



# Grid computing, 基本的な環境, ATLAS の資源, Localgroupdisk 等

ATLAS ソフトウェア講習会 2016

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# Overview

- Your Grid environments
  - Lxplus at CERN
  - VMs at Heidelberg
  - Grid UI with Docker in your Linux Box
- Introduction to Grid computing
  - Concepts
  - Certificate Authorities and VOMS
  - Setup CVMFS
  - Grid user interface (CLI) and CVMFS
  - ATLAS Grid computing & WLCG Resources
  - ATLAS Resources
- Links and references

## Your Grid environments



東京大学  
THE UNIVERSITY OF TOKYO



# Lxplus at CERN

- lxplus

```
## If you have a CERN account  
ssh -Y YOUR_CERN_ACCOUNT@lxplus.cern.ch
```

- 東大 UI

- [https://naf-wiki.desy.de/Main\\_Page](https://naf-wiki.desy.de/Main_Page)

```
## If you have a NAF account  
ssh -Y schoolNN@nafhh-atlasMM.desy.de
```



# Grid UI with Docker in your Linux Box - 1

- In RedHat Enterprise 6 (CentOS, Scientific Linux)

## **## Installing Docker (as root)**

```
yum install docker-io
```

## **## You may need a permission (as root)**

```
chown root:dockerroot /var/run/docker.sock  
service docker start
```

## **## Check you are in docker group**

```
uid=500(gen) gid=500(gen) groups=500(gen),489(dockerroot)
```

## **## Make your Docker file**

```
cat Dockerfile
```

```
FROM binet/cvmfs-atlas
```

```
# Replace user, group, uid, gid by your user in a local PC
```

```
RUN export uid=500 gid=500 user=atlas001 group=atlas001 && groupadd $group -g $gid && useradd $user -u $uid -g $gid -d /home/$user -s /bin/bash
```

```
USER atlas001
```

```
ENV HOME /home/atlas001
```

## **## Building Docker container using CVMFS and ATLAS environments**

```
docker build -t atlas-ui .
```

## **## Running Docker container**

```
docker run -it -w /home/atlas001 -v $HOME:/home/atlas001 -v /tmp:/tmp atlas-ui /bin/bash
```



# 概念 - 1

- 物理学では普通使わないテクニカルな用語。ただし覚えておくとたまに役に立つ。
  - User certificate, proxy certificate, CA, Virtual Organization (VO), VOMS, authentication, authorization, Computing Element, Storage Element, Worker nodes, Workload Management System, data management system, Job, data replica, information provider, site



# 概念 - 2

- Grid はどのように動くのか？

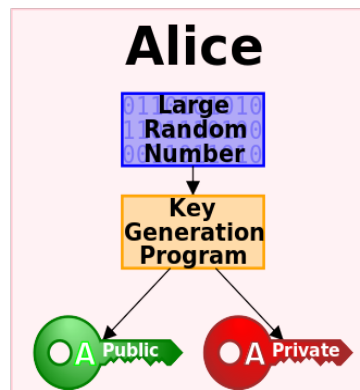
- 基本

- PKI（公開鍵認証インフラ）によるセキュリティ基盤
    - 同時に多人数のユーザーが利用
    - ユーザーの所属、実験等の識別
    - 計算資源のコントロール
    - ディスク資源やデータレプリケーションのコントロール
    - 世界中に分散した計算機の管理
    - ローカルな計算機のインターフェース
    - （例えば DNS のような）Tree 型の情報、計算資源検索
    - 末端ユーザーのためのツール（UI）



# 概念 - 4

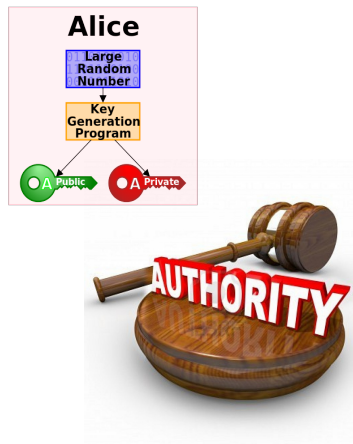
- User certificate, proxy certificate, CA, Virtual Organization (VO), VOMS, authentication, authorization
  - 証明書と認証メカニズム
    - ユーザー証明書の発行
      - 2つの巨大素数  $\rightarrow p$  and  $q$
      - 巨大な積  $N = pq$
      - 秘密鍵 (SK) に  $p + q$  を保存、 $N$  は公開鍵 (PK) として使用



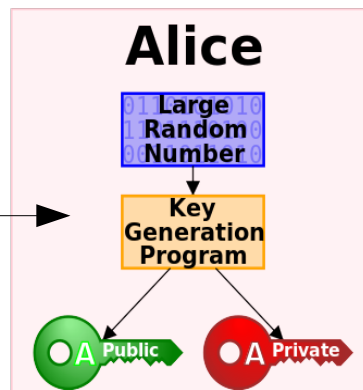


# 概念 - 4

- User certificate, proxy certificate, CA, Virtual Organization (VO), VOMS, authentication, authorization
  - 証明書と認証メカニズム
    - ユーザー証明書は CA によって署名される。
      - 署名 (S) はユーザー秘密鍵と公開鍵と文字列 X からタグ (T) 返す
      - 検証 (V) はユーザー公開鍵と X と T から 1/0 を返す。

