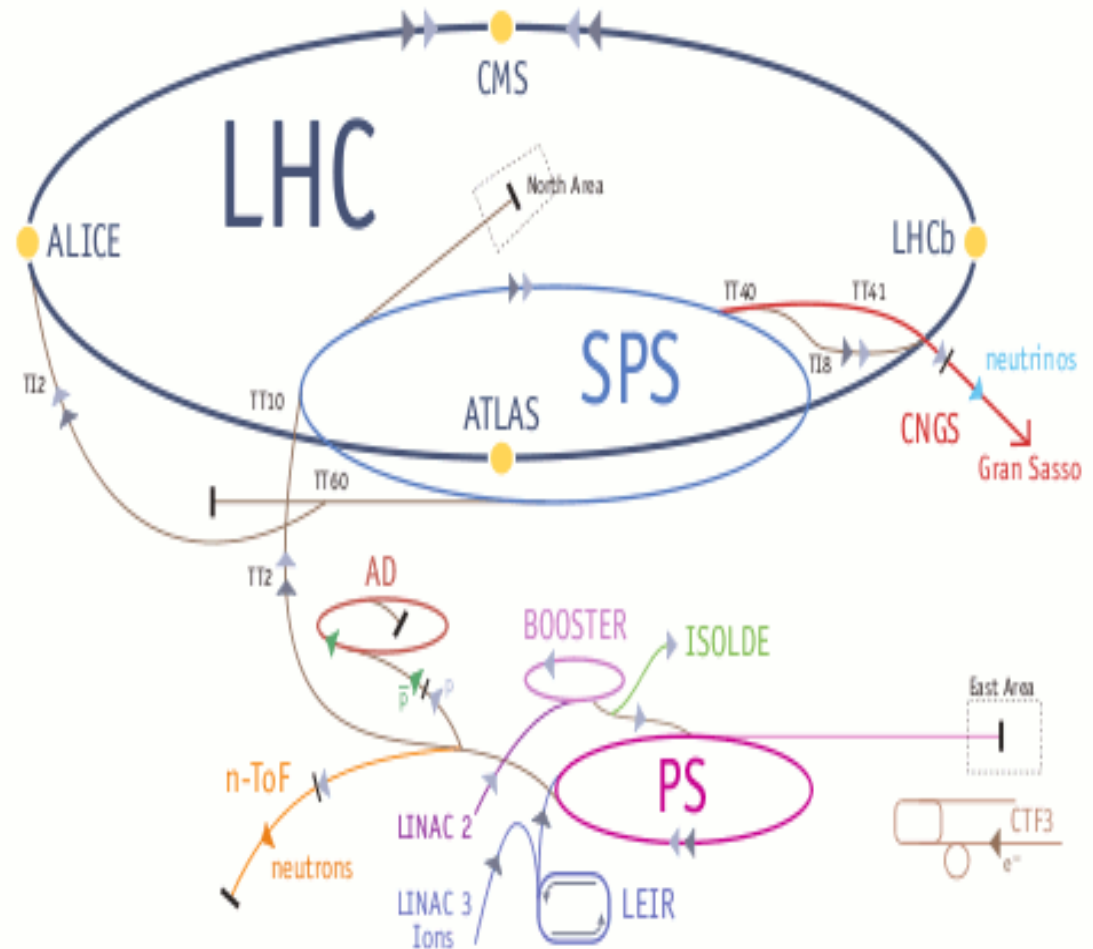
19 sezioni, 11 gruppi,
4 laboratori nazionali,
1850 dipendenti.

~ 5000 ricercatori, la maggior
parte universitari,
distribuiti in 16 regioni
diverse

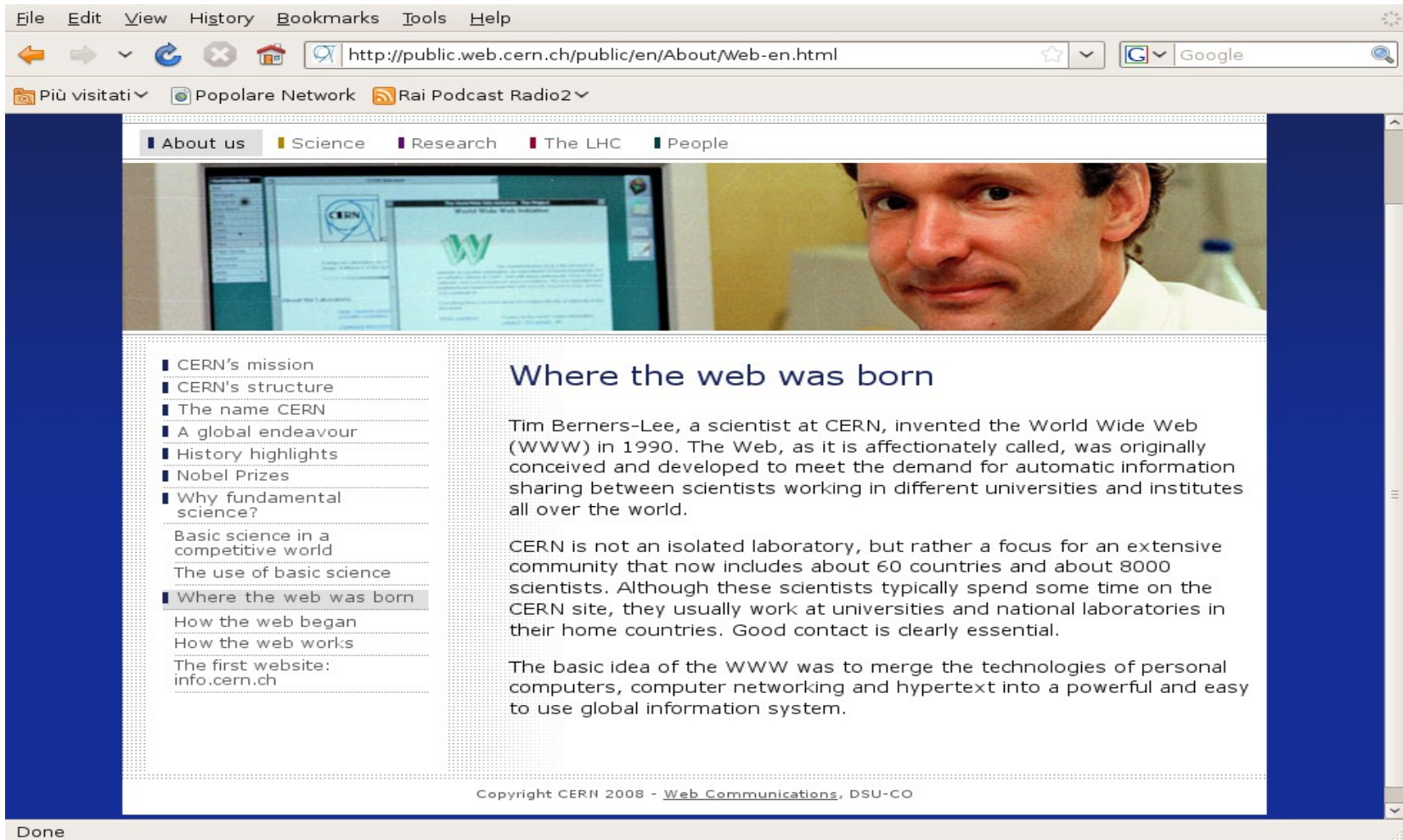
CERN

European Organization for Nuclear Research

Laboratorio europeo
per la fisica delle
particelle elementari



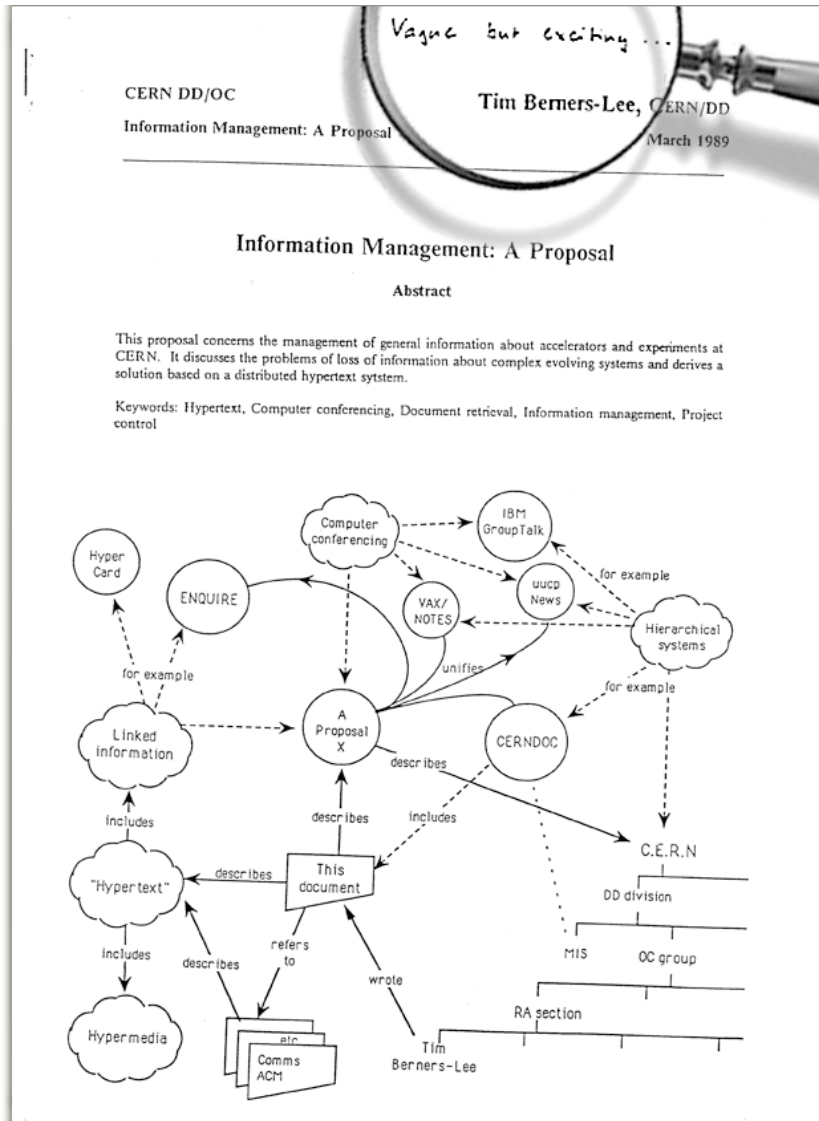
dove è nato il Web ?



The screenshot shows a web browser window with the address bar displaying <http://public.web.cern.ch/public/en/About/Web-en.html>. The browser's menu bar includes File, Edit, View, History, Bookmarks, Tools, and Help. The address bar also shows a search engine dropdown set to Google. Below the address bar, there are navigation icons and a list of visited sites including 'Più visitati', 'Popolare Network', and 'Rai Podcast Radio2'. The main content area features a navigation menu with links for 'About us', 'Science', 'Research', 'The LHC', and 'People'. A large image shows a man in a white shirt looking at a computer monitor displaying the CERN website. Below the image, there is a sidebar with a list of links: 'CERN's mission', 'CERN's structure', 'The name CERN', 'A global endeavour', 'History highlights', 'Nobel Prizes', 'Why fundamental science?', 'Basic science in a competitive world', 'The use of basic science', 'Where the web was born' (highlighted), 'How the web began', 'How the web works', and 'The first website: info.cern.ch'. The main content area has the heading 'Where the web was born' and the following text: 'Tim Berners-Lee, a scientist at CERN, invented the World Wide Web (WWW) in 1990. The Web, as it is affectionately called, was originally conceived and developed to meet the demand for automatic information sharing between scientists working in different universities and institutes all over the world. CERN is not an isolated laboratory, but rather a focus for an extensive community that now includes about 60 countries and about 8000 scientists. Although these scientists typically spend some time on the CERN site, they usually work at universities and national laboratories in their home countries. Good contact is clearly essential. The basic idea of the WWW was to merge the technologies of personal computers, computer networking and hypertext into a powerful and easy to use global information system.' At the bottom of the page, there is a copyright notice: 'Copyright CERN 2008 - Web Communications, DSU-CO'. The browser's status bar at the bottom left shows 'Done'.

nel 2009 ha festeggiato i 20 anni
<http://info.cern.ch/www20>

la proposta iniziale ...



