

LHC Computing

Tetsuro Mashimo
(ICEPP, University of Tokyo)

LEP Symposium 2001
5-6 November 2001

Date: Tue, 23 Oct 2001 11:36:31 +0900 (JST)

From: Tomio Kobayashi <tomio@icepp.s.u-tokyo.ac.jp>

Reply-To: atlas-japan@ml.post.kek.jp

To: atlas-japan@ml.post.kek.jp

Subject: [atlas-japan:00214] [hecforum:00488] LEP symposium (fwd)

ATLAS-Japanの皆様:

LEPの物理と成果

下記のシンポジウムでは、

LHC physics 浅井祥仁

LHC experiment 田中秀治

LHC computing 真下哲郎

その他、萩原(KEK)、柳田(東大)、諸井(東北大)、岡田(KEK)各氏による理論の話など、面白くためになると思いますので、学生の人達も含め是非ふるって参加してください。参加費は無料。早めにweb pageで登録お願いします。

Softwareの話は
しません

旧タイトル

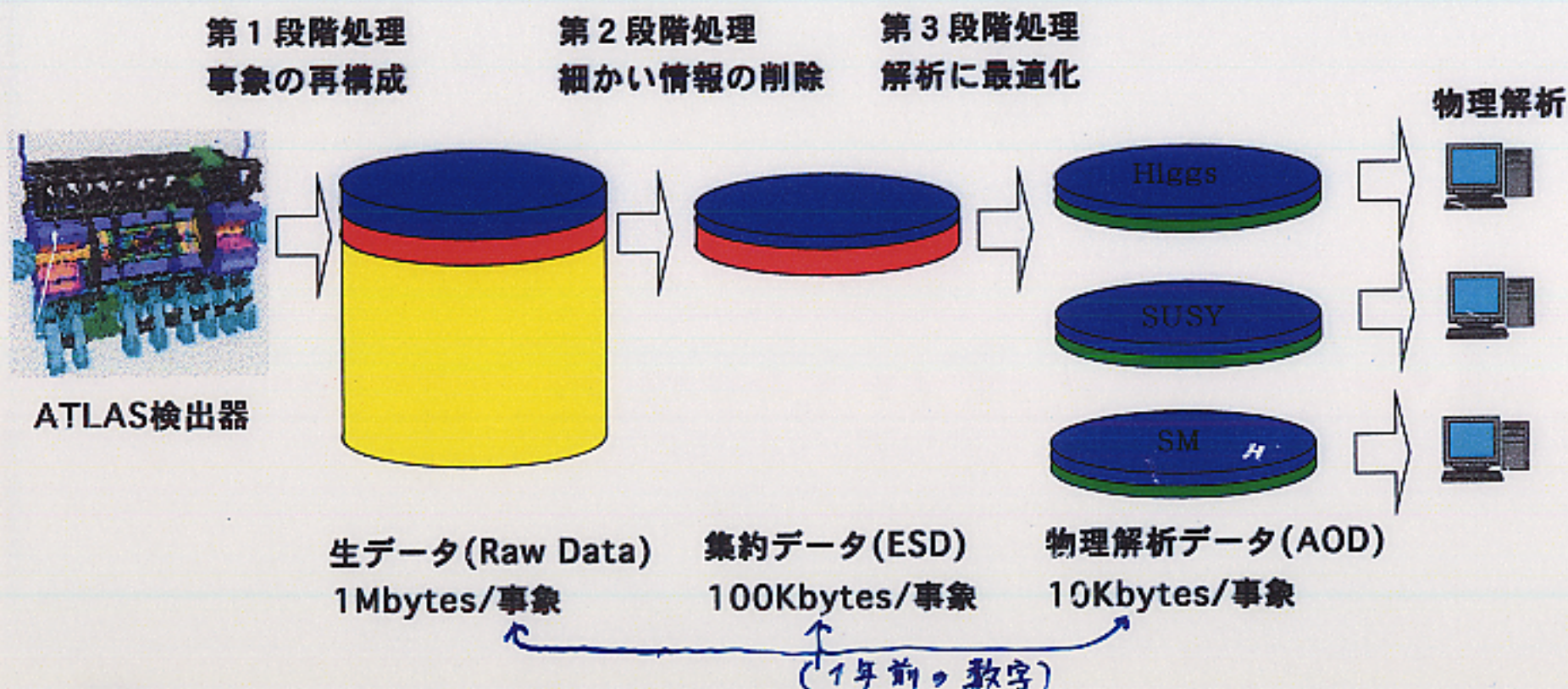
Regional Computing Center

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東大素粒子センターが、日本ATLAS
グループ全体の協力のもとにICEPPに
ATLAS地域解析センターを構築する

