

# XTREMWEB-HEP :

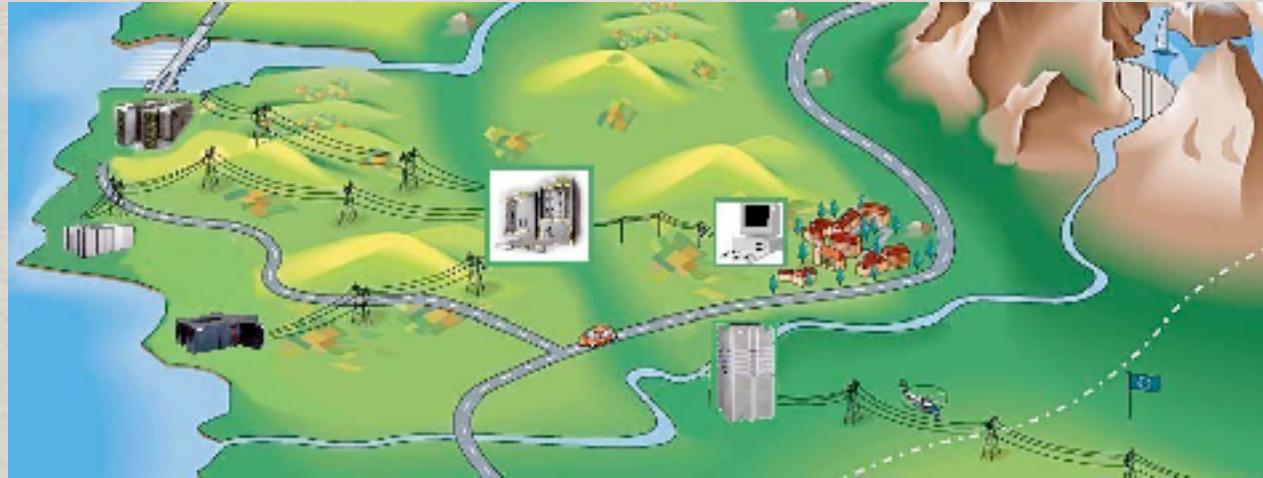
## A BEST EFFORT VIRTUALIZATION MIDDLEWARE

Oleg Lodygensky  
iExec

# XTREMWEB-HEP

- Introduction
- Security
- Inter grids connection
- Applications
- Monitoring
- Virtualization
- Internode connection
- Usage
- Discussion

# GRID COMPUTING



Grid : analogy with electric power grid.

Distributed resources (CPU, storage etc.):

- On demand.
- Known QoS.
- Highly secured.
- Standardised.
- Over the network.

Build dynamic communities (VO) and provide access to VO members.

# VOLUNTEER COMPUTING

	Volunteer cluster	Volunteer computing			
	Condor	Boinc	OurGrid	XtremWeb	XWHEP
volunteer ressources	✓			✓	
multi OSes	✓			✓	
type	cluster			desktop grid	
deployment	per domain			global	
firewall bypassing	✗			✓	
shared FS	✓			✗	
authentication	delegated			included	
authorization	delegated	✗	✓	✗	✓
Open ID	✗	✗	✗	✗	✓
X509	✗	✗	✓	✗	✓
Sandbox	✓	✓	✓ ✓	✓	✓
Heartbeat signal	✗	✗	✗	✓	✓
data	✓	✓	✗	✗	✓ ✓
multi users	✓	✗	✓	✓	✓
multi applications	✓	✗	✓	✓	✓
volunteer experience	✓	✓	✗	✗	✗
large deployment	✗	✓	✗	✗	✗

# THE XTREMWEB-HEP PROJECT

## Goals

- secured meta clusters
- grid interconnection
- virtualization over DG

## Main features :

- certified server
- TSL communications
- authentication (X509 cert)
- authorisations
- access rights
- confinement