1989

"vague but exciting"

<http://first-website.web.cern.ch/>

30 aprile 2013:

Vent'anni di web aperto e libero:

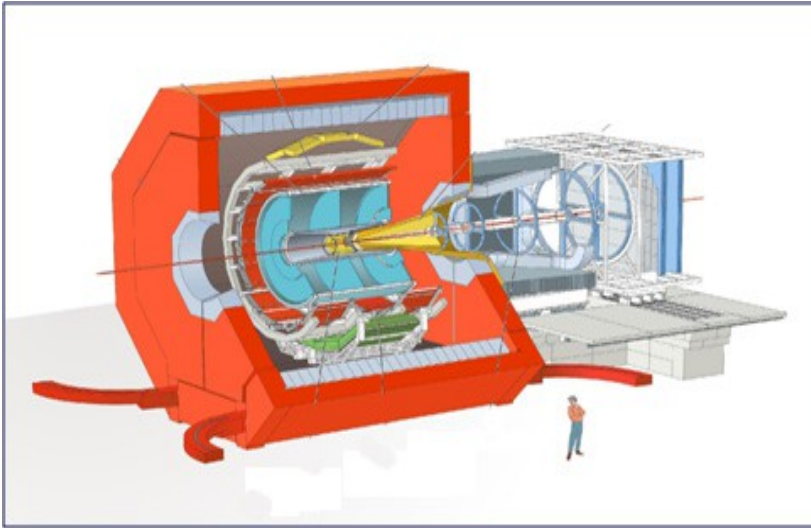
"On 30 April 1993 CERN published a statement that made World Wide Web technology available on a royalty free basis, allowing the web to flourish"

giostra "europea" per protoni



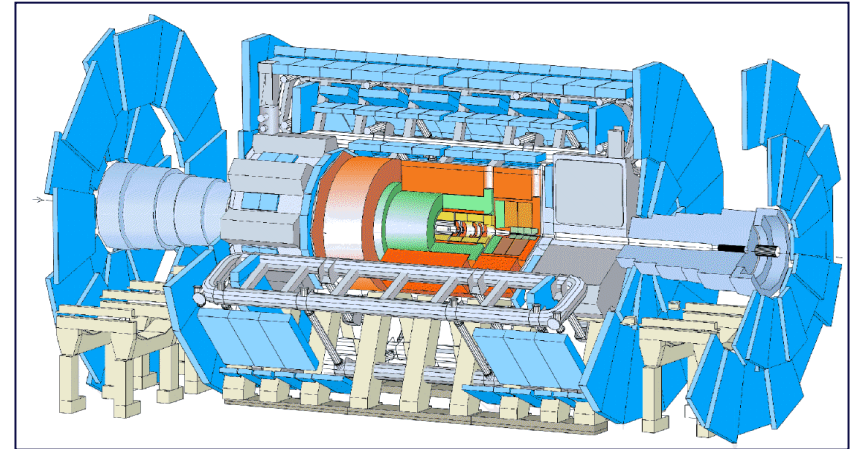
esperimenti @ LHC [portavoce 2011]

ALICE [Paolo Giubellino]

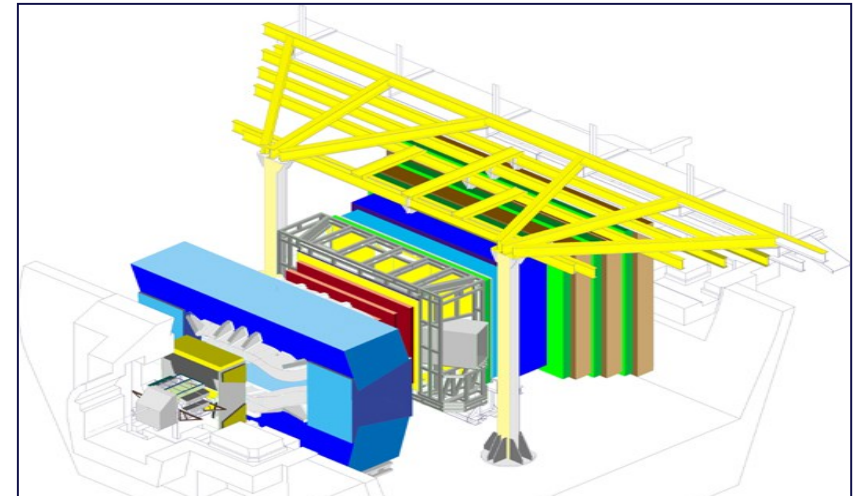
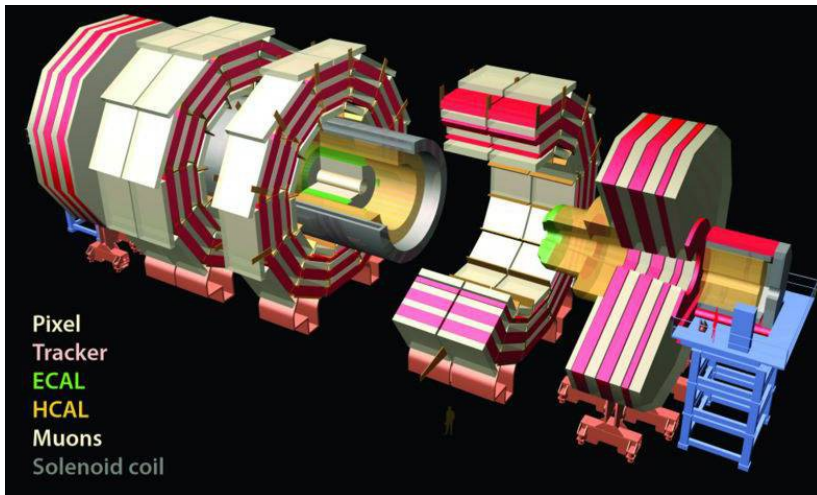


CMS [Guido Tonelli]

ATLAS [Fabiola Gianotti]



LHCb [Pierluigi Campana]



più Totem e LHCf

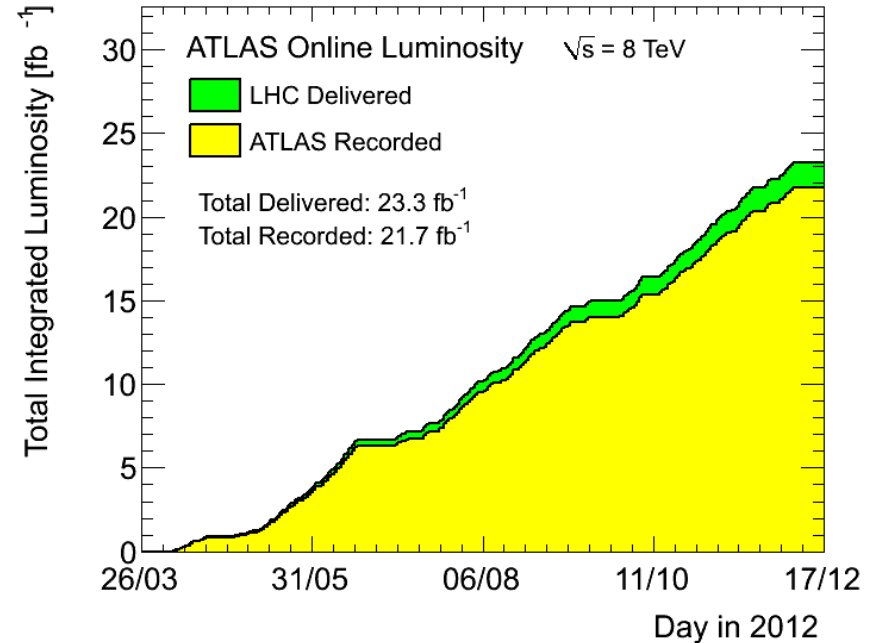
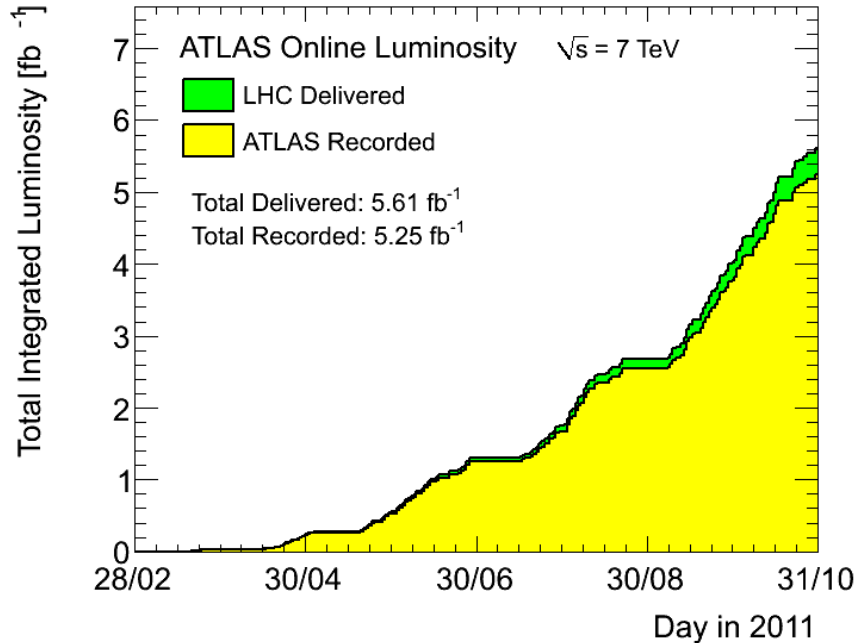
il calcolo in ATLAS @ LHC

ATLAS: un microscopio alto 25 e lungo 46 m

- ONLINE: interattivo / in tempo reale (?)
 1. selezione e acquisizione dati (DAQ)
 2. trasferimento e storsaggio

- OFFLINE: ~ non interattivo (code batch)
 3. ricostruzione eventi
 4. analisi
 5. simulazione

dati 2011-2012



$1.5 \text{ MB/evento} \times 400 \text{ eventi/s} \times 50\% \text{ (compr.)}$

$\rightarrow 1 \text{ TB/ora} \times 1/3 \text{ (live time)}$

$\rightarrow \underline{3 \text{ PB/anno}} \text{ (} \rightarrow 10 \rightarrow 50 \rightarrow >100 \text{)}$

[4 miliardi di eventi]

problematiche

- ONLINE (acquisizione dei dati):

a) controllo strumentazione

b) selezione, controllo e spostamento dati in **tempo reale**

→ efficienza, velocità, robustezza, stabilità

- OFFLINE (ricostruzione e analisi dei dati):

→ precisione, ripetibilità

rete, storage, database, fogli elettronici, ...

versioning, documentazione ... "event display"

Condivisione e discussione di dati/informazioni/idee !

[parentesi] ... tempo reale ?

Sistema operativo "real-time" :

massimo ritardo di risposta definito

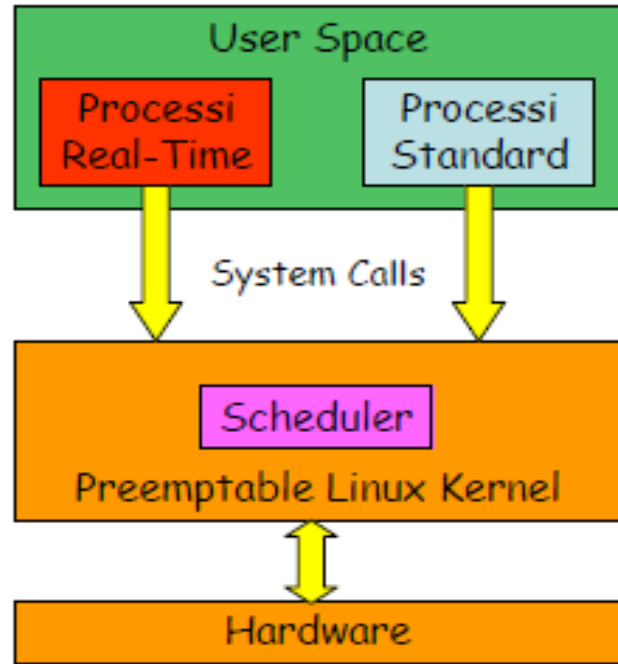
(comportamento del sistema ~deterministico)

UNIX (e linux) "standard" non sono real-time:

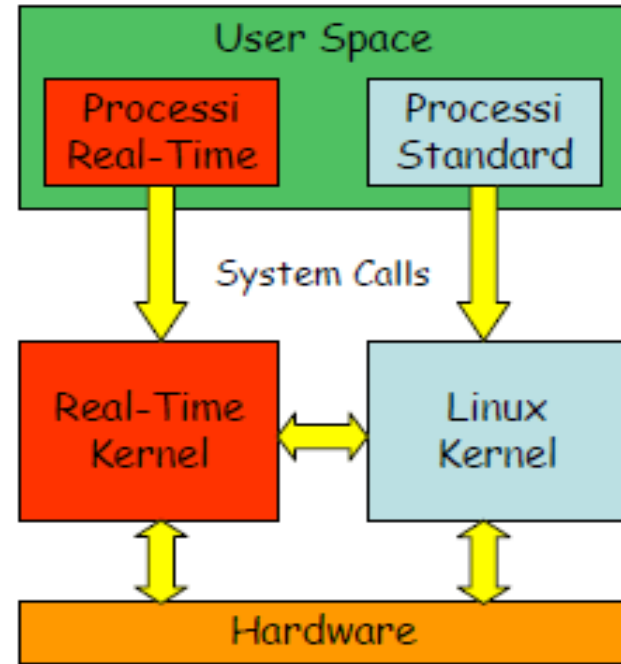
una chiamata di sistema può richiedere un tempo lungo a piacere ...