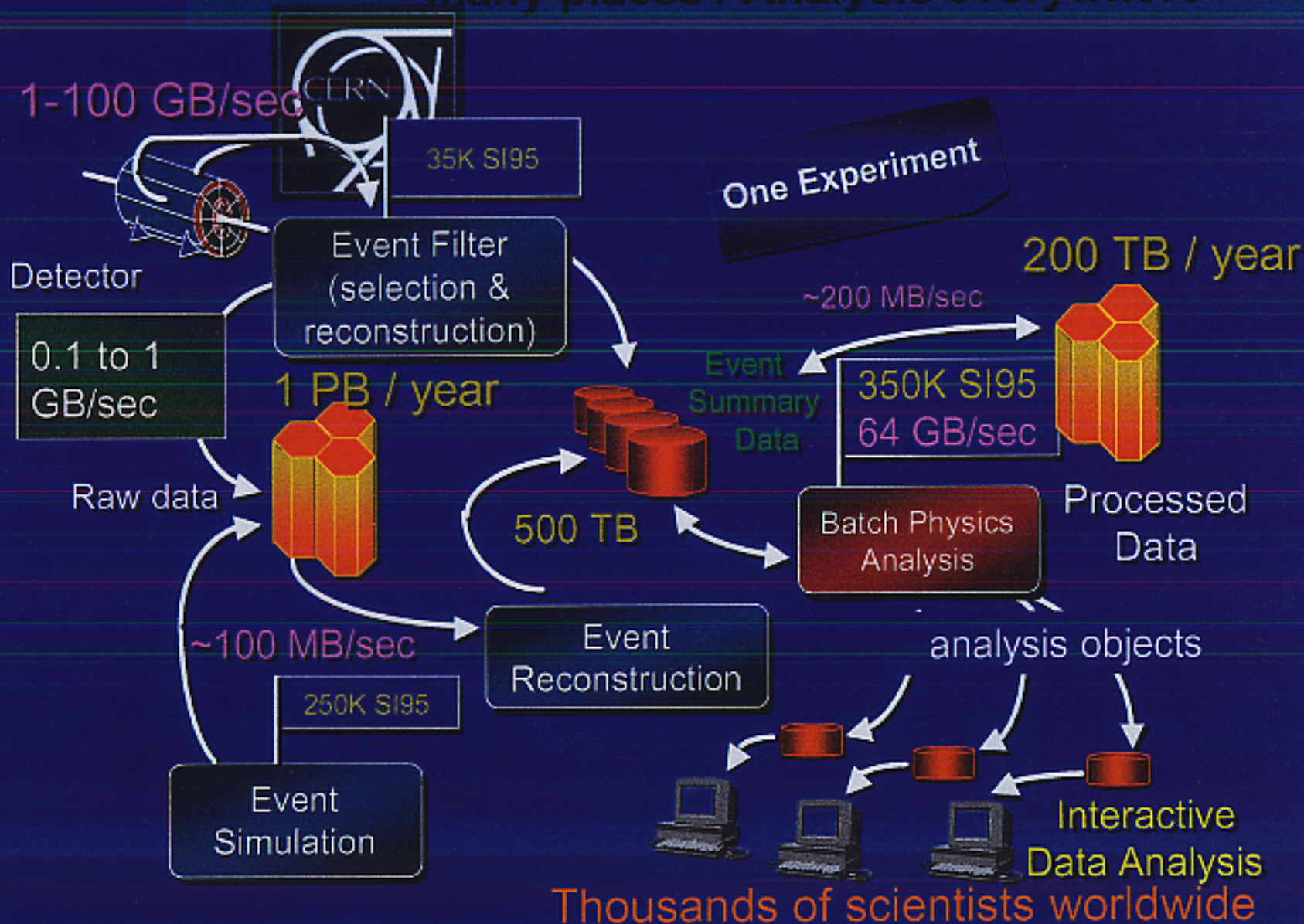
ATLAS実験 データ加工の流れ



- イベント ヘッダー (時間や検出器の状態の情報)
- 再構成した粒子の情報 (ヒットなどの情報を使って再構成した粒子の情報)
- ヒット情報 (検出器からの直接の情報)
- 物理量 (再構成した粒子の情報から計算した物理解析に必要な情報)