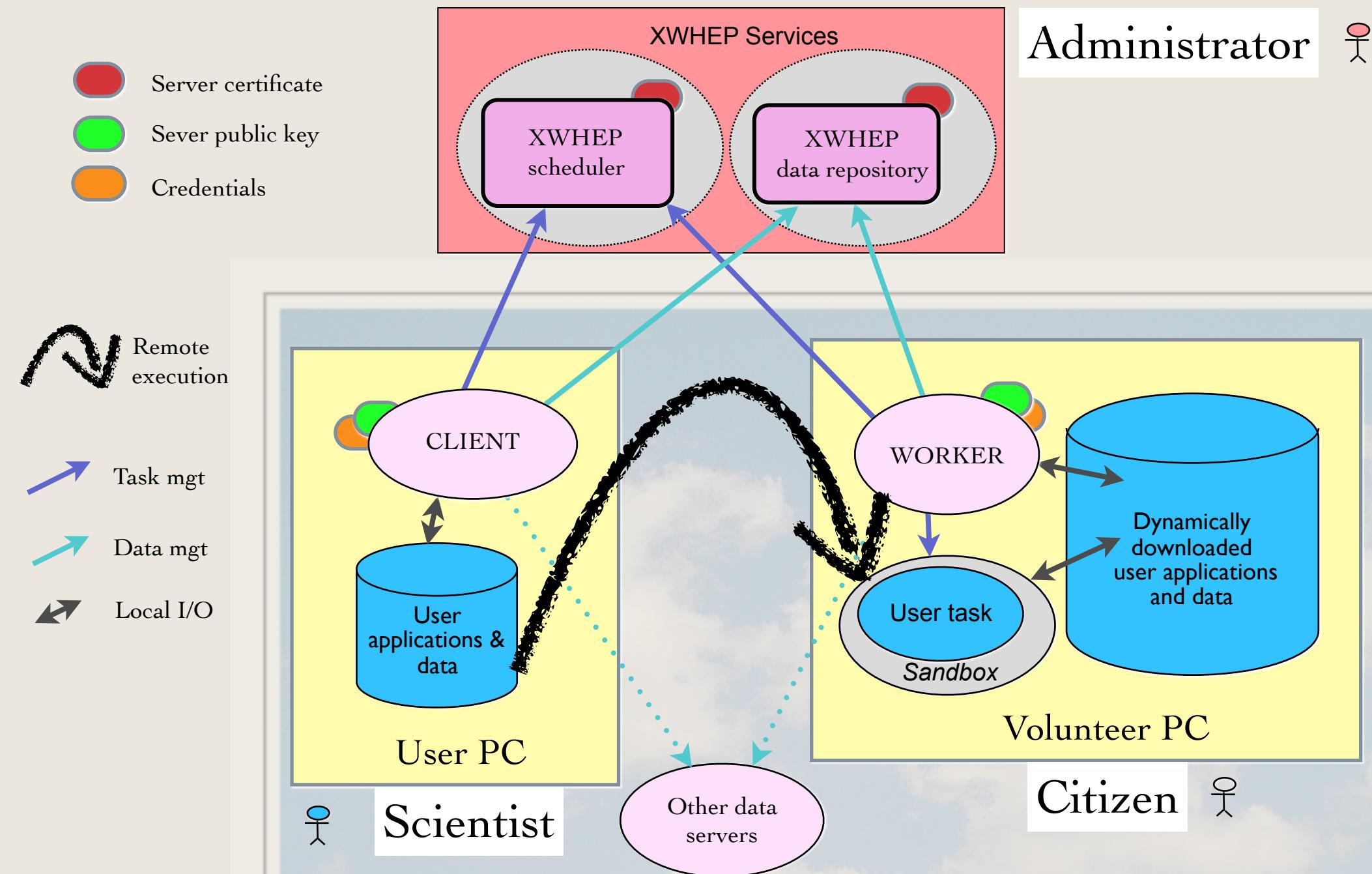
## Informations

- since 2006
- 600K€ E.U. funded
- 300K€ ANR funded

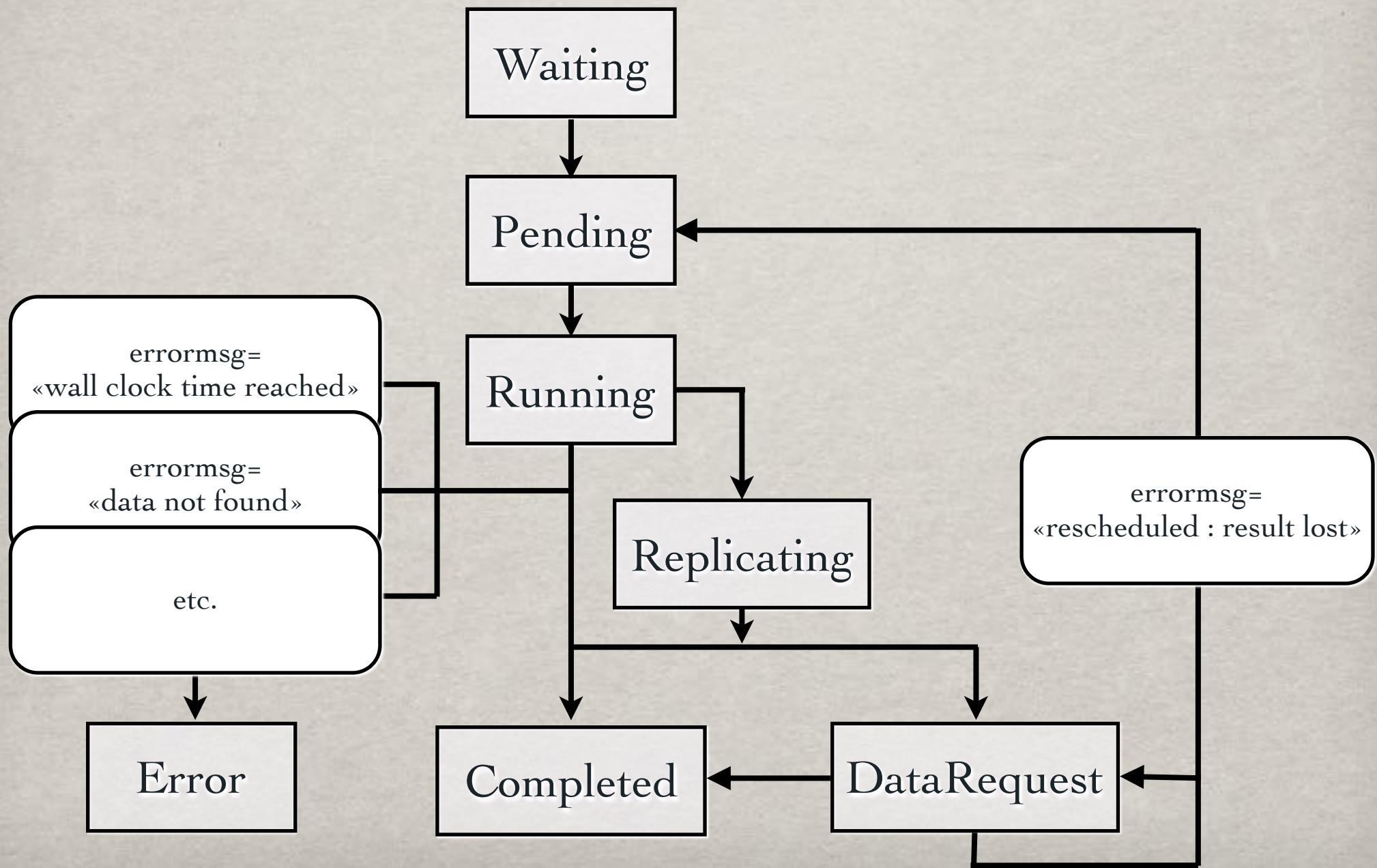
## Contacts

- [xtremweb@lal.in2p3.fr](mailto:xtremweb@lal.in2p3.fr)
- <http://www.xtremweb-hep.org>

# XTREMWEB-HEP : A SECURED 3 TIERS ARCHITECTURE



# JOB STATE GRAPH





# INTERNATIONAL DESKTOP GRID FEDERATION

► IDGF brand for general communication activities

- With appropriate acknowledgement of EDGI support, and EC support

► EDGI for project related information

- Plans, work done, partners, EC support

Volunteers

Users

General public



Peer projects

EC

Peer researchers

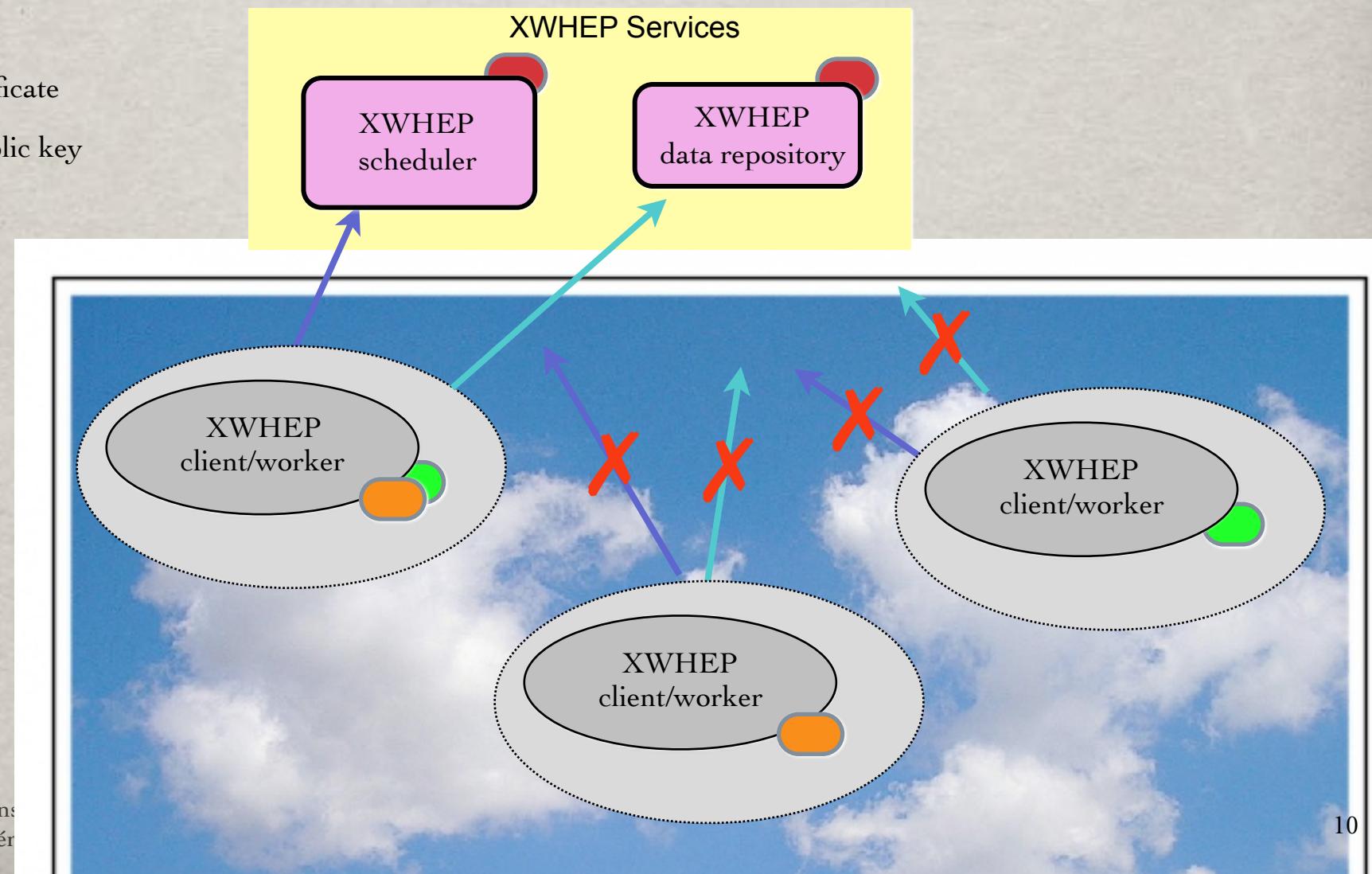


# XTREMWEB-HEP

- Introduction
- Security
  - ✓ authentication
  - ✓ authorization
  - ✓ access rights
  - ✓ confidentiality
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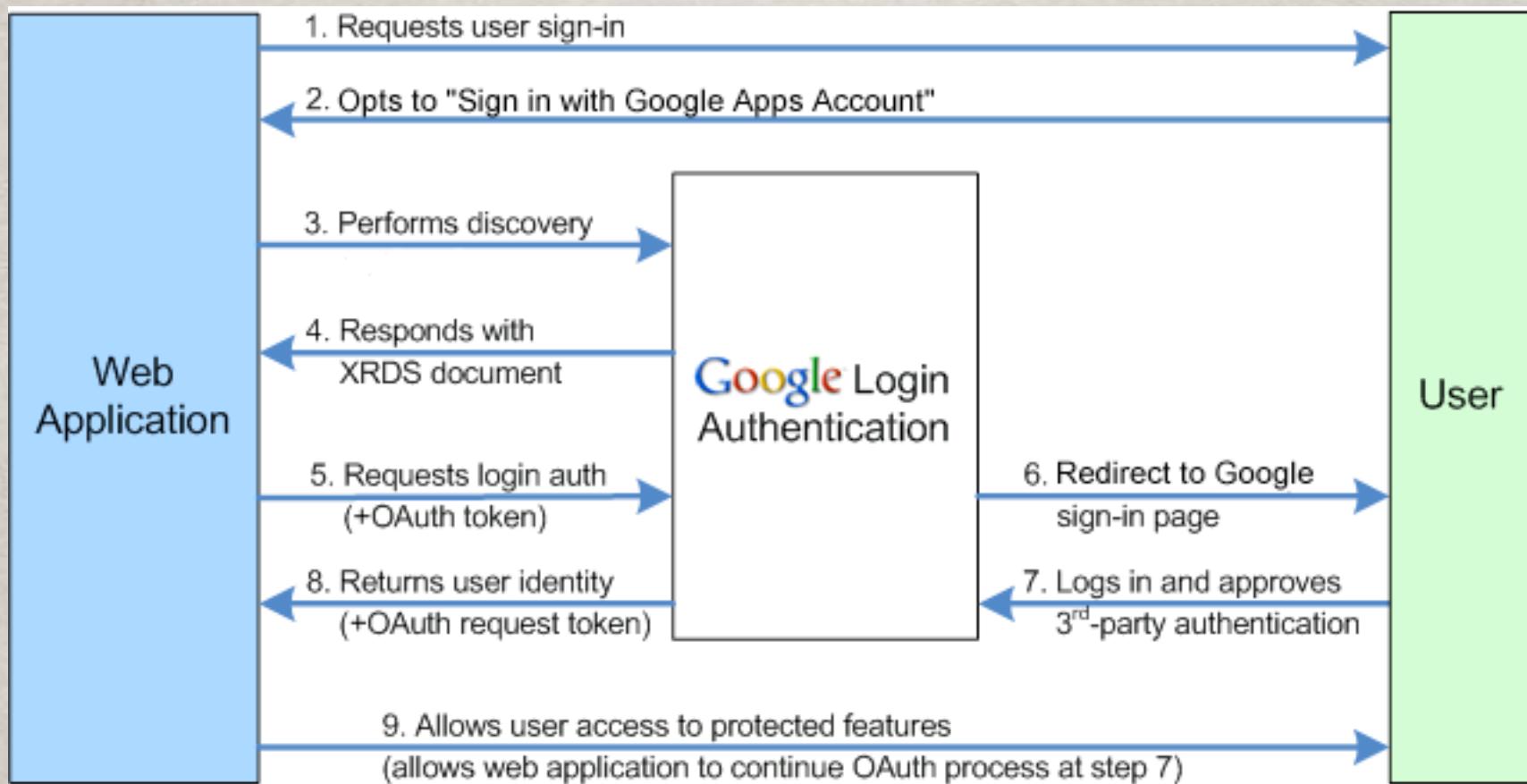
# AUTHENTICATION: CERTIFICATES