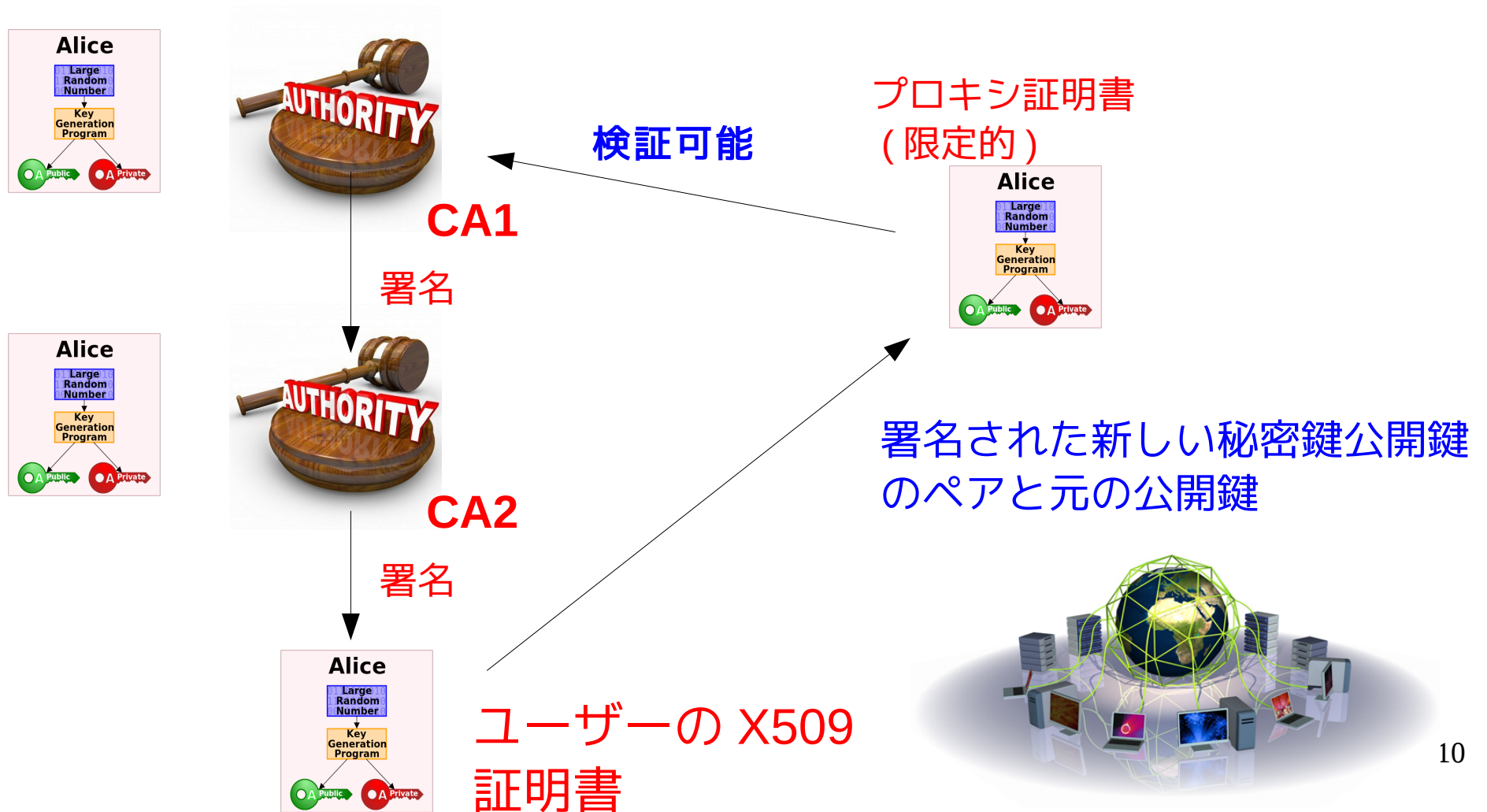


署名と検証



# 概念 - 5

- 新しい一時証明書の発行 = プロキシ証明書



# 概念 - 6

- Virtual Organization (VO), VOMS
  - VOMS 認証方式

認証局 (CA)



署名



署名



VO の要求  
voms-proy-init

ユーザー証明書

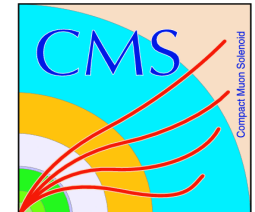
VOMS server

ATLAS VOMS  
CMS VOMS  
LHCb VOMS

VO 拡張フィールドの発行

プロキシ証明書  
= 限定された証明書

VOs



- 全員認証局の証明書の無限連鎖（署名＝売買）
  - デジタル通貨 (Bitcoin)