Experiments at CERN / Simulation in many places / Analysis everywhere

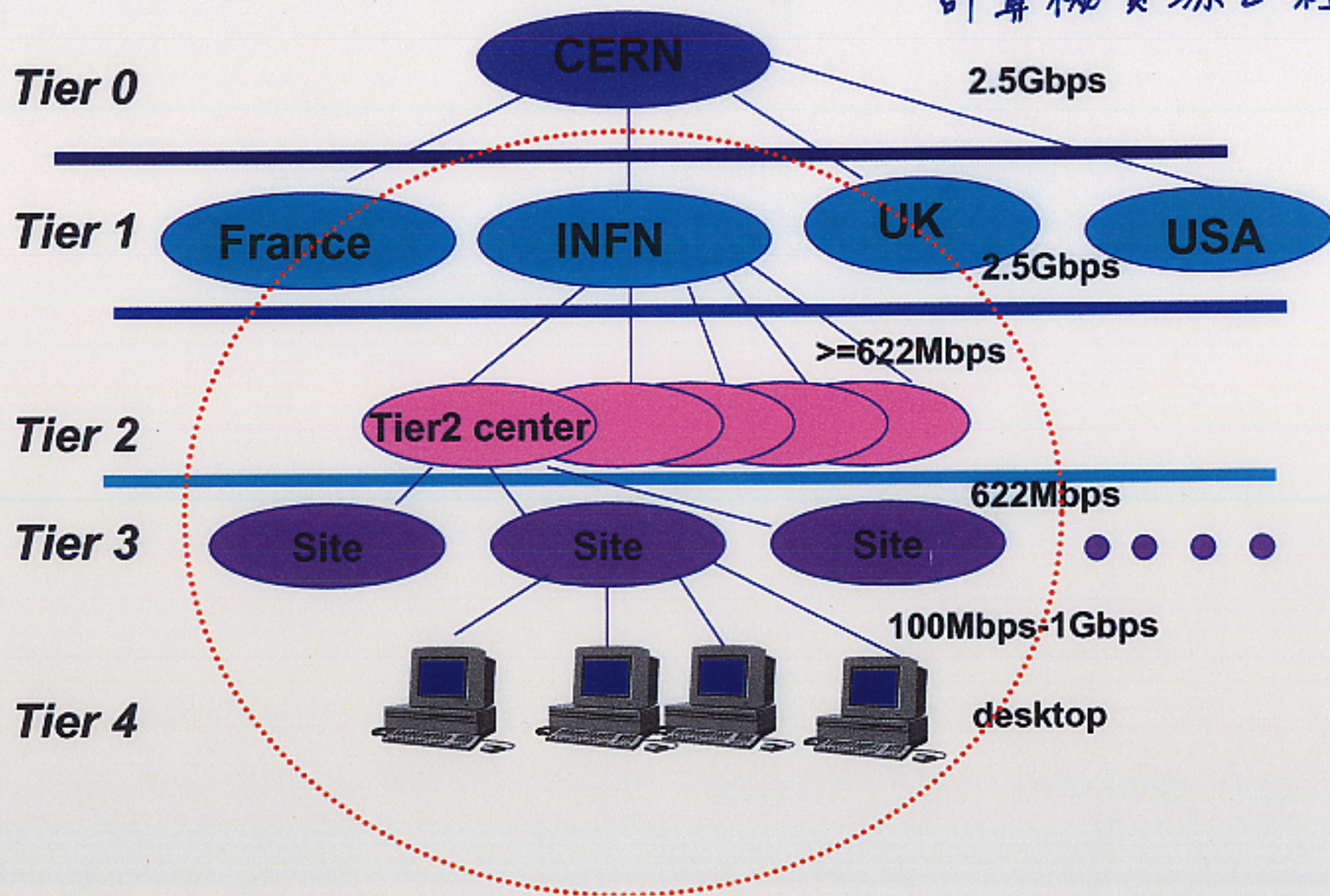


“1 PB/year” CERNが供給する計算機資源だけでは足りない。

HEP Monarc Regional Centre

Hierarchy

世界中に分散した
計算機資源を利用



Present

- The ATLAS World Wide Computing „Model“ was based on the MONARC hierarchical Model
- Tier-0
 - Repository for Raw Data
 - Reconstruction
- Tier-1² Regional
 - Data Analysis
 - ESD, AOD, TAG
 - MC Production
- Tier-2 Group of Institutes or Smaller Countries
 - AOD, Tag, Small Samples of ESD
- Tier-3 Institute
 - Part of AOD
- Tier-4 User desktop
 - Tag, „N-Tuple“



- LHC Computing is **challenging and expensive**, but it must be done. It is an integral **part of the LHC programme and essential** for extracting physics.
- LHC Computing is **much larger than previous** detector generations (two steps on log scale rather than "historical" one).
- LHC analysis teams will dynamically form **"virtual teams"** distributed around the planet.
Automation of sparse data access is essential.
Good match to Grid.
- **Much more efficient utilization of worldwide resources** must be made than previously. Regional Centres=Collaboration-wide
- **Development and Deployment** of LHC Computing Grid Infrastructure should be **setup and managed as a unified project**, similar in some ways to a detector collaboration.
- **CERN** is viewed as the institution that **should co-ordinate** this project. CERN has **additional development as host lab**.

