Impatto sulle Infrastrutture dei Servizi di Calcolo locali: “Futuri” Esperimenti

(Virgo) LHC

Paolo Capiluppi

Dept. Of Physics and INFN – Bologna

Grazie a L.Luminari (Atlas), A. Masoni (Alice), D. Galli (LHCb)

Antifona

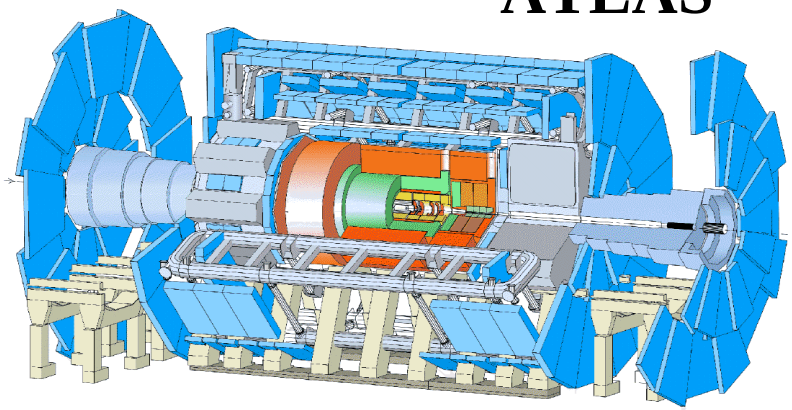
Many Thanks to Stefano Belforte: we also need all of that! NOW!

- **"Futuri" NON vuol dire che non hanno esigenze di Calcolo, Software ed Infrastruttura**
  - **Anzi... Ma *Qualcuno* ritiene che sia *troppo presto*...**
- **LHC e VIRGO sembrano differenti tra loro e dagli altri Esperimenti (ed in parte lo sono): tuttavia molte necessita' sono comuni...**
  - **Network (of course)**
  - **OS support and maintenance**
  - **Hardware choices**
  - **Local and remote Management tools**
  - **DATA access and replication**
  - **Distributed resources utilization**
  - **Security and authentication/authorization**
  - **...**
  - **Analysis ! Today too!!**

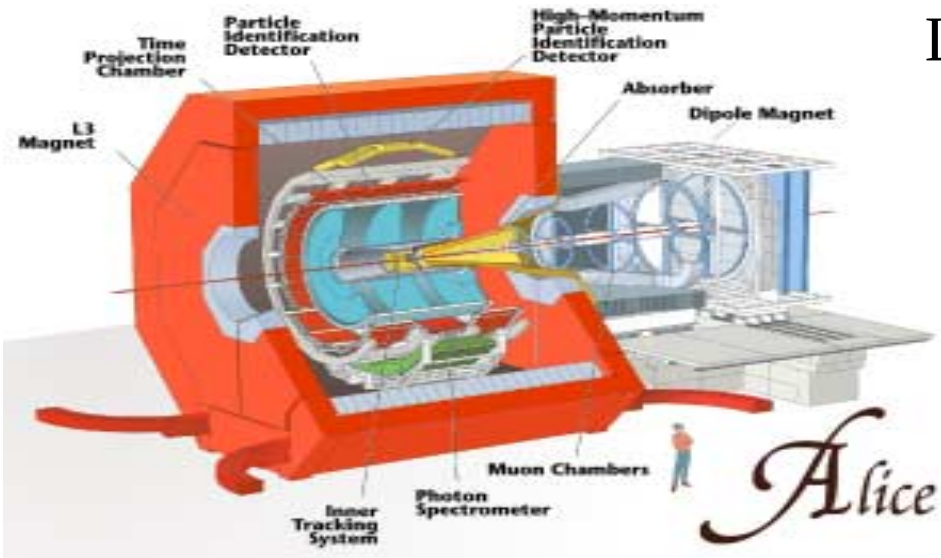
VIRGO

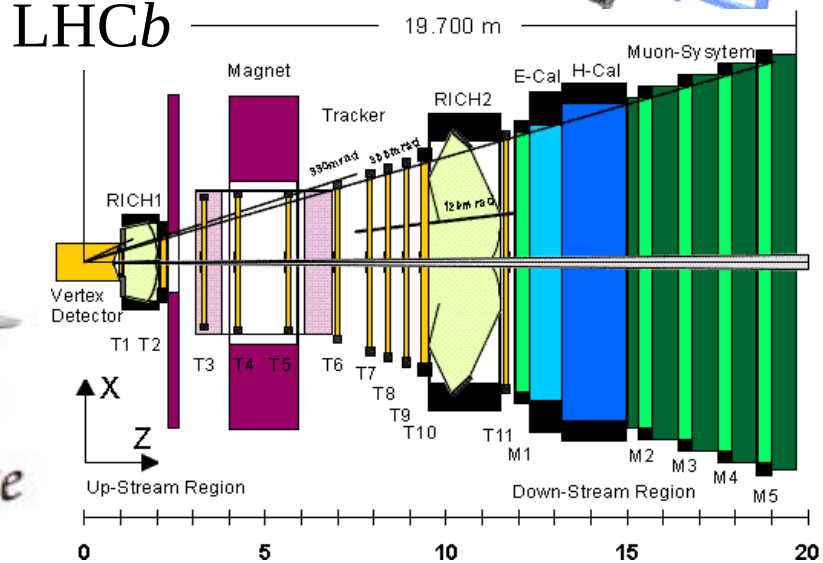
LHC Experiments
PetaByte - ExaByte Era

ATLAS



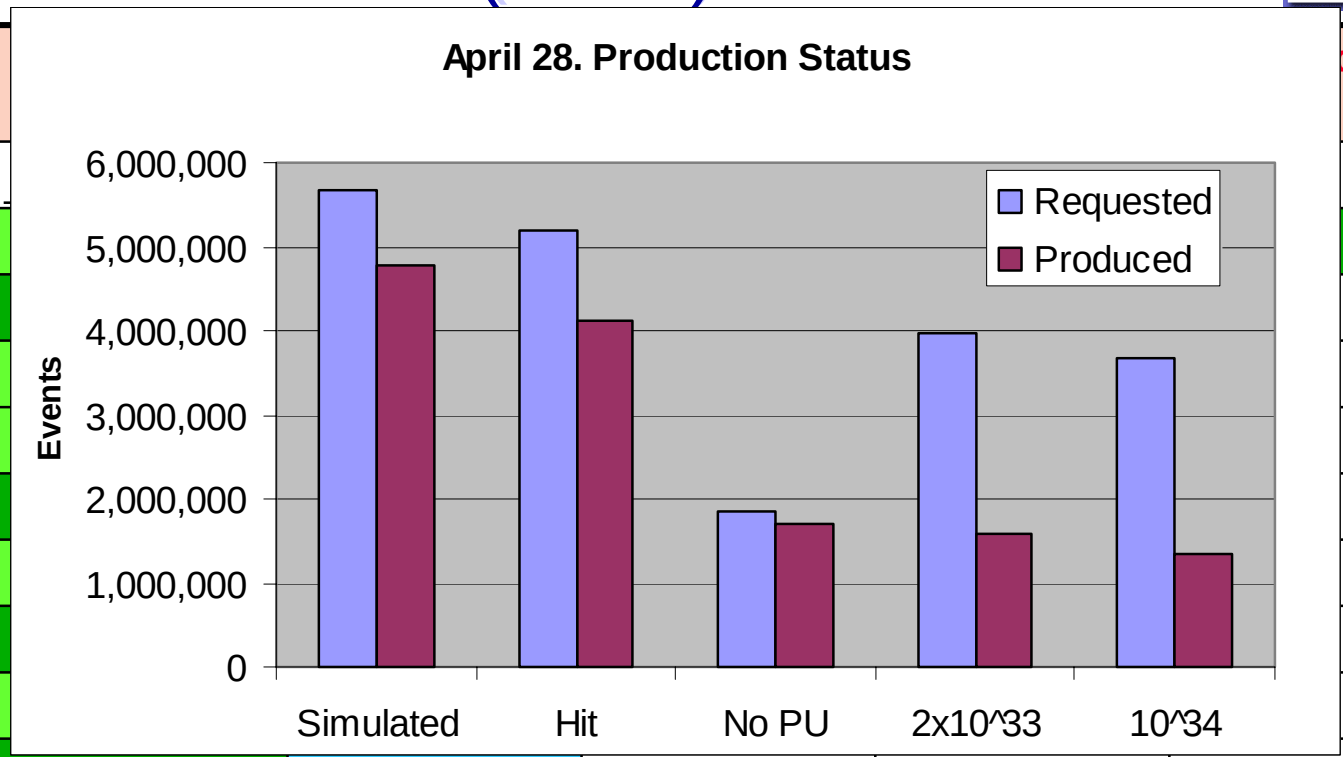
CMS





Production Status: 15.04.2002 (CMS)