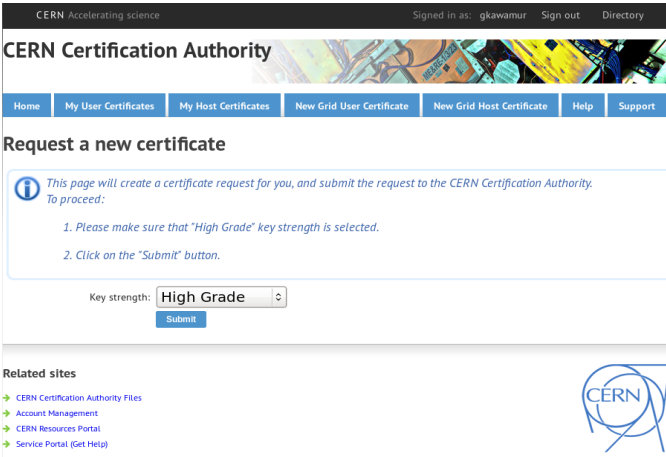
# 認証局と VOMS

- 日本

- <https://gridka-ca.kit.edu/>

- CERN

- <https://ca.cern.ch/ca/user/Request.aspx?template=EE2User>



The screenshot shows the CERN Certification Authority website. At the top, there is a header with the CERN logo and the text 'CERN Accelerating science'. Below this, there is a navigation bar with links: 'Home', 'My User Certificates', 'My Host Certificates', 'New Grid User Certificate', 'New Grid Host Certificate', 'Help', and 'Support'. The main content area is titled 'Request a new certificate'. It contains an information icon and a message: 'This page will create a certificate request for you, and submit the request to the CERN Certification Authority. To proceed:'. Below this, there are two numbered instructions: '1. Please make sure that "High Grade" key strength is selected.' and '2. Click on the "Submit" button.' There is a dropdown menu for 'Key strength' with 'High Grade' selected, and a 'Submit' button. At the bottom, there is a section for 'Related sites' with links to 'CERN Certification Authority Files', 'Account Management', 'CERN Resources Portal', and 'Service Portal (Get Help)'. The CERN logo is also visible in the bottom right corner.

# 認証局と VOMS

- VOMS top page
  - <https://voms2.cern.ch:8443/>
- VOMS ATLAS (ATLAS VO の要求 )
  - <https://voms2.cern.ch:8443/voms/atlas>
- VOMS ATLAS ユーザー
  - <https://voms2.cern.ch:8443/voms/atlas/services/VOMSCompatibility?method=getGridmapUsers&container=/atlas>



# CVMFS の設定

- 個人的な好み
  - ~/.bashrc などを書いておくと便利

```
## Alias to initialization of VOMS proxy
alias vinit='voms-proxy-init --voms atlas -hours 200 --valid 200:00'

## Alias to setupCVMFS
setupCVMFS(){
  export LCG_LOCATION=
  export ATLAS_LOCAL_ROOT_BASE=/cvmfs/atlas.cern.ch/repo/ATLASLocalRootBase
  source $ATLAS_LOCAL_ROOT_BASE/user/atlasLocalSetup.sh ""

  ## Using EMI LCG package
  source ${ATLAS_LOCAL_ROOT_BASE}/packageSetups/atlasLocalEmiSetup.sh --emiVersion ${emiVersionVal}
}

setupATLAS(){
  export ATLAS_LOCAL_ROOT_BASE=/cvmfs/atlas.cern.ch/repo/ATLASLocalRootBase
  source $ATLAS_LOCAL_ROOT_BASE/user/atlasLocalSetup.sh ""
}

## Using CVMFS (with EMI LCG client tools)
SetupCVMFS

## Using ATLAS env
setupATLAS
```



# ユーザー証明書

- ユーザー証明書の取得

```
## Check important environment variables for your certificate  
env | grep X509
```

```
## Generating a proxy certificate  
export X509_USER_CERT=~/.globus/usercert.pem  
export X509_USER_KEY=~/.globus/userkey.pem
```

```
## Generate user certificate  
## (usercert.p12 was already exported by your browser)  
openssl pkcs12 -clcerts -nokeys -in usercert.p12 -out $X509_USER_CERT
```

```
## create a private certificate with passphrase  
openssl pkcs12 -nocerts -in usercert.p12 -out $X509_USER_KEY
```

```
## Set permissions  
chmod 644 $X509_USER_CERT  
chmod 400 $X509_USER_KEY
```

```
## show enddate  
openssl x509 -in $X509_USER_CERT -noout -enddate
```

```
## show if the certificate is valid  
openssl verify -CApath $X509_CERT_DIR -purpose sslclient $X509_USER_CERT
```



# プロキシ証明書

- プロキシ証明書と簡単な検証

## **## Generating a proxy**

**vinit**

Enter GRID pass phrase for this identity:

Contacting voms2.cern.ch:15001 [/DC=ch/DC=cern/OU=computers/CN=voms2.cern.ch] "atlas"...

Remote VOMS server contacted succesfully.

voms2.cern.ch:15001: The validity of this VOMS AC in your proxy is shortened to 345600 seconds!