LEPの
時代は
比べる100
倍の規模

米国から始まった CPU intensive な "Grid" project(s) に対し,



EU DataGrid background

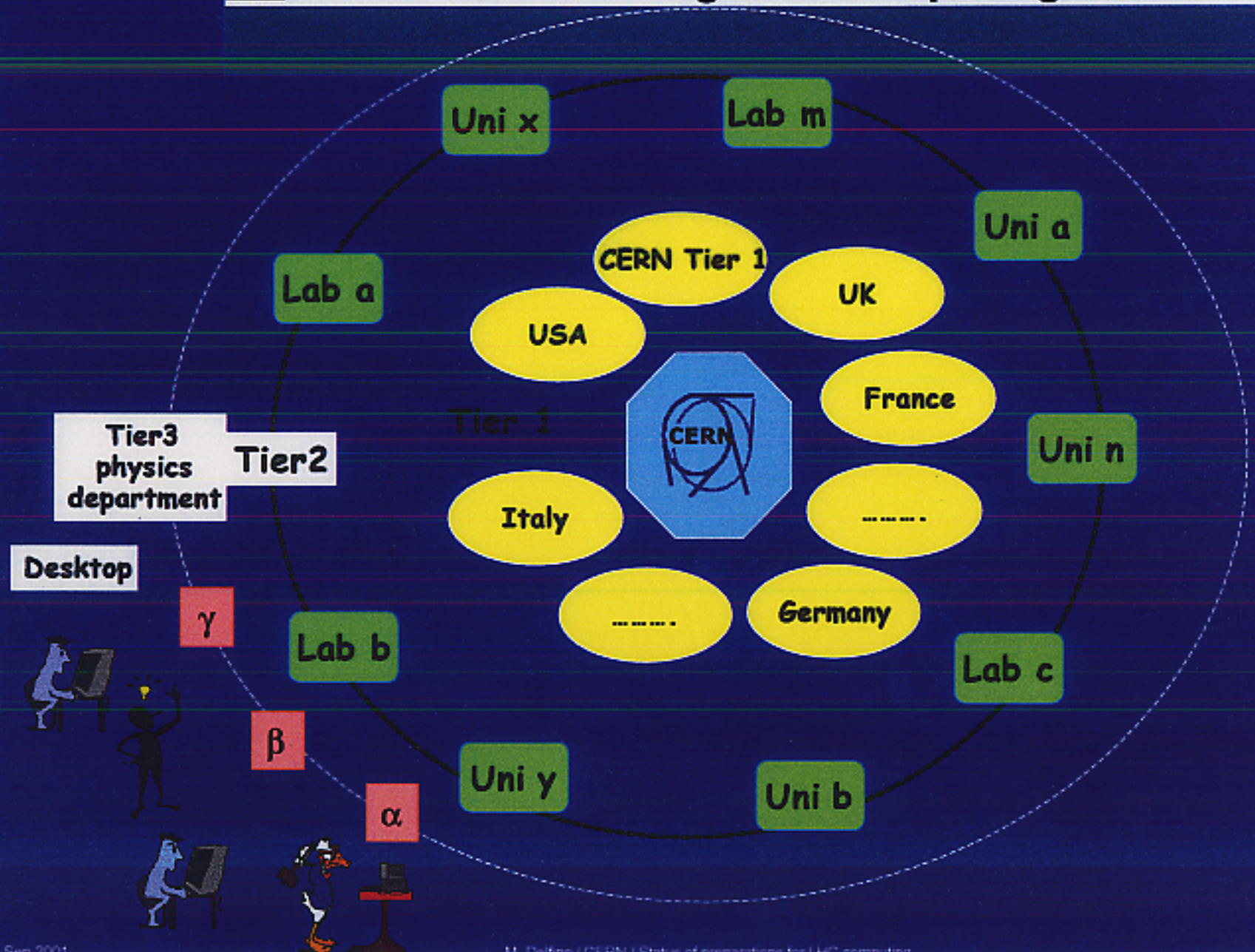
→ 2001 ~

"Data Intensive Computing"

- **Motivated by the challenge of the LHC computing**
 - Large amount of data (~10 Pbytes/year starting in 2006)
 - Distributed computing resources and skills
 - Geographical worldwide distributed community (VO)
- **Excellent Grid computing model match to HEP requirements (Foster's quote: HEP is Grid computing "par excellence")**
 - Transition from supercomputers to commodity computing done
 - Distributed job level parallelism (no strong need for MPI)
 - High throughput computing rather than supercomputing
 - VO tradition already long established
 - Prototype Grid activity in some CERN member states