Prod.Cycle					digi
RC					
CERN					
INFN					
Imperial Coll.					
UCSD					
Moscow					
FNAL					
UFL					
Wisconsin					
Caltech	100%	Test in progress			
IN2P3	100%	Test in progress			
Bristol/Ral	28%	Test in progress			
USMOP	0%				
Done	88%	61%			

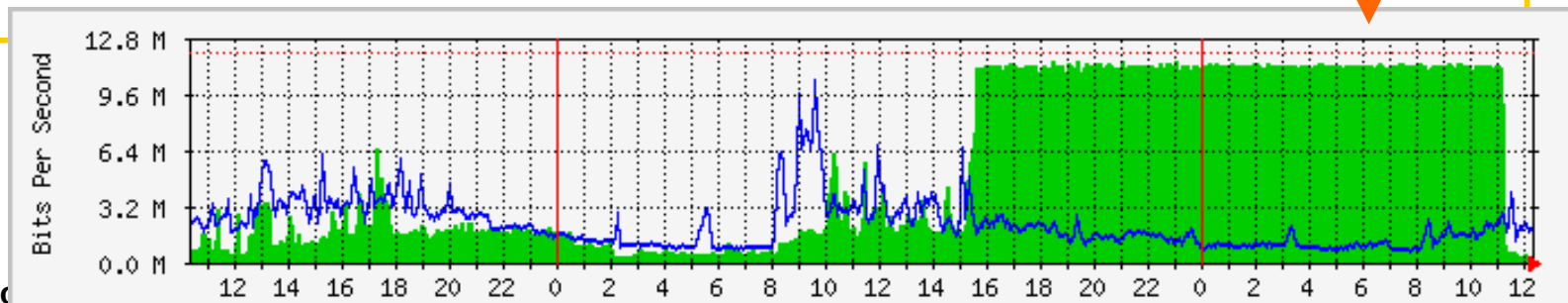


Estimate 27/April/02, complete in 3 Weeks.

(One week before June 1 deadline!)

Simulazioni per il P.P.R. (ALICE)

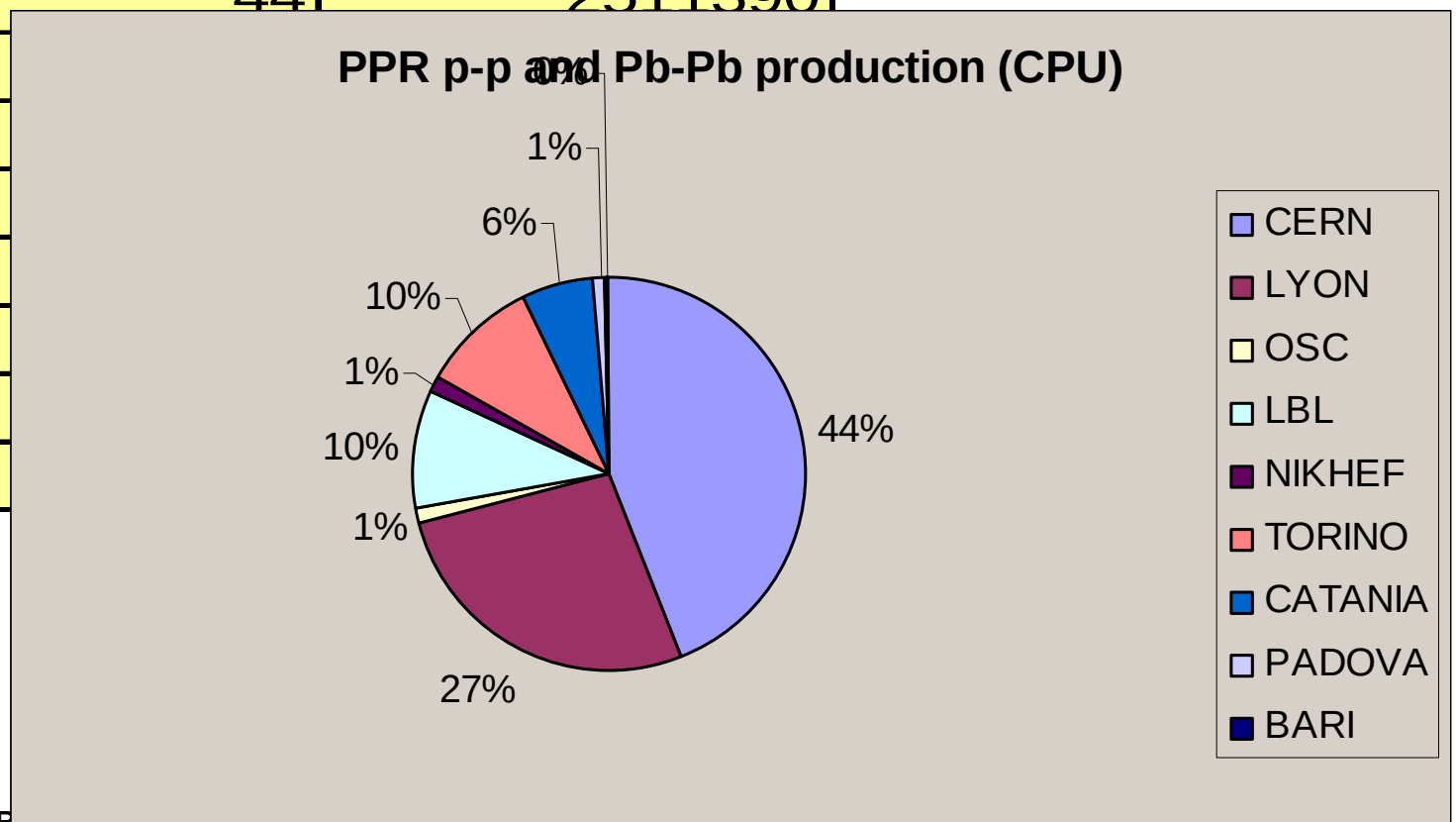
- **p-p**
  - **Prima produzione effettuata completamente in Italia (Torino).**
  - **10000 eventi (simulazione e ricostruzione nel barrel – ITS + TPC)**
  - **~80 Gbytes – 4.85×10^6 s di CPU (PIII @ 1GHz)**
  - **Files replicati al Cern (AliEn) per consentirne l'uso a tutta la collaborazione. Ottimo test per la connessione di rete, saturata per 20 ore consecutive.**
  - **Prossima produzione: fine Marzo 10^5 eventi**



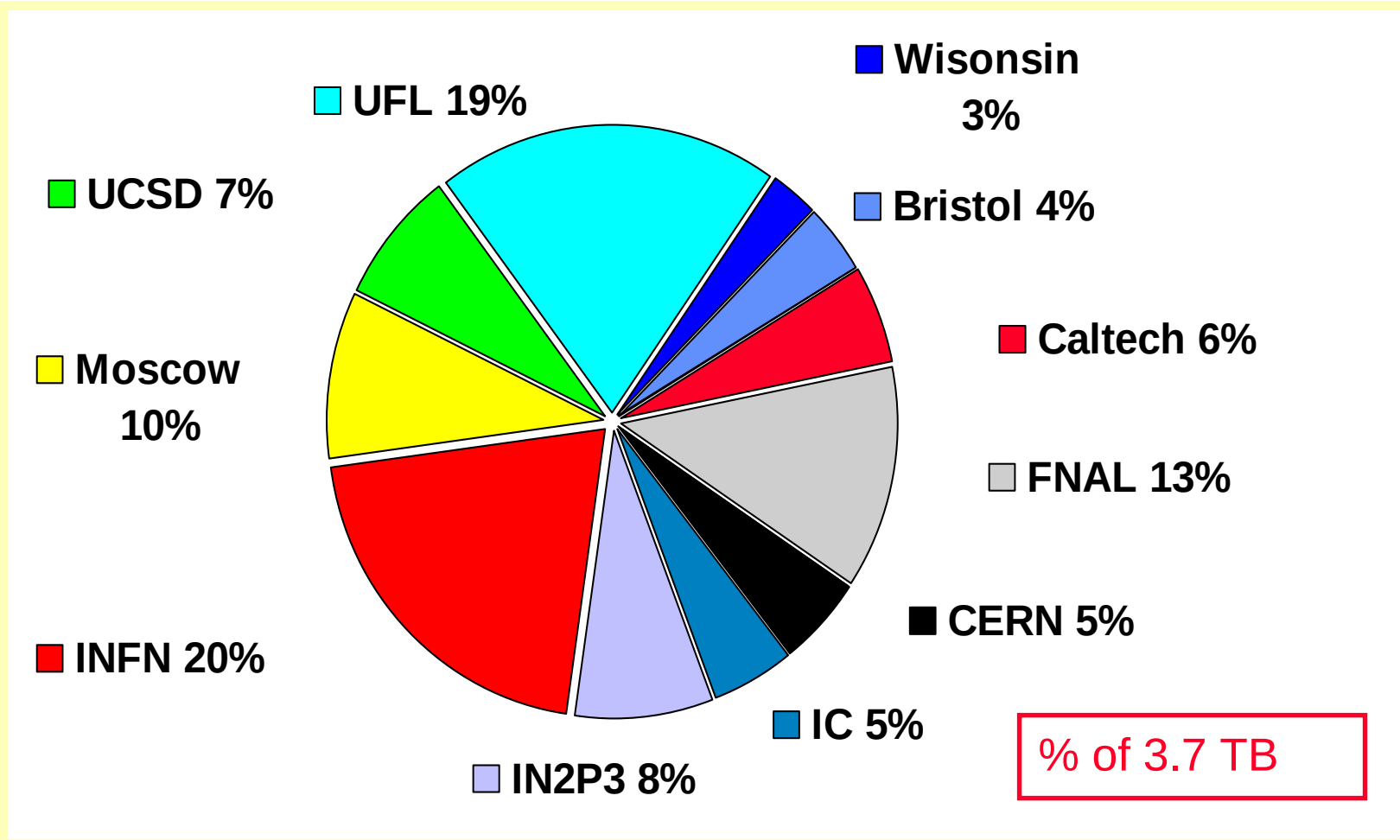
Simulazioni per il P.P.R. (3)