Distributed parts connect using services public key and must present valid credentials

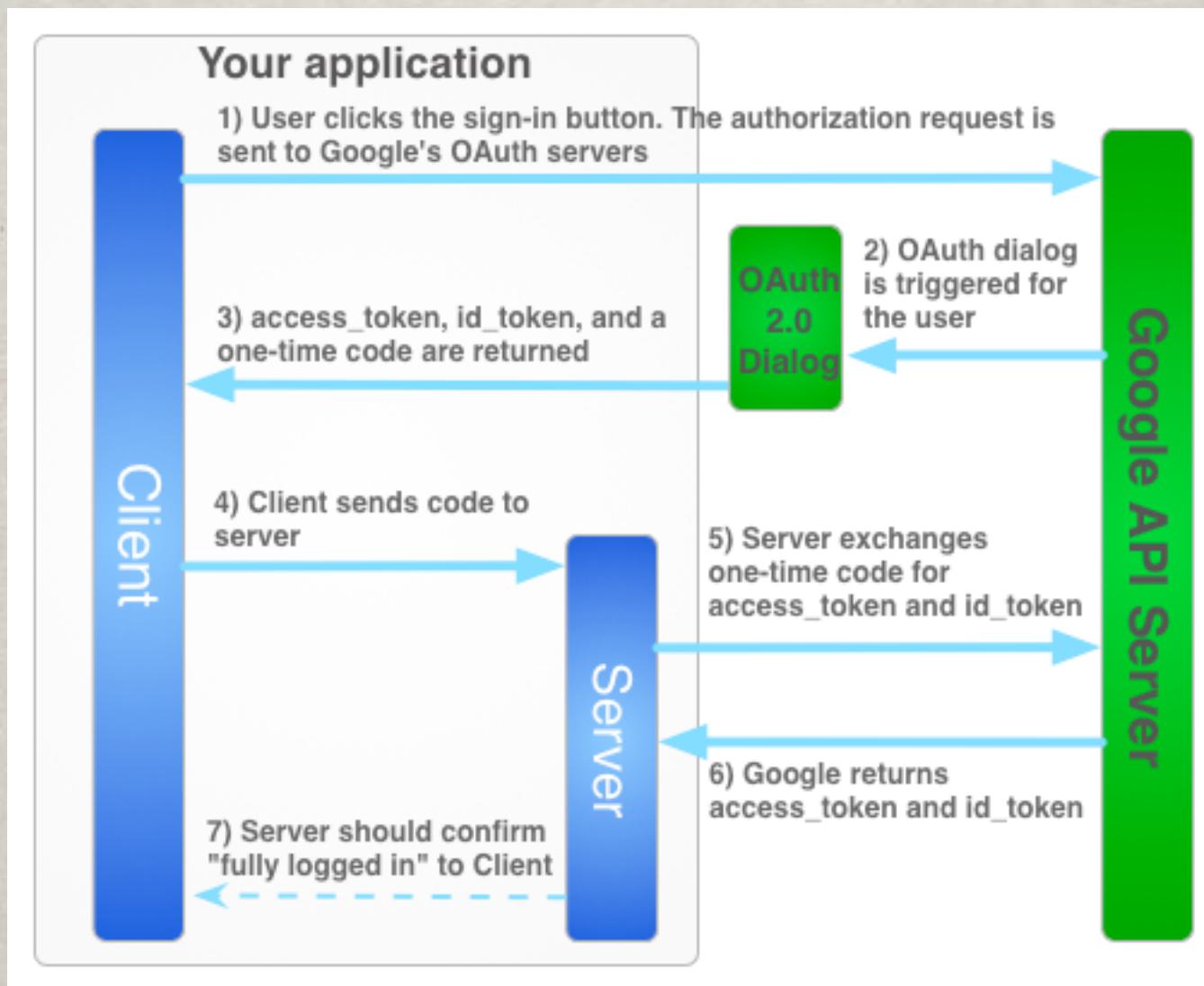


# ATHENTICATION : OPENID

Credentials may be certified by a third party



# ATHENTICATION : OAUTH



[https://developers.google.com/+web/signin/server-side-flow#using\\_one-time-code\\_flow](https://developers.google.com/+web/signin/server-side-flow#using_one-time-code_flow)

# AUTHORIZATION

Credential is associated to a usage level.

## Administrator

- manage public applications
- manage jobs, datas etc.
- manage users and usergroups
- manage workers

## Standard user

- manage private applications
- manage its own jobs and datas

## Group Administrator

- manage its group
  - ▶ applications
  - ▶ users
  - ▶ jobs
  - ▶ datas

## Worker user

This is used to deploy workers

- **no action allowed**
- user rights delegation
  - ▶ can compute user job
  - ▶ can update user job
  - ▶ can upload user job results

# ACCESS RIGHTS

Request completions depend on **access rights**.

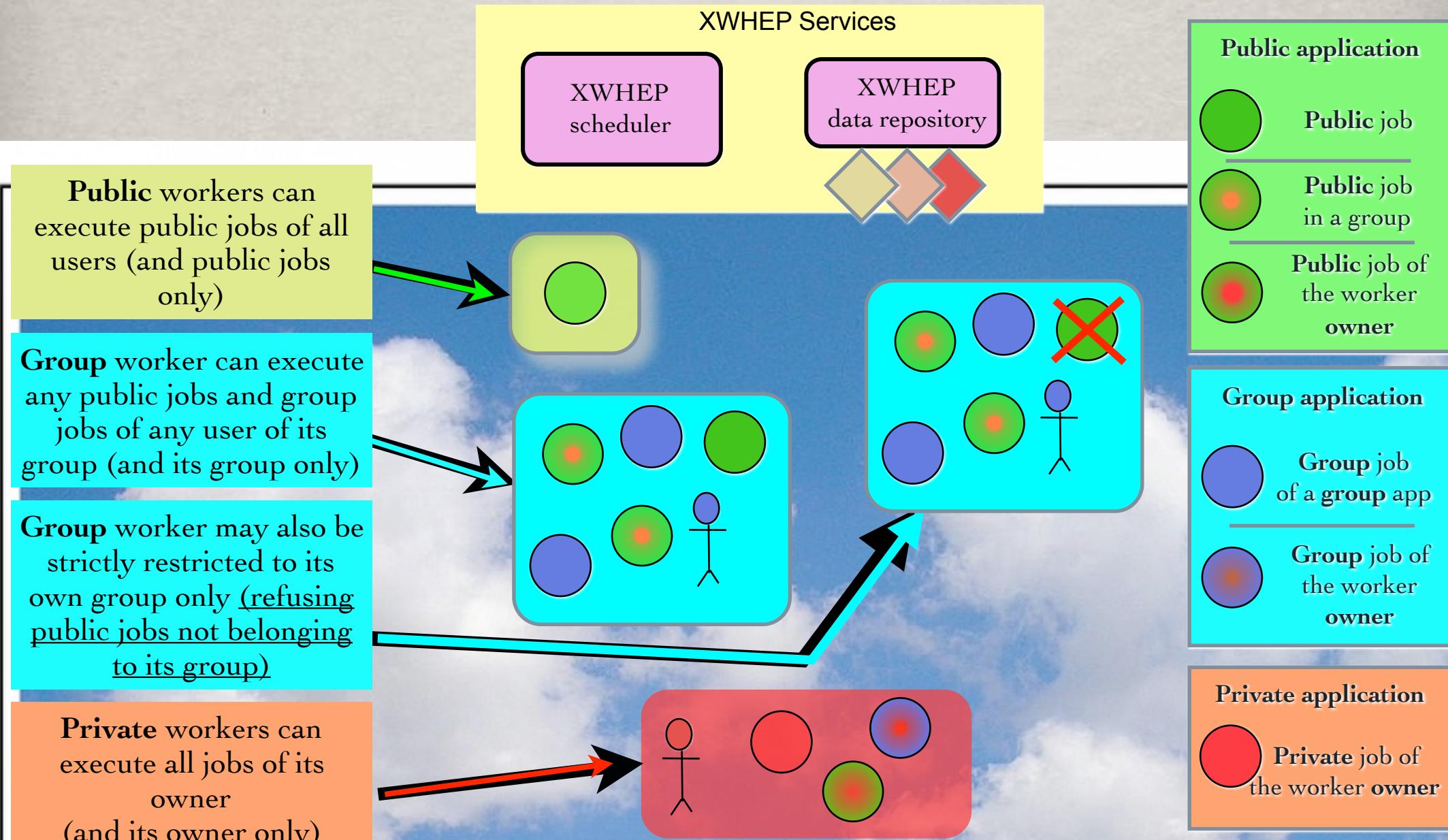
All objects (applications, datas, users, jobs, usergroups etc) are associated to access rights (AR) that allow/deny accesses (read, write, execute).

