dCache, a managed storage in grid

Patrick
for the dCache Team

support and funding by

DESY

NDGF
NORDIC DATAGRID FACILITY

HEP CG
D-GRID

Open Science Grid

VDT
Virtual Data Toolkit

egee
Enabling Grids for E-sciencE

Topics

Project Topology

Why do we need storage elements in the grid world ?

The idea behind the LCG (gLite) storage element.

Available Solutions

The dCache implementation

dCache in a nutshell

Weak points and outlook

Usage

Selected Topics

Project Topology : The Team

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What do we need a grid storage element for ?

We need to serve large amounts of data locally

- Access from local Compute Element
- Huge amount of simultaneously open files.
- Posix like access (What does that mean ?)

We need to exchange large amount of data with remote sites

- Streaming protocols.
- Optimized for low latency (wide area) links.
- Possibly controlling 'link reservation'.

What do we need a grid storage element for ? (cont.)

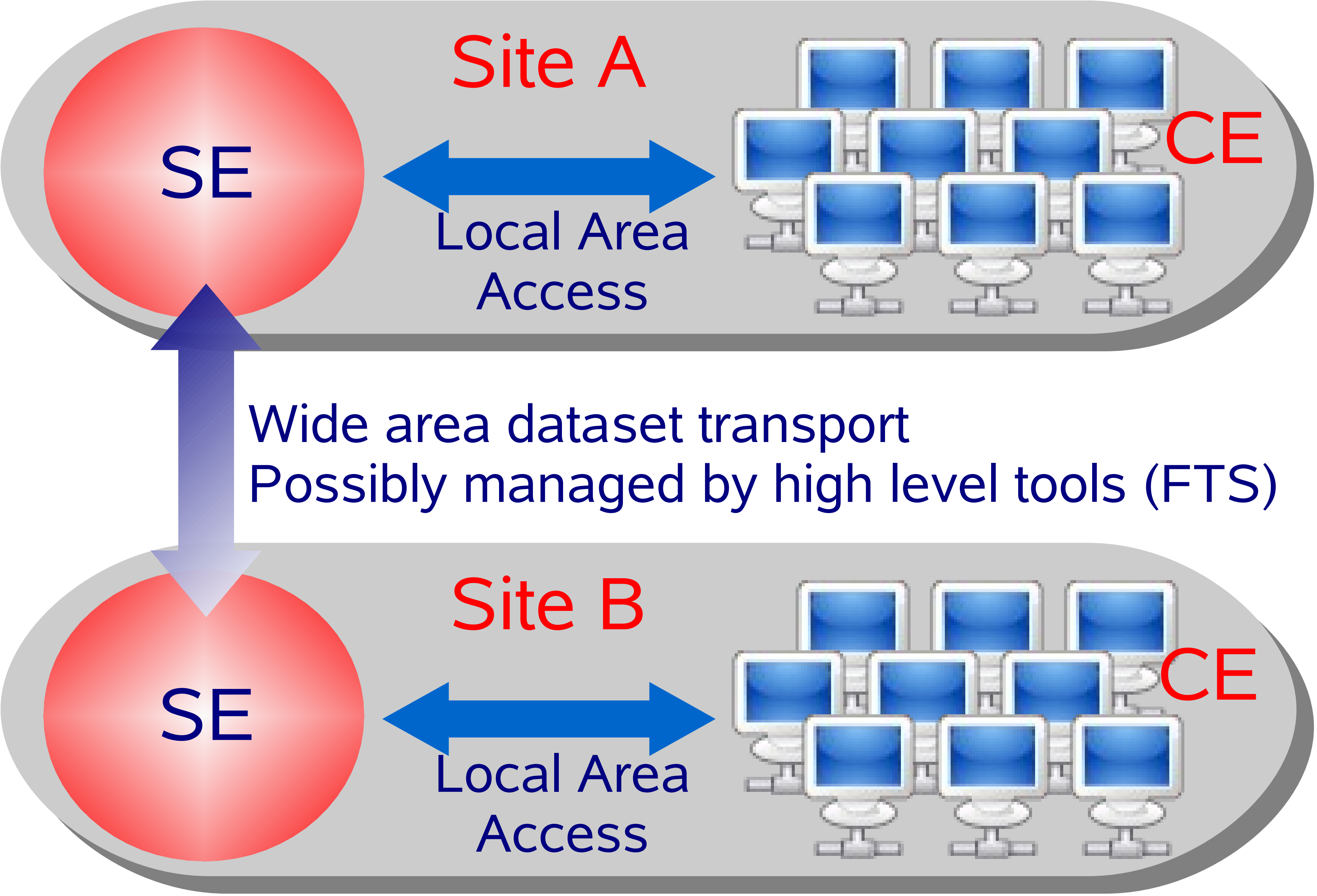
We need to allow storage control

- Space reservation to guarantee maximum streaming.
- Define space properties (TAPE, ONLINE, ...)
- Transport protocol negotiation.

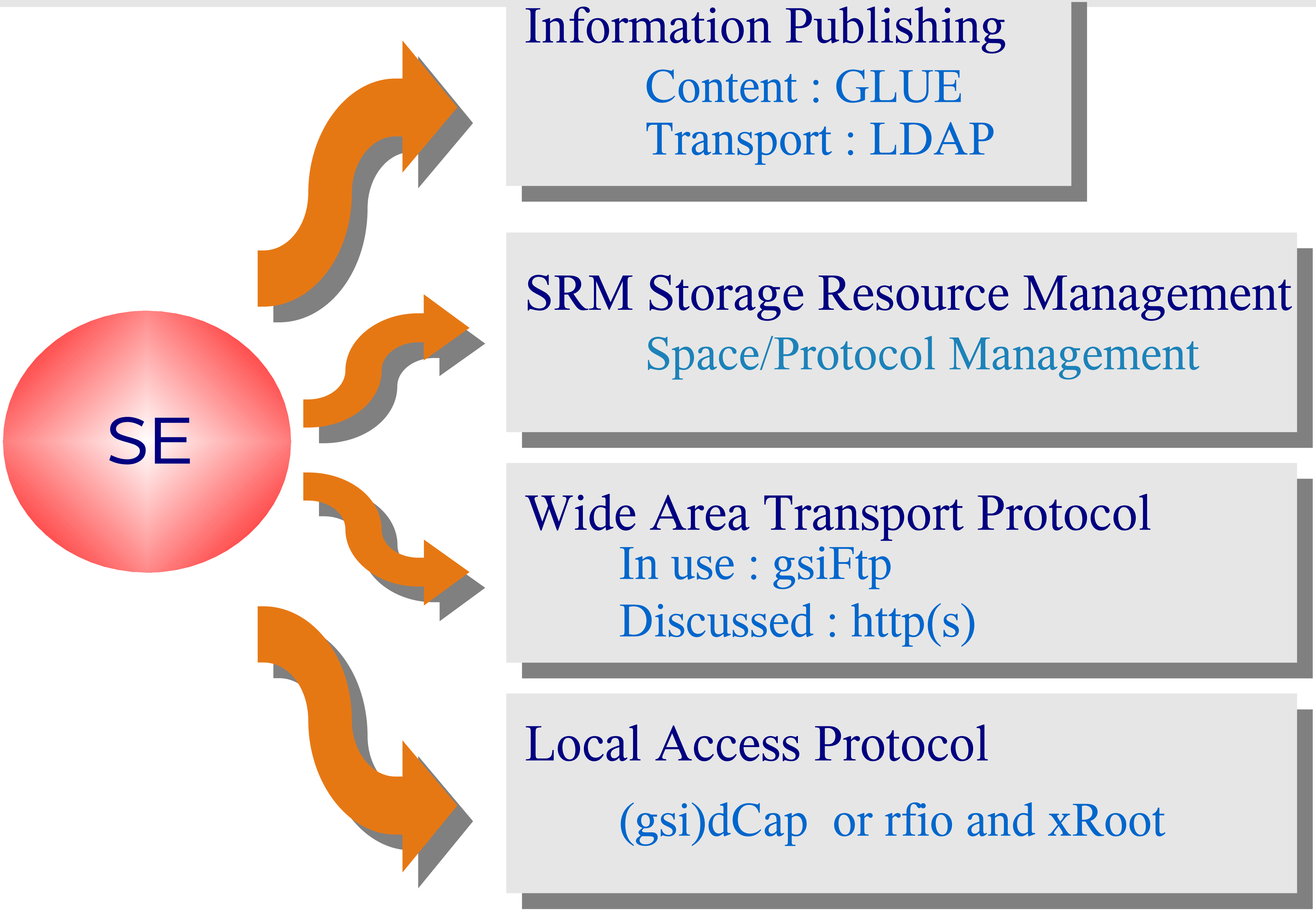
We need to publish SE specific information

- Clients need to select 'best' SE or CE for a job.
- Availability
- Available Space (max, used, free ...)
- Supported Spaces (Tape, disk ...)
- Which VO owns which space ?