PPR PB-PB + P-P PROD.		
sito	***# Job***	***CPU norm.***
CERN	2508	115280146
LYON	726	71583048
OSC	44	2511390
LBL		
NIKHEF		
TORINO		
CATANIA		
PADOVA		
BARI		

I centri di Torino e Catania hanno



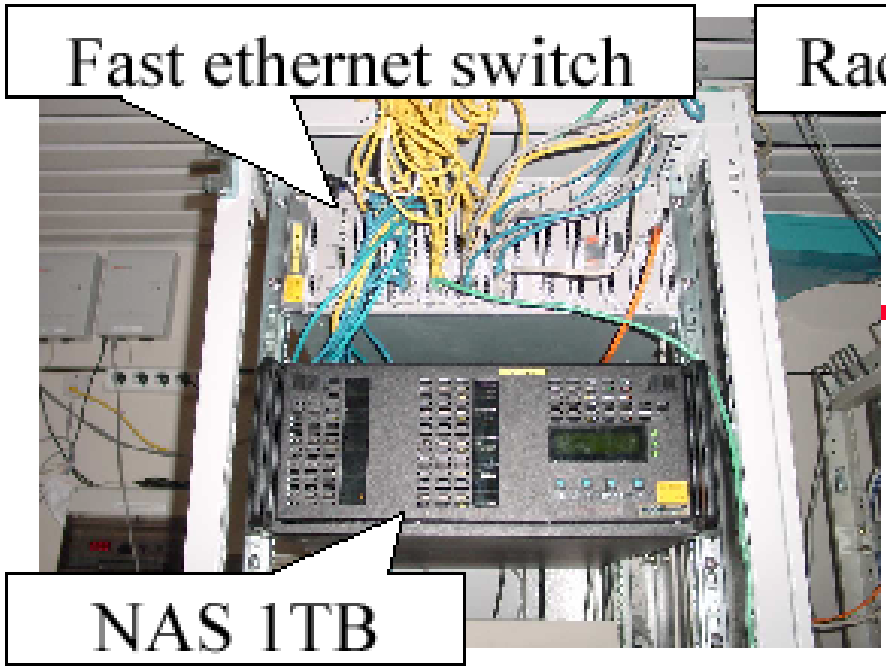
CMS
Spring02 Production Status
12 April 2002: 3.7 TB = 4.6 M evts

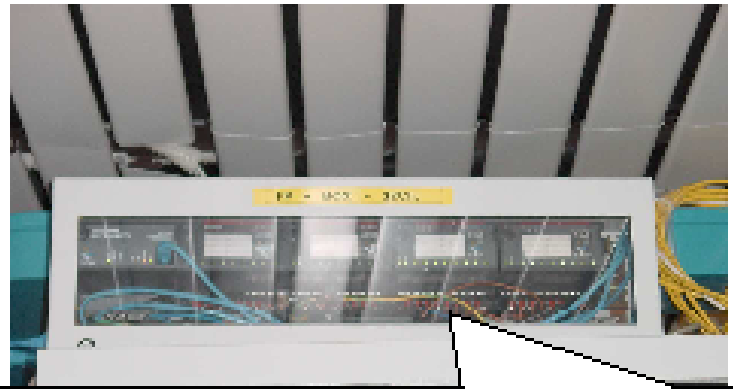


Virtual Organizations

- **Farms, Farms, Farms....**
  - **Public and hidden**
  - **Gestione**
  - **LAN & WAN access (Point-to-point connections)**
  - **Data Storages (backups, archiving,...management)**
    - **Disk servers**
    - **Scratch areas**
    - **Reliability (RAID5, tapes, ...)**
- **Grid services**
  - **Chi li gestisce?**
  - **Chi li mantiene?**
  - **Chi li manterra'!!!???**
  - **User management, grigliati e/o non**
- **VO services**
  - **Common**
  - **Specific**

LHCb Farm
(prototype already active since time)





CMS
Legnaro,

piu'
"tradizionale?"

Computing Models and Architectures

- **Tiers : cosa sono in realta'? →**
- **Distributed Models**
  - **What's distributed in the Model?**
    - **Users**
    - **Data**
    - **Computing power**
    - **Software**
    - **Support**
    - **Maintenance**
    - **Development**
    - **Analysis !!!!**
    - **.....and Money →**
- **Data Model and Job Model**
  - **RAW-> ESD -> AOD -> TAG**
  - **Job-to-the-data or Data-to-the-job ?**
- **Experiment's Activities**
  - **Scheduled**
  - **Chaotic**

Revised estimate of the missing funds (in MCHF) for LCG, Phase II at CERN

	CERN/2379/rev Physics in 2006	Physics in 2007	Savings and External funding
S	2005-2007	2006-2008	
T	72.3	51.3	21.0
Outs	17.6	10.9	6.7
Wide area net…rki… …sics	12.0	11.4	0.6
Additional savings on infrastructure			0.4
Additional savings on above due to trigger rate re-evaluation			9.9
Funding to be found from external sources, EU projects, etc.			20.0
			58.6
Total additional funds needed	117.7	89.4	59.1

Probably premature minimizing of problem.

But, computing model needs revisiting, as do costs and rate estimates.

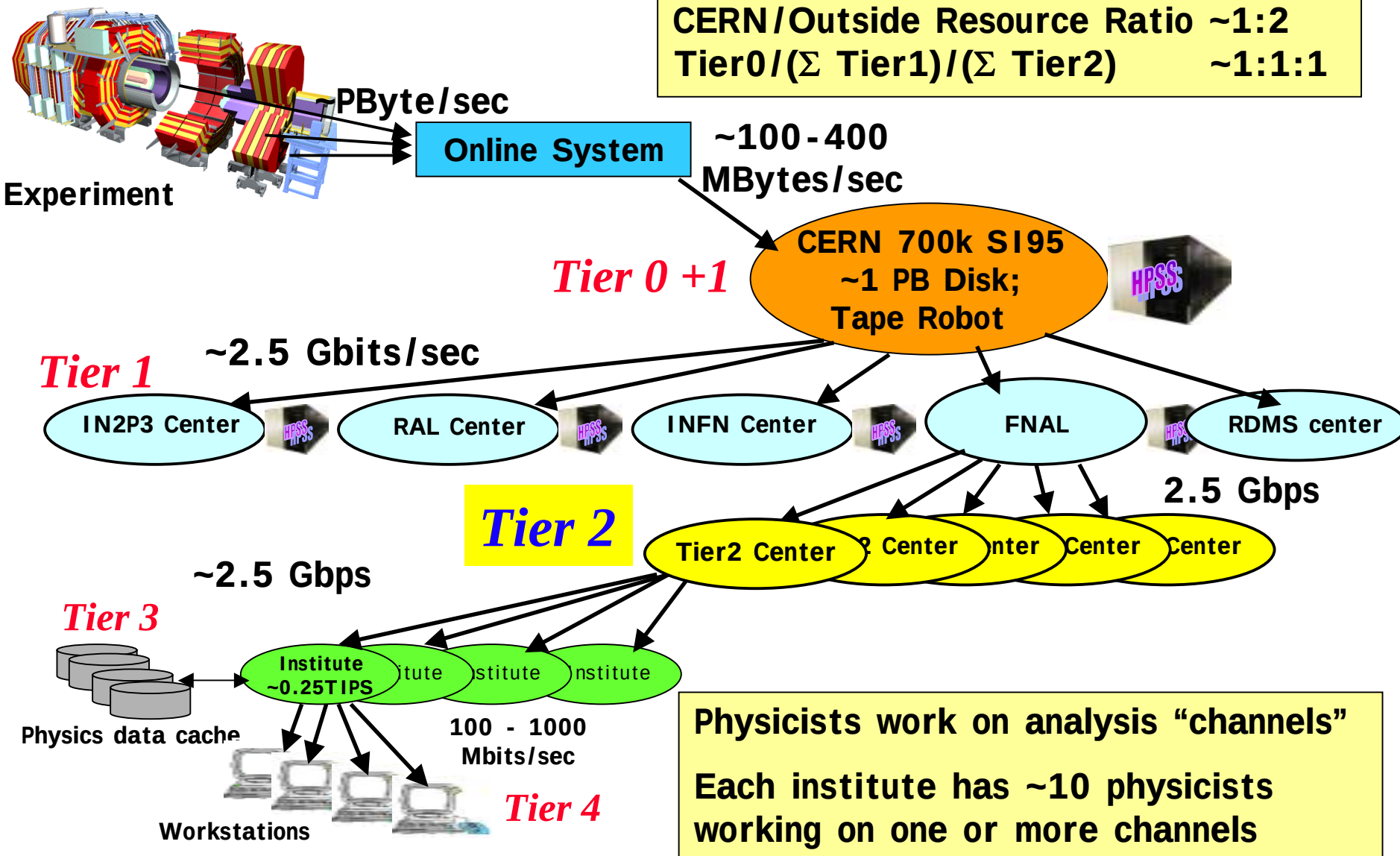
Moore's law

Seems optimistic

Double Counting? (And premature)