Access rights define access types

Access Types	Default Access Rights
Private	700
Group	750
Public	755

# CONFIDENTIALITY

Authorisations and access rights define confinement levels



# XTREMWEB-HEP

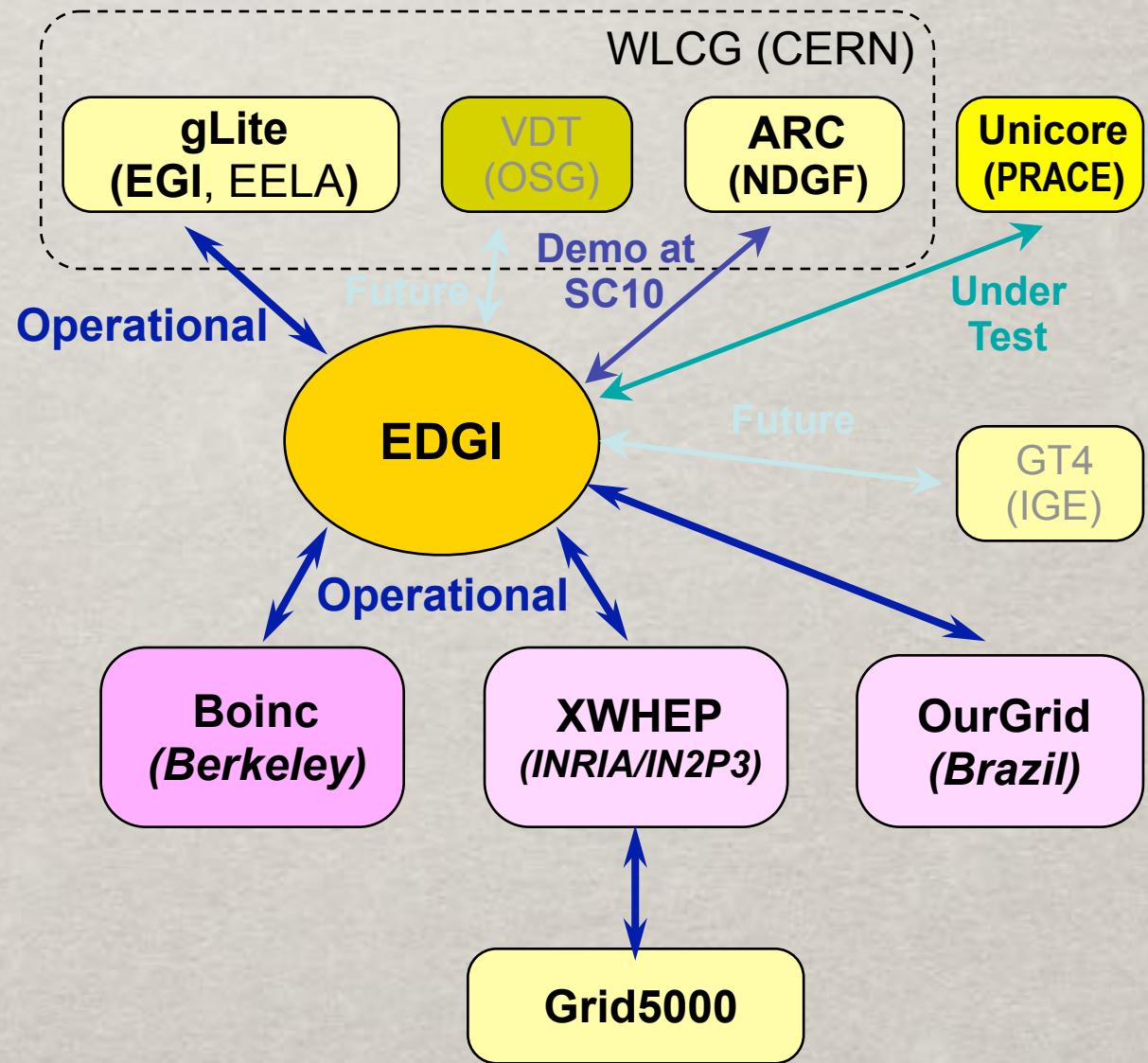
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# INTER GRID CONNECTIONS



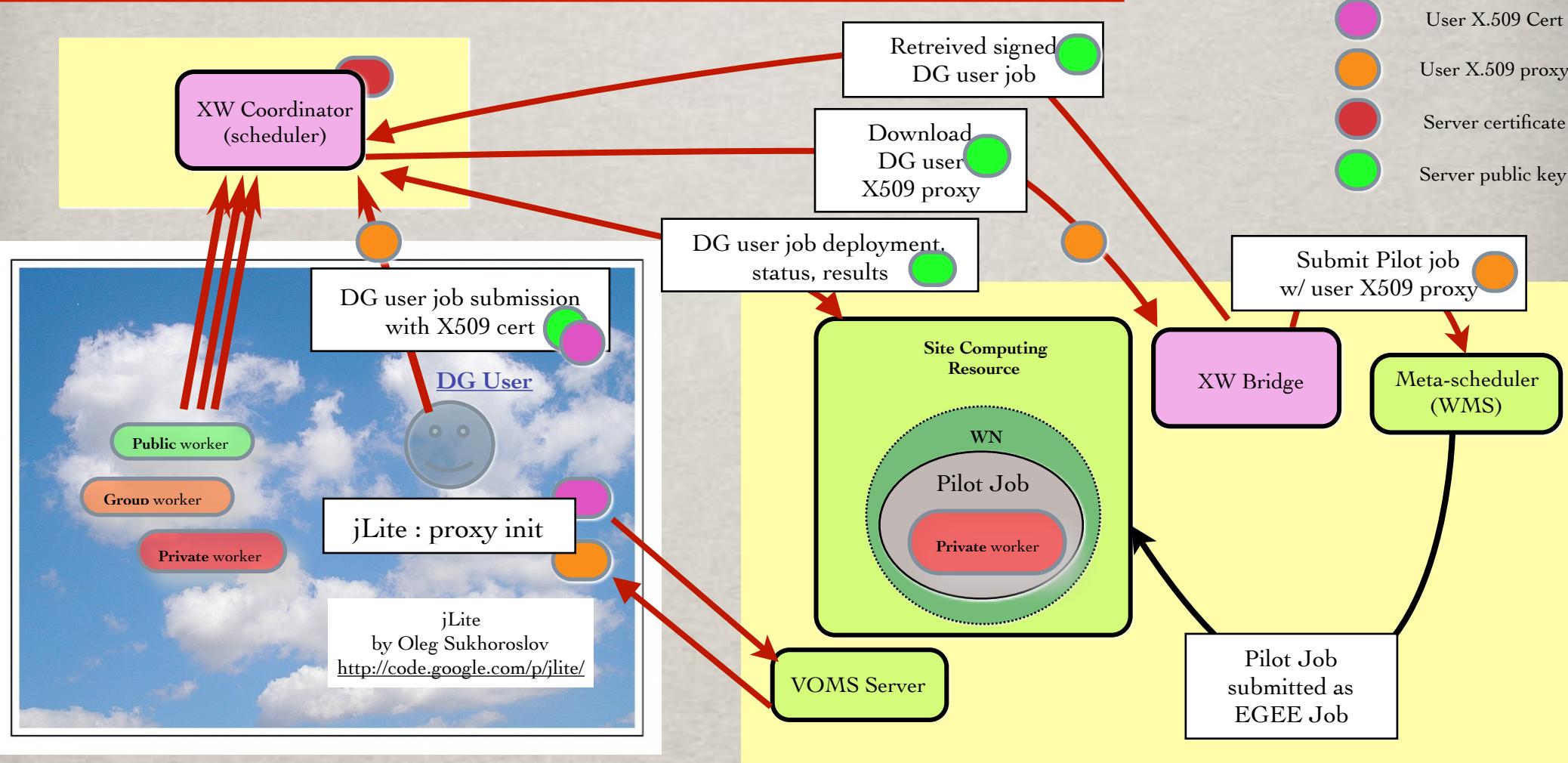
FP7 project started in 2010

- Integrate Service Grids and Desktop Grids
- Enable very large number of computing resources (100K-1M processors)
- Attract new scientific communities
- Provide a Grid application development environment
- Provide application repository and bridges for the execution in the SG-DG system



# PILOT JOBS

Security, monitoring and logging are the main issues in Pilot Jobs. (<http://edms.cern.ch/document/855383>)

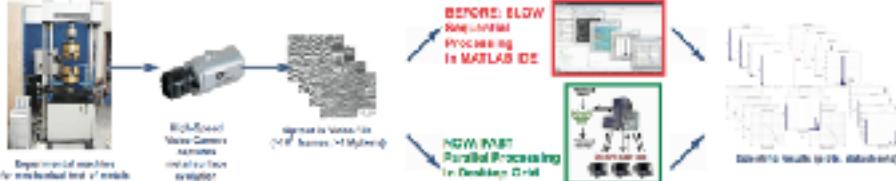


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# APPLICATIONS

**2.Typical Experimental Workflows: Sequential and Parallel at BOINC and XtremWeb DG platforms**  
 MultiScaleVideo<sup>®</sup> with 4GL MATLAB-code was successfully ported and tested on BOINC-based local DG at IMP with Windows-workers [2] and on XtremWeb DG [4] at LAL with Linux-workers; now the work is going on delivering it to EGEE through EDGeS XtremWeb->EGEE Bridge [5].

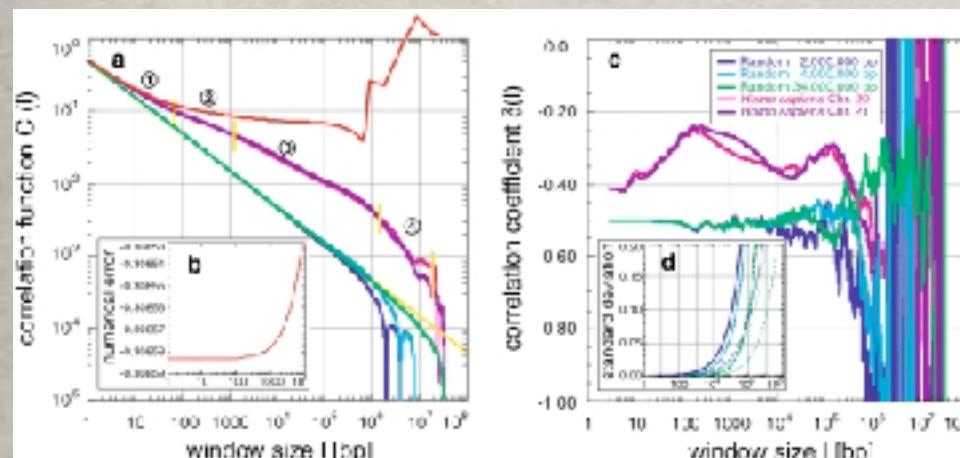


The main achievement: applicability and feasibility of integration of typical scientific application coded in 4GL environments with DG on the basis of Desktop Grid for high-performance distributed computing were proved, tested and demonstrated.