The Idea of a Grid Storage Element


Site A
SE
Local Area Access
CE
Wide area dataset transport
Possibly managed by high level tools (FTS)
Site B
SE
Local Area Access
CE

The Idea of a (LCG) Grid Storage Element



SE

Information Publishing

Content : GLUE

Transport : LDAP

SRM Storage Resource Management

Space/Protocol Management

Wide Area Transport Protocol

In use : gsiFtp

Discussed : http(s)

Local Access Protocol

(gsi)dCap or rfio and xRoot

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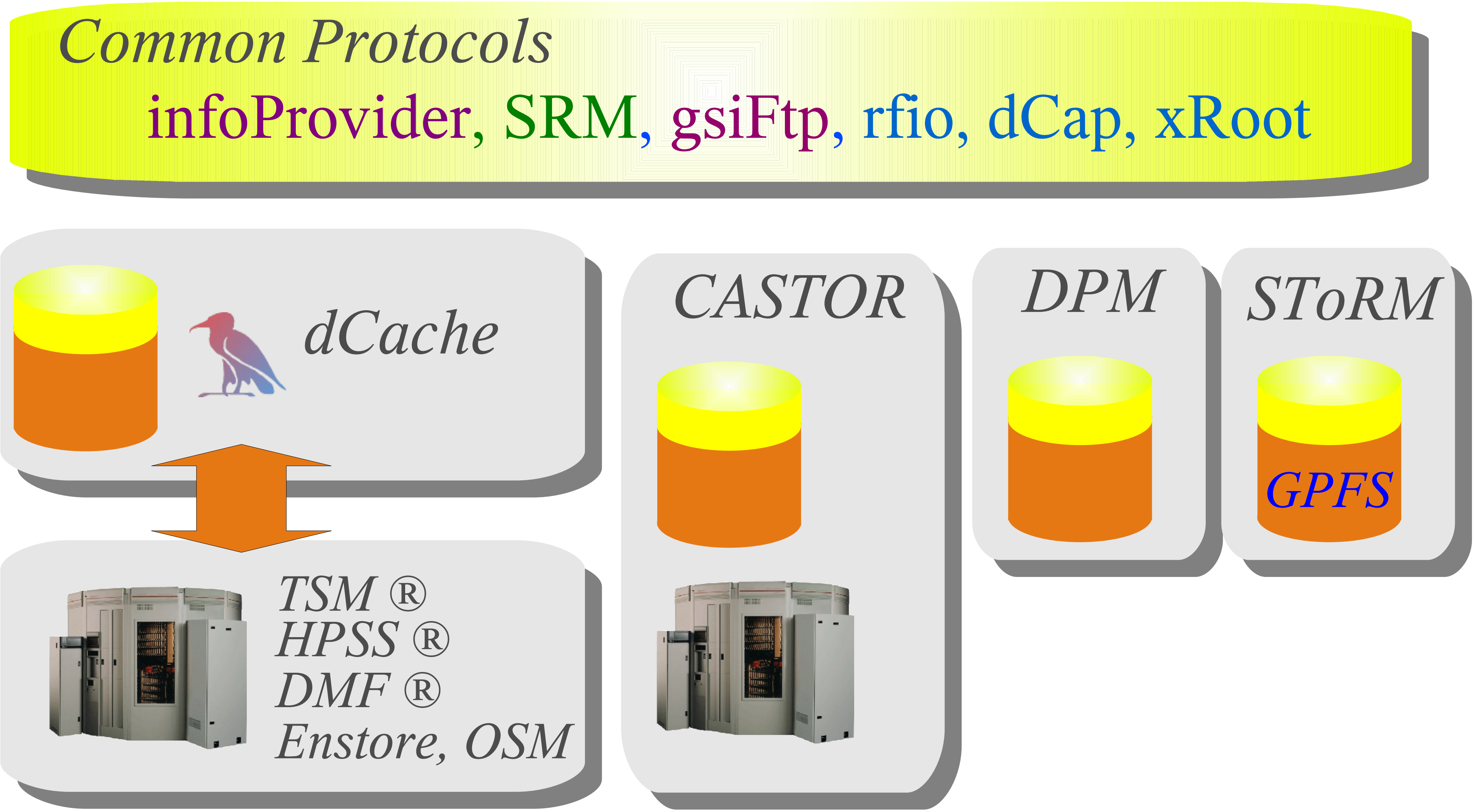
Available Solutions



Common Protocols

infoProvider, SRM, gsiFtp, rfio, dCap, xRoot

dCache

TSM ®
HPSS ®
DMF ®
Enstore, OSM

CASTOR

DPM

SToRM

GPFS

The dCache SE implementation
Black Box View

High Level Services

Resilient Manager

Admin Module (ssh, jpython)

Maintenance Module

Flush Manager

Hopping Manager

dCache Core

Tape Storage

OSM, Enstore
Tsm, Hpss, DMF

Namespace provider

ACLs

Information Protocol(s)

Storage Management Protocol(s)

SRM 1.1 2.2

Data & Namespace Protocols

(NFS 4.1)
ftp (V2)

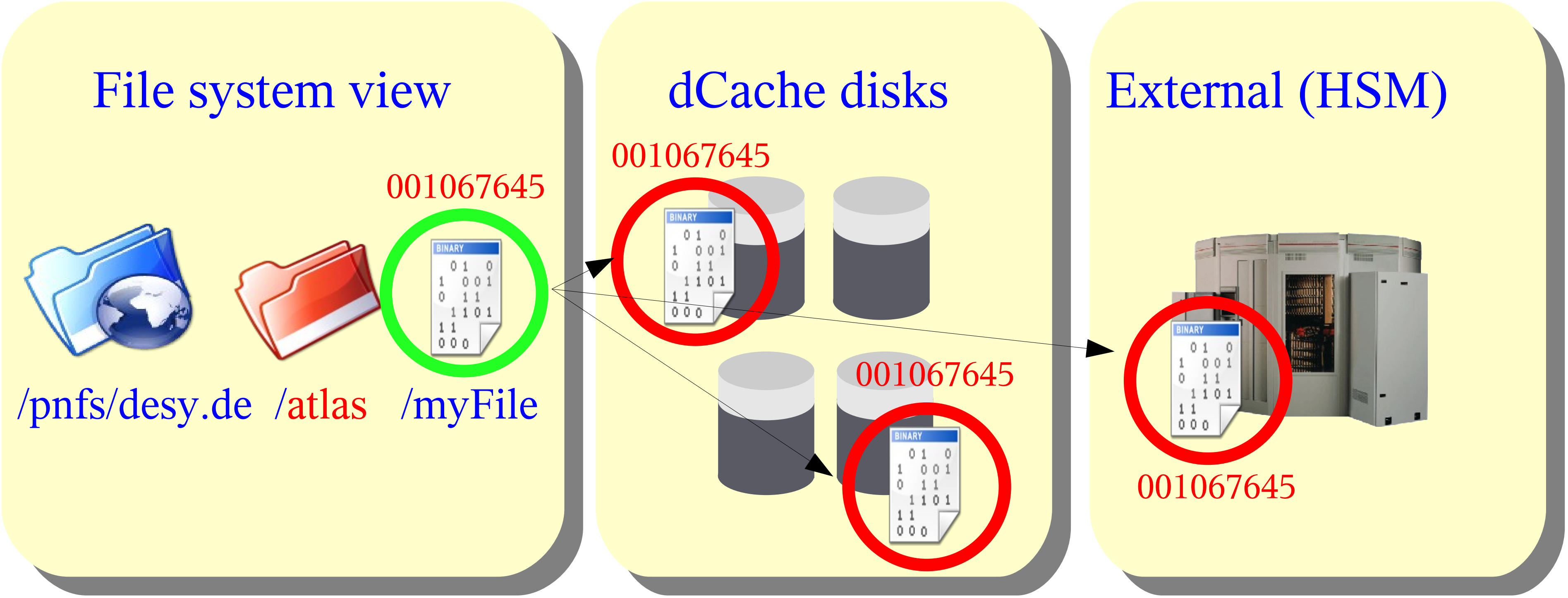
dCap
gsiFtp
xRoot
(http)