Estensioni real-time (a linux)

esempi di distribuzioni oggi disponibili:



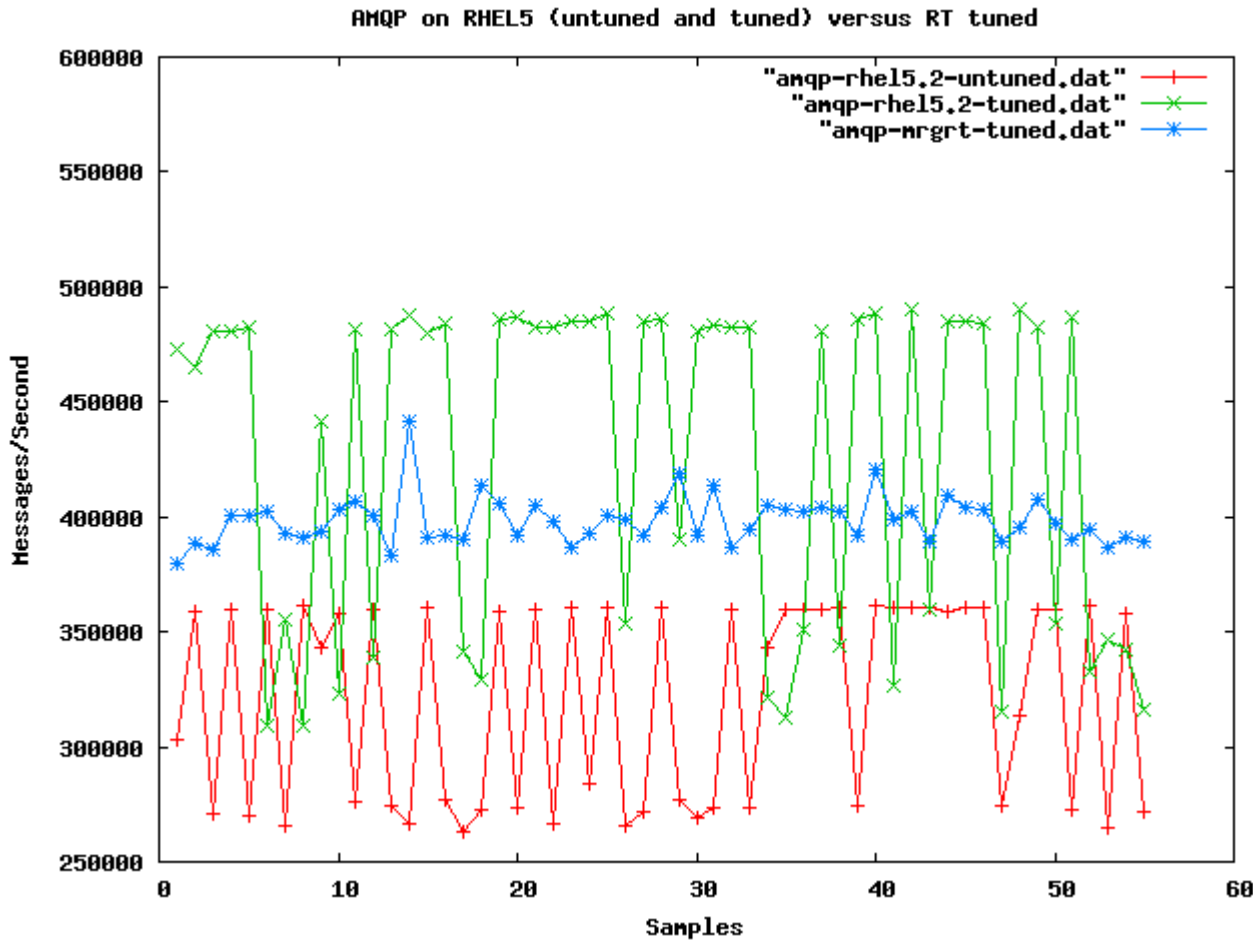
kernel linux interrompibile
e deterministico
(low-latency patch:
Ubuntu studio)



un kernel real-time gestisce il
kernel linux come un processo
a bassa priorità
(RTAI, Red Hat MRG)

Differenza ?

Confronto fra diversi kernel (Red Hat 5):
numero di messaggi gestiti / secondo



— RHEL untuned
— RHEL tuned
— RH MRG tuned

a) media circa uguale
b) fluttuazioni molto diverse

da dove siamo partiti ? (anni 80) ...

minicomputer: PDP e VAX con VAX/VMS (real-time)

- acquisizione dati, calcolo interattivo, ...

mainframe: IBM 379 con MVS e VM/CMS (code batch)

- grossi "job" di ricostruzione e simulazione dati

supercomputer: CRAY X-MP 48 con UNICOS

- calcolo vettoriale

rete: - DECNET, BITNET, X.25

- + CERN INTERLINK (bridge)

linguaggio: FORTRAN 77



CRAY X-MP 48 con UNICOS (1988)

- calcolo vettoriale
- UNIX con code batch (sviluppate in casa)
- clock ~ 118 MHz, RAM 128 MB
- costo ~10 M\$
- potenza di calcolo enorme [$\ll \sim \frac{1}{2}$ Xbox]

... di colpo qualcosa cambia ...

Calcolo offline, fine anni 80 - primi anni 90:

rete: internet (TCP/IP) inizia a prendere il sopravvento

progresso nei compilatori, memorie sempre meno costose:

processori **RISC** (Mips, Sparc, Alpha, ...) basati su Unix & C
molto aggressivi e competitivi ...

da grossi mainframe → mini/microcomputer (calcolo distribuito su farm con limitati costi unitari), workstation con capacità di calcolo significative

parole chiave: Unix, C, RISC, TCP/IP, * SCALABILITA' *

prima macchina: Apollo DN10000 (CERN 1989)

architettura cpu

prima metà anni '90 transizione:

CISC → RISC (Motorola: 68000 → PowerPC)

CISC: chiusura del "gap semantico" fra istruzioni di alto livello e microcodice (molti registri, molte istruzioni complesse, molti modi di accedere la memoria)

RISC: il contrario → complessità nel software (unix & C), semplicità nell'hardware, velocità sempre in aumento (migliori compilatori, memorie meno costose)

intel x86 ?

babilonia di dialetti

SGI: processore MIPS con sistema operativo IRIX (1)

SUN: SPARC con SunOS-4 (2) e poi SOLARIS (1)

Apollo: Domain/OS (3)

HP: PA-RISC con HP-UX (1)

DEC: ALPHA con Ultrix (2) e poi Digital Unix (3)

IBM: RS/6000 e PPC con AIX (1)

(1) UNIX System V; (2) UNIX BSD; (3) UNIX ibrido;

comunque vita molto più semplice di prima ...

... a cavallo del 2000 inizia la transizione a **Linux (e i686)**:

→ **Red Hat Linux (!)** → **Scientific Linux Cern**

termina la corsa del clock, inizia la moltiplicazione dei core

Red Hat → S.L.C. (x86/x86_64)

Scientific Linux: release creata nel 2004 da FermiLab

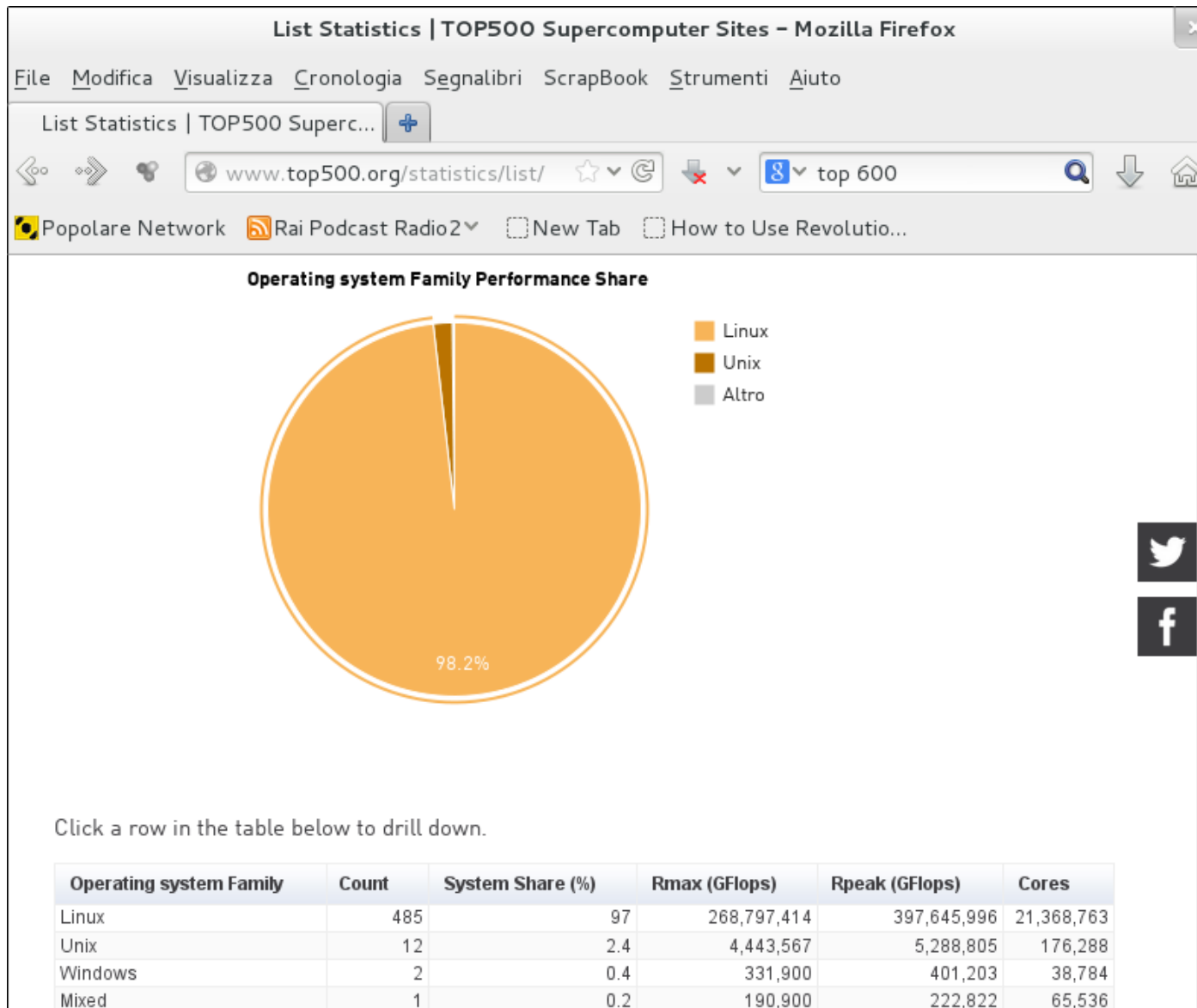
<http://www.scientificlinux.org/>

Scientific Linux Cern: sottovariante CERN

<http://linux.web.cern.ch/>

- "Red Hat Enterprise Linux" ricompilata e integrata con pacchetti specifici
- disponibili versioni con kernel real-time
basate su Red Hat MRG ("Messaging, Real-time, Grid")

High Performance Supercomputing (giugno 2014)



acquisizione dati (DAQ)

Verso la metà degli anni 80:

da VAX/VMS → Single Board Computer (**SBC**)

- sistemi modulari, processori Motorola 68000 (CISC)
- sistema operativo real-time OS-9

Inizi anni 90 - R&D per LHC:

da CISC → RISC, da OS-9 → real-time Unix

parole chiave: **VME**, **rt-Unix**, **C**, **RISC**, **TCP/IP**, * **SCALABILITA'** *

!!!

DAQ → LHC

Seconda metà' anni 90:

front-end (SBC): powerPc+ LynxOs (ma anche test con windows NT)

back-end: Solaris/HP-UX/... (→ pc con linux)

necessità di "real time" diminuisce rapidamente ...

rimangono diffidenze verso mondo "open source"

Nei primi anni 2000, graduale convergenza:

Red Hat linux !

front-end (SBC): 80x86 + linux (Red Hat linux → S.L.C.)

back-end: rack di macchine linux (Red Hat linux → S.L.C.)