## **## Generating a proxy certificate without VO**

**grid-proxy-init**

**voms-proxy-info -all**

# (it displays information without VO attributes)

## **## Generating a proxy certificate with VO (a normal use)**

**voms-proxy-init --voms atlas -hours 200**

**voms-proxy-info -all**

# (it displays information with VO attributes)

## **## Using another role (if you have another)**

**voms-proxy-init -voms atlas:/atlas/de/Role=production**

**voms-proxy-info -all**

# プロキシ証明書の検証

- 中身を見てみましょう

```
## Check context of your certificate
## The proxy certificate has 3 fields (PK, New PK, New SK)
less /tmp/x509up_u$UID | grep '\-'

-----BEGIN CERTIFICATE-----
-----END CERTIFICATE-----
-----BEGIN RSA PRIVATE KEY-----
-----END RSA PRIVATE KEY-----
-----BEGIN CERTIFICATE-----
-----END CERTIFICATE-----

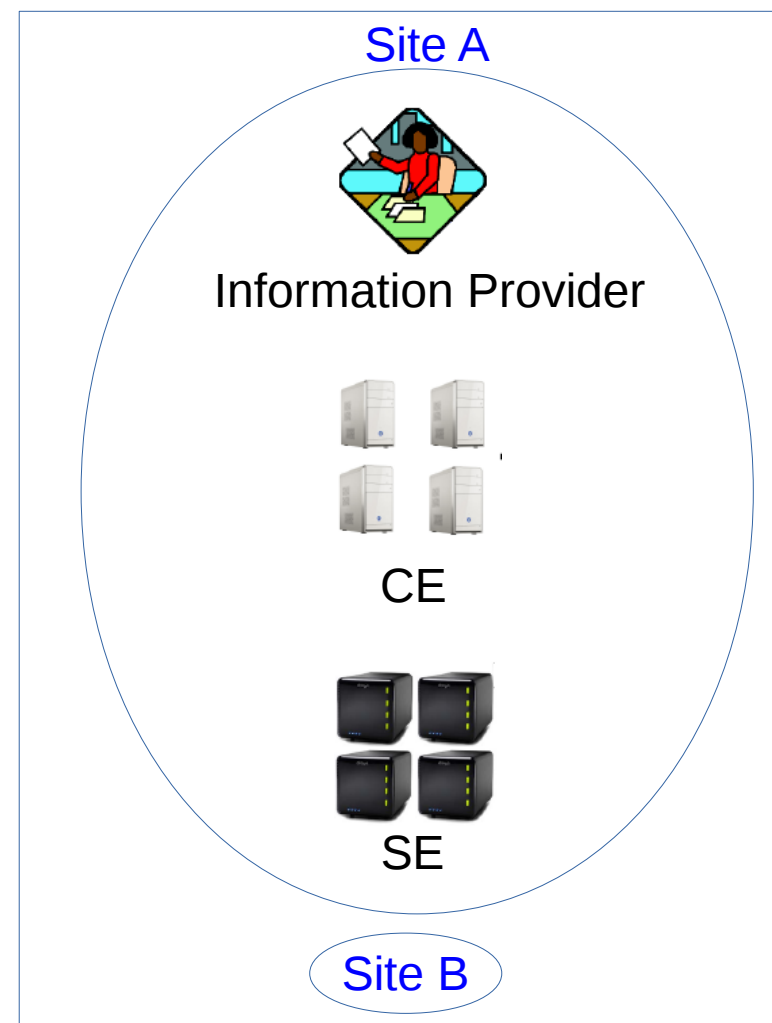
## Check X509 attribute
openssl x509 -in /tmp/x509up_u$UID -text | less

## Using a different proxy certificate
## (switch them if you have several ones)
mv -v /tmp/x509up_u$UID /tmp/x509_different_cert
export X509_USER_PROXY=/tmp/x509_different_cert
voms-proxy-info -all
```