Namespace ONLY

NFS 2 / 3

dCache in a Nutshell

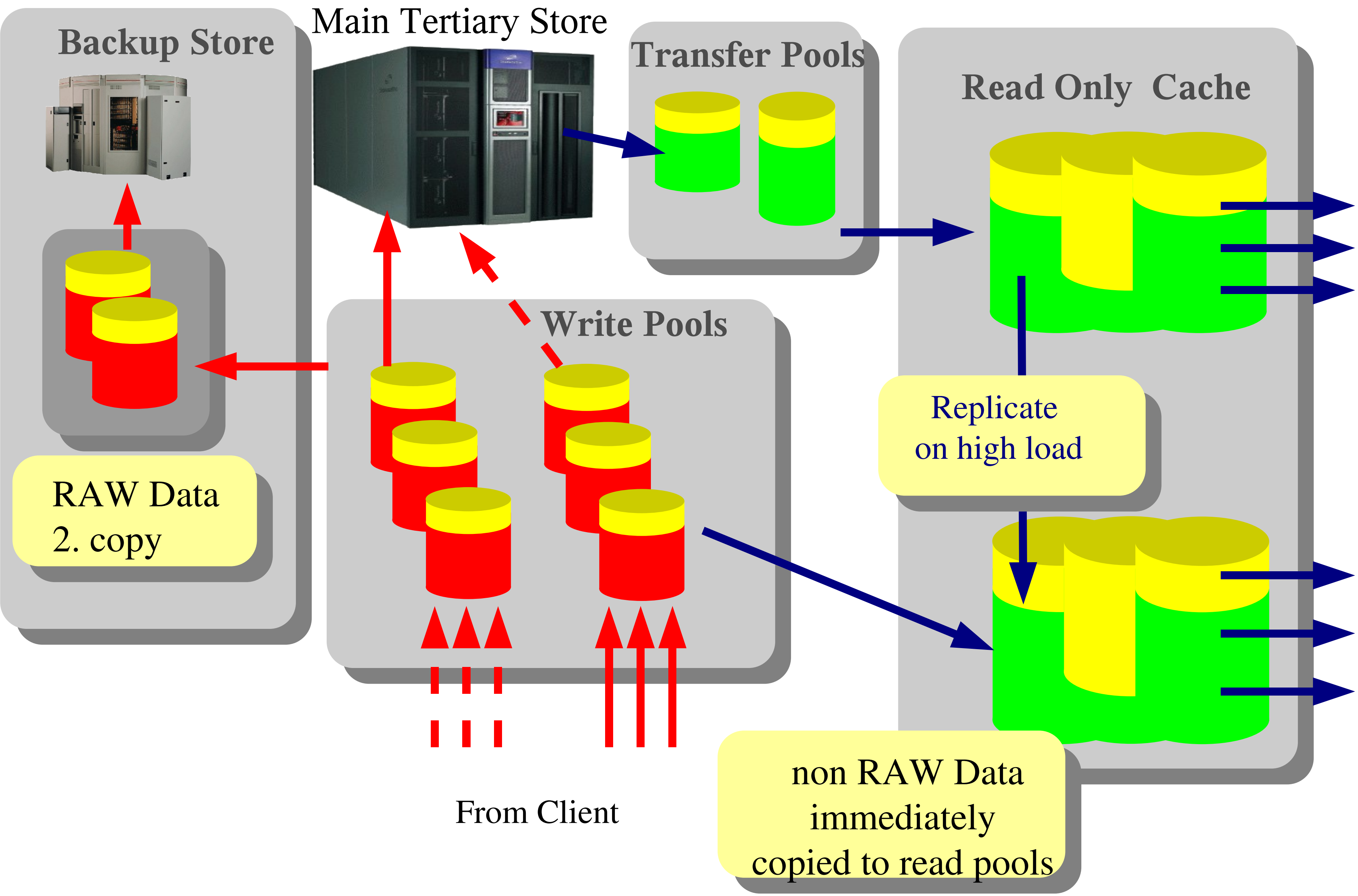
- **Strict name space and data storage separation, allowing**
  - consistent name space operations (mv, rm, mkdir e.t.c)
  - consistent access control per directory resp. file
  - managing multiple internal and external copies of the same file
  - convenient name space management by nfs (or http)



In a Nutshell

- **dCache partitioning for very large installations**
- **File hopping on**
  - automated hot spot detection
  - configuration (read only, write only, stage only pools)
  - on arrival (configurable)

