



# Computer Resources at IN2P3

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# Overview



- Computer Center IN2P3
- France Asia Virtual Organization
- g-2 Preliminary Simulations
- Summary

# Computer Center IN2P3



Provide computing facilities to research projects in the area of Particle Physics

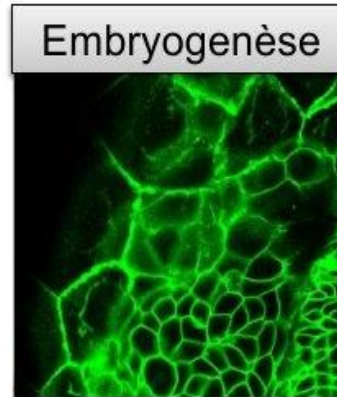
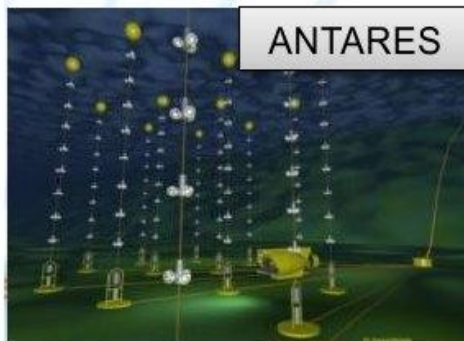
Main node of the national French grid