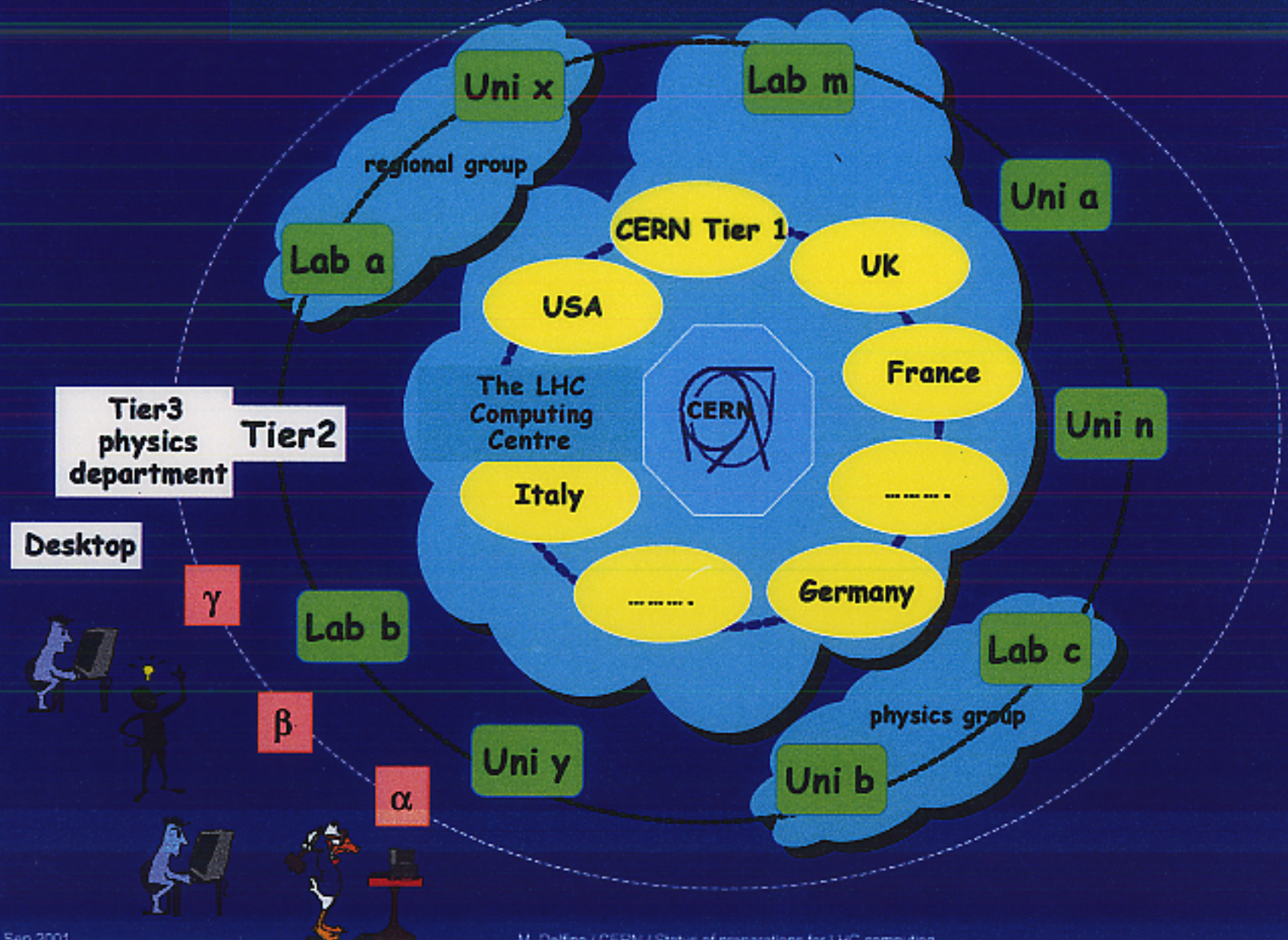
The evolving LHC computing model



(比較的) 独立した Tier-1 centers



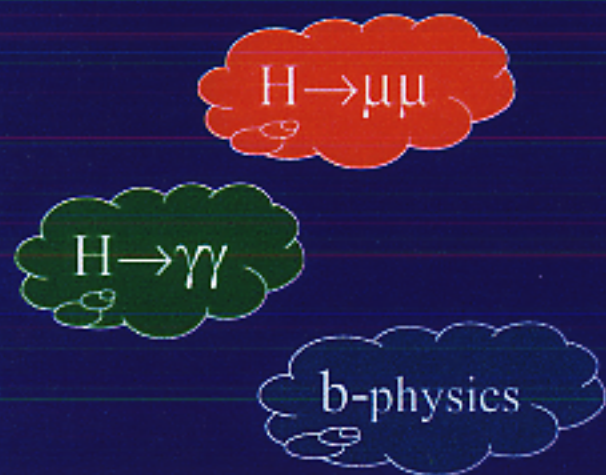
The opportunity of Grid technologies



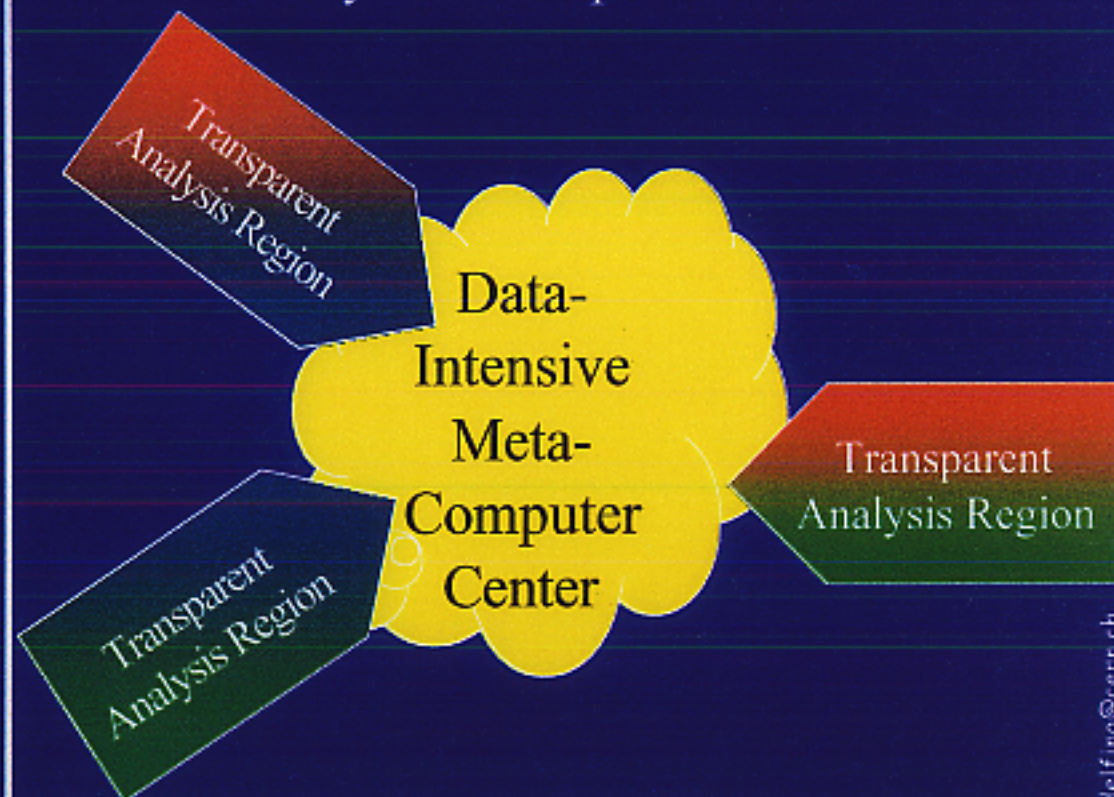
Grid
テクノロジー
で密接
に結ば
れた
Tier-x
centers



User point of view:
Virtual analysis
communities



Physical setup



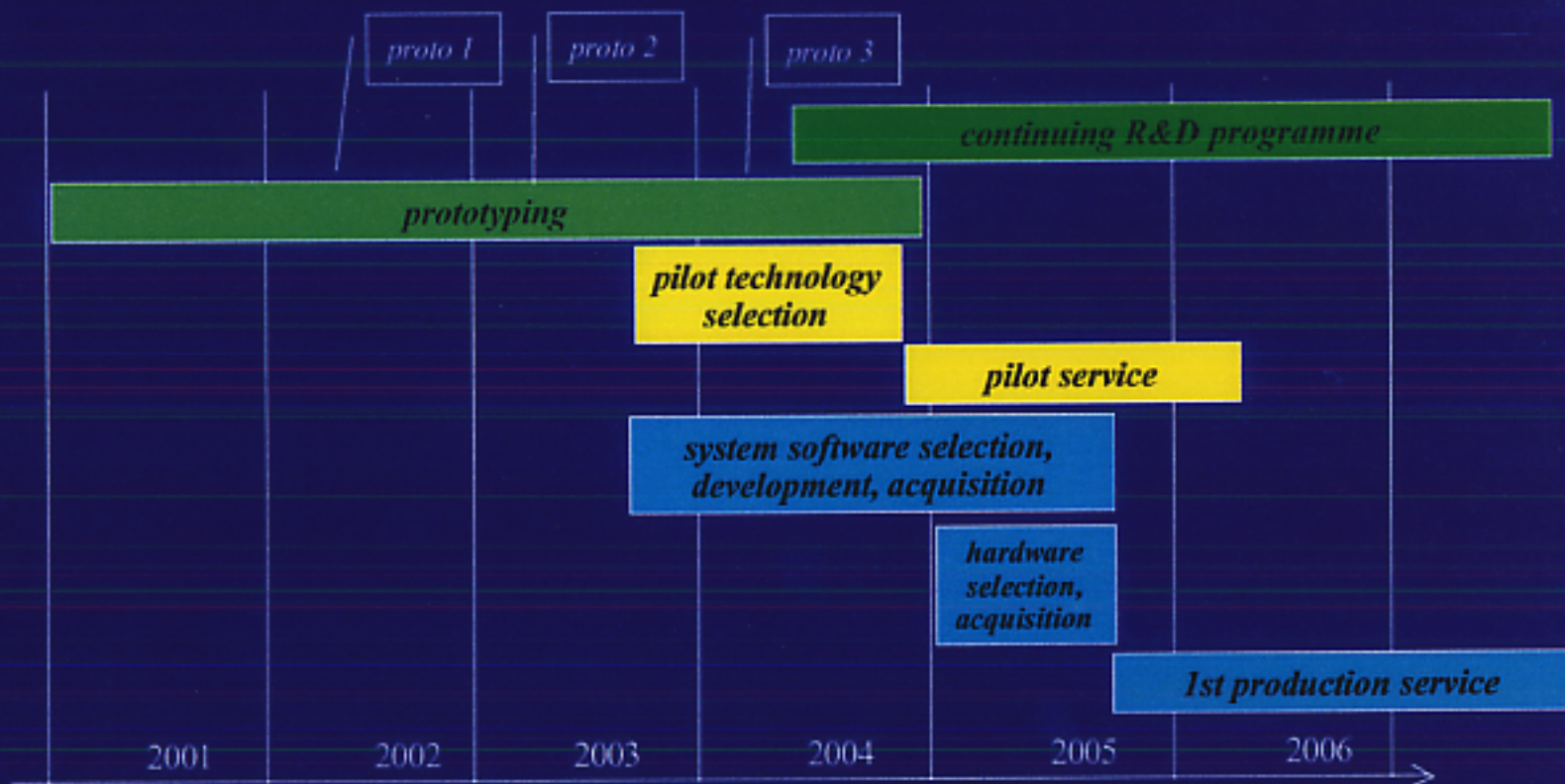
世界中に分散した多数の計算資源を 1つの巨大な計算機があるかのように使う

CERNのTier-0(+Tier1 at CERN)の建設計画



IT Division

Prototype and Data Challenge driven development

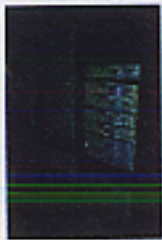




Some implications of review and posterior digestion (1)

➤ Rough Timing

- This is computing, not civil engineering !!!!
- But need to fire a warning shot for funding agencies' 2005-2007 plan (worldwide materials cost of initial infrastructure ~240 MCHF, complemented by non-negligible human resources)
- **2001-2004** Build **increasingly complex and powerful prototypes** and study options. Includes "Data Challenges". (Note: Prototype is distributed, i.e. Tier 0/1/2, grid, etc.)
- **2H2003 Write Technical Design Report** synchronized with experiment's computing TDRs. Make approximate **resource estimates** so that funding agencies can put in **2005-2007 budgets**.
- **2004** Final prototyping work. Write an **Engineering and Deployment plan and firm-up resource requirements**