ATLAS Trigger & DAQ - 2012

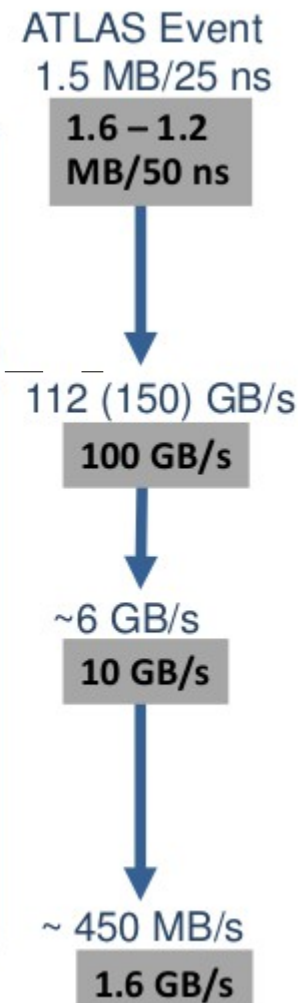
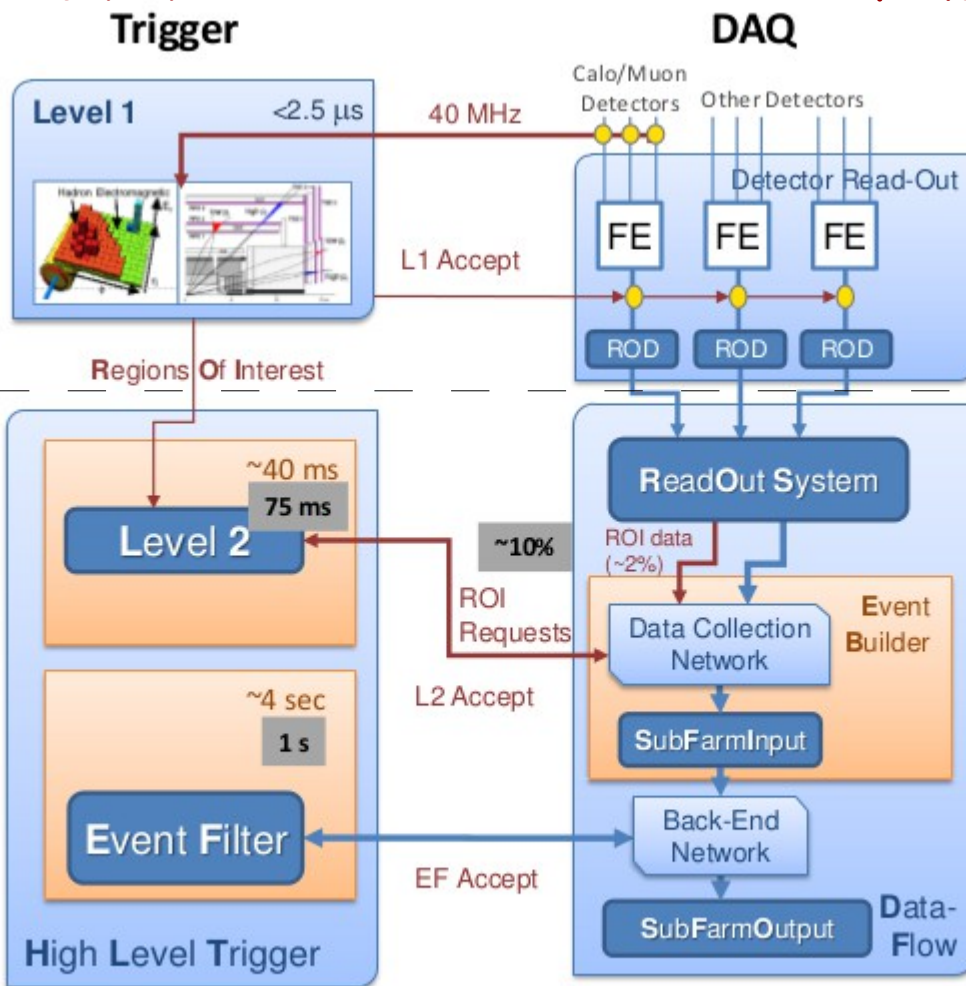
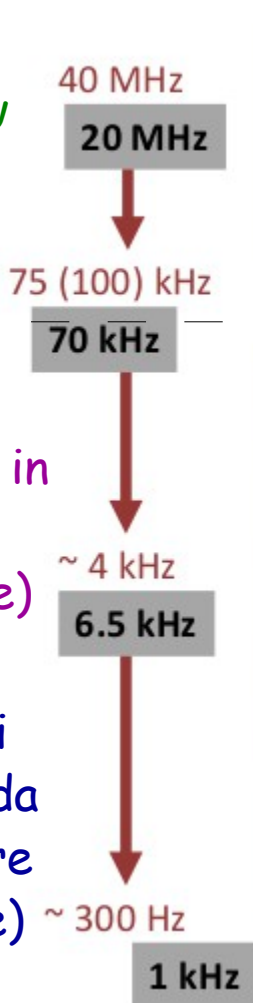
Selezione eventi "online"

Flusso dati

processori/hw dedicati

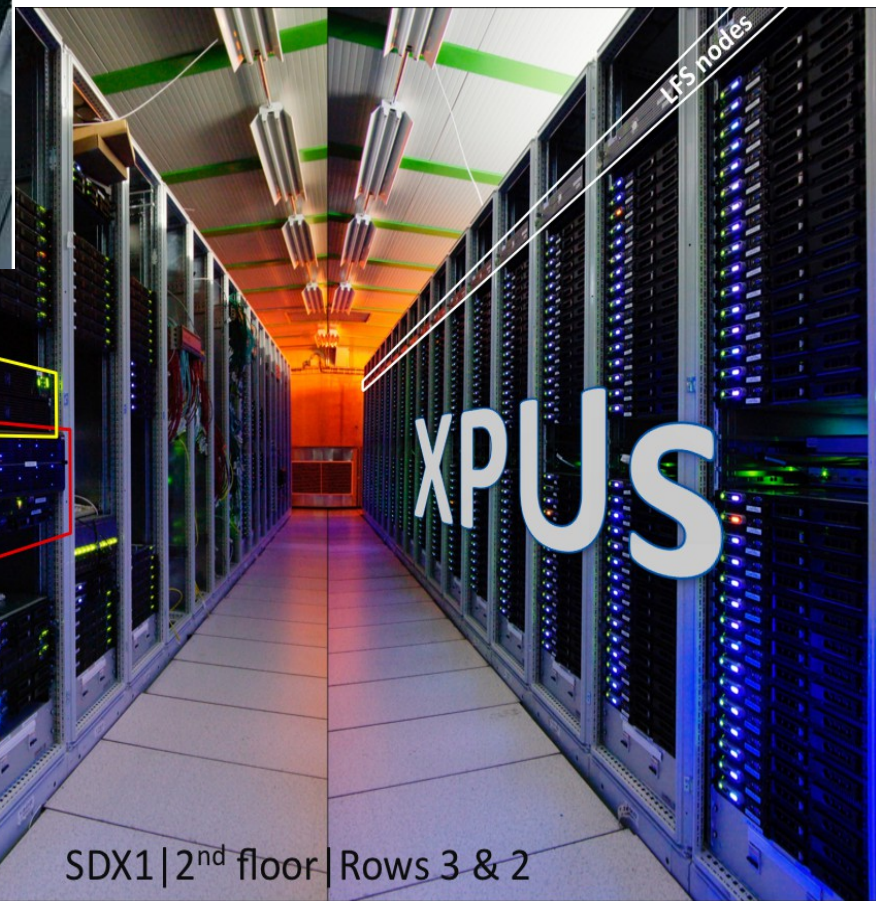
migliaia di computer in parallelo (hardware)

decine di migliaia di processi da controllare (software)

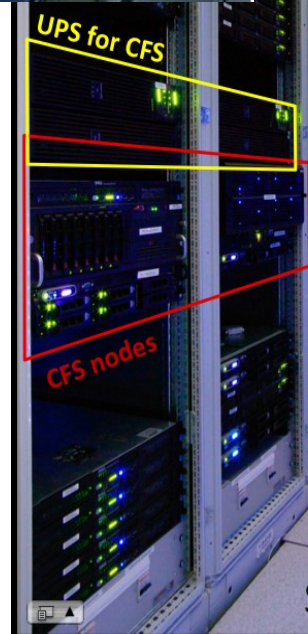




sala di controllo di
ATLAS



farm processori
online



Parma, 15 novembre 2014

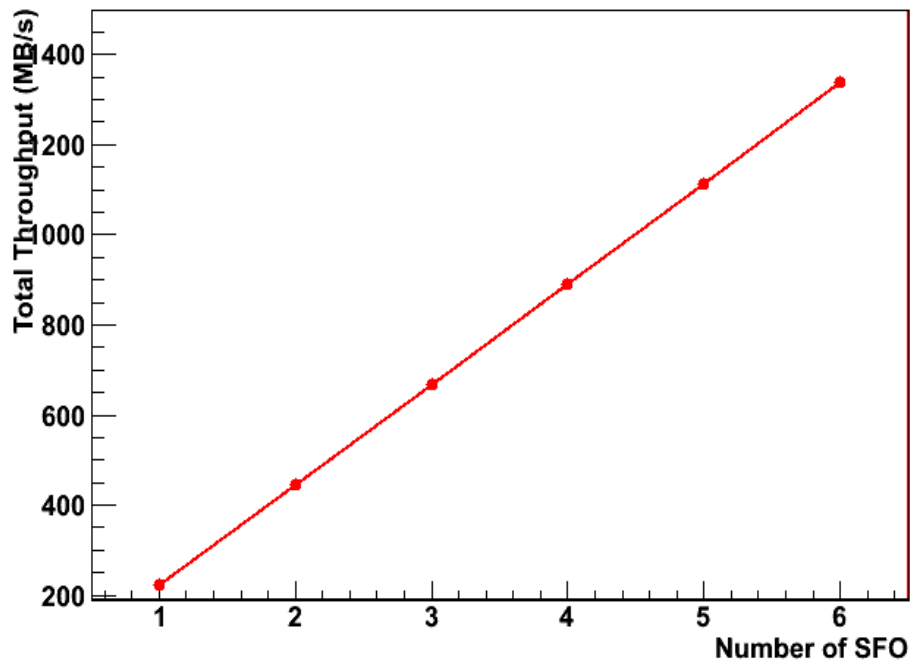
SFO = Online Storage (cache)

6 macchine:

24 dischi 1 TB = 144 TB

2x4 core (16 "processori" ind.)

24 GB RAM



Parma, 15 novembre 2014



fra la via Emilia e il West

E4 Computer Engineering - Scandiano

<http://www.e4company.com/>

500 sistemi di calcolo HPC all'INFN

Aggiudicandosi questa importante fornitura, E4 si riconferma ancora una volta come realtà di riferimento nell'ambito dei supercomputer a livello nazionale, ma anche internazionale

E4 Computer Engineering, Azienda specializzata nella produzione di sistemi informatici d'alta fascia e a elevate performance per l'industria e i centri di calcolo e ricerca scientifica, ha vinto l'ultima gara di appalto di IT procurement dell'INFN - CNAF, il Centro Nazionale per la Ricerca e Sviluppo nelle Tecnologie Informatiche e Telematiche.

Aggiudicandosi questa nuova fornitura di quasi 500 High Performance PC (HPC), E4 ha dimostrato ancora una volta sul campo la bontà del proprio modello di business e l'elevata professionalità del proprio team, in gran parte ingegneri provenienti dalle università emiliane, che le hanno consentito di competere ad armi pari e superare anche in questo caso i più importanti player della techno-



Vincenzo Nuti.

logia a livello mondiale.

Aggiudicandosi quest'ultima gara, la dinamica azienda emiliana può oggi vantare all'interno dell'INFN circa 2.300 computer ad alte prestazioni, che contribuiscono quotidianamente al lavoro dell'ente di ricerca, ai quali si aggiungono sistemi storage in grado di immagazzinare sui loro 6.700 dischi rigidi informazioni per oltre 14 Petabyte, ossia 14.000 Terabyte.

Le esperienze e il know-how

accumulato sul campo, anche grazie al CNAF dell'INFN, hanno consentito all'azienda di diventare da qualche anno fornitore di sistemi ad alte prestazioni anche per il prestigioso CERN di Ginevra, il più importante e famoso centro di ricerca mondiale. In questo "tempio" della ricerca, i sistemi di E4 costituiscono dal 25 al 33% dei sistemi di calcolo e d'immagazzinamento dei dati del data center e, a oggi, l'azienda è l'unica realtà tutta italiana che riesce a competere con successo con i "big" internazionali.