More than 50 engineers

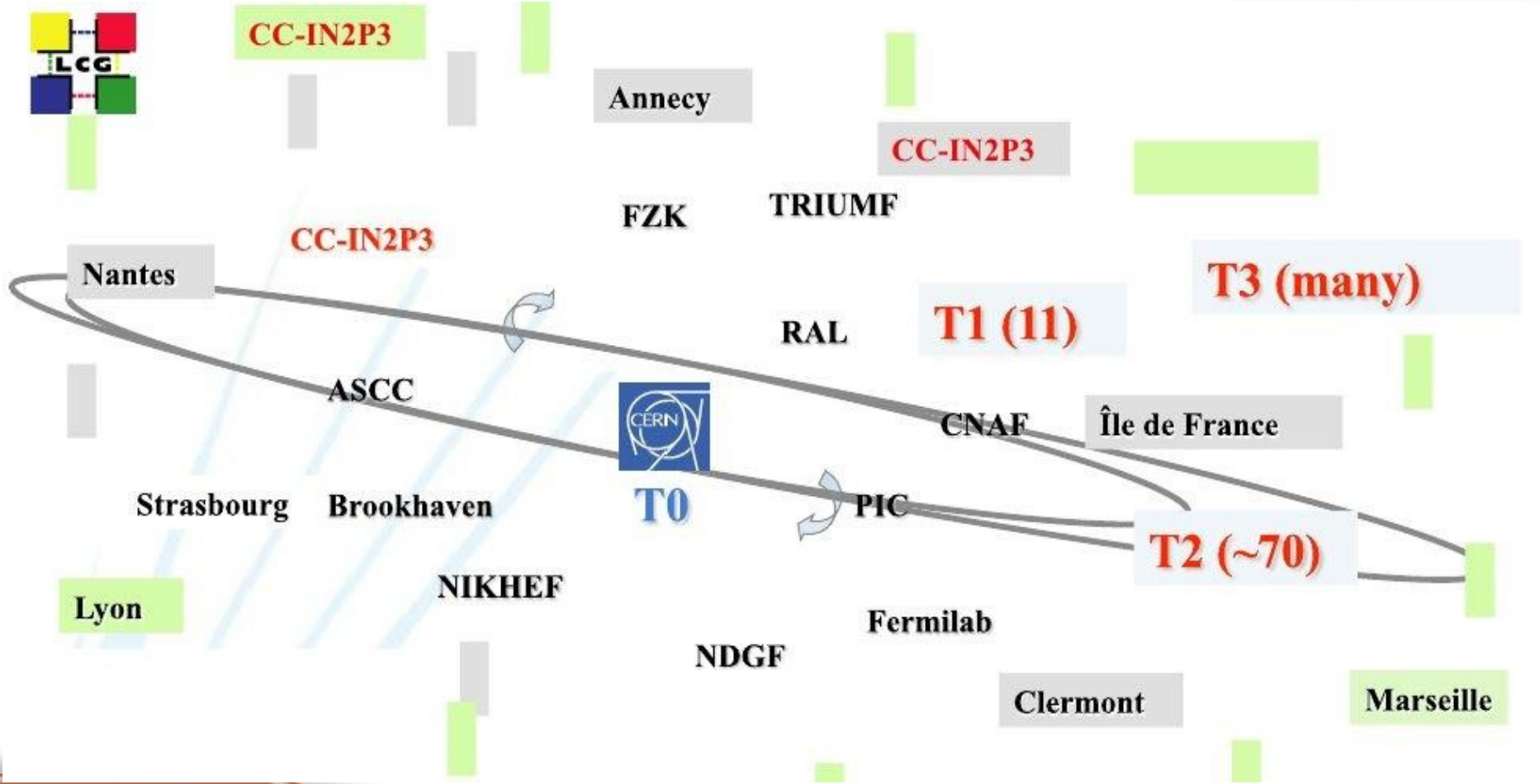
Budget global ~ 6 M€



# Computer Center IN2P3



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## Computing:

- 1209 workers
- 16832 processors

## Storage:

- Tape: 15 Pb
- Disk: 10 Pb (LHC)

*HPSS, XROOTD, dCache, iRODS, SRB,  
GPFS, AFS, (Databases) ...*





# France-Asia VO

France-Asia virtual organization is a collaboration to share computing resources to make them accessible to multidisciplinary scientific projects and primarily the ones which are part of the Associated International Laboratories between France and Asian countries.

Members:

KEK (Japan)

KISTI (Korea)

IHEP (China)

CC-IN2P3 (France)



# France-Asia VO Services

- Computing
  - Grid Computing (gLite)
  - DIRAC (June 2012)
- Data Storage
  - IRODS
  - AFS
  - SRM and LFC
- User Support
  - Wiki Site
  - Application porting
  - High-level grid tool
- Training
  - Grid tutorials