The further increase of performance is possible by delivering 4GL-based applications to global computing resources of EGEE on the basis of XtremWeb desktop grid platform [4] and EDGeS XtremWeb->EGEE Bridge [5].

## Porting Multiparametric MATLAB Application for Image and Video Processing to Desktop Grid for High-Performance Distributed Computing

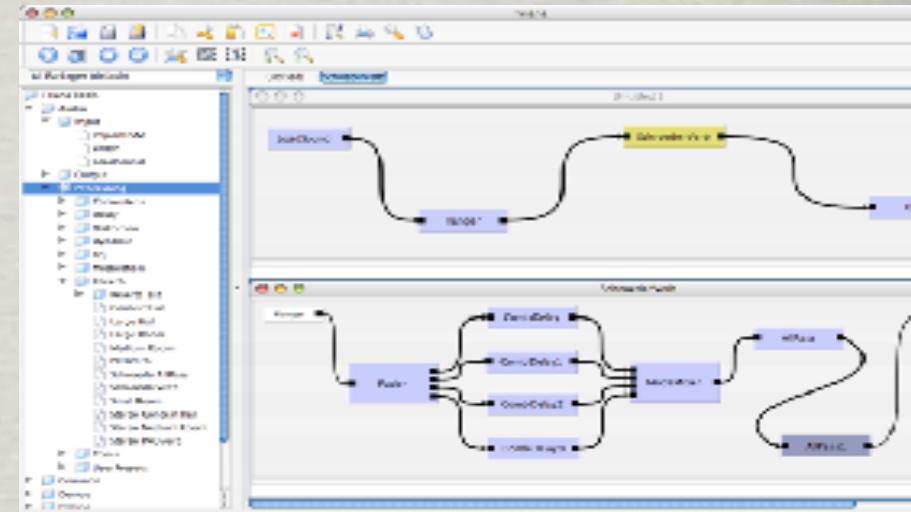
Yuri Gordienko, Institut de Physique du Metal - Kiev - Ukraine



## DNA Correlation Applications

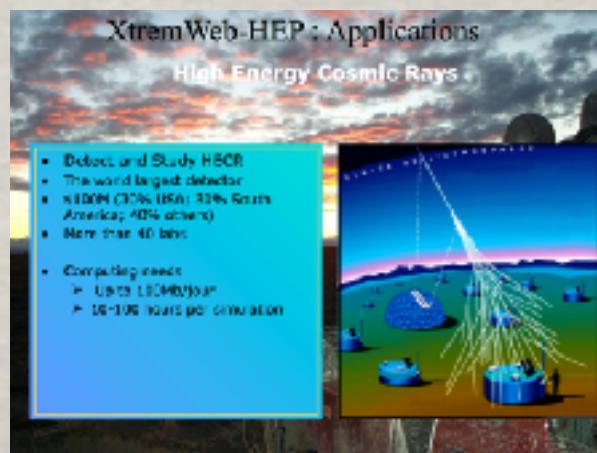
A. Abuseiris, Erasmus - NL

O. Lodygensky  
 Laboratoire de l'Accélérateur Linéaire



## DART: A Framework for Distributed Audio Analysis and Music Information Retrieval

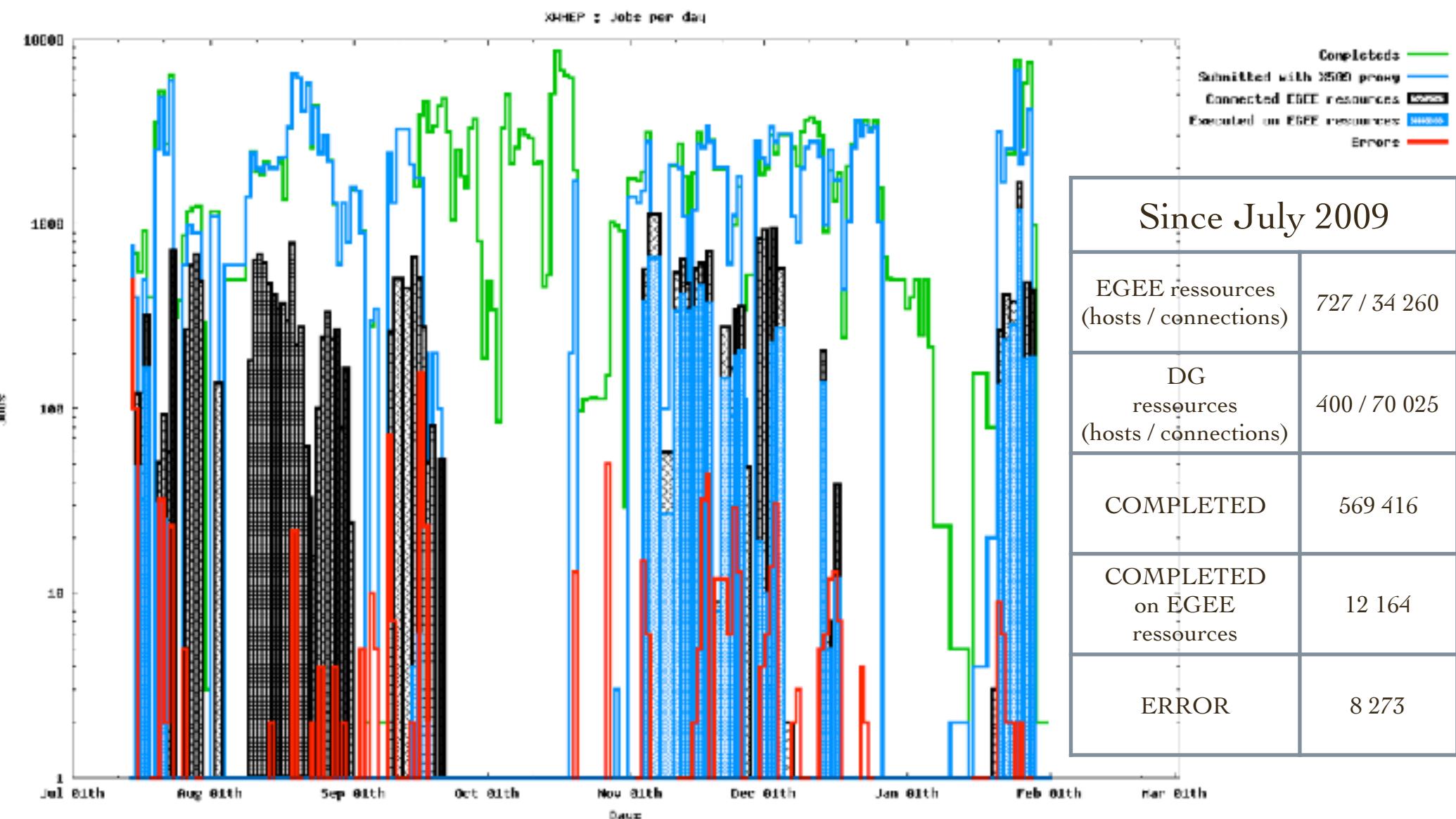
Eddie Al-Shakarchi, Cardiff University - UK



## High Energy Cosmic Rays

A. Cordier LAL - France

# USAGE



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# MONITORING

- The server includes services and protocols implementing logging and bookkeeping.
- Ganglia permits a global monitoring of the platform.
- Ticket management is under the responsibility of the grid administrator.
- On server side, the middleware logs all events.
- On client side, the middleware proposes tools to retrieve all stored events.