LHC Computing Hierarchy (MONARC view)

CERN/Outside Resource Ratio ~1:2
Tier0/(Σ Tier1)/(Σ Tier2) ~1:1:1



Physicists work on analysis "channels"

Each institute has ~10 physicists working on one or more channels

Risorse (non solo Hardware!)

- **Cosa vuol dire avere “in sede” :**
  - **un Tier2?**
  - **due Tier2 ?**
  - **un Tier2 ed un Tier3 ?**
  - **due Tier3 ?**
  - **o ... ?**
- **Cosa vuol dire condividere le risorse locali con altri esterni (inbound)**
  - **nazionali ?**
  - **internazionali ?**
- **Cosa significa garantire l’accesso ad un Tier esterno? (outbound)**
  - **Tier0 (Virgo e LHC)**
  - **Tier1 (nazionale e non)**
  - **Tier2 (nazionali e non)**
  - **Tier3 (nazionali, solo?)**

Dimensioni dei Tier-n italiani di CMS

- **Le dimensioni delle risorse dei Tier-n di CMS in Italia sono quelle espresse nei vari documenti di Review (per i quali vale la regola 1/3, 2/3).**
- **Le risorse necessarie (senza EFFICIENZA d'uso, Network, Infrastruttura e Personale)**
  - **Tier1 (per CMS) di ~100kSI95 e ~1000 TB storage (dischi e nastri)**
  - **Tier2 da ~30 kSI95 a ~80 kSI95, e da ~400 TB a ~120 TB storage (dischi, possibilmente senza nastri)**
  - **Tier3 ~5 kSI95 e ~20 TB storage (dischi)**
- **Commitment preliminari di Tier1, Tier2 e Tier3**
- **Lo sharing delle risorse:**
  - **Storage:**
    - **50% nel Tier1, 50% distribuito nei Tier2/3**
  - **CPU:**
    - **35% nel Tier1, 65% distribuito nei Tier2/3**

Regional Centres

- **Services:**
  - **Prototyping phase, provide services for:**
    - Data Challenges
    - Physics Challenges
    - Growing complexity control
    - Test of functionalities
    - Measure of performances
    - Software and Middleware building
    - VO management
    - GRID testing
    - Experiment software and framework support/development
    - ...
  - **LHC running phase, provide services for:**
    - Data storage and location
    - Data processing and simulation
    - Data access and consistency
    - VO management and support
    - Grid support/development
    - Distributed Analysis
    - User support
    - Software and Middleware maintenance/development
    - Support and development of Experiment specific and common software/framework
    - Many of the prototyping phase services
    - ...

INFN SeXtions

1.	Bari			Alice	CMS	
2.	Bologna			Alice	CMS	LHCb
3.	Cagliari			Alice		LHCb
4.	Catania			Alice	CMS	
5.	Ferrara					LHCb
6.	Firenze	Virgo			CMS	LHCb
7.	Genova		Atlas		CMS	LHCb
8.	Lecce		Atlas			
9.	Milano		Atlas		CMS	LHCb
10.	Napoli	Virgo	Atlas		CMS	
11.	Padova			Alice	CMS	
12.	Pavia		Atlas		CMS	
13.	Perugia	Virgo			CMS	
14.	Pisa	Virgo	Atlas		CMS	
15.	Roma1	Virgo	Atlas	Alice	CMS	LHCb
16.	Roma2		Atlas			LHCb
17.	Roma3		Atlas			
18.	Torino			Alice	CMS	
19.	Trieste			Alice		
20.	CNAF					
21.	LNF	Virgo	Atlas			LHCb
22.	LNGS					
23.	LNL				CMS	
24.	LNS					

Tiers e non Tiers (non completo)

- **An LCG RTAG is just working on the definition of them!?:**
  - **Political Issues**
  - **Services (level of and commitments on) and dimension of available resources**
- **Really a mess?!**
  - **CNAF: Tier1 VIRGO, Tier1 CMS, Tier1 Alice, Tier1 Atlas, Tier1 LHCb, ...TierA BaBar ?, TierB CDF ?, ... what else?**
  - **Bari: Tier2 CMS, Tier2 Alice**
  - **Bologna: Tier2 CMS, Tier2 Alice, Tier3 LHCb**
  - **Cagliari: Tier3 Alice, Tier3 LHCb**
  - **Catania: Tier3 CMS, Tier2 Alice**
  - **Firenze: Tier3 CMS, Tier? LHCb, Tier3 Virgo**
  - **Genova: Tier3 Atlas**
  - **Lecce: Tier3 Atlas**
  - **Milano: Tier2 ATLAS, Tier3 CMS, Tier3 LHCb**
  - **Napoli: Tier3 ATLAS, Tier3 CMS, Tier2 Virgo**
  - **Padova: Tier2 CMS, Tier3 Alice**
  - **Pavia: Tier3 CMS, Tier3 Atlas**
  - **Perugia: Tier3 CMS, Tier3 Virgo**
  - **Pisa: Tier2 CMS, Tier3 Atlas**
  - **Roma1: Tier2 CMS, Tier2 Atlas, Tier3 Alice, Tier3 LHCb, Tier2 Virgo**
  - **Roma2: Tier3 ATLAS**
  - **Torino: Tier2 Alice, Tier3 CMS**
  - **Trieste: Tier3 Alice**
  - **Legnaro: Tier2 CMS**
  - **Salerno: Tier3 Alice**