# GLite Grid Services



**User Interface (UI)**: The place where users logon to access the Grid



**Workload Management System (WMS)**:  
Matches the user requirements with the available resources on the Grid



**File and replica catalog**: Location of grid files and grid file replicas



**Computing Element (CE)**: A batch queue on a site's computers where the user's job is executed



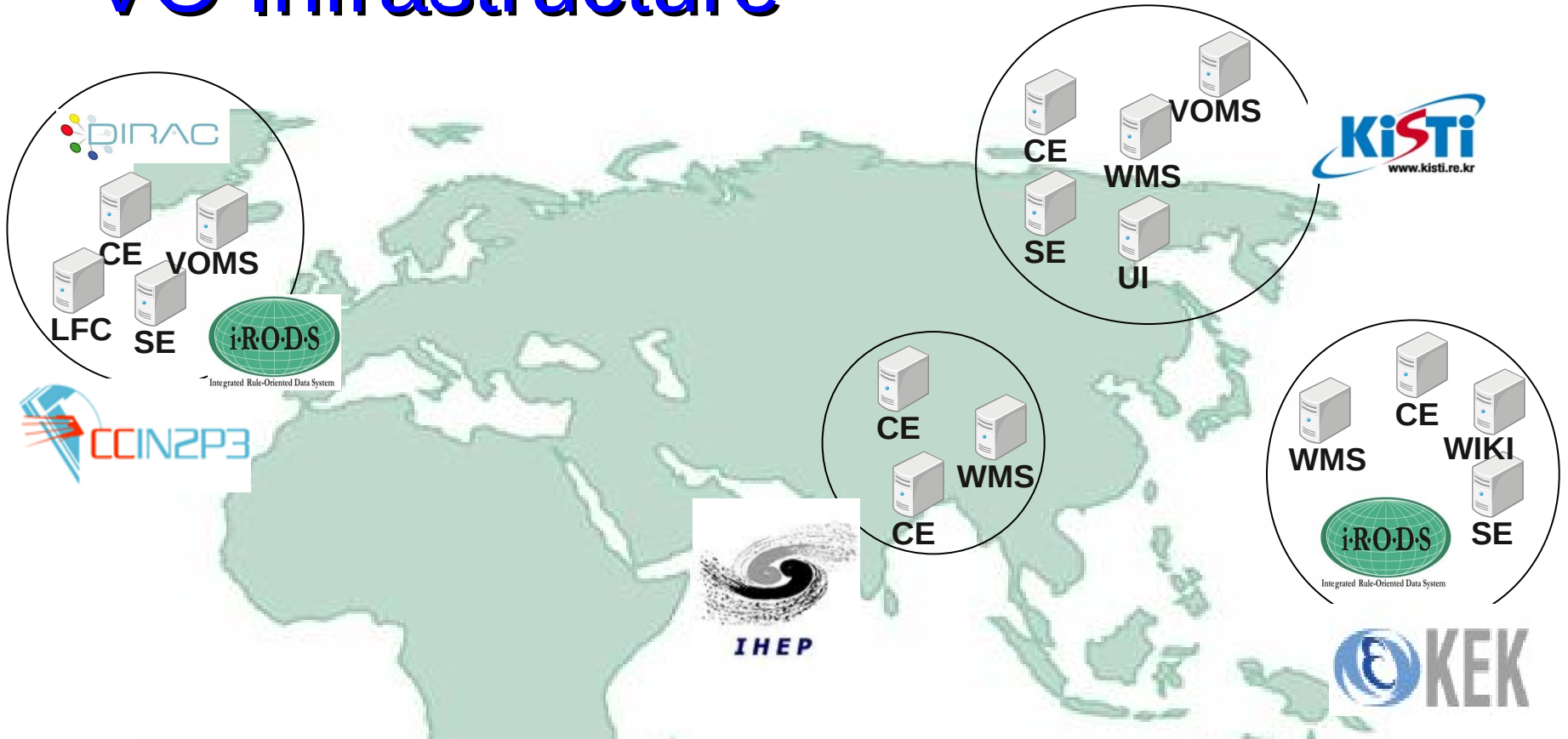
**Storage Element (SE)**: provides (large-scale) storage for files



# Glite Distributed Resources

gLite Service	Host	Site
UI	kenobi.kisti.re.kr ccage.in2p3.fr	KISTI CC-IN2P3
VOMS	snow.kisti.re.kr cclcgvomsl01.in2p3.fr	KISTI CC-IN2P3
WMS	snow02.kisti.re.kr kek2-wms.cc.kek.jp wms01.ihep.ac.cn	KISTI KEK IHEP
SE	ccsrm02.in2p3.fr (5 TB) hansolo.kisti.re.kr (2 TB) kek2-se01.cc.kek.jp (2 TB)	CC-IN2P3 KISTI KEK
CE	cccreamcelixx.in2p3.fr (14000 CPU cores)* kek2-ce0x.cc.kek.jp (3000 CPU cores)* darthvader.kisti.re.kr (128 CPU cores)* cce.ihep.ac.cn (904 cores)*	CC-IN2P3 KEK KISTI IHEP

# VO Infrastructure





# Resource and Service Usage

- CPU Used
  - 5.1 millions of hours HS06
- Number of Jobs executed
  - 193434
- 72 years for 1 processor intel Xenon 2.5 GHz



# Application porting (Korea)

- **Deployment of Geant4 applications**
  - Used extensively by the National Cancer Center in Korea to carry out compute-intensive simulations relevant to cancer treatment planning
  - In collaboration with National Cancer Center in Korea
- **Deployment of two-color QCD (Quantum ChromoDynamics) simulations in theoretical Physics**
  - Several hundreds or thousands of QCD jobs are required to be run on the Grid, with each jobs taking about 10 days.
  - In collaboration with Prof. Seyong Kim of Sejong University



# Activities: IHEP joints the VO

- Computer Center IHEP
  - Institute of High Energy Physics / Chinese Academy of Sciences
- April 2012 the VO was deployed at Beijing
- Relationship
  - FCPPL France China Particle Physics Laboratory
- Expectation
  - Trend project production (June 2012)