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# VIRTUALIZATION



Real

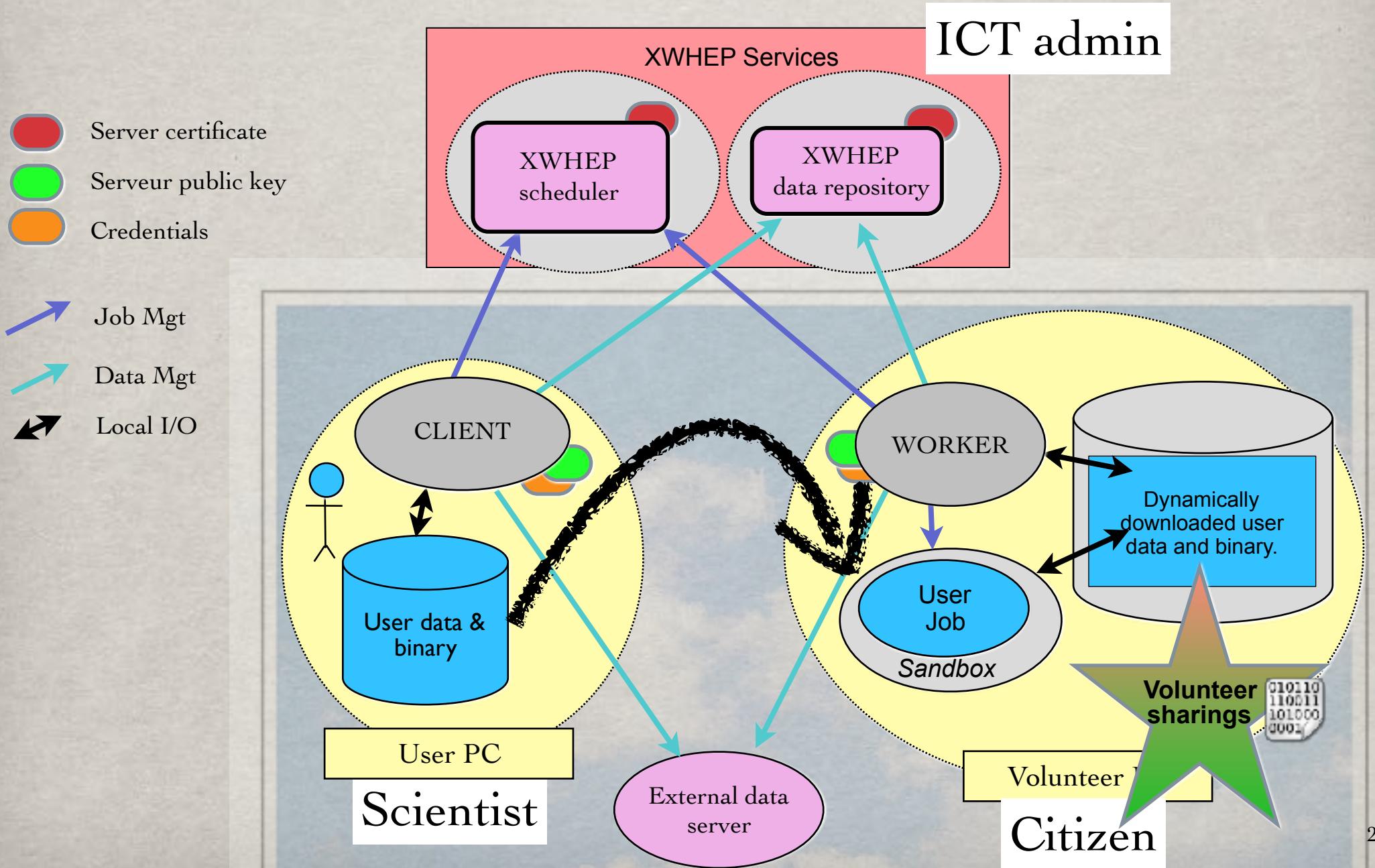
**PayPal™**

 moneo

Virtuel

# XTREMWEB-HEP : ARCHITECTURE

A three tiers architecture, secured and bypassing firewalls



# VM OVER XWHEP

StratusLab  
proposes  
distributions  
with the IaaS  
paradigms.

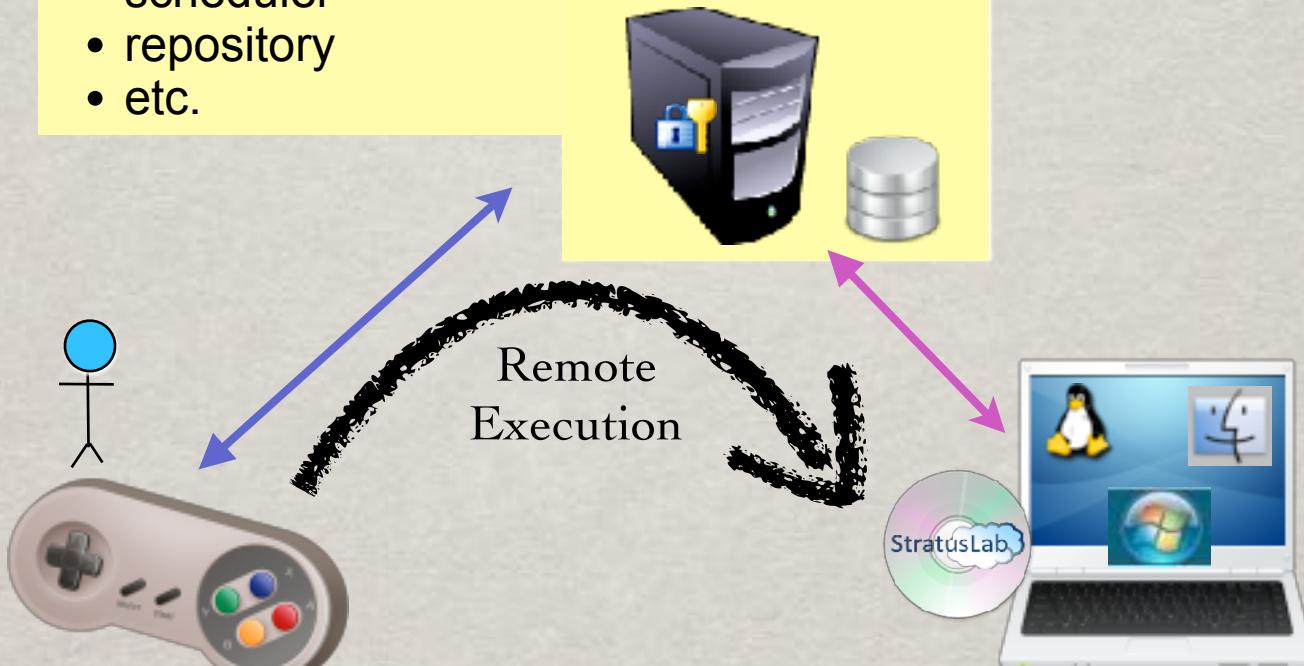


## Distributed User

- submit a virtualbox job with a virtual disk

Centralized and securized services store applications and data

- scheduler
- repository
- etc.



Distributed ressource may declare the virtualbox application.



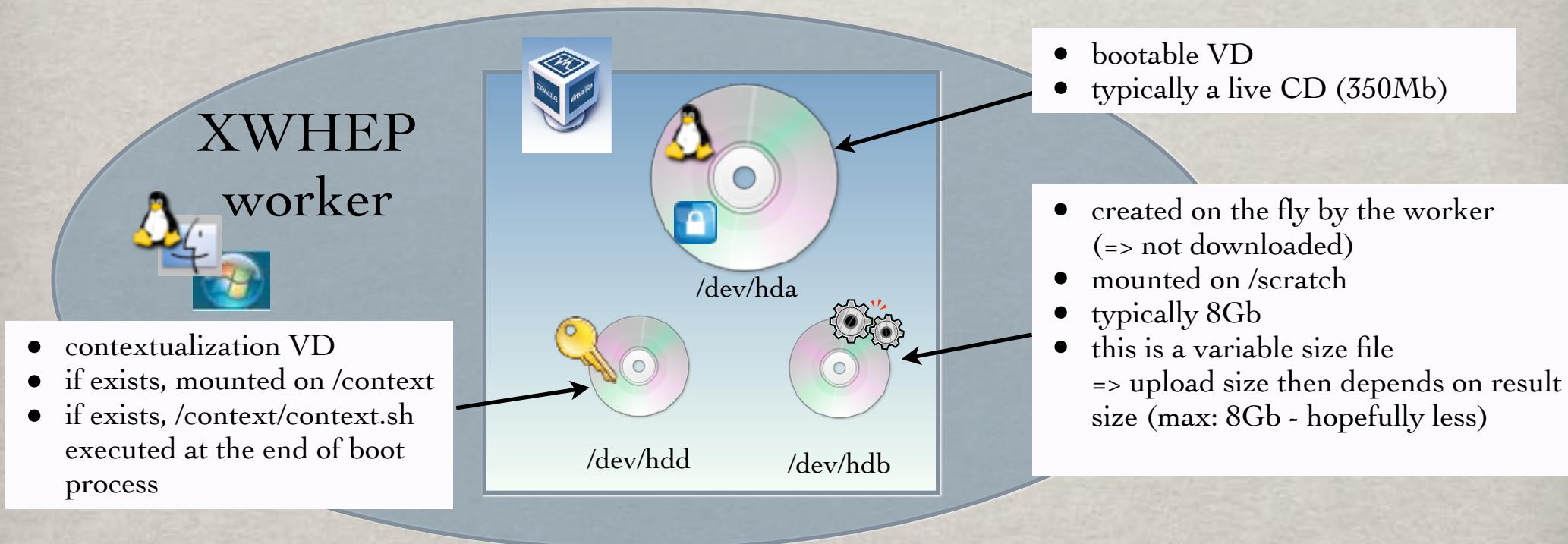
## Distributed ressource (volunteer PC)

- download the virtual disk
- create and run a new VM inside its local VirtualBox

# VM : CONTEXTUALIZATION

It is not simple to create a virtual disk (VD) containing a virtualized OS.

- we need a repository of «template» VD to ease the user life
- any user can still create and use its own VD
- any VD can be contextualized



All XWHEP security paradigms apply

- authentication
- authorization
- access rights

Virtual machines :

- recent OS including last known bugs and security corrections
- root access denied
- “sudo” usage disabled
- no access to LAN
- connection only using electronic keys

## VM : USE CASE

- HEP applications are linked to ROOT (<http://root.cern.ch>)
- DG resources don't have ROOT
  - submitted jobs will not run



- ✓ Deploy a VM with ROOT and XWHEP worker
- ✓ Submit such VM on the fly
  - the native worker shares VirtualBox
  - the native worker launches the VM
    - the virtualized worker shares ROOT
    - the virtualized worker run HEP jobs