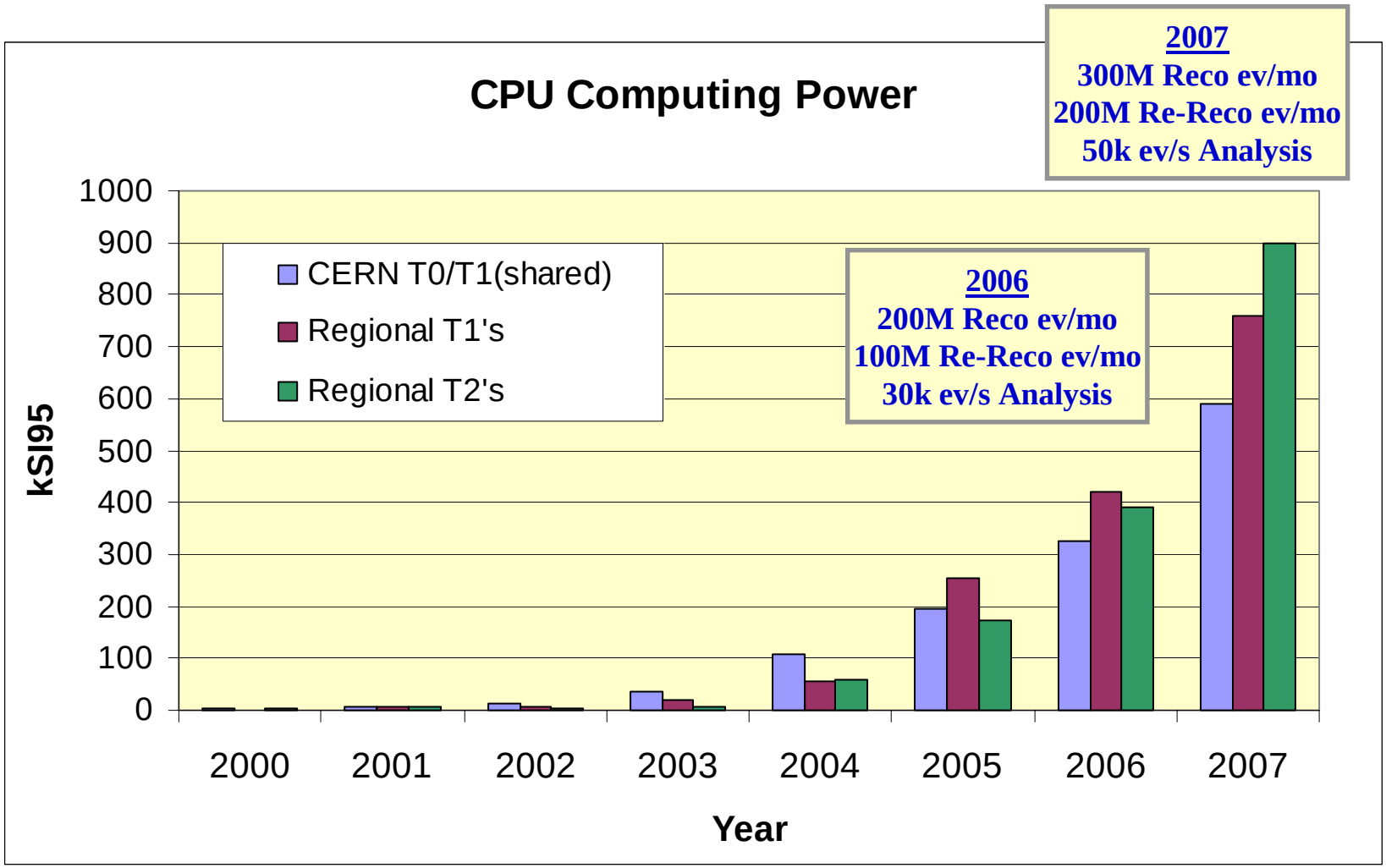
Le Creusot
Bâle
Innsbruck
AUSTRIA
Klagenfurt
Graz
HUNGARY
SWITZERLAND
Lyon
Sion
Trento
SLOVENIA
Pécs
Zagreb
Bergamo
Udine
Osijek
Aosta
VENETO
Trieste
Milan
Novi Sad
Banja Luka
Cremona
Abriès
EMILIA-ROMAGNA
Belgrade
PIEMONTE
Genoa
Florence
CROATIA
BOSNIA &
Monaco
Ancona
TOSCANA
Split
HERZ.
MARCHE
Toulon
Grosseto
UMBRIA
Teramo
CORSE
Terni
ABRUZZO
Podgorica
Ajaccio
Manfredonia
Tirana
Sartène
Rome
ITALY
Bari
Olbia
Foggia
Sassari
PUGLIA
Naples
Salerno
SARDEGNA
Taranto
Oristano
Corigliano Calabro
Tyrrhenian
Carbonia
CALABRIA
Cagliari
Sea
Vibo Valentia
Catanzaro
Mediterranean Sea
Messina
Palermo
Marsala
Ionian Sea
Catania
SICILIA
Annaba
Tunis
Gela
Syracuse

ATLAS Data Challenges (old plans)

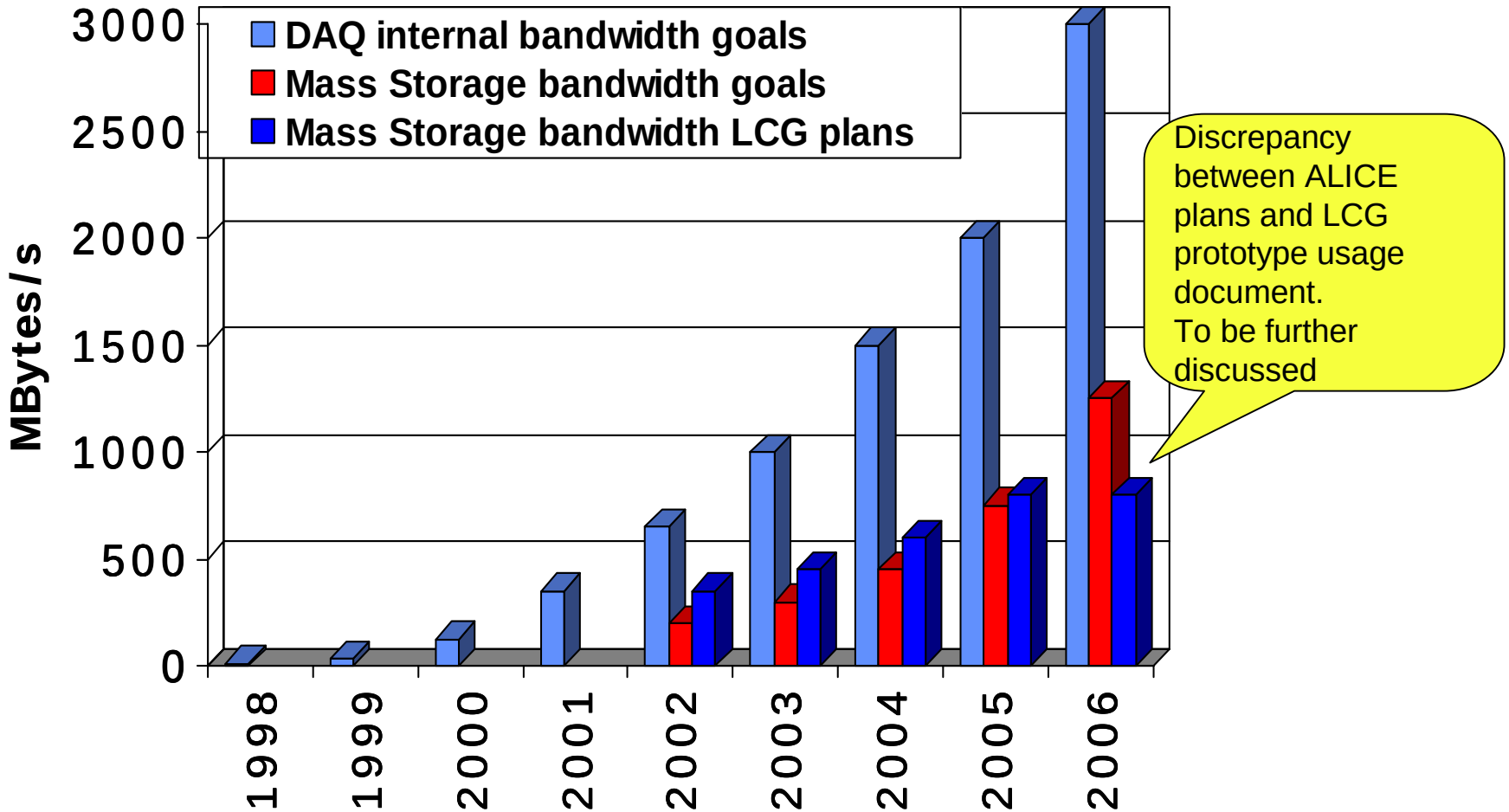
- **Iterate on a set of Data Challenges (DCs) of increasing complexity**
  - **DC0: Spring 2002 (mostly at CERN)**
    - Check readiness and perform ‘continuity’ test (event generation-> final analysis)
  - **DC1: May 2002 – End 2002 (early 2003 ?)**
    - Production (geographically distributed) of data for High Level Trigger TDR;
    - Test of software functionality and performance
  - **DC2: 2003 (September-December?)**
    - Use of LCG ‘testbed’
    - Extensive use of Grid middleware
    - New software (next ATLAS ‘cycle’ and LCG common-project software)
  - **Then expect one DC per year up to LHC start-up**
- **Computing TDR and MoU to be prepared in due time, and in phase with LCG project.**
- **‘Physics Readiness’ report to be completed one year before data taking.**

LHC Computing CPU

- Ramp Production systems 05-07 (30%,+30%,+40% of cost each year)
- Match Computing power available with LHC luminosity