# Activities: Trend project (FCPPL)

- Sino-french collaboration in astronomy
  - NAOC,IHEP (China) & IN2P3/CNRS (France)
- Objective:
  - Participate in the development of the autonomous radiodetection technique
  - Radiodetection of high-energy neutrinos with earth-skimming trajectory



# VO France-Asia Future actions:

- Create iRODS federation between KEK and CC-IN2P3
- Copy of precious Trend data to KEK site
- DIRAC evaluation
- Trend project pre-production
- g-2 project evaluation



# ▶ Preliminary Simulations



- Some test at CC-IN2P3 (Mars and April)  
by Wilfrid DA SILVA LPNHE/IN2P3
- Use g-2Simv0.1 (based on Geant4) provided by U. Kazuki
- Number of events: 20000
- 2 ROOT files generated (1 ROOT file = 10000 events)
- 1 event:
  - CPU = 9.47 HS06 seconds
  - Storage = 7.98 Kbytes



# ▶ Preliminary Simulations



- Global estimation for  $10^{12}$  events
  - CPU = **26389 millions of HS06-hours**
  - Storage = **7.8 Petabytes** (ROOT files)
  - Notes:
    - 1 computer (like used test) = 2 millions of HS06-hours/year
    - The overall Computing Center power is 1200 millions HS06-hours/year
    - Requirements for  $\approx 21$  years of overall CC-IN2P3 power !
  - This requires a grid computer power

# ▶ Preliminary Simulations



## Code Optimization

- Parallelism (multi-core,...)
- I/O Operations
  - Are time expensive
  - Have strong effect on others resources and services: disks, network, data servers, ...
- Code application: algorithms, programming, execution strategies, ...
  - (+) Increase performance – time reduction
  - (-) Considerable effort and/or skill - man power
  - Difficult with complex and legacy software, example: Geant4

# Preliminary Simulations



Process 2667 attached

% time	seconds	usecs/call	calls	errors	syscall
93.07	0.002997	71	42		close ←
4.88	0.000157	4	42		open
2.05	0.000066	0	684		write
0.00	0.000000	0	12		lseek
0.00	0.000000	0	24		rt_sigaction
100.00	0.003220		804		total

Process 2667 attached

```
close(18) = 0 <0.011019>
close(18) = 0 <0.010337>
close(18) = 0 <0.015231>
```

Process 2667 attached

```
open("./currentEvent.rndm", 0_WRONLY|0_CREAT|0_TRUNC, 0666) = 18 <0.000094>
open("./currentEvent.rndm", 0_WRONLY|0_CREAT|0_TRUNC, 0666) = 18 <0.000097>
open("./currentEvent.rndm", 0_WRONLY|0_CREAT|0_TRUNC, 0666) = 18 <0.000073>
open("./currentEvent.rndm", 0_WRONLY|0_CREAT|0_TRUNC, 0666) = 18 <0.000102>
open("./currentEvent.rndm", 0_WRONLY|0_CREAT|0_TRUNC, 0666) = 18 <0.016285>
```

```
$ ls -l ./currentEvent.rndm
```

```
-rw-r--r--. 1 cardenas ccin2p3 40 Apr 24 17:18 ./currentEvent.rndm
```

40 bytes !!!

# Summary



- CC-IN2P3 can provide consulting, resources and services following the IN2P3 policy.
- The VO France-Asia is an available computing grid infrastructure, members KEK and IN2P3.
- This VO is ready to use as testbed, scalability tests and preliminary production.
- Huge computing resources are required, it is necessary to make optimizations.



Thank you

Questions ?