# ATLAS ジョブとデータ



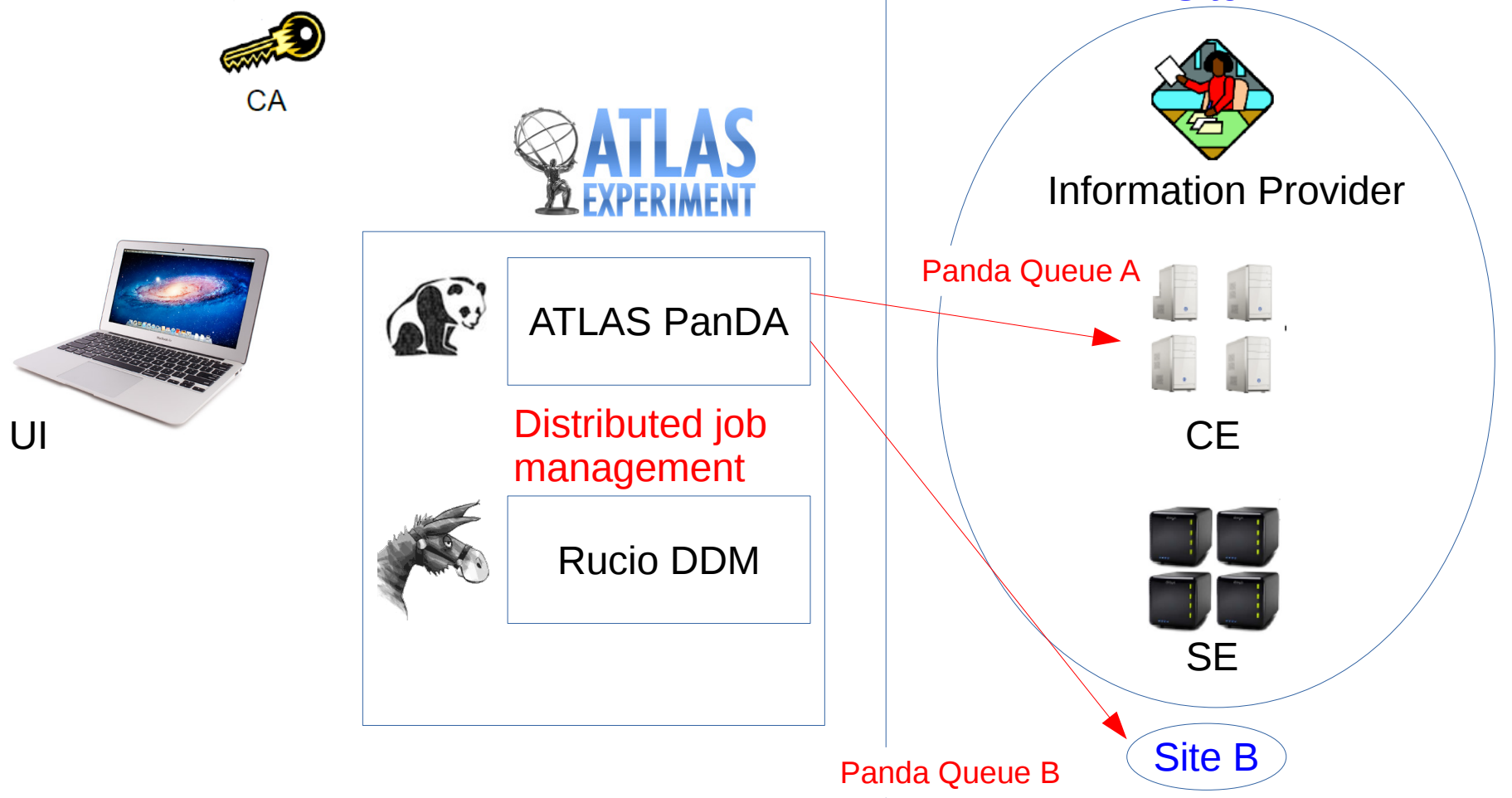
- あくまで概略



# ATLAS ジョブとデータ



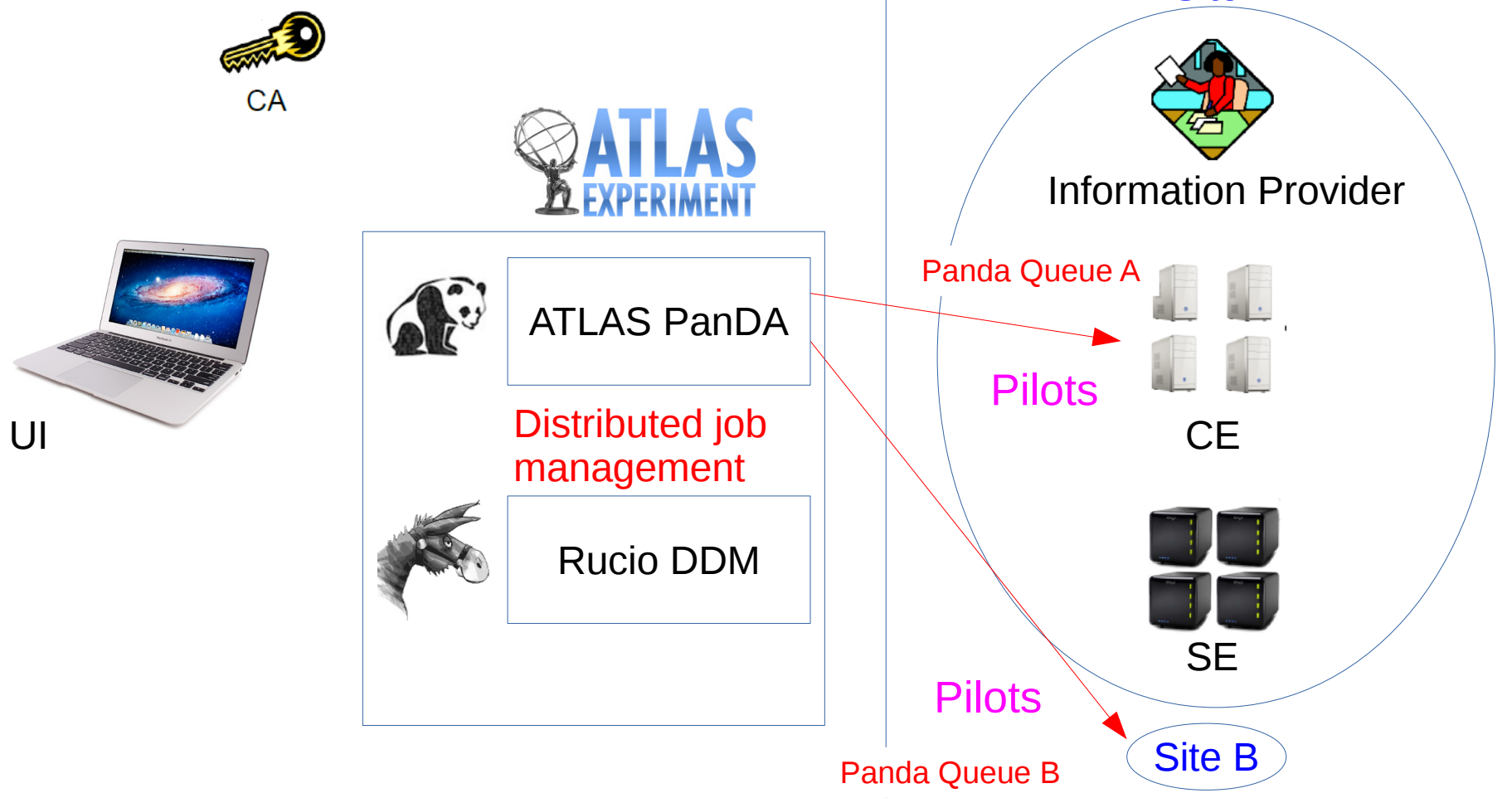
- あくまで概略



# ATLAS ジョブとデータ



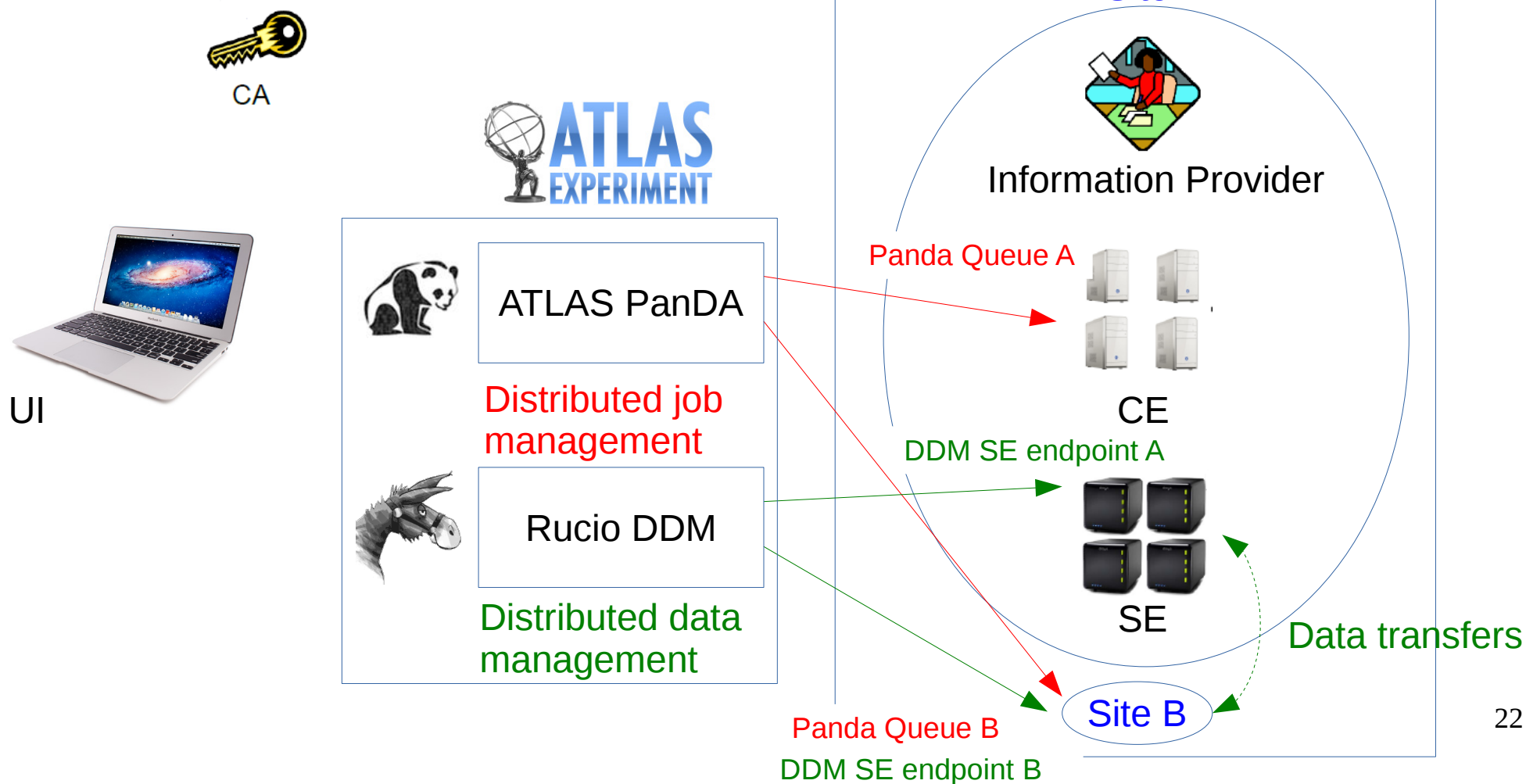
- あくまで概略



# ATLAS ジョブとデータ



- あくまで概略



# ATLAS Resources - 1

- AGIS (ATLAS Grid Information Sysgtem)
  - <http://atlas-agis.cern.ch/agis/>

ATLAS Grid Information System			
<a href="#">RC Site</a> <a href="#">ATLASSite</a> <a href="#">DDMEndpoint</a> <a href="#">PANDA Queue</a> <a href="#">Service</a> <a href="#">Central Services</a> <a href="#">DDM Groups</a>			<a href="#">Docs</a> <a href="#">TWiki</a> <a href="#">OLD</a>
TOPOLOGY MANAGEMENT	SERVICE MANAGEMENT	OPERATIONS	DOCUMENTATION
<ul style="list-style-type: none"> <li>Define RC site</li> <li>Define Experiment site</li> <li>Define DDM endpoint</li> <li>Define OS RSE endpoint (new implementation)</li> <li>Define PANDA site</li> <li>Define PANDA queue</li> <li>RC pledges</li> <li>Find DDM endpoints links</li> <li>Find TransferMatrix links</li> </ul>	<ul style="list-style-type: none"> <li>Define OS service</li> <li>Define LFC service</li> <li>Define SE service</li> <li>Define CE service</li> <li>Define Redirector service</li> <li>Define PerfSonar service</li> <li>Define Frontier service</li> <li>Define Squid service</li> <li>Define Central service</li> <li>SE protocols (DDM/Panda activities)</li> </ul>	<ul style="list-style-type: none"> <li>Crons list</li> <li>ADMINS list</li> <li>Changes log</li> <li>Request ADMIN privileges</li> </ul>	<ul style="list-style-type: none"> <li>Main TWiki</li> <li>TWiki WEBUI instructions</li> <li>API Docs</li> </ul>