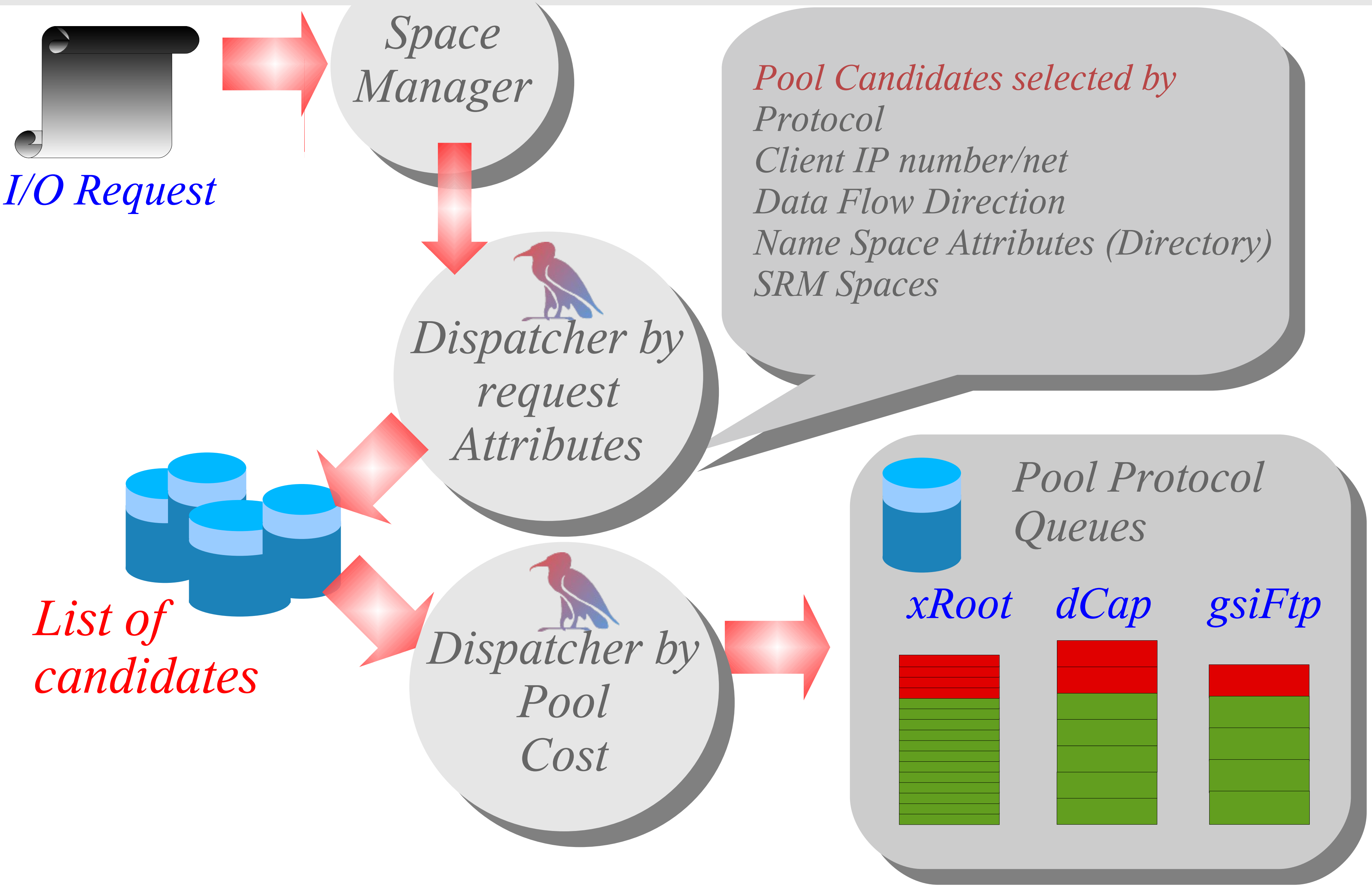
File Hopping



dCache in a Nutshell

- **Overload and meltdown protection**
  - Request Scheduler.
  - Separate I/O queues per protocol (load balancing)
- **Supported protocols : (gsi)ftp , (gsi)dCap, xRoot, SRM, nfs2/3**
- **xRoot support**
  - Vector read
  - Currently working on asyn I/O

Scheduler and I/O queues



I/O Request

Space Manager

Dispatcher by request Attributes

Pool Candidates selected by
Protocol
Client IP number/net
Data Flow Direction
Name Space Attributes (Directory)
SRM Spaces

List of candidates

Dispatcher by Pool Cost

Pool Protocol Queues

xRoot dCap gsiFtp

In the Nutshell

dCache.ORG
dCache.ORG

- **HSM Support**
  - TSM, HPSS, DMF, Enstore, Osm
  - Automated migration and restore
  - Working on Central Flush facility
  - support of multiple, non overlapping HSM systems (NDGF approach)
- **Misc**
  - Graphical User Interface
  - Command line interface
  - Jpython interface
  - SRM watch
  - NEW : Monitoring Plots

Is this useful for non LCG applications ?

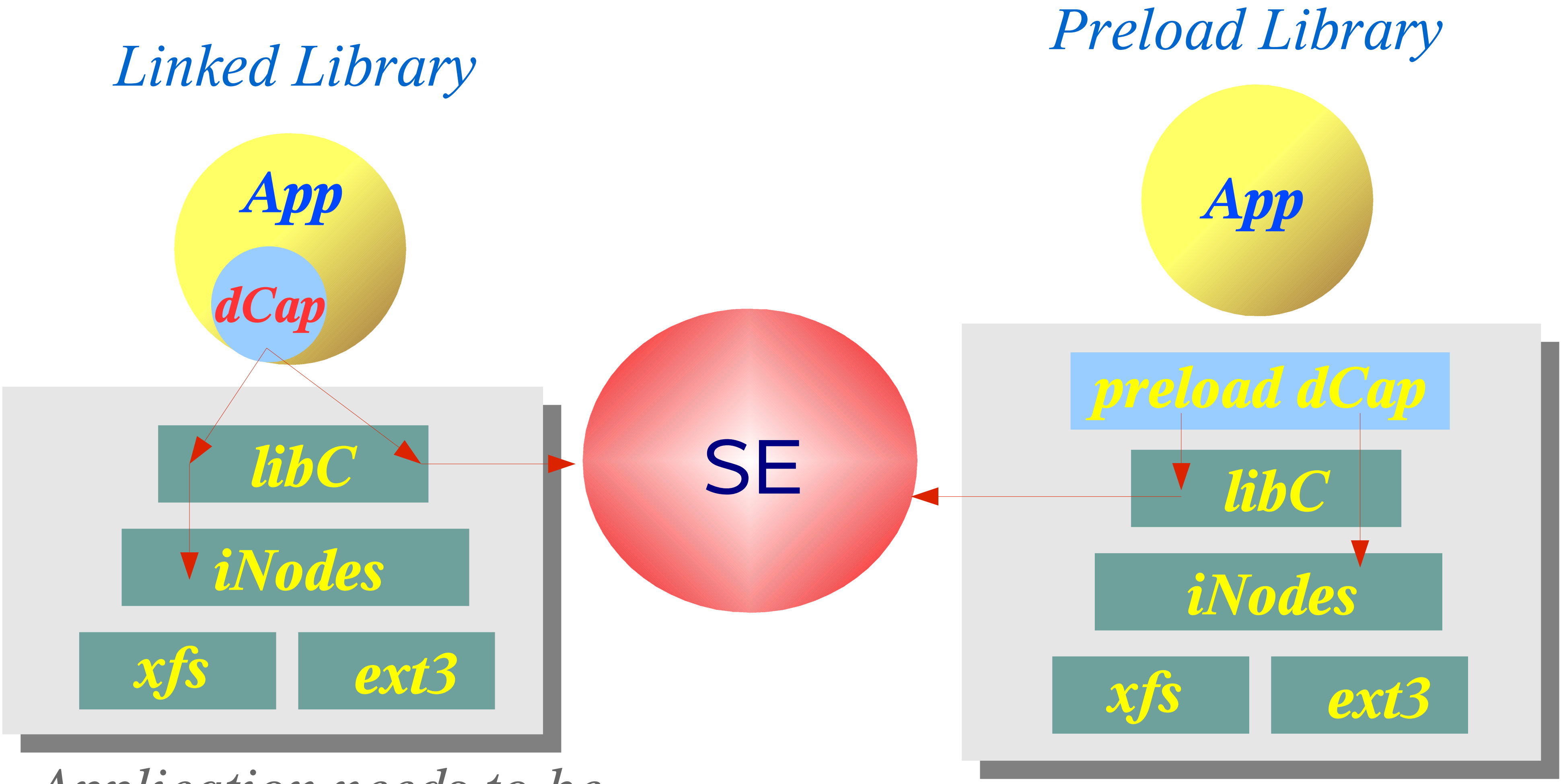
Weak points :

Posix like is NOT posix (file system driver)