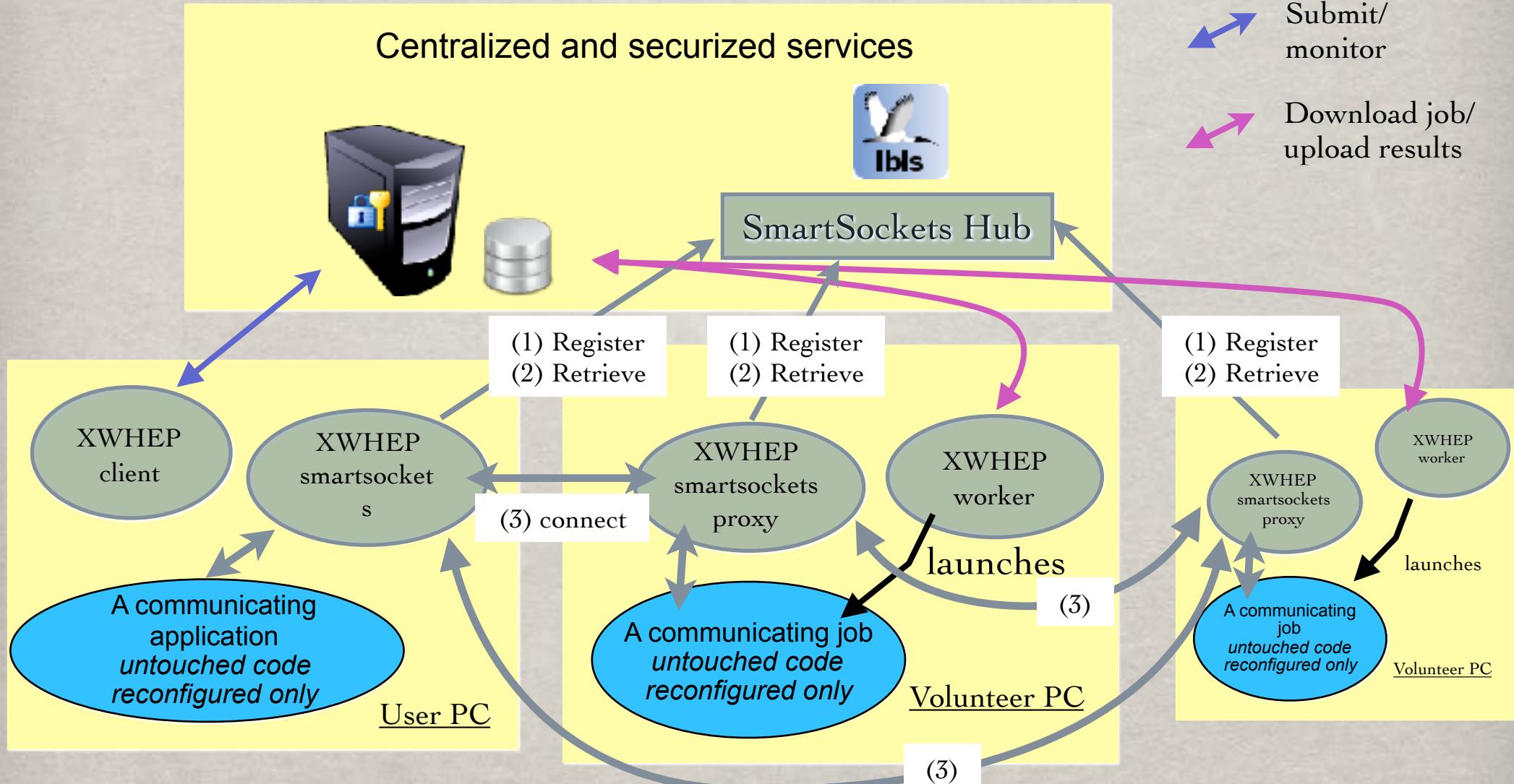
Template VD under progress

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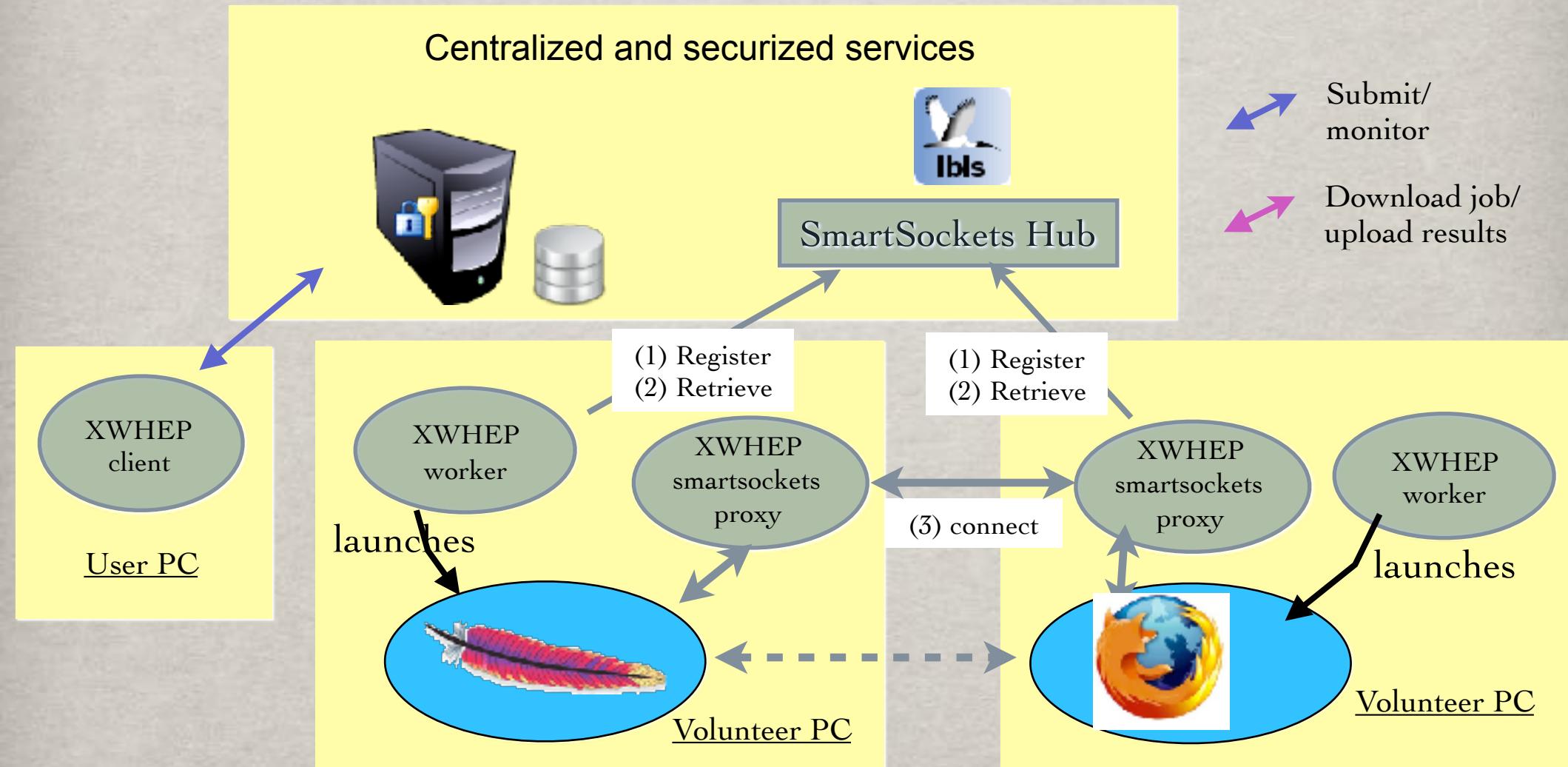
# INTERNODE COMMUNICATIONS

## Interconnect jobs and applications over DG



# INTERNODE COMMUNICATIONS

Example : interconnect jobs running on volunteer resources



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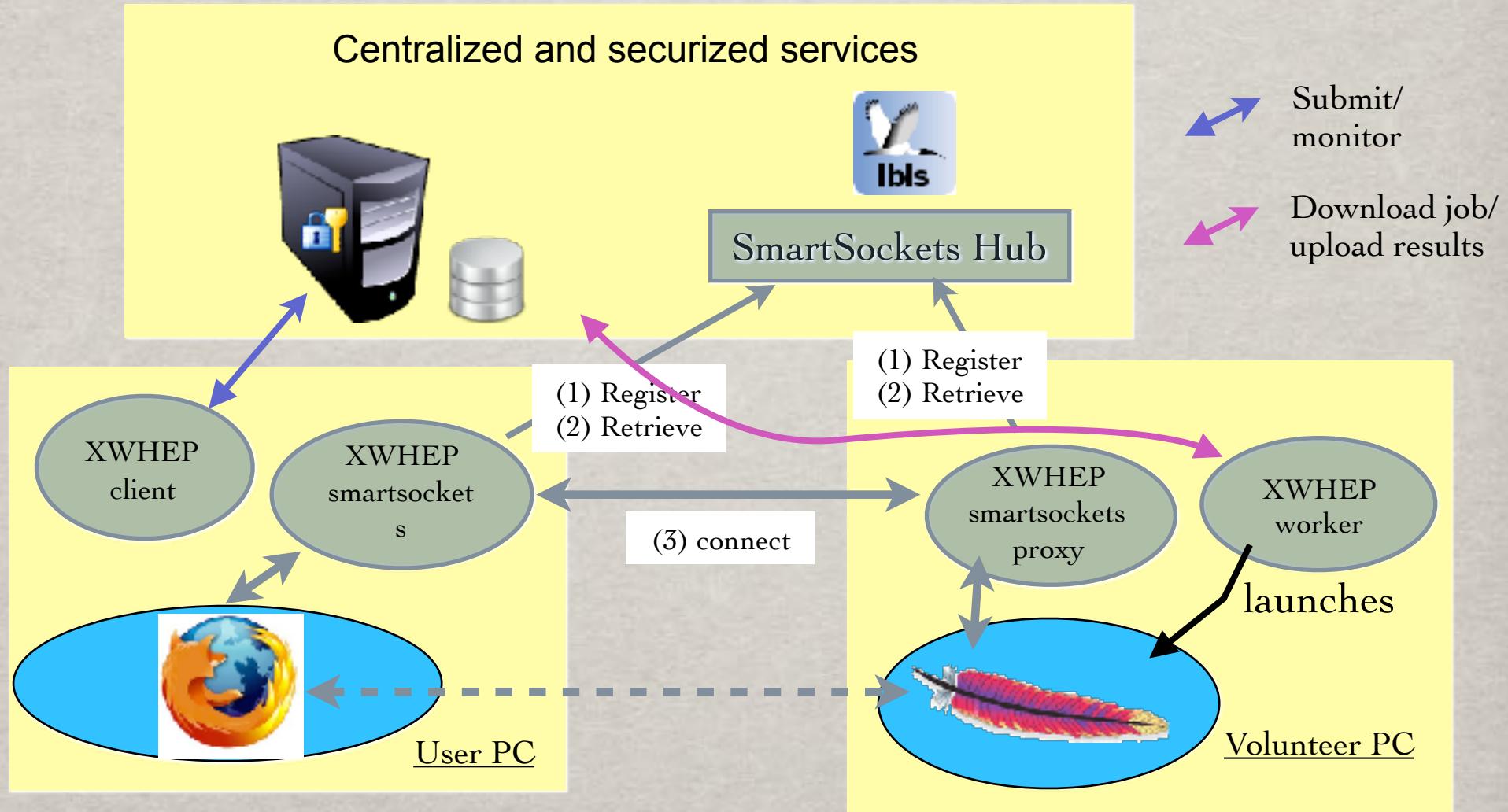
## INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.