DOWNTIMES	TOACACHE EXPORT	COMPARISON & VALIDATION TOOLS	
<ul style="list-style-type: none"> <li>Downtime caledar</li> <li>DDM Blacklisting data</li> <li>PANDA Blacklisting data</li> </ul>	<ul style="list-style-type: none"> <li>dynamic ToACache (changes are immediately propagated): <a href="http://atlas-agis-api.cern.ch/request/toacache/TiersOfATLASCache.py">http://atlas-agis-api.cern.ch/request/toacache/TiersOfATLASCache.py</a></li> <li>static ToACache: <a href="http://atlas-agis-api.cern.ch/ToACache/TiersOfATLASCache.py">http://atlas-agis-api.cern.ch/ToACache/TiersOfATLASCache.py</a></li> <li>previous caches: <a href="http://atlas-agis-api.cern.ch/ToACache/cache/">http://atlas-agis-api.cern.ch/ToACache/cache/</a></li> <li>View/Modify ToACache ExtraData (RSE integration)                             <ul style="list-style-type: none"> <li>ToACache with Extra data</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Consistency checker</li> <li>ToAComparator</li> <li>AGIS-BDII CE comparison</li> <li>AGIS-Schedconf-PF mon CE comparison</li> <li>AGIS-OIMGOCDB sites+services comparison</li> <li>AGIS-PANDA PandaResource+SWReleases comparison</li> <li>AGIS-Schedconfig (topology) comparison</li> <li>AGIS-Schedconfig JSON comparison</li> <li>AGIS-GSR services comparison</li> </ul>	