Http(s) not really supported

Security might not be sufficient

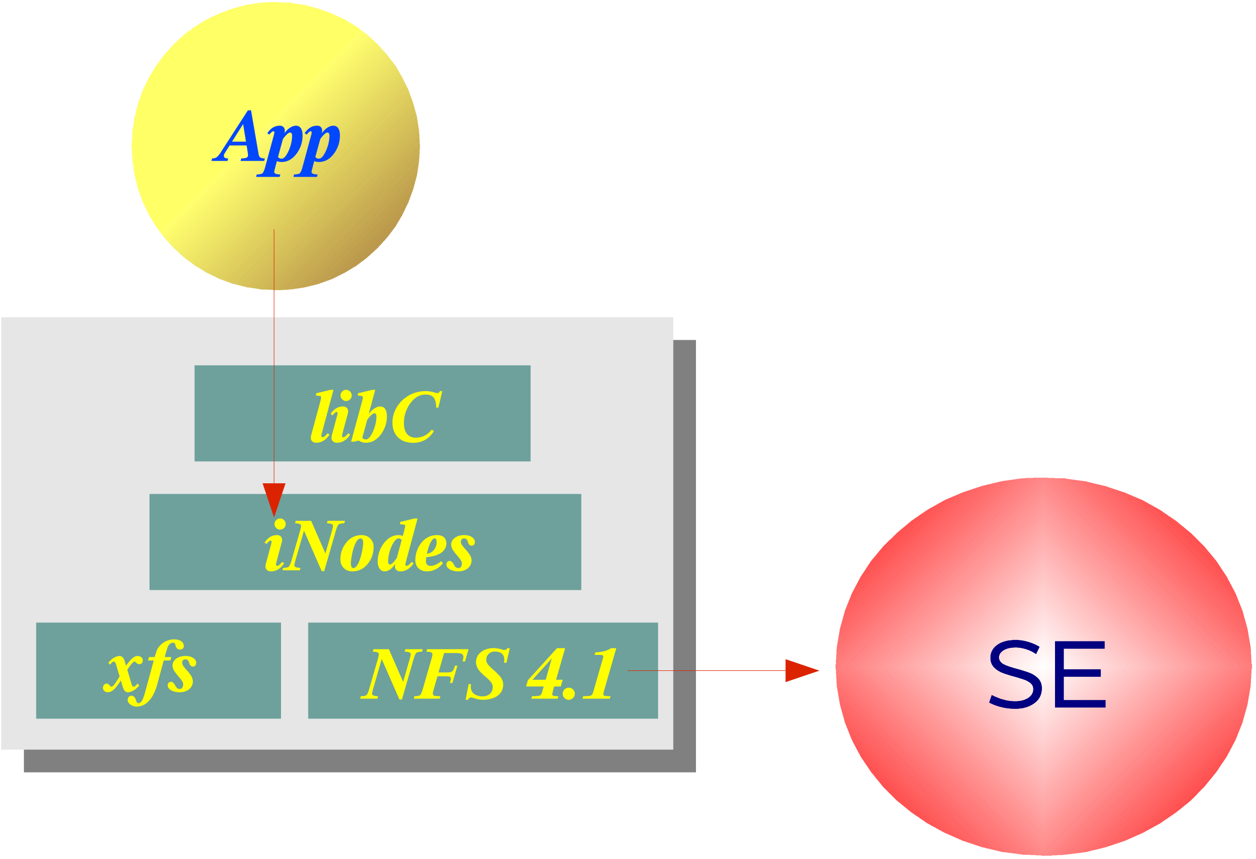
Posix like is NOT posix



Application needs to be linked with the dCap library.

Application stays unchanged but doesn't work in all cases. (Static linked, Some C++ apps.)

And this is real posix



Application doesn't need to be changed.
NFS 4.1 driver comes with OS.

Solution is on the way....

NFS 4.1

We are currently putting significant efforts in the NFS 4.1 protocol

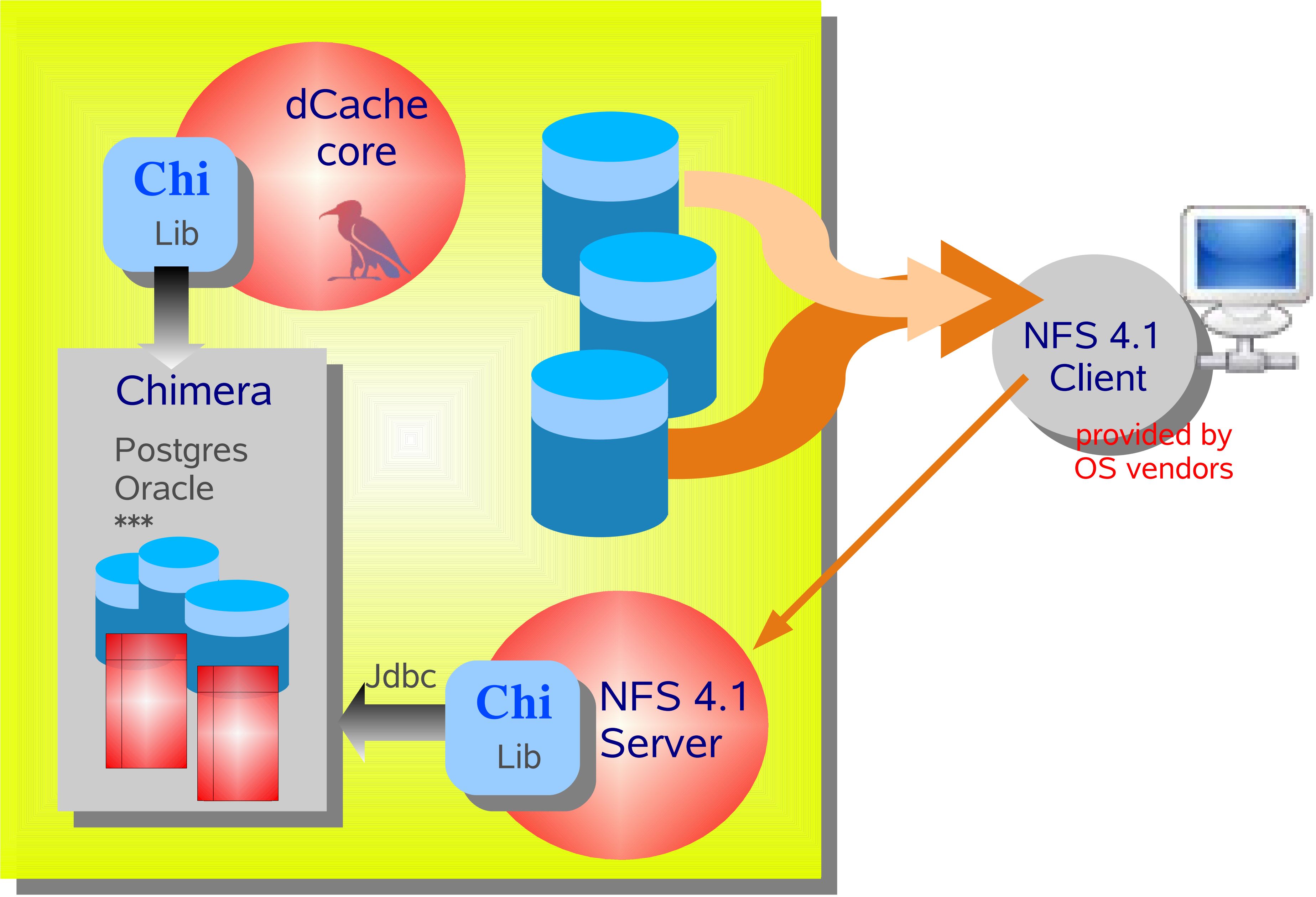
Deployment Advantages :

Clients are coming for free (provided by all major OS vendors).