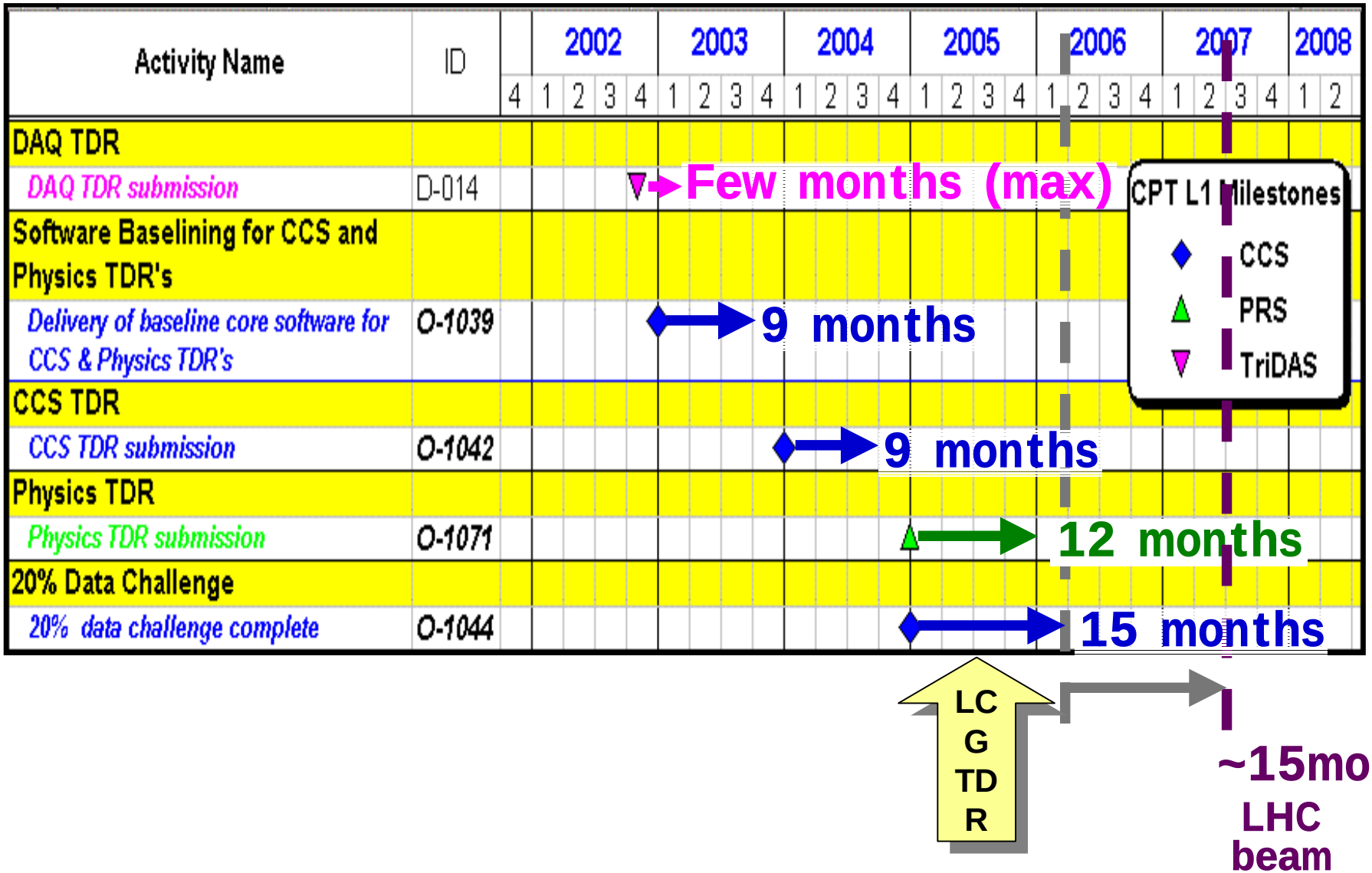
ALICE Computing Data Challenges
Bandwidth goals for data recording



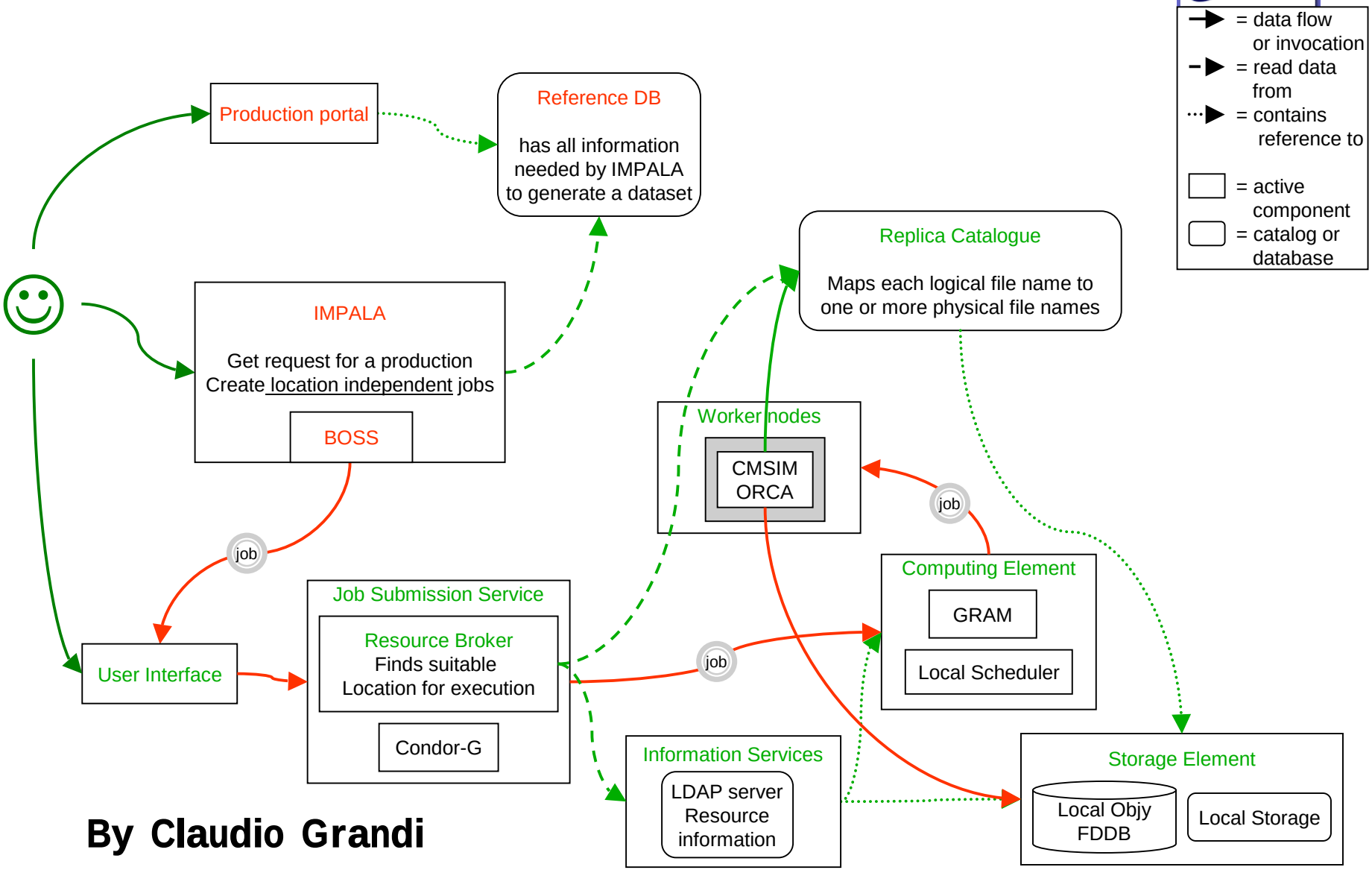
Don't forget the e-mails!!

- **E-mail a basic service!**
  - **Services should be so simple like this (indeed simple for "a" User?)**
  - **Experiments need a "robust" support (and continuous advertise by IT people)**
  - **True for <u>All</u> "basic" services (and also for other services not commonly recognized as so basic...e.g. DataBases or Licences)**
- **GRID !!!**
  - **It's a "basic" service?**
    - **Yes, it's already at the basis of Computing for "future" Experiments.**
  - **Which plans for Grid?**
    - **Timings and current milestones (CMS example) →**
    - **Architecture: expectations →**
    - **Experiments expectations → Data and Physics Challenges**
    - **Projects today and just starting →**