- **2005-2006-2007 Build up LHC Computing Grid infrastructure** following ramp-up of LHC luminosity
- **2008 Go into maintenance + evolution**, mostly by component replacement



お仲間以外にも:

Run 2b Computing (CDF)

- **Very Preliminary estimates for Run 2b (2007~) computing:**
 - 8x CPU, disk, tape storage.
 - Expected cost is same as Run 2a because of increased price/performance of CPU, disk, tape.
 - Plans for R&D testing, upgrades/acquisitions will start next year.
- **Data-taking rate:**
 - Potentially 80 MB/s or more.
 - About 1 Petabyte/year to storage.

日本にも

5. Future of Belle

- Luminosity upgrade of KEKB accelerator is now being discussed.
 - Goal : New physics search in rare B meson decays

Target: Luminosity = $10^{35} \text{ cm}^{-2} \text{ sec}^{-1}$ in 2006

Change in the requirements

	Current	After upgrade
L1 trigger	100Hz(phys), 200Hz(BG)	1KHz(phys), 1-10KHz(BG)
Event Size	30KB/ev	100KB/ev (use of pixel detector, wave form sampling)
Storage speed	5-10MB/sec	300-500MB/sec
Storage size	~ 50TB/year	~1PB/year
CPU power	~1000 Pentium@1GHz	~10000 Pentium@4GHz

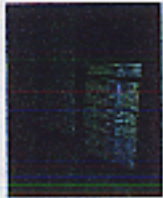
Basic Strategy

to cope with the 2 orders of magnitude of gap
(between LEP era and LHC era)

- Expect ~10 times increase in basic component (CPU speed, capacity per disk)
- Increase number of components (number of PCs, number of disk drives, ...) by a factor of 10~50

4 main components (hardware)