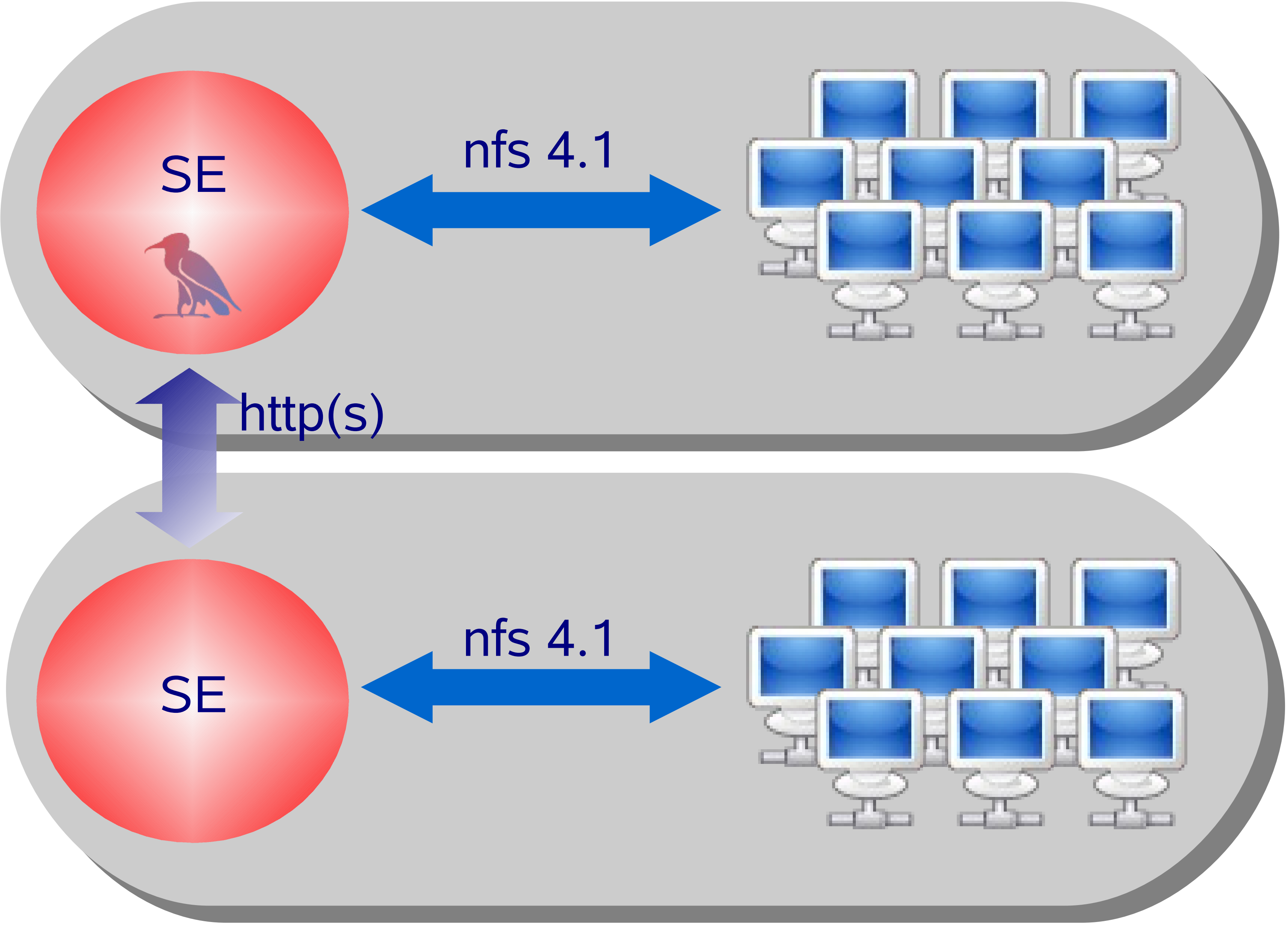
Technical Advantages :

- NFS 4.1 is aware of distributed data
- Faster (optimized) e.g.:
  - Compound RPC calls
  - 'Stat' produces 3 RPC calls in v3 but only one in v4
- GSS authentication
  - Built in mandatory security on file system level
- ACL's
- OPEN / CLOSE semantic (so system can keep track on open files)
- 'DEAD' client discovery (by client to server pings)

NFS 4.1 in dCache



Goal : Industry standards in HEP ?



dCache.ORG
dCache.ORG

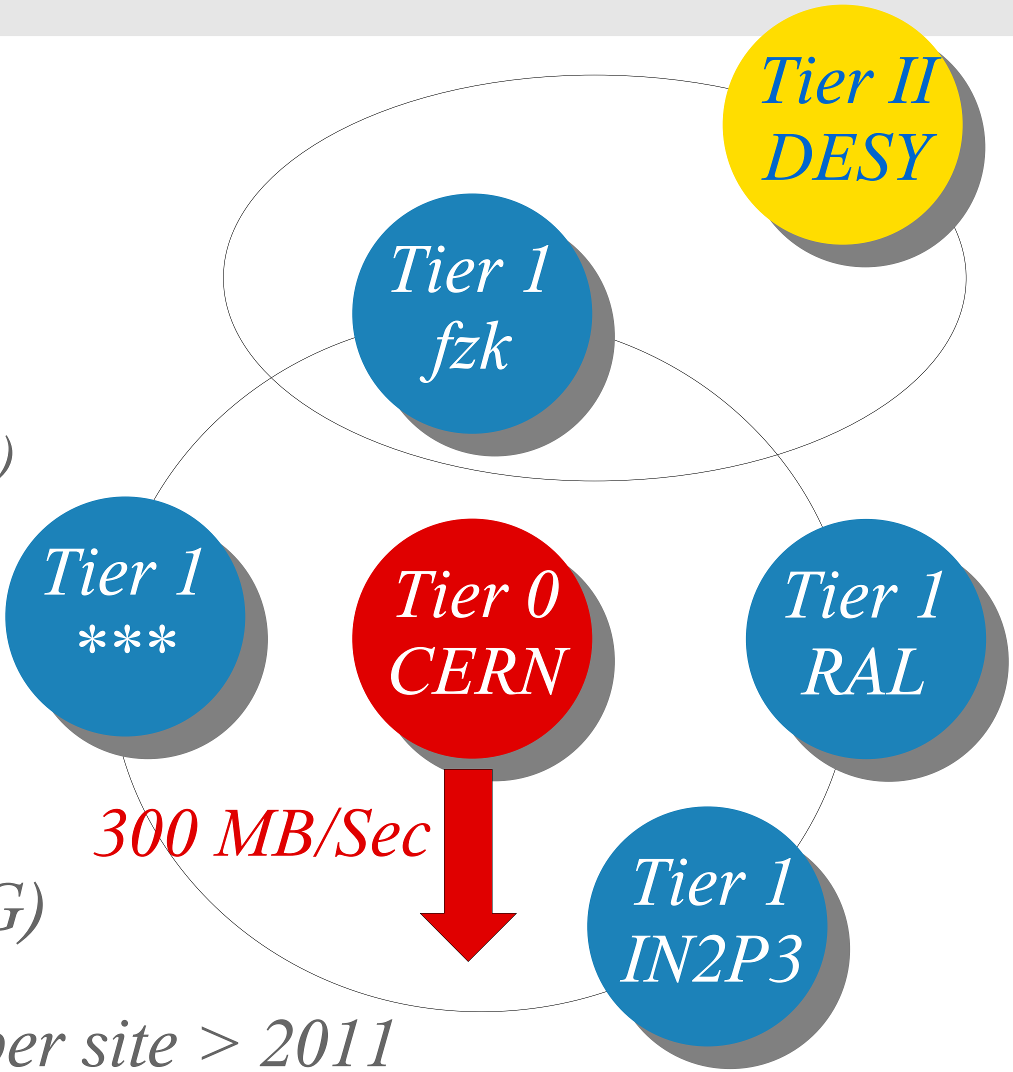
dCache usage

In use at 9 Tier I centers

- fzk (Karlsruhe, GR)
- in2p3 (Lyon, FR)
- RAL (Rutherford, UK)
- BNL (New York. US)
- FERMILab (Chicago, US)
- SARA (Amsterdam. NL)
- PIC (Spain)
- Triumf (Canada)
- NDGF (NorduGrid)

About 40 Tier II's

dCache is part of VDT (OSG)