"I sistemi di calcolo e supercalcolo sono spesso totalmente sconosciuti al grande pubblico, ma i supercomputer giocano, in realtà, un ruolo straordinariamente importante quando si ragiona in termini di competi-

tività e sviluppo di un paese, poiché permettono di effettuare, ad esempio, simulazioni e test su nuovi prodotti, prima ancora di averli realizzati, con evidenti vantaggi in termini di tempo e denaro.", ha affermato Vincenzo Nuti, Amministratore Delegato di E4 Computer Engineering, che ha poi proseguito: "Ritengo, in ogni caso, che i livelli di eccellenza che abbiamo raggiunto vadano in parte sicuramente ricercati nel tessuto dell'Emilia Romagna, regione in cui abbiamo sede e dove abbiamo avuto modo di trovare sia professionalità, che opportunità, due ingredienti che hanno certamente contribuito al nostro successo anche in campo internazionale."

Per informazioni:
www.e4company.com

- PC / WS INTEL ENTRY
- WORKSTATION INTEL
- SERVER INTEL 1U RACK
- SERVER INTEL 2U/3U RACK
- SERVER INTEL 4U/TOWER
- SISTEMI EMBEDDED
- HIGH DENSITY
- SERVER AMD 1U/2U RACK
- GPU SOLUTIONS
- SISTEMI DI STORAGE
- SWITCH ETH / FC / IB
- ARMADI
- CPU-HD-RAM-SW-VGA
- Componenti ed accessori
- Supermicro - chassis M/B
- Adapter HBA / HCA
- Networking - KVM - UPS

Software ...

Trasferimento, processamento, monitoraggio dati:

C/C++ (protocolli di rete: UDP, TCP)

GUI: Java / JS / Qt / Python (tk/tcl)

Sistema Esperto: Common Lisp

Inter Process Communication: CORBA

Configurazioni/Calibrazioni/Allineamenti/Geometrie:

file, OXS (xml), COOL, ORACLE, SQLITE, Python ...

largo uso di Proxy

Documentazione, gestione problemi: WWW, Twiki, Savannah

... Nagios (monitoraggio !), IPMI (controllo !) ...

Parole chiave: Macchine a Stati Finiti, Scalabilità,

Partizionabilità, Configurabilità, Sicurezza

DAQPanel (on pc-atlas-cr12.cern.ch)

Insert Here Some Info

Setup Script: /sw/tdaq/setup/setup_tdaq-02-00-03.sh

Part Name: ATLAS

Database File: /atlas/oks/tdaq-02-00-03/combined/partitions/ATLAS.data.xr

Buttons: Start Partition, Monitor Partition, RC Status, Local Procs, OKS, DVS, Log Manager, MRS, Busy, DQM Display, Trigger Presenter, Event Dump, OHP, OMD, ISPY, SFO Display, Get Default, Read Info, Get Partition, Log Messages, Resize, Clear Log, Change File, Exit

Run Control Macchina a Stati Finiti

ATLAS TDAQ Software Graphical User Interface - Expert Control

RELOAD CONFIGURATION

Run control: RUN CONTROL STATE: RUNNING

START/STOP FLOW

PROCESSES RUNNING. Should coincide with the RUN CONTROL STATE

ERROR LOGGER. Messages for experts so far...

16:12:55 WARNING ArchivingService... SctIsException

16:12:44 WARNING ArchivingService... SctIsException

MRS Monitor [ATLAS]

TIME	SEVERITY	APPLICATION	NAME	MESSAGE
15:39:41	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3599./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:41
15:39:40	WARNING	LVL2-L2-2-rack...	gatherercissue	Histogram'L2PU-5920./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:40
15:39:40	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3752./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:40
15:39:40	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3176./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:40
15:39:40	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3560./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning
15:39:40	ERROR	CheckBCIDGnam	bcidcheck:AnyError	Run 136207 Ev 18434 Ref 1 L1 Ox0c03643 TT Ox0c BC Ox576 Status Ox 1 full 0 - event format error -- 95 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:38
15:39:40	ERROR	CheckBCIDGnam	bcidcheck:AnyError	(opt=0) (ROB Ox810000) BCID internal mismatch: 0xbdb1 / 0xaaee -- 95 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:38
15:39:39	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3690./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning
15:39:40	WARNING	ROS-TLc-LBC-01	ROS:CoreException	Timeout: in request for fragment with L1 ID 2919260819 -- 2252 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:39
15:39:39	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3194./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning
15:39:39	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3199./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning
15:39:39	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3162./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning
15:39:39	WARNING	LVL2-L2-1-rack...	gatherercissue	Histogram'L2PU-8103./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:39
15:39:39	WARNING	LVL2-L2-2-rack...	gatherercissue	Histogram'L2PU-6107./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEC' can not be summed because histograms have incompatible binning -- 10 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:39
15:39:39	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3208./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning
15:39:39	WARNING	SFI-32	SFEDataIntegrity	Problem with data integrity: Event fragment from ROB Ox810000 (ROS: BCM_ROS_SubDet: 129) with LVL1ID: Oxaa040e and BCID: 1357 has a BCID mismatch: Event_BCID - ROD_BCID = -195. [ROS Fragment status]= Ox 1 -- 57 similar messages suppressed, last occurrence was at 2009-Oct-23 15:39:38
15:39:38	WARNING	LVL2-L2-2-rack...	gatherercissue	Histogram'L2PU-6307./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning
15:39:38	WARNING	LVL2-L2-4-rack...	gatherercissue	Histogram'L2PU-3119./EXPERT/CosmicLArCalib_V2LArL2ROBListWriter/RobldTTHEM' can not be summed because histograms have incompatible binning

ATLAS ATLAS - Konqueror (on pc-atlas-cr02.cern.ch)

Location: https://pc-atlas-www.cern.ch/lego/ATLAS/ATLAS/

Electronic logbook for the ATLAS experiment. Page 1 of 2669

Logged in as "Ferrari Roberto"

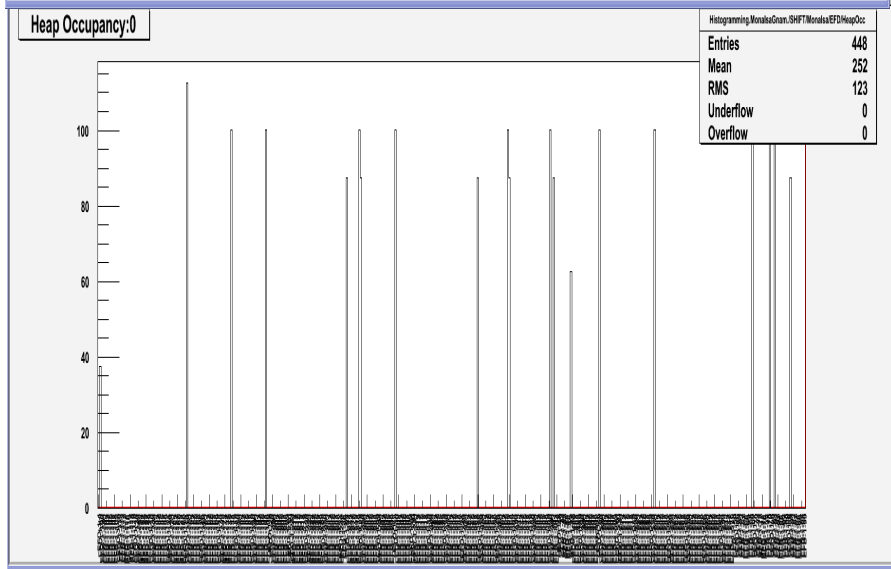
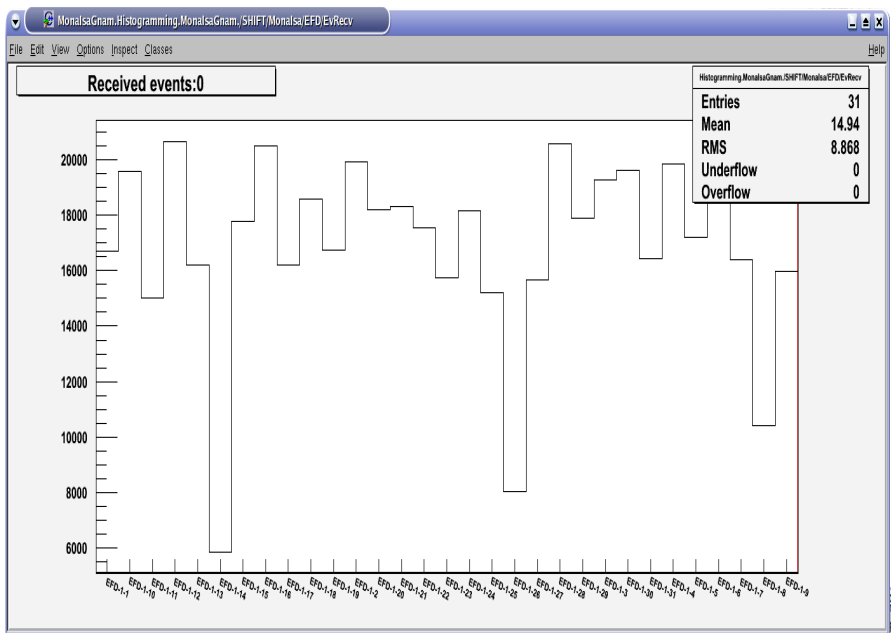
Full | Summary | Threaded

Go to page 1, 2, 3, ..., 2467, 2468, 2469, Next

Date	Author	Message Type	System Affected	Subject	Text
23.10.09 15:29	Canepa Anadi	Data Quality		Online DQ Shifter Summary	Summary of online dq shifter Atlantis and VPI running fine
23.10.09 15:26	DCS JS	Slimos-TI	DSS Tech. Infra.	MAG_Toroid_SlowDump	DOB Alarms MAG_Toroid_SlowDump
23.10.09 15:17	Tikhomirov Vladimir.O	Default Message Type	TRT	New shift	Combined cosmic run #13620 is going thrm. TRT status OK.
23.10.09 15:14	Bondoli Bond	Shift Summary	DAQ	Shift Summary for Run Control desk	run 136183 from previous shift
23.10.09 15:11	Hayakawa Takashi	Default Message Type	TGC	TGC on-call shift report	*** Readout and Trigger timing *** run#136176 run#136183
23.10.09 15:10	Perez Reale Valeria	Shift Summary	TRT TDC Cyo DCS Pixel Magnets TGC ID Gen. (IC) MDT DSS SCT LArg Network RPC CSC DAQ HLT LVL1 Monitoring GAS SysAdmins BCM LUCID Counting Room Tier0 Beam Conditions ZDC Event Displays	Shift Summary for Shift Leader	07:00 run from started at 4am last night is #1311 running: run 136183 (620, 881, 775) / (R) . Initially.
23.10.09 15:06	Kim Tae Jong	Shift Summary	HLT LVL1	Shift Summary for Trigger desk	Run upon arrival: #136183 Going since 04:00
23.10.09 15:05	Qi Ming	Shift Summary	TGC	Shift Summary for Moon Desk 3 - TGC	Shift summary: 07:00-15:00, 23 Oct. 2009
23.10.09 15:04	Dubbert Jorg	Default Message Type	DCS MDT	BOG6A12 ML1 HV interlock asserted	run136183, Begin at 03:55:26, Run continued, Asserted HV interlock for BOG6A12 ML1 chamber (triggered repeatedly since yesterday, stable for some time (up to some hours) then East) ongoing run: 136207
23.10.09 15:03	Ghodbane Nabli	Title	Title	end of shift summary	List of good runs with L1cal in : Summary of what happened during the shift.
23.10.09 15:02	Ferretti Claudio	Shift Summary	TGC MDT RPC CSC	Shift Summary for Moon Desk 1 - MDT/CSC	Many runs (staged mostly because of AC problems) 136183 - 160 Rev. Run 136183 ended at about 9:00, Bectors In

Monitoraggio Online

Information Service



Partition 'ATLAS', server 'DF-EF-Segment-01-rack-Y03-06D2-iss'

Name	Type	Modified	Description
EFD-1-25	EFD	16/7/08 09:43:31,549965	
EFD-1-26	EFD	16/7/08 09:43:34,503773	
EFD-1-27	EFD	16/7/08 09:43:31,834124	
EFD-1-28	EFD	16/7/08 09:43:31,946579	