Proposal: CMS CPT Schedule Change

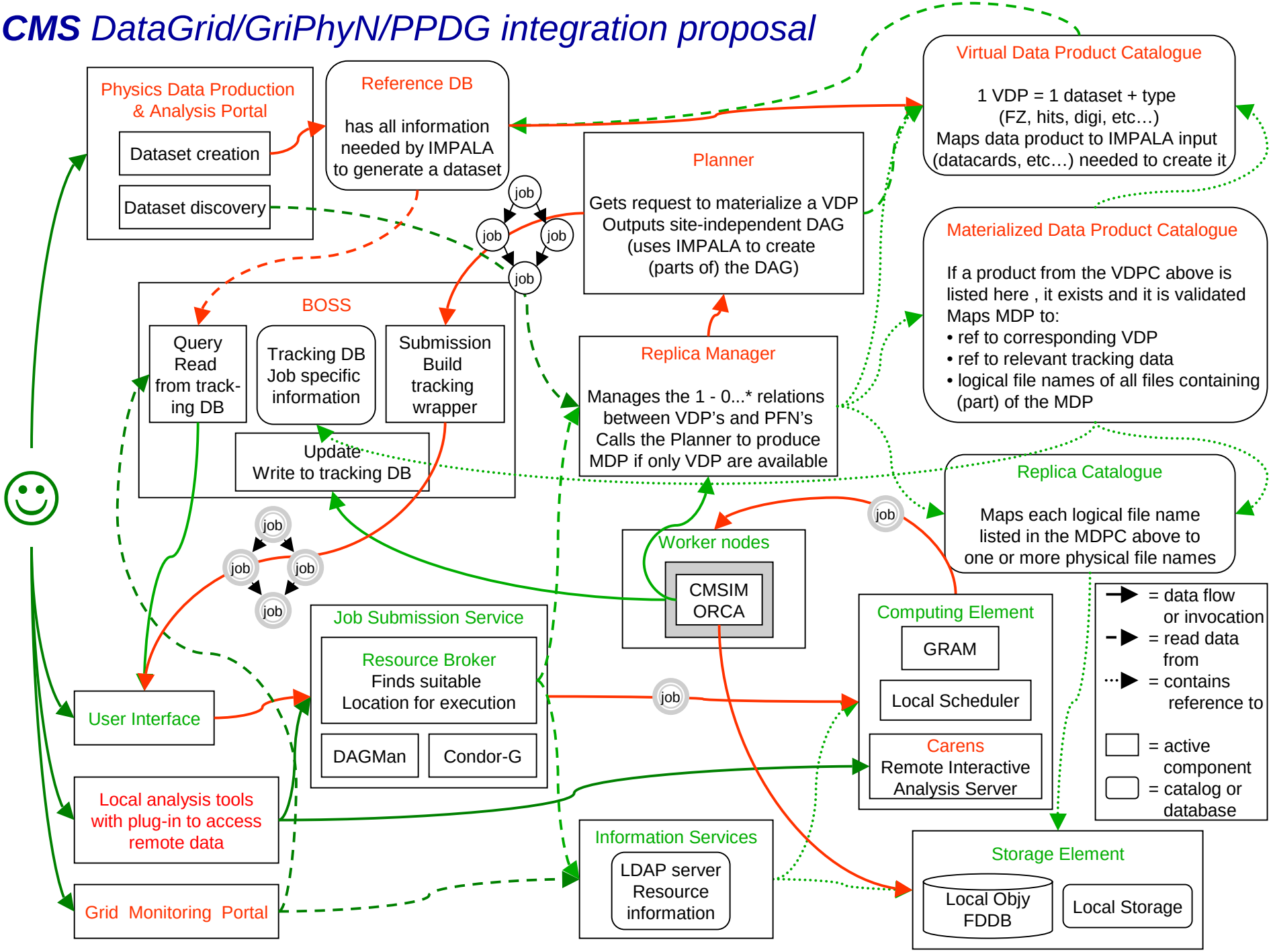


CMS IMPALA/EDG integration



By Claudio Grandi

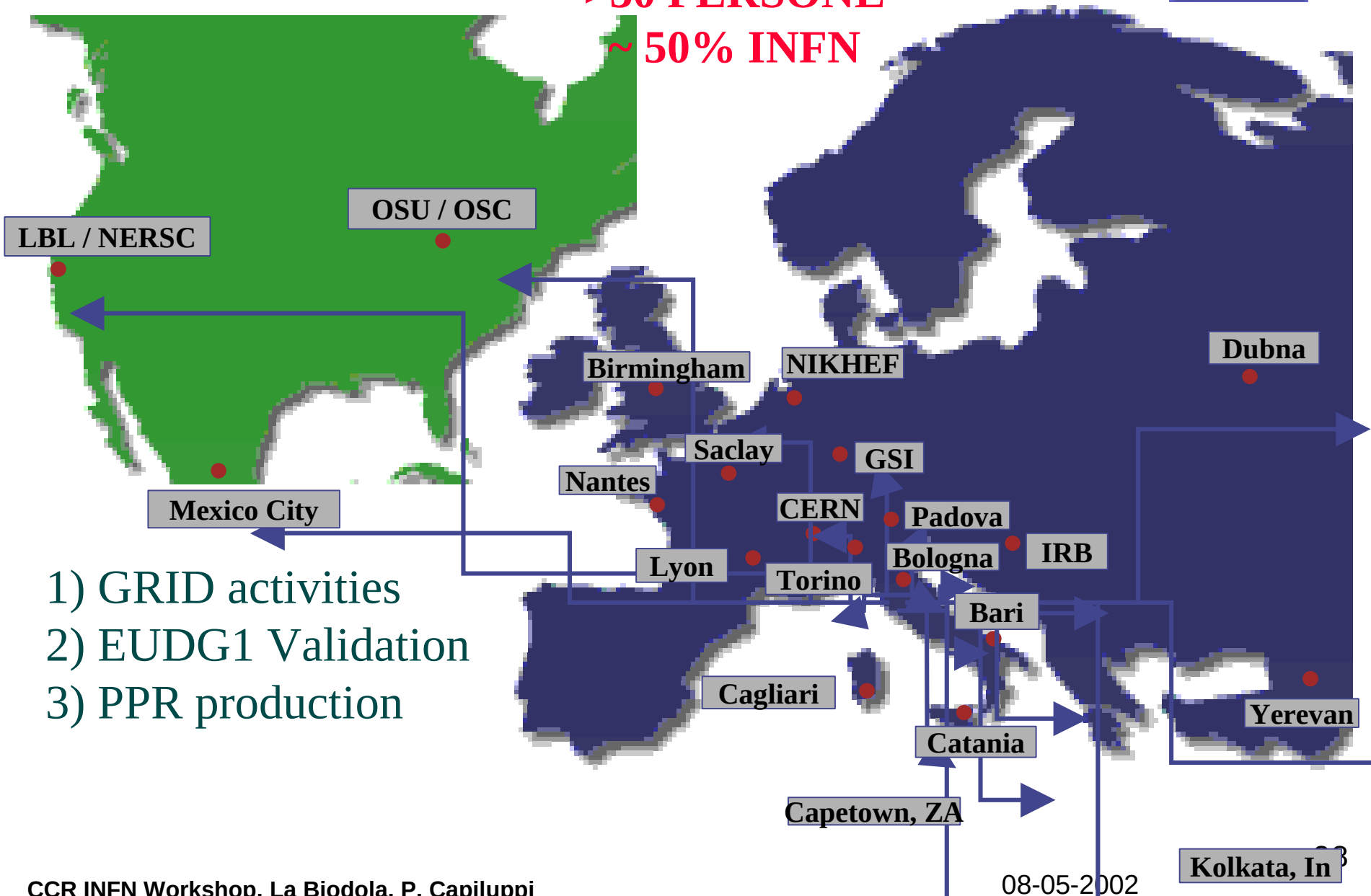
CMS DataGrid/GriPhyN/PPDG integration proposal



GRID developments in ALICE

>30 PERSONE

~ 50% INFN



1) GRID activities
2) EUDG1 Validation
3) PPR production

Grid Projects

- DataGrid
- GriPhyn
- PPDG
- DataTag
- InterGrid
- iVDGL
- VDT
- CrossGrid
- …
- EU VI FP ?