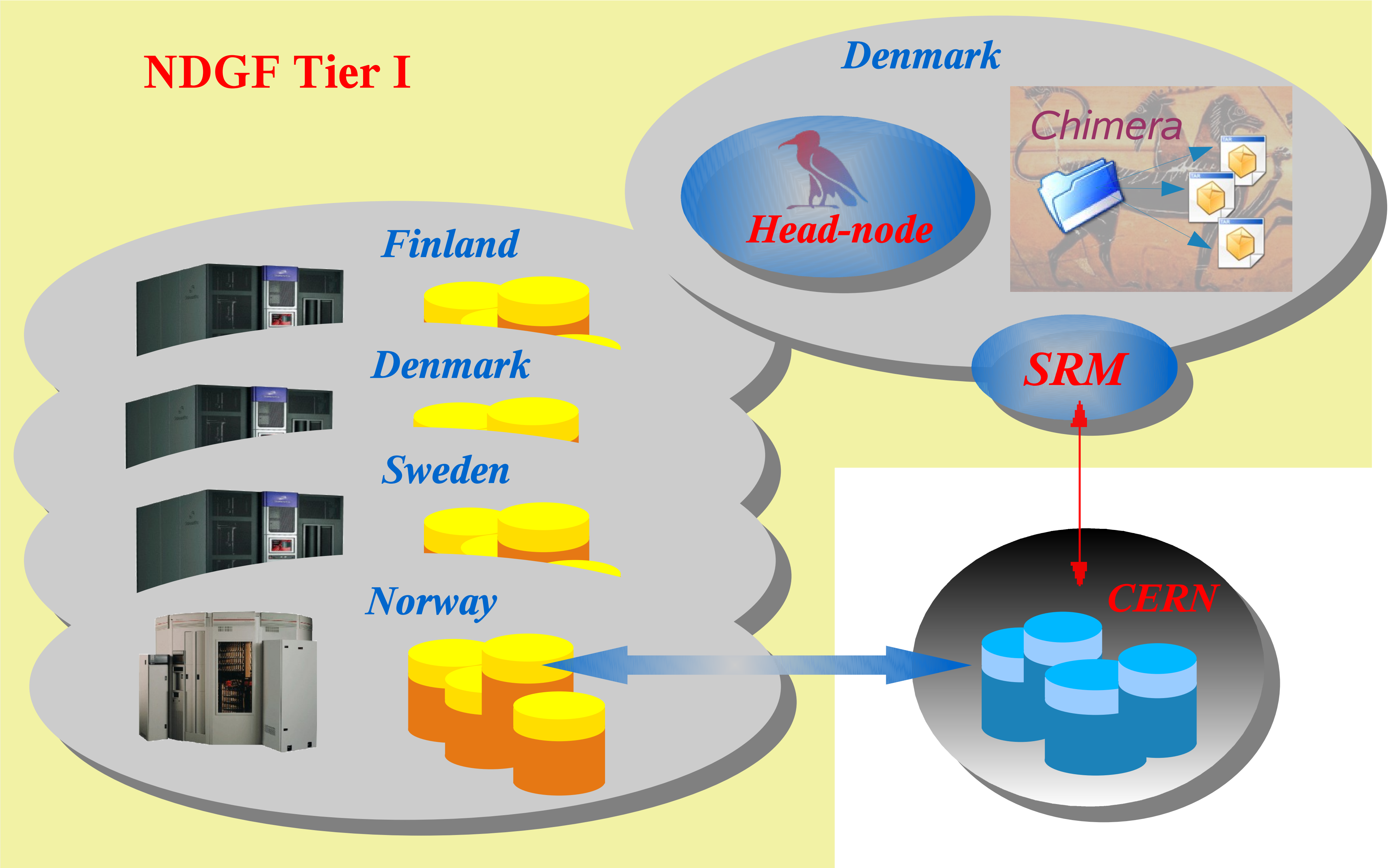


We are expecting > 20 PB per site > 2011

dCache will hold the largest share of the LHC data.