Value	Type	Name	Description
pc-tdq-xpu-0245:/local_L/efHeap/sharedHeap.cmc.ATLAS	String	SharedHeap	SharedHeap file fullpath
3	U16	ConnNbrSFIs	Number of connected SFIs (sum over InputTasks)
5	U16	ConnNbrSFOs	Number of connected SFOs (sum over OutputTasks)
4	U16	ConnNbrPTs	Number of connected PTs (sum over ExtPTsTasks)
87.54	Double	HeapOcc	SharedHeap occupancy (%)
1521	S32	EventsRcv	Number of received events
1514	S32	EventsSent	Number of events sent to SFO (ie: Dismissed-Deleted)
7	S32	EventsInside	Number of events inside
0	U32	EventsWaitingForProc	Number of events waiting for processing
2	U32	EventsWaitingForDeli	Number of events waiting to be sent to SFO
0	Double	RateIn	Current rate of incoming events (Hz)
0	Double	RateOut	Current rate of events sent to SFO (Hz)
0	Double	FluxIn	Current rate of space allocation in SH; >M data flux
0	Double	FluxOut	Current data flux to SFO (MB/s)
-1	Double	FlowCtrlStopTime	Guess of the stop transition time (s)
460	U32	FlowCtrlISleepTime	Current flow control sleep time (ms)
538	U32	FlowCtrlBarrierLocks	Number of times the input barrier has been locked
0	S32	ptionNbrProcTimeouts	Number of processing timeouts
0	S32	ptionNbrSocketHungUps	Number of PT socket hung-ups
0	S32	ptionNbrForceAccept	Number of force accepted events
0	S32	efionNbrSFiBrokenConn	Number of broken connections to SFI
0	S32	efionNbrSfoBrokenConn	Number of broken connections to SFO
1521, 0, 0, 0, 0, 0	S32[6]	EventTagTypesIn	Type counters: phys, calib, reserved, debug, unknow
1519, 0, 0, 2, 0, 0	S32[6]	EventTagTypesOut	Type counters: phys, calib, reserved, debug, unknow

403 objects | 24 attributes

JavaScript + Web

Web Interface to Atlas Online Information Service

The WebIS service complements the Web Monitoring Interface by providing generic access to any object and histogram in the Atlas online Information Service. This allows to build simple HTML and/or Javascript based web pages that show up-to-date online information from Point 1.

The following list shows some general applications that will be useful for experts who are outside of P1 as well as some examples on how the information can be processed and presented with some simple Javascript code.

Simply look at the HTML source to see how to include e.g. the status display or a histogram into your own page.

Generic Applications

Based on the [ExtJS](#) framework

These are best viewed with a modern browser with a fast Javascript implementation (Firefox > 3.0, Opera > 10.0, Google Chrome, Internet Explorer 8.x). Older browsers will be either very slow or not work at all (e.g. Konqueror). In fact, in many cases IE will not work properly either, I suggest to use any other browser instead...

- [Histogram Browser](#)
- [Information Service](#)
- [Process Manager](#)
- [OKS Configuration Browser](#)
- [Combined Browser](#)

Simple HTML plus some Javascript

- [A simple example on how to integrate histograms into a web page](#)
- [Simple Browser](#)

DAQ Examples

- [Status Display for other partition Status message only](#)

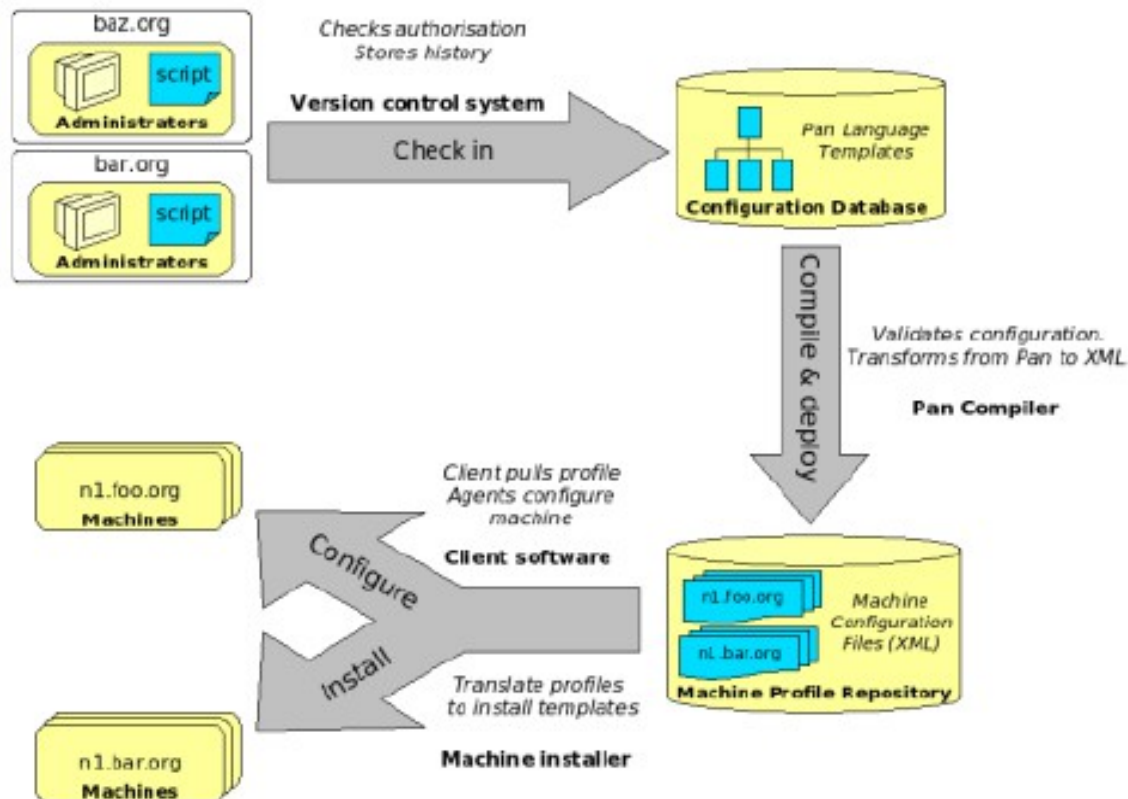
```
ATLAS: RUNNING Run Number: 167521 Run Type: Physics Start: 22/10/10 23:08:14 End: 1/1/70 01:00:00
```

- [Run Status](#)

System Management

Quattor Workflow

The quattor toolsuite caters for every stage of a typical system management workflow, from specification and management of configurations, to installation of new machines from scratch, to ongoing maintenance of software and services.



Offline

$O(1 \text{ miliardo})$ di eventi all'anno da ricostruire e analizzare
~ Altrettanti da simulare

STORAGE

~3 PB/anno

CPU

~ 7000 kSi2k*anno

Analisi Eventi

Ambiente complesso ... ogni livello richiede competenze specifiche:

Dall'online arrivano informazioni "grezze" (numeri):

→ misure di tempi, cariche elettriche, tensioni

Ricostruzione a più stadi (attività centralizzata):

→ informazioni fisiche (posizioni, velocità)

→ identificazione particelle, energia, quantità di moto

Analisi fisica (attività caotica):

→ criteri di separazione fondo / segnale (selezione eventi)

→ analisi statistica

Simulazione, Ricostruzione e Analisi Dati

Attività distribuita verticalmente e orizzontalmente::

Tier-0 (CERN) → Tier-1 (grossi centri nazionali)

→ Tier-2 (centri regionali) → Tier-3 (istituti)

Ampio uso della virtualizzazione (→ cloud computing)

Dati distribuiti con ridondanza (almeno due copie di ogni dataset)

Cataloghi (database) per tenerne traccia

Esecuzione delocalizzata: nuovo strato software (middleware) che indirizza gli eseguibili dove si trovano i dati, raccoglie e assembla i risultati

la GRID

la Griglia (GRID)

Dati LHC equivalenti a ~20 milioni di CD (una pila alta 20 km) all'anno

Per l'analisi necessari ~100mila dei più veloci processori odierni



WWW: accesso a informazione archiviata in diverse località geografiche

GRID: accesso a risorse di calcolo e di archiviazione dati distribuite su tutto il pianeta



il Middleware

un ulteriore livello di astrazione:

connette applicazioni, componenti, sistemi, su
scale regionali, nazionali, internazionali

hardware → software → middleware

permette di analizzare dati o eseguire
applicazioni su macchine distribuite in tutta
la rete → cloud

il Calcolo LHC in Italia

Tier-1: CNAF (Bologna) unico per tutti gli esperimenti LHC (e non solo)

Tier-2: ~10 (Roma, Legnaro, Torino, Napoli, Catania, CNAF, Pisa, Milano)

Investimento (ad oggi) ~ 30 M Euro (incluse infrastrutture CNAF)

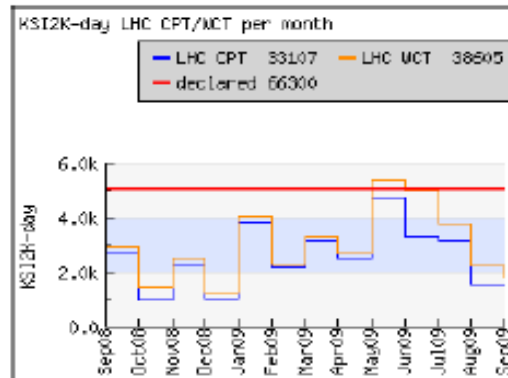
+ molti anni uomo di sviluppo sw (anche grazie a finanziamenti europei)

il Portale di Monitoring

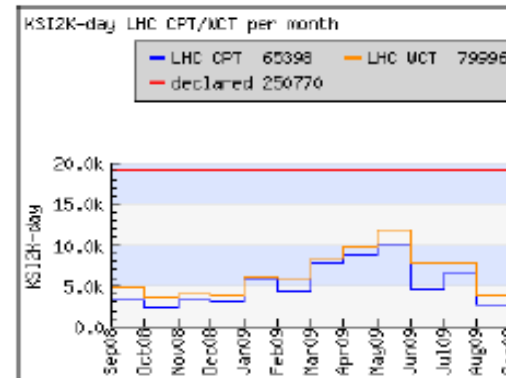


Uso CPU T2 ATLAS

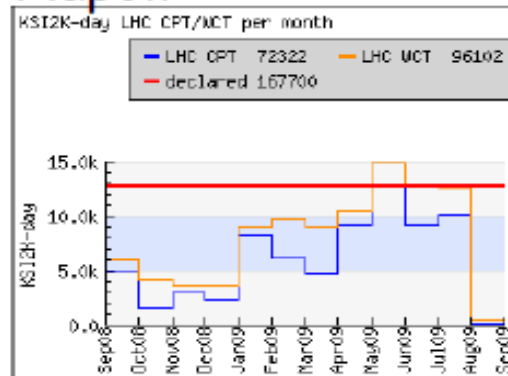
"Frascati"



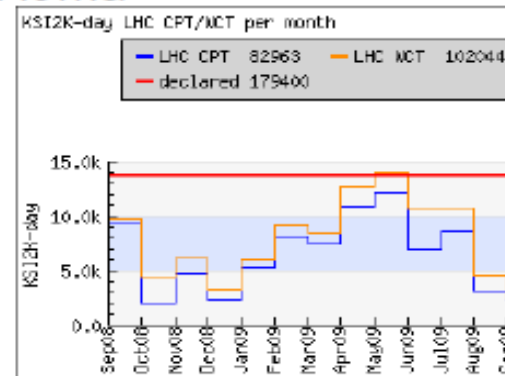
Milano



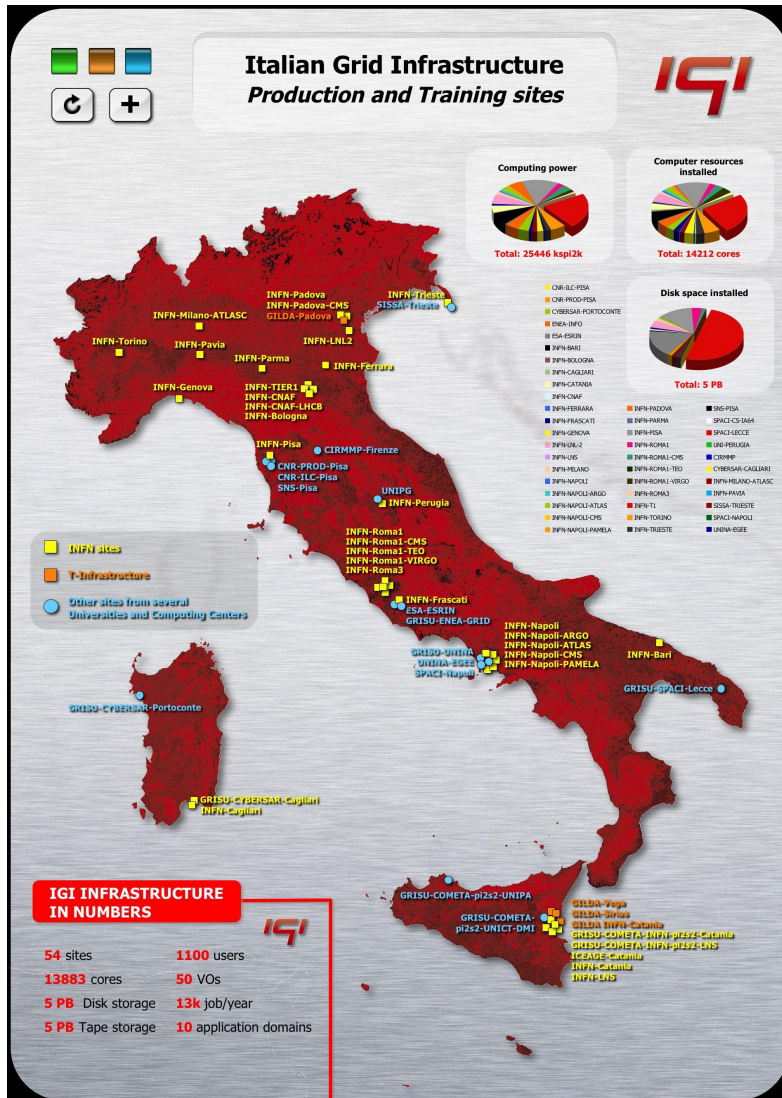
Napoli



Roma



Italian Grid Infrastructure



<http://www.italiangrid.org>

la GRID in casa

BOINC : <http://boinc.berkeley.edu/>

Open-source software for volunteer computing and grid computing.