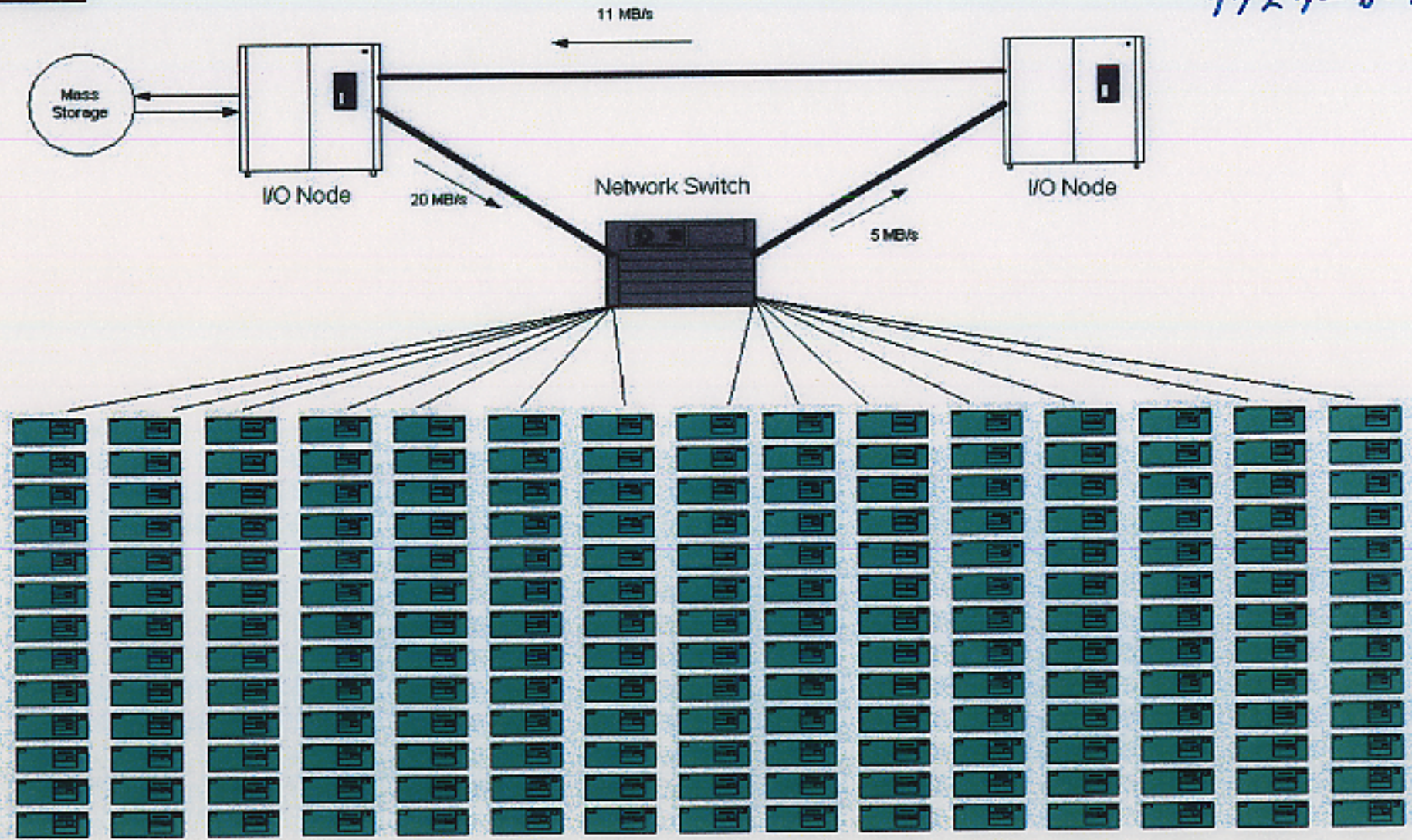
- CPU
- Disk storage
- Tertiary storage (tape)
- Connectivity
 - Inside the system
 - Network inside the nation
 - International network



Run II CDF PC Farm

例：現在のCDF

(CERNには >800ヶのPCの
クラスターがある)