# ATLAS Resources - 2

- PanDA queue end points

ATLAS Grid Information System

RC Site ATLASite DDMEndpoint **PANDA Queue** Service Central Services DDM Groups PandaQueue combined resources Docs TWiki OLD JSON

Show 200 entries First Previous 1 Next Last

give me url of this page hold shift + click column for Multi-column ordering

VO name	ATLAS Site	PanDA Site	Template object	PanDA Resource	PanDA Queue	state	(current) status	type	capability	CLOUD	TIER
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	ANALY_FZK	Clone ANALY_FZK	ACTIVE	online	analysis	score	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	ANALY_FZK_HI	Clone ANALY_FZK_HI	ACTIVE	online	analysis	score	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	ANALY_FZK_SHORT	Clone ANALY_FZK_SHORT	ACTIVE	online	analysis	score	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	FZK-LCG2	Clone FZK-LCG2-all-prod-CEs	ACTIVE	online	production	score	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	FZK-LCG2_HIMEM	Clone FZK-LCG2_HIMEM	ACTIVE	online	production	himem	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	FZK-LCG2_MCORE	Clone FZK-LCG2_MCORE	ACTIVE	online	production	mcore	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	FZK-LCG2_MCORE_HI	Clone FZK-LCG2_MCORE_HI	ACTIVE	online	production	mcore	DE	T1
atlas	FZK-LCG2	FZK-LCG2	FZK-LCG2_VIRTUAL	FZK-LCG2_MCORE_LO	Clone FZK-LCG2_MCORE_LO	ACTIVE	online	production	mcore	DE	T1