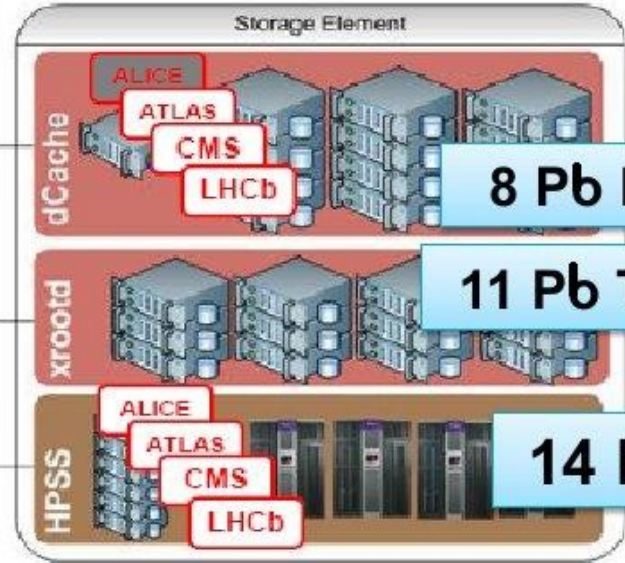
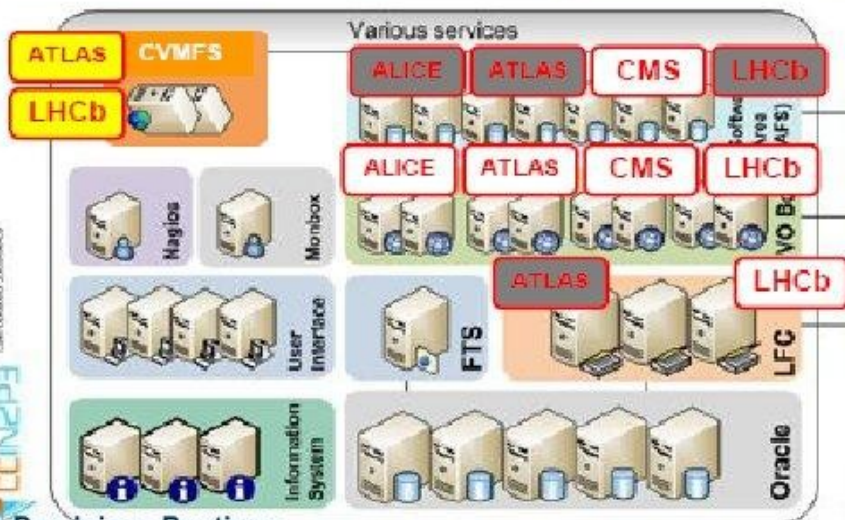
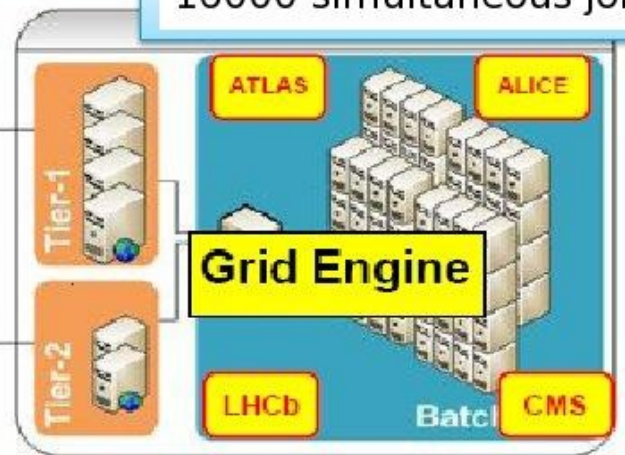
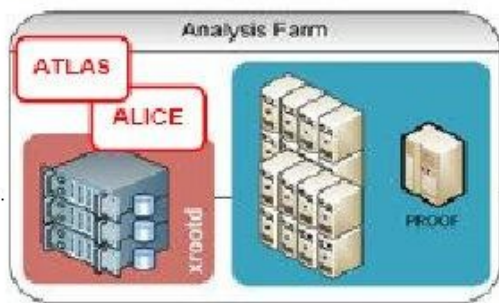
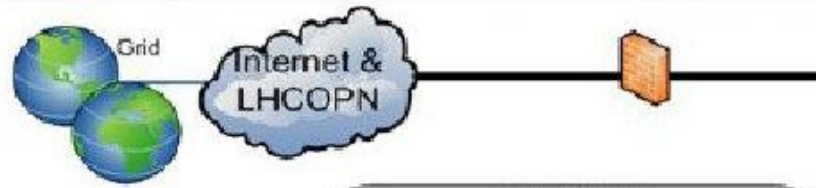