Note: if your computer is equipped with a Graphics Processing Unit (GPU), you may be able to use it to compute faster.

Projects	Windows		Linux		Mac OS X		Solaris	
	95/98/ME	XP/2000/2003/Vista/7	x86	x86-64	PowerPC	x86	SPARC	x86
climateprediction.net	No	Yes	Yes			Yes		
Einstein@home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Leiden Classical	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Rosetta@home	Yes	Yes	Yes	Yes	limited	Yes	No	No
SETI@home	98 only	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIMAP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SpinHenge@home	Yes	Yes	Yes	No	No	No	No	No
The Lattice Project	Yes	Yes	Yes	Yes	Yes	Yes	No	No
World Community Grid	No	Yes	Yes		Yes	Yes	No	No

il valore aggiunto della collettività ...

Risultati altrimenti impensabili possono essere raggiunti grazie a tanti piccoli contributi ...

BOINC Berkeley Open Infrastructure for Network Computing

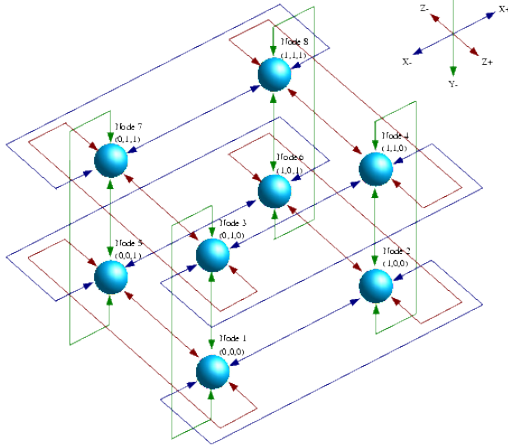
es:

<http://milkyway.cs.rpi.edu/milkyway/>

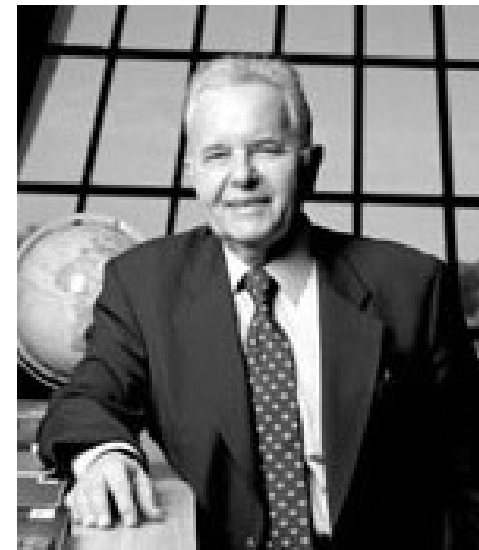
<http://einstein.phys.uwm.edu/>

... ricerche in campo medico, farmacologico, ...

Calcolo Parallelo ...



dalla Fisica Teorica
al Super-Computing
ovvero il progetto APE



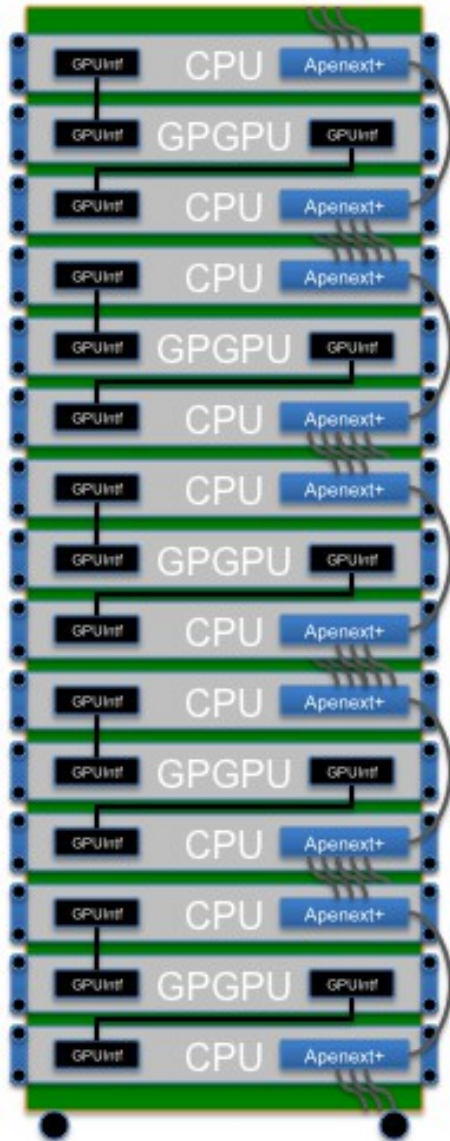
N. Cabibbo

APE Group Projects

Here we collect past and present APE Group projects:

- The [NaNet](#) project (2012-2014).
- The [QUonG](#) initiative (2011-2014).
- The [APENet+](#) project (2009-2014).
- The [EURETILE](#) project (2010-2014).
- The [SHAPES](#) project (2006-2010).
- The [APENet](#) [↗](#) (formerly Apelink) project (2003-2006).
- The [apeNEXT](#) project (2001-2006).
- The [APEmille](#) project (1995-2000).
- The [APE100](#) project (1989-1994).
- The first [APE](#) project (1984-1988).

QUOnG: GPU-based HPC system



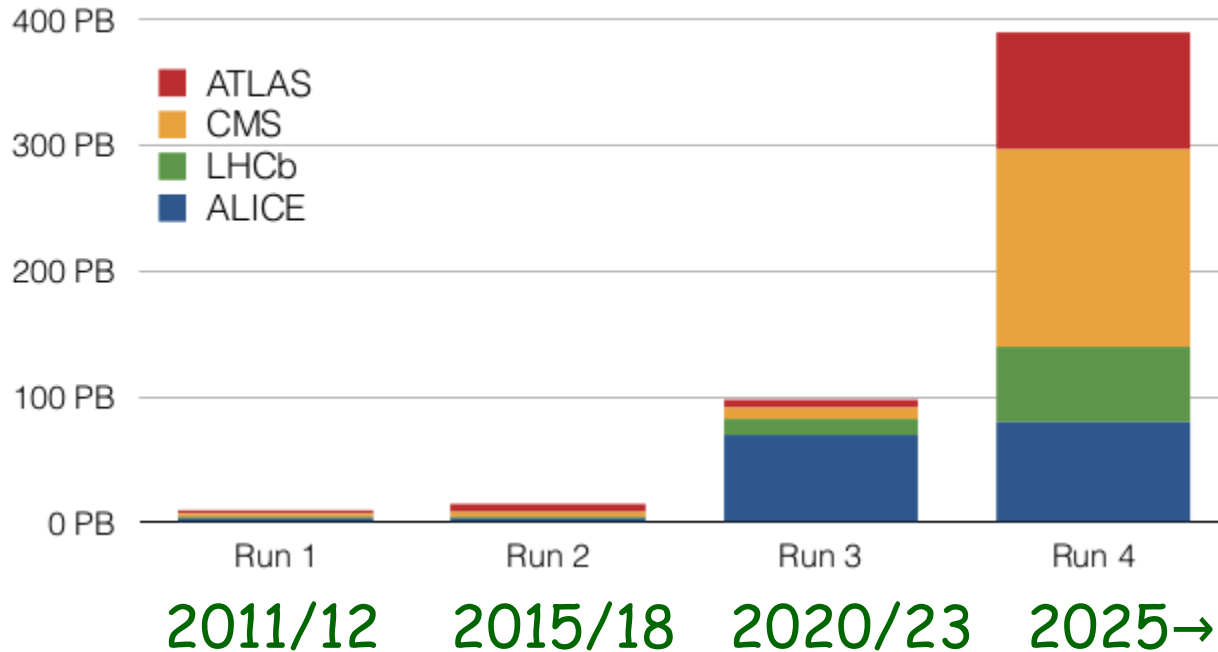
- QUantum chromodynamics ON Gpu

PC clusters + GPU + 3D network
APEnet+ boards

- 42U rack system:
- 60 TFlops/rack peak
- 25 kW/rack (i.e. 0.4 kW/TFlops)
- 300 k€/rack (i.e. 5 k€/TFlops)

Futuro di LHC

previsioni dati/anno



Processori: ARM64, PowerPC, Nvidia CUDA, AMD GPUs, ecc.
... di nuovo fuori dalla monocultura x86

... naturalmente, tanti problemi in vista ...

finanziamenti (!!)

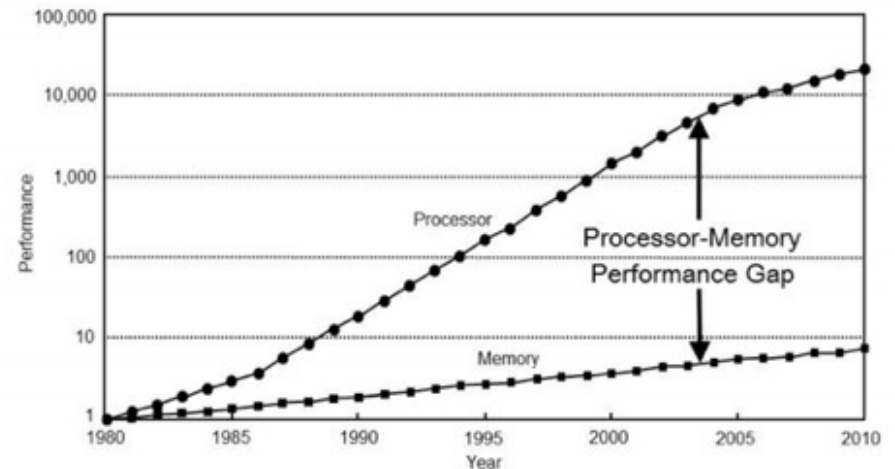
... ma non solo ...
già ora - ad es. - grosso problema:
performance processori (multicore) .vs. densità memoria (cache)

Xeon Phi: 16 GB / 60 core

→ ~256 MB / core

Tesla K40: 12 GB / 2880

→ ~ 4 MB / core



necessità di una ristrutturazione e riscrittura del sw
("Data Oriented Design")

a) ottimizzazione multi-threading (!)

b) ottimizzazione multi-piattaforma (CPU, GPU, ...)

~ 3000 scienziati di 174 istituti da 38 paesi diversi
più di 1000 studenti di dottorato!