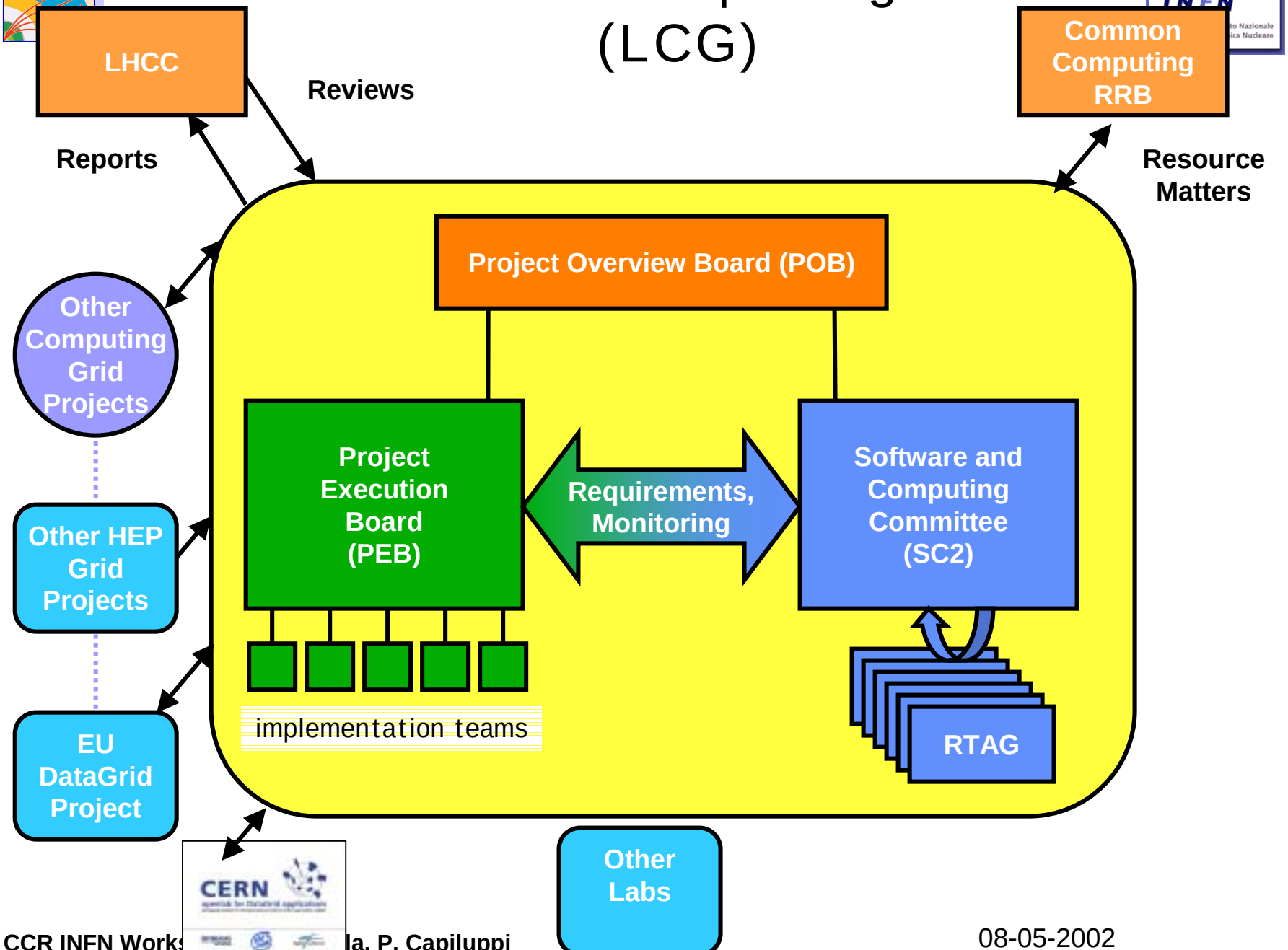
- Globus
- Condor
- …
- LDAP
- CAs
- …

LCG
(LHC Computing Grid Project)

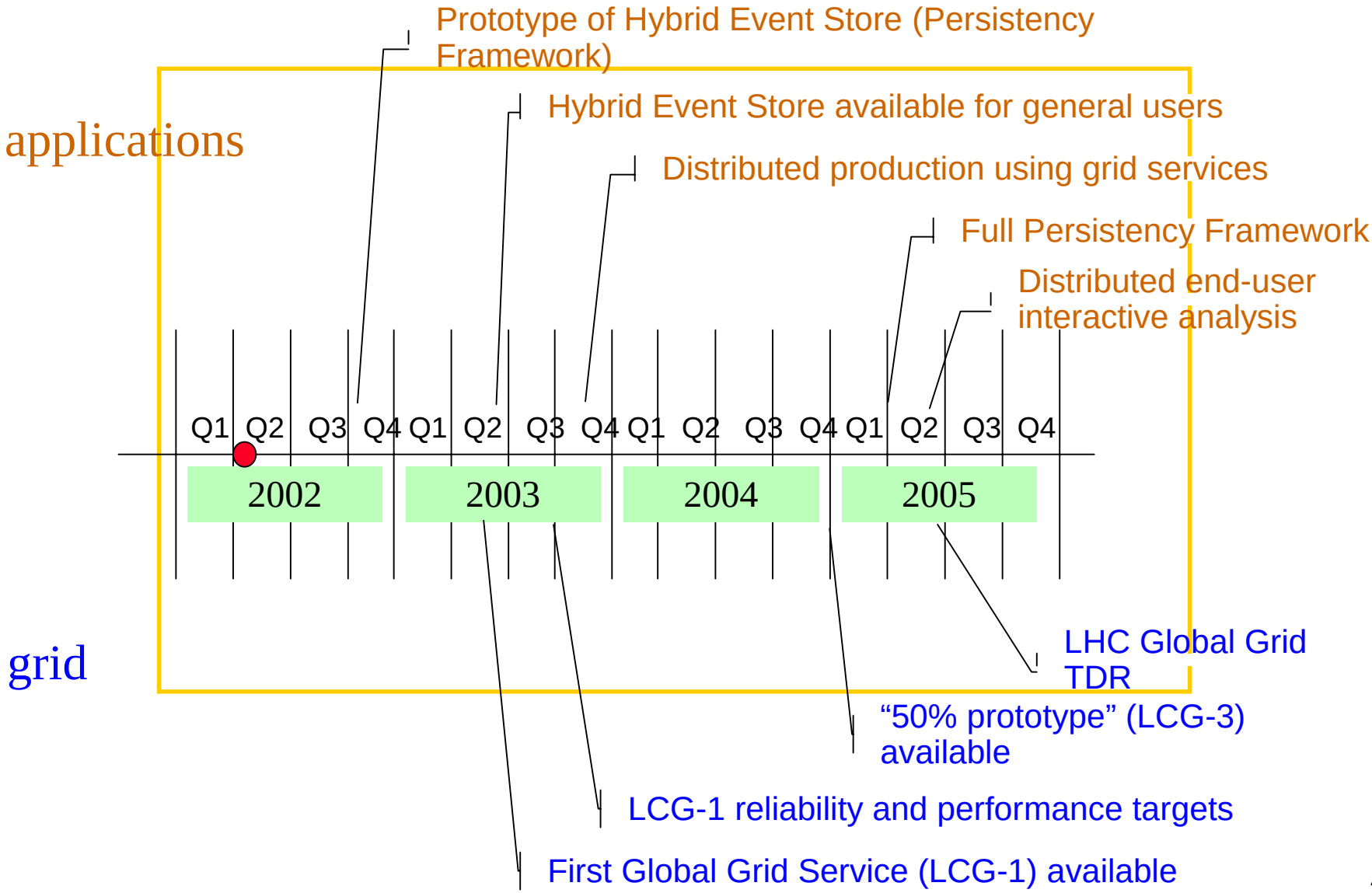
- INFN-GRID
- GRIDPP
- NordGrid
- …
- Etc.

- HICB (+JTB)
- GLUE
- GGF

The LHC Computing Grid (LCG)



LCG: DRAFT – High Level Milestones



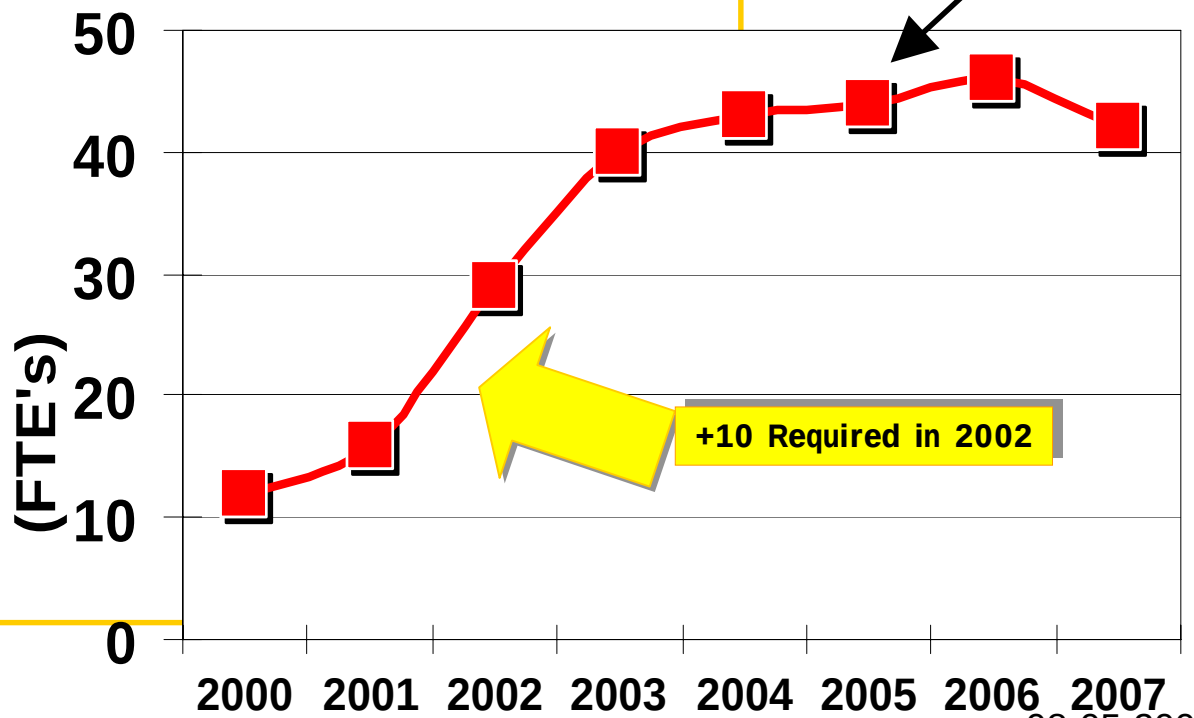
Copyright © 2002 United Feature Syndicate, Inc.

CMS Software Manpower

- Serious shortfall in Core Software manpower
  - **As recognised in numerous reviews, incl. Hoffman, LHCC, US-DOE/NSF**
  - **Milestones are at risk**

N.B. Core software only

Excludes:

- regional centre operations
- physics software development

Context: ~80 Physicist Users / Developers in 2001