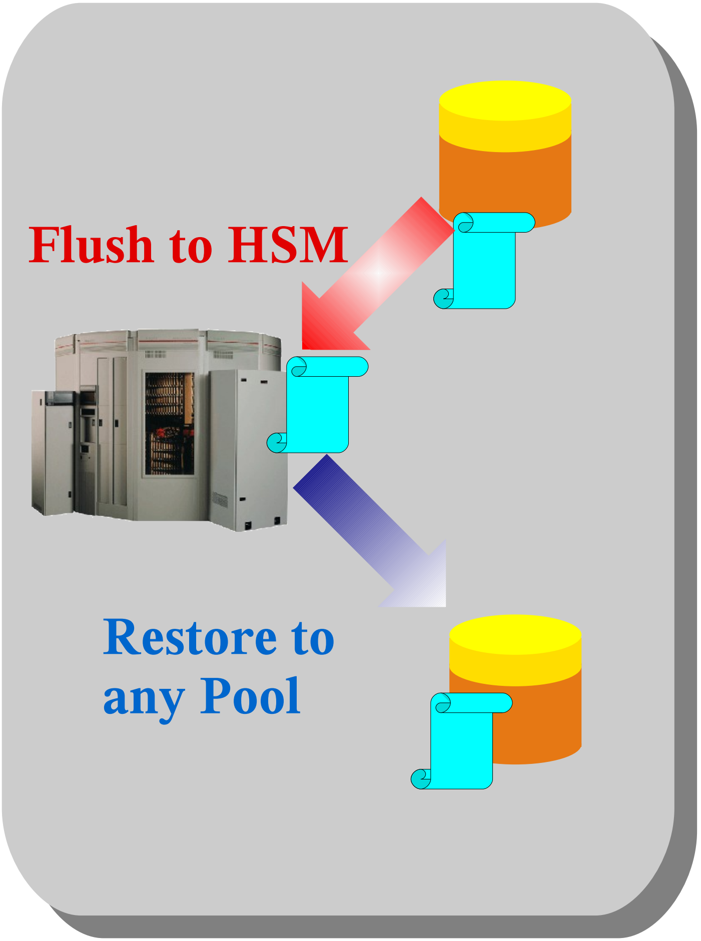
Some more hot topics

The NDGF Challenge : gsiFtp Protocol Version II



The NDGF Challenge : Multi Site HSM support

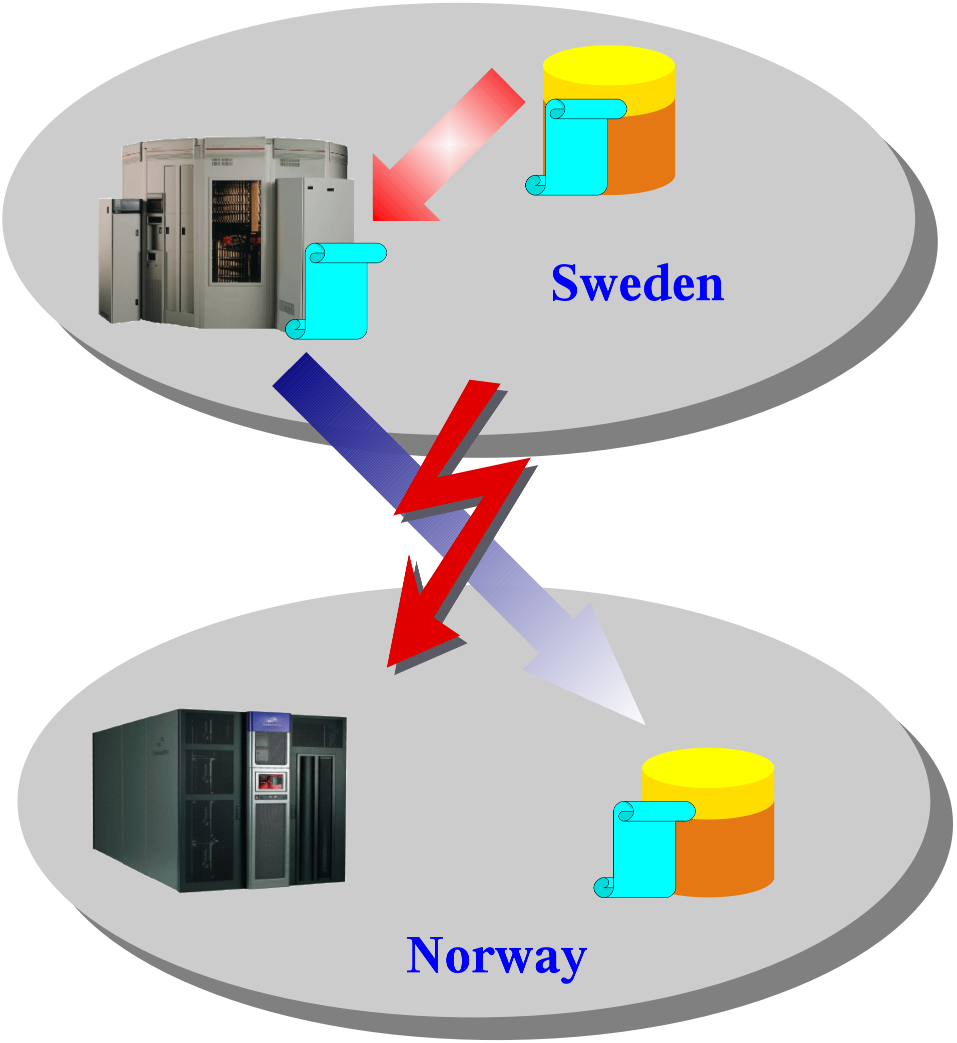
Single Site approach



Flush to HSM

Restore to any Pool

Multi Site approach



Sweden

Norway

Not all pools can access all HSM systems

The wonderful world of

SRM 2.2

Only if there is a lot of time left

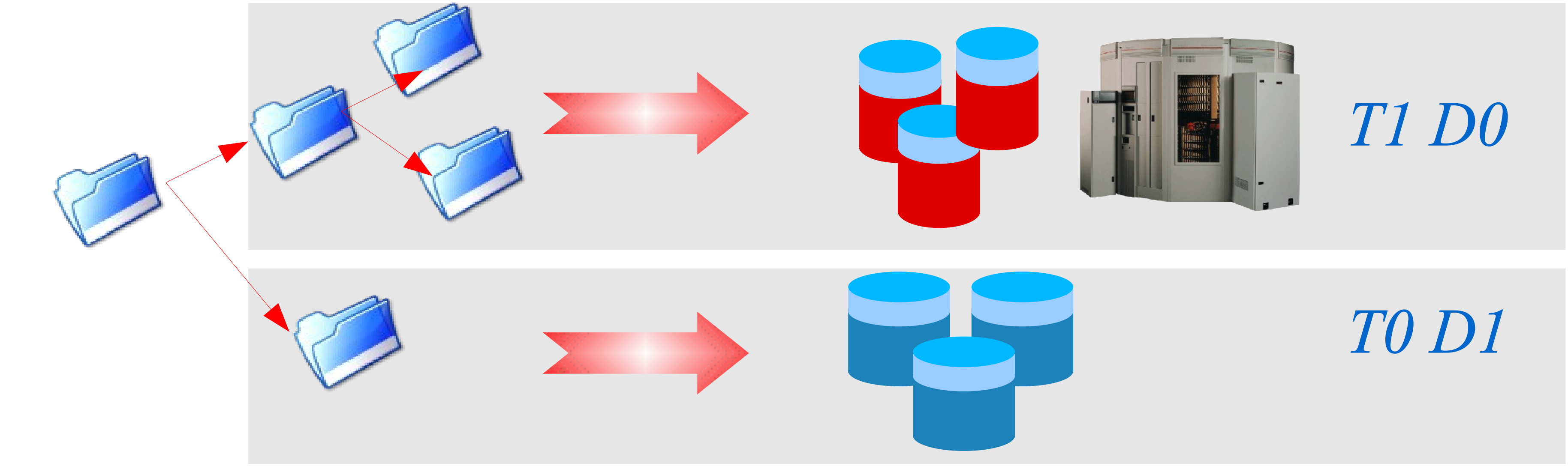
SRM 2.2

The SRM in dCache supports

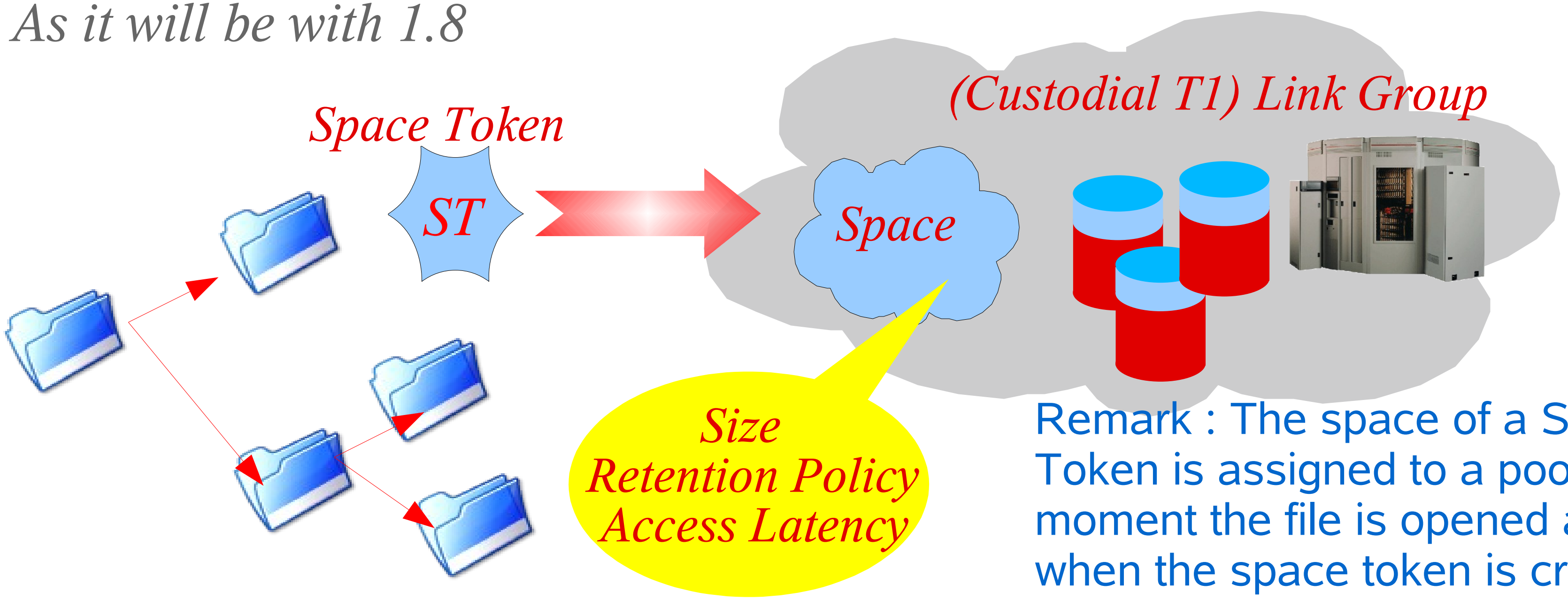
- *CUSTODIAL (T1Dx)*
- *NON-CUSTODIAL (T0D1)*
- *Dynamic Space Reservation*
- *late pool binding for spaces*
- *and more*

SRM 2.2 (The space token)

As it used to be (<= 1.7)



As it will be with 1.8



Remark : The space of a Space Token is assigned to a pool at the moment the file is opened and not when the space token is created.

Further reading

www.dCache.ORG