CDF PC 792A-

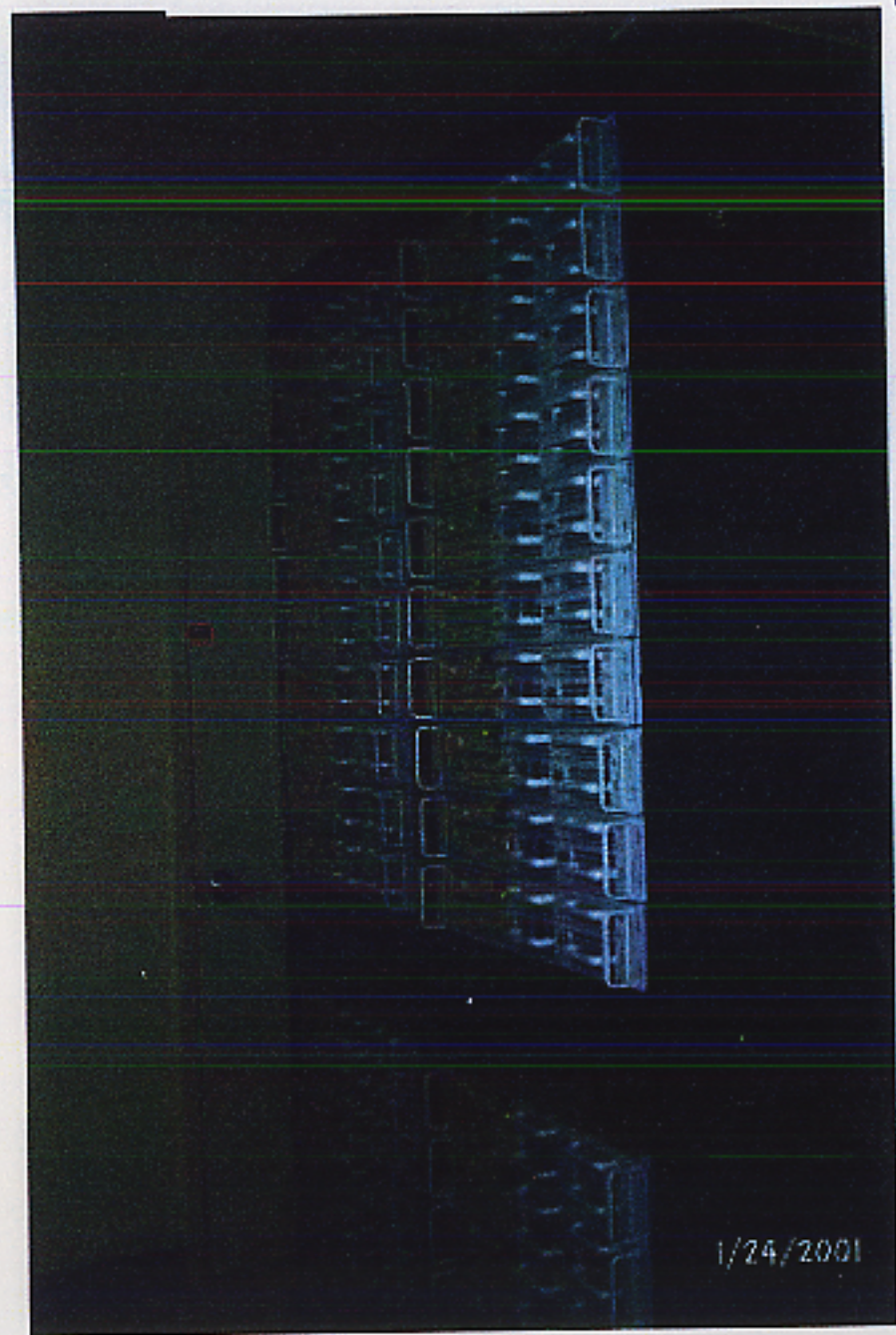


September 4, 2001

Stephen Wolbers, CHEP2001,
Beijing, China

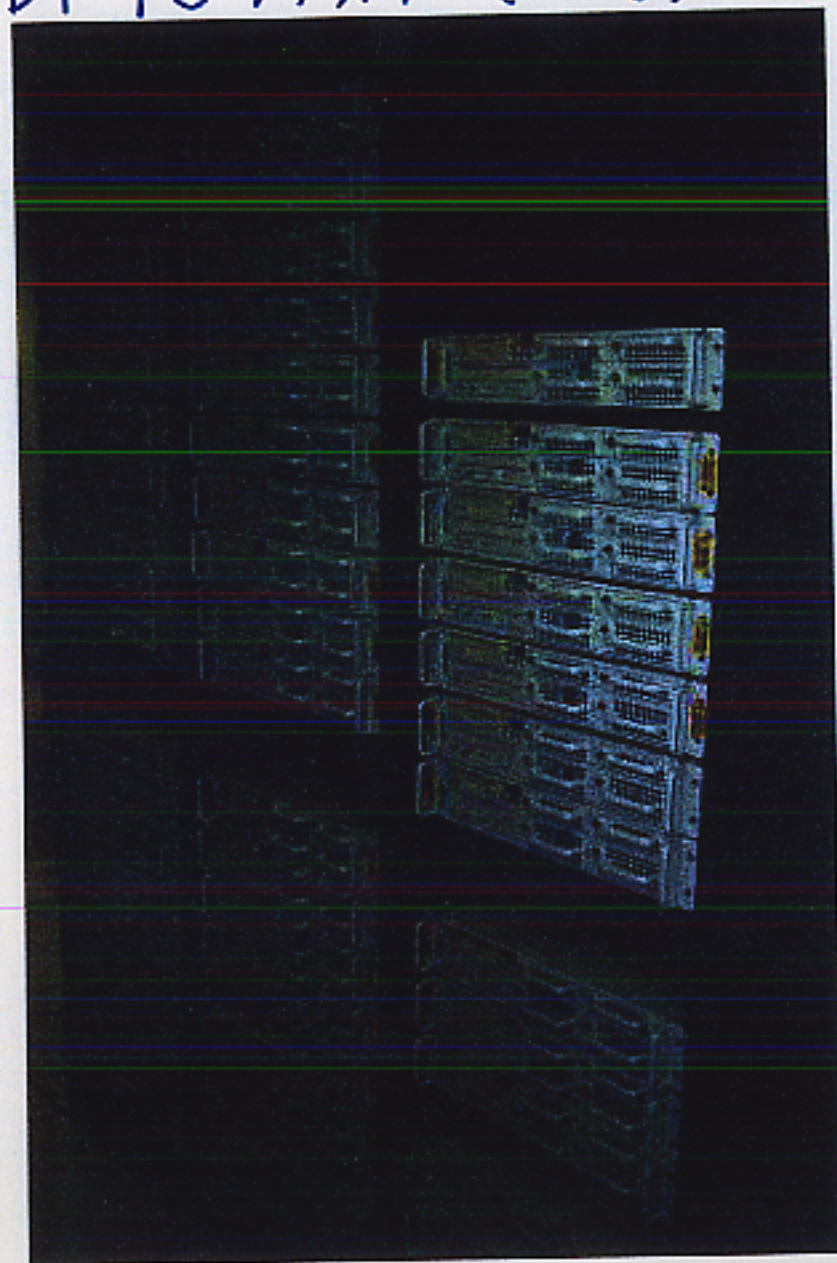
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CDF PC 7729-(つづき)



1/24/2001

September 4, 2001



Stephen Wolbers, CHEP2001,
Beijing, China

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データ量の estimate
1年前より 5 倍に → すべての ESD を 1ヶ所の regional center で 保持するのは無理 → ESD をすべての Tier-1 centers で 分担してもつ

Sharing of Resources

- **Centres are Regional and NOT National**
- ! • Physicists from other Regions should have also Access to the Computing Resources
- Profit from GRID Middleware for
 - access control
 - priority handling
 - information on available resources
- **Agreement as part of the Computing M.o.U.**
- However, all Institutes have to contribute adequately to the ATLAS GRID Infrastructure and Maintenance.

∴ 各地域の regional center が自分たちのために 計算機センターをつくる、という発想ではすまなく なった。

Summary?

- Need extensive and intensive R&D studies for constructing the Regional Computing Center in Japan
- Not much time left (only 2~3 years or less for the R&D)
- 大変な世の中になったものだ
 - technically
 - sociologically
 - politically