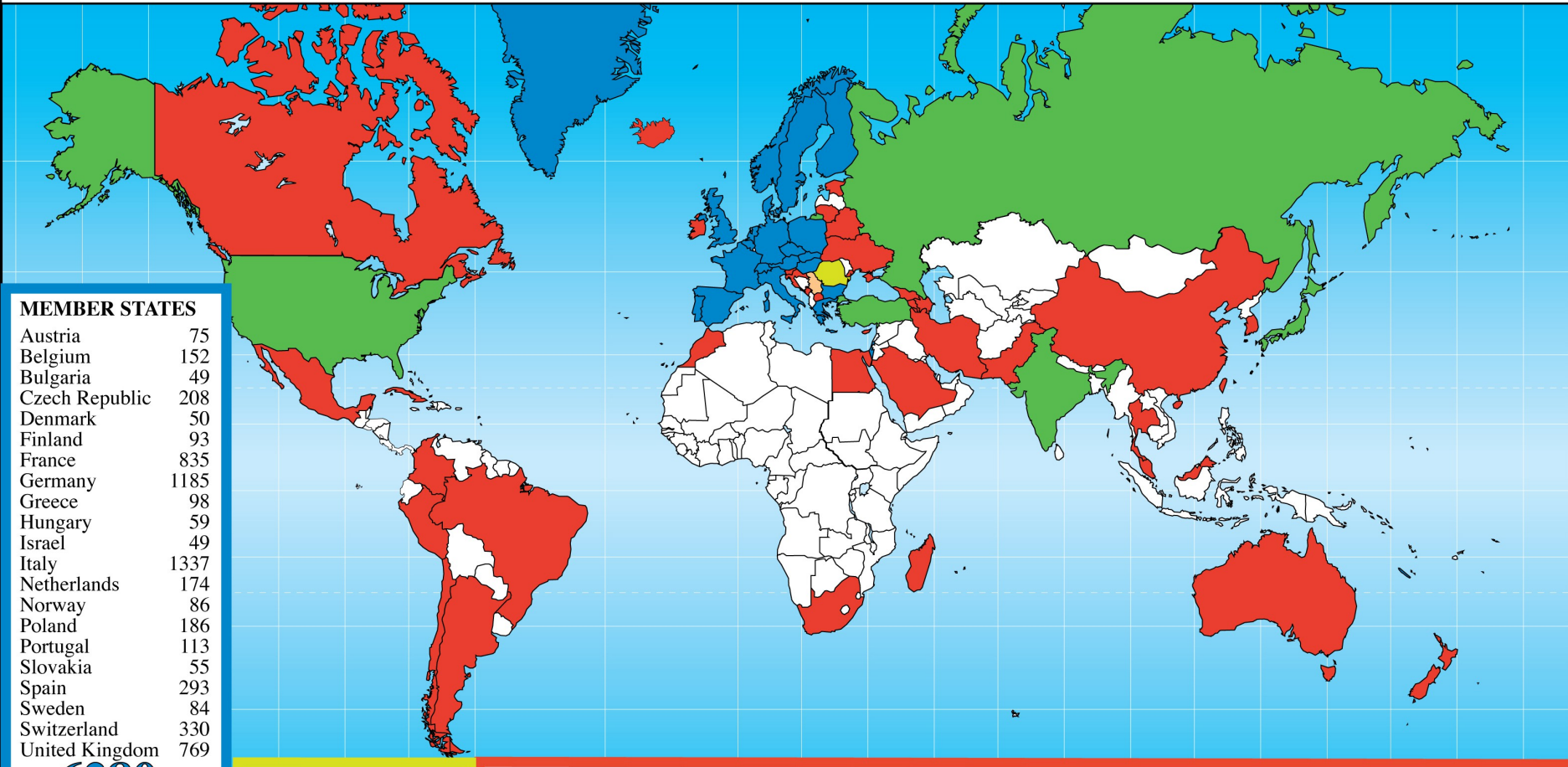


- | | |
|----------------|--------------|
| Argentina | Morocco |
| Armenia | Netherlands |
| Australia | Norway |
| Austria | Poland |
| Azerbaijan | Portugal |
| Belarus | Romania |
| Brazil | Russia |
| Canada | Serbia |
| Chile | Slovakia |
| China | Slovenia |
| Colombia | South Africa |
| Czech Republic | Spain |
| Denmark | Sweden |
| France | Switzerland |
| Georgia | Taiwan |
| Germany | Turkey |
| Greece | UK |
| Israel | USA |
| Italy | CERN |
| Japan | JINR |

ATLAS
Collaboration



Distribution of All CERN Users by Location of Institute on 14 January 2014



MEMBER STATES

Austria	75
Belgium	152
Bulgaria	49
Czech Republic	208
Denmark	50
Finland	93
France	835
Germany	1185
Greece	98
Hungary	59
Israel	49
Italy	1337
Netherlands	174
Norway	86
Poland	186
Portugal	113
Slovakia	55
Spain	293
Sweden	84
Switzerland	330
United Kingdom	769

6280

OBSERVERS

India	153
Japan	217
Russia	890
Turkey	110
USA	1724

3094

CANDIDATE FOR ACCESSION

Romania	86
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ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

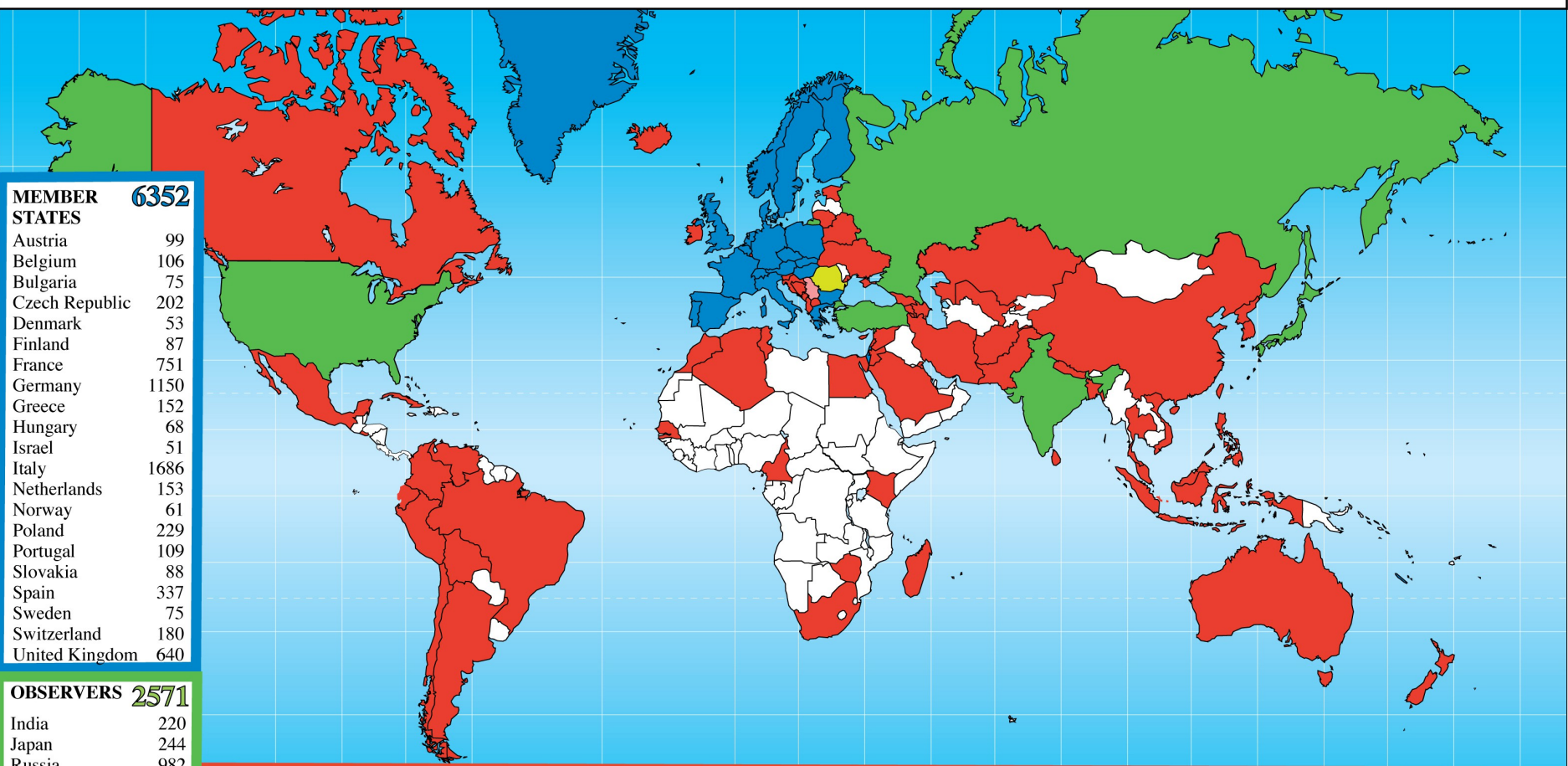
Serbia	30
--------	----

OTHERS

Argentina	13	China	122	Iran	20	Pakistan	18
Armenia	16	China (Taipei)	71	Ireland	5	Peru	2
Australia	39	Colombia	10	Korea	105	Saudi Arabia	3
Azerbaijan	2	Croatia	23	Lithuania	13	Slovenia	25
Belarus	24	Cuba	3	Madagascar	3	South Africa	32
Brazil	116	Cyprus	13	Malaysia	8	Thailand	8
Canada	147	Egypt	18	Mexico	46	T.F.Y.R.O.M.	1
Chile	8	Estonia	17	Montenegro	1	Ukraine	24
		Georgia	11	Morocco	6		
		Iceland	4	New Zealand	5		

982

Distribution of All CERN Users by Nationality on 14 January 2014



MEMBER STATES	6352
Austria	99
Belgium	106
Bulgaria	75
Czech Republic	202
Denmark	53
Finland	87
France	751
Germany	1150
Greece	152
Hungary	68
Israel	51
Italy	1686
Netherlands	153
Norway	61
Poland	229
Portugal	109
Slovakia	88
Spain	337
Sweden	75
Switzerland	180
United Kingdom	640

OBSERVERS	2571
India	220
Japan	244
Russia	982
Turkey	146
USA	979

CANDIDATE FOR ACCESSION	
Romania	118

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP	
Serbia	41

OTHERS	Bolivia	3	Cuba	7	Iran	28	Madagascar	4	Philippines	1	Tunisia	6	
Afghanistan	1	Bosnia & Herzegovina	1	Cyprus	16	Ireland	22	Malaysia	15	Saudi Arabia	3	Ukraine	55
Albania	2	Brazil	108	Ecuador	3	Jordan	2	Mauritius	1	Senegal	1	Uzbekistan	4
Algeria	8	Cameroon	1	Egypt	19	Kazakhstan	1	Mexico	64	Singapore	2	Venezuela	9
Argentina	11	Canada	134	El Salvador	1	Kenya	1	Montenegro	3	Sint Maarten	2	Viet Nam	9
Armenia	25	Cape Verde	1	Estonia	16	Korea, D.P.R.	1	Morocco	12	Slovenia	27	Zimbabwe	2
Australia	25	Chile	12	Georgia	36	Korea Rep.	117	Nepal	5	South Africa	16		
Azerbaijan	8	China	280	Gibraltar	1	Kuwait	1	New Zealand	7	Sri Lanka	5		
Bangladesh	4	China (Taipei)	45	Hong Kong	1	Lebanon	12	Pakistan	41	Syria	2		
Belarus	47	Colombia	30	Iceland	4	Lithuania	19	Palestine (O.T.)	4	Thailand	12		
		Croatia	35	Indonesia	1	Luxembourg	4	Peru	8	T.F.Y.R.O.M.	1		

1415

c'è sempre bisogno di nuove idee e di nuova gente:

<https://jobs.web.cern.ch/join-us/students>

Stage @ CERN:

- 1) openlab students (2 months)
- 2) summer students (2-3 m)
- 3) technical students (6-12 m)
- 4) doctoral students (3-36 m)

Scuole (fra molte altre):

- 1) European school of high-energy physics (2 weeks)
- 2) CERN school of computing (2 w)
- 3) CERN accelerator school (2 w)
- 4) International School of Trigger and Data Acquisition (1 w)

qualcuno che l'ha fatto ...



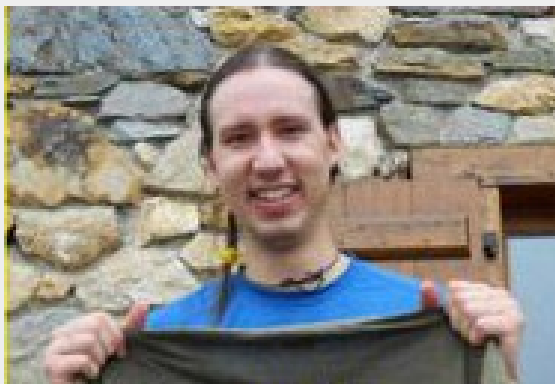
Giulia - liceo sc. Ulivi
ingegneria delle
telecomunicazioni (PR)



Alberto - ITIS Sassuolo
fisica (PI e SNS)



Wainer - ITIS Sassuolo
fisica (PR)



Leo - ITC Fossati (SP)
ingegneria
informatica (PR)



Martino - liceo sc. Marconi
ingegneria
informatica (PR)