Showing 1 to 8 of 8 entries

Active PanDA (job) queues  
ANALY\_ .... = Analysis queue



# ATLAS Resources - 3

- DDM end points

ATLAS Grid Information System

RC SiteATLASSiteDDMEndpointPANDA QueueServiceCentral ServicesDDM GroupsDDM EndpointsDocsTWikiOLDJSON

Show 200 entries

give me url of this page hold shift + click column for Multi-column ordering

DDM EndpointStateDDM SiteATLAS SiteATLAS TIERCLOUDtypeFull EndpointTokenDomainLFC NameFTS MasterFTS Master2FTS

FirstPrevious1NextLast

DDM EndpointStateDDM SiteATLAS SiteATLAS TIERCLOUDtypeFull EndpointFTS MasterFTS Test

FZK-LCG2\_DATADISKACTIVEFZK-LCG2FZK-LCG2T1DEDATADISKtoken:ATLASDATADISK:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/disk-only/atlasdatadisk/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_DATATAPEACTIVEFZK-LCG2FZK-LCG2T1DEDATATAPEtoken:ATLASDATATAPE:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlasdatatape/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_GROUPTAPE\_PERF-EGAMMAACTIVEFZK-LCG2FZK-LCG2T1DEGROUPTAPEtoken:ATLASMCCTAPE:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlasgrouptape/perf-egamma/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_LOCALGROUPDISKACTIVEFZK-LCG2FZK-LCG2T1DELOCALGROUPDISKtoken:ATLASLOCALGROUPDISK:srm://dgridsrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlaslocalgroupdisk/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_LOCALGROUPTAPEACTIVEFZK-LCG2FZK-LCG2T1DELOCALGROUPTAPEtoken:ATLASLOCALGROUPTAPE:srm://dgridsrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlaslocalgrouptape/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_MCTAPEACTIVEFZK-LCG2FZK-LCG2T1DEMCTAPEtoken:ATLASMCCTAPE:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlasmcctape/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_PERF-EGAMMAACTIVEFZK-LCG2FZK-LCG2T1DEGROUPDISKtoken:ATLASDATADISK:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/disk-only/atlasgroupdisk/perf-egamma/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_PERF-IDTRACKINGACTIVEFZK-LCG2FZK-LCG2T1DEGROUPDISKtoken:ATLASDATADISK:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/disk-only/atlasgroupdisk/perf-idtracking/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_PERF-TAUACTIVEFZK-LCG2FZK-LCG2T1DEGROUPDISKtoken:ATLASDATADISK:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/disk-only/atlasgroupdisk/perf-tau/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

FZK-LCG2\_PPSSCRATCHDISKACTIVEFZK-LCG2FZK-LCG2T1DESPECIALtoken:ATLASPPSSCRATCHDISK:srm://ppssrm-kit.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/atlasppsscratchdisk/CERNFTS3\_REST | https://fts3.cern.ch:8446

FZK-LCG2\_SCRATCHDISKACTIVEFZK-LCG2FZK-LCG2T1DESCRATCHDISKtoken:ATLASSCRATCHDISK:srm://atlassrm-fzk.gridka.de:8443/srm/managerv2?SFN=/pnfs/gridka.de/atlas/disk-only/atlasscratchdisk/CERNFTS3\_REST | https://fts3.cern.ch:8446CERNFTS3PILOT\_REST | https://fts3-pilot.cern.ch:8446

Showing 1 to 11 of 11 entries

Active DDM storage

Showing 1 to 11 of 11 entries

Active DDM storage end points

# ATLAS Resources - 4

- **SCRATCHDISK** (Tier1 + Tier2s in Germany)
  - FZK-LCG2\_SCRATCHDISK
  - DESY-HH\_SCRATCHDISK
  - DESY-ZN\_SCRATCHDISK
  - LRZ-LMU\_SCRATCHDISK
  - WUPPERTALPROD\_SCRATCHDISK
  - UNI-FREIBURG\_SCRATCHDISK
  - GOEGRID\_SCRATCHDISK
- **LOCALGROUPDISK** (e.g. DESY-HH and UniGoettingen)
  - DESY-HH\_LOCALGROUPDISK
  - GOEGRID\_LOCALGROUPDISK
  - ..... \_LOCALGROUPDISK

# ATLAS Resources - 4

- **SCRATCHDISK** (Tier1 + Tier2s in Germany)
  - FZK-LCG2\_SCRATCHDISK
  - DESY-HH\_SCRATCHDISK
  - DESY-ZN\_SCRATCHDISK
  - LRZ-LMU\_SCRATCHDISK
  - WUPPERTALPROD\_SCRATCHDISK
  - UNI-FREIBURG\_SCRATCHDISK
  - GOEGRID\_SCRATCHDISK
- **LOCALGROUPDISK** (e.g. DESY-HH and UniGoettingen)
  - DESY-HH\_LOCALGROUPDISK
  - GOEGRID\_LOCALGROUPDISK
  - .....\_LOCALGROUPDISK

Storages for temporary data of PanDA jobs. Would be automatically REMOVED!

Permanently KEPT. Generally speaking, in total a few hundred TB in each site