Backup slides



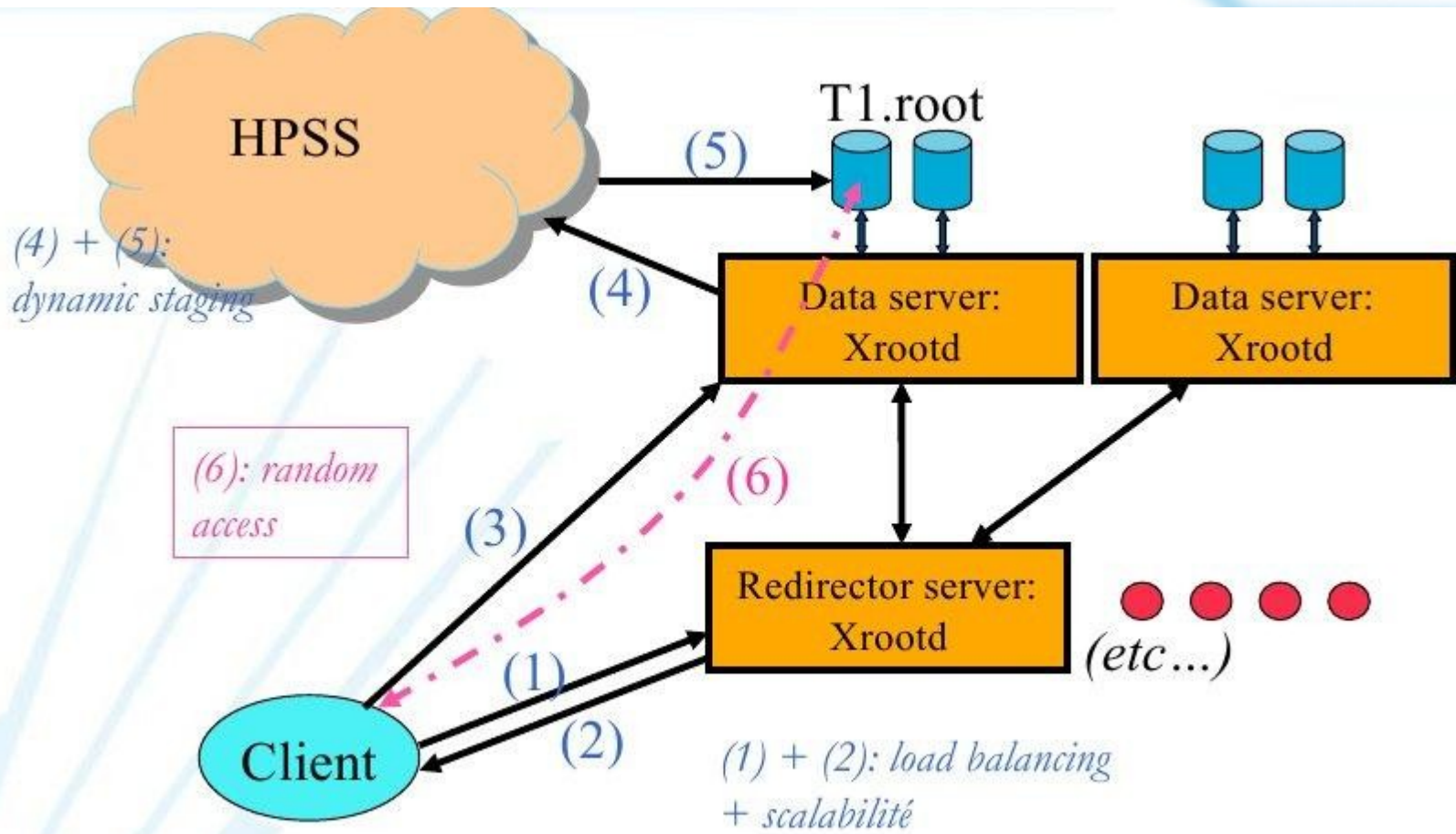
16000 simultaneous jobs



8 Pb LHC

11 Pb Total

14 Pb



/hpss/in2p3.fr/T1.root ?