E.G. : deploying jackrabbit over DG  
(<http://jackrabbit.apache.org>)

# INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.



## Example 1 : connect client to a job running on volunteer resource.

### 1.1) Register application as usual

```
$> ./bin/xwsendapp jackrabbit java ~/Download/jackrabbit-standalone-2.2.8.jar  
xw://MacBookPro-de-Oleg.local/911eeeb0-b4c2-4672-80c6-84971dd17a57  
$> ./bin/xwapps  
UID='911eeeb0-b4c2-4672-80c6-84971dd17a57', NAME='jackrabbit'  
$>
```

# INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.

## 1.2) submit a job listening to a port

This informs the worker to create a proxy for this job and forward incoming connections to port 8080

```
$> ./bin/xwsubmit jackrabbit --xwlistenport 8080  
xw://MacBookPro-de-Oleg.local/f87da0c4-2324-4cb2-8622-ef81e30525a7  
$> ./bin/xwworks --xwformat xml f87da0c4-2324-4cb2-8622-ef81e30525a7  
<?xml version='1.0' encoding='UTF-8'?>  
<get>  
<work uid="f87da0c4-2324-4cb2-8622-ef81e30525a7" ... status="PENDING"  
listenport="8080" />  
</get>
```

This job has a listening port

# INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.

## 1.3) checking the job proxy

```
$> ./bin/xworks --xwformat xml f87da0c4-2324-4cb2-8622-ef81e30525a7
<?xml version='1.0' encoding='UTF-8'?>
<get>
<work uid="f87da0c4-2324-4cb2-8622-ef81e30525a7" ... status="RUNNING"
listenport="8080" smartsocketaddr="127.0.0.1-64349#02.9a.bc.39.10.7b.00.00.2f.
71.6e.7f.8a.71.27.35:3000@127.0.0.1-4329#12.be.25.38.10.7b.00.00.7c.8b.
7f.d1.c1.05.94.ce~root#" />
</get>
```

The worker has automatically instanciated a SmartSockets proxy for this job. Incoming connections on worker side will be forwarded to local port 8080.

# INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.

## 1.4) create a proxy on client side

This command starts a new client proxy

This is the URI or UID of the job you want to reach

The new client proxy listens to a local port

```
$> ./bin/xwproxy f87da0c4-2321-4cb2-8622-ef81e30525a7 \
    --xwlistenport 1234
SLF4J: This version of SLF4J requires log4j version 1.2.12 or later. See also
http://www.slf4j.org/codes.html#log4j\_version
log4j:WARN No appenders could be found for logger
(ibis.smartsockets.properties).
log4j:WARN Please initialize the log4j system properly.
```

# INTERNODE COMMUNICATIONS

Example 1 : connect client to a job running on volunteer resource.

1.5) connect to jackrabbit running on worker side

The screenshot shows a web browser window with the title bar "Apache Jackrabbit JCR Server". The address bar displays "http://localhost:1234". The page content includes the Apache Jackrabbit logo, the text "Apache Jackrabbit", and the Apache Software Foundation logo. A callout bubble points to the browser's address bar with the text: "We must connect to the local client proxy (localhost, port 1234 in our example)".

We must connect to the local client proxy (localhost, port 1234 in our example)

Apache Jackrabbit JCR Server

http://localhost:1234

Apache Jackrabbit

The Apache Software Foundation

Apache Jackrabbit JCR Server

Welcome to the Apache Jackrabbit JCR Server. This web application contains a JCR content repository and makes it available to clients through WebDAV and other means.

The following WebDAV view is provided for accessing the content in the JCR content repository.

- Standard WebDAV

In addition the JCR Server project provides means for JCR remoting over HTTP:

- JCR remoting over WebDAV
- JCR remoting over WebDAV (including Batch Read/Write)

Clients can also access the repository using the JCR API. Both local and remote access is supported.

- Remote repository access

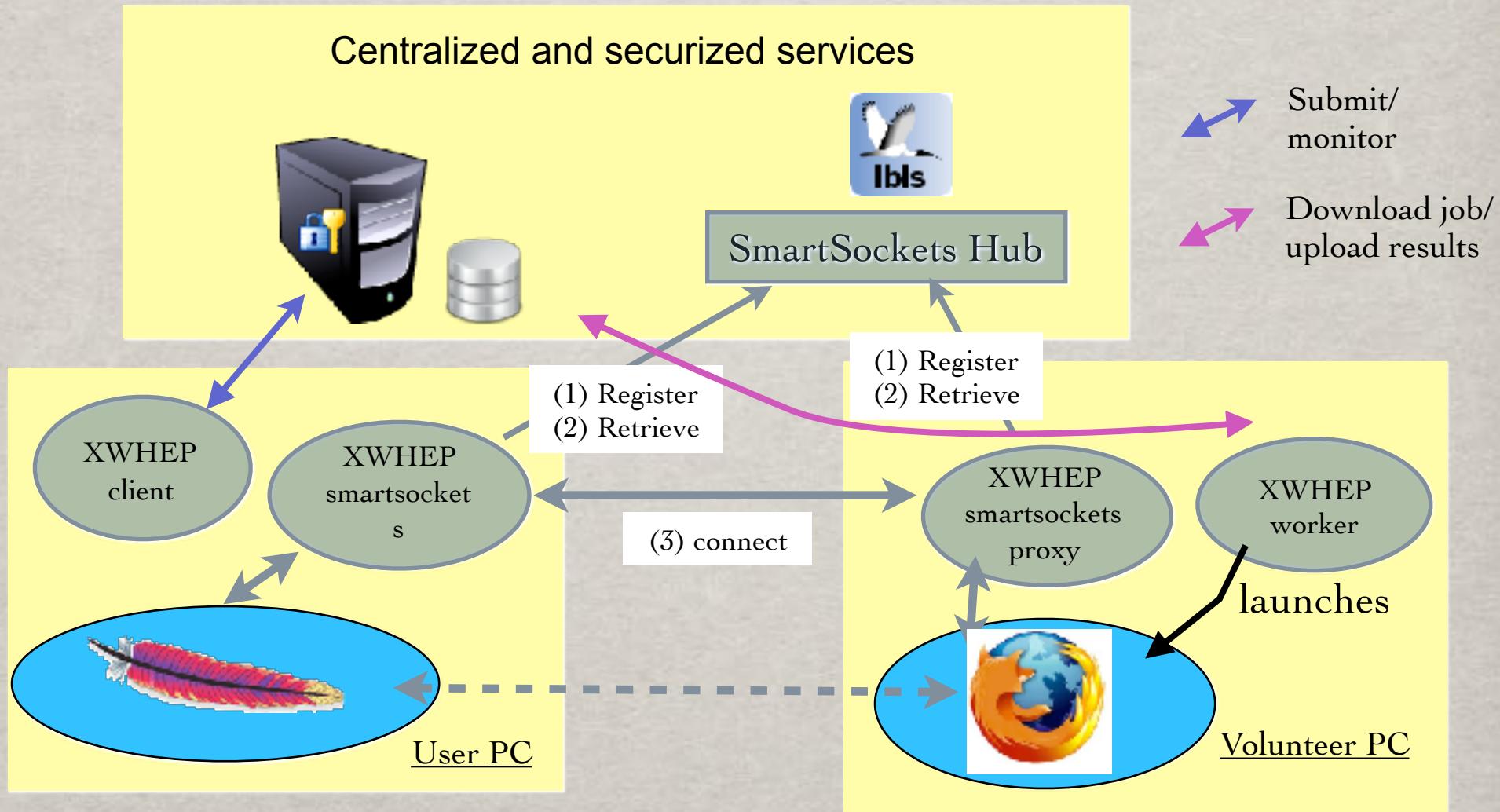
## INTERNODE COMMUNICATIONS

**Example 2 : connect a job running on volunteer resource to a service**

**E.G. : deploy wget and connect to a web server running on client**

# INTERNODE COMMUNICATIONS

Example 2 : connect a job running on volunteer resource to a service



# INTERNODE COMMUNICATIONS

Example 2 : connect a job running on volunteer resource to a service

## 2.1) Register application as usual

```
$> ./bin/xwsendapp wget macosx x86_64 /sw/bin/wget  
xw://new-host.home/9cc4da17-97d0-4abb-a4b4-c12e01f9ba76
```

# INTERNODE COMMUNICATIONS

## Example 2 : connect a job running on volunteer resource to a service

### 2.2) create a proxy on client side

To start a server proxy on client side

This proxy forwards to a local port on client side

```
$> ./bin/xwproxy --xwlistenport 8080
Starting server proxy
SLF4J: This version of SLF4J requires log4j version 1.2.12 or later. See also
http://www.slf4j.org/codes.html#log4j\_version
log4j:WARN No appenders could be found for logger
(ibis.smartsockets.properties).
log4j:WARN Please initialize the log4j system properly.
Proxy started on : 192.168.1.14-50163#32.1f.1b.46.10.7b.00.00.4c.1b.
34.65.22.ff.be.ff:3000@192.168.1.14-4329#86.a4.19.46.10.7b.00.00.df.
40.df.b0.c5.c9.69.08~root#
```

# INTERNODE COMMUNICATIONS

## Example 2 : connect a job running on volunteer resource to a service

### 2.3) submit a job that will be able to connect to our local proxy

This informs the worker to create a proxy for this job and forward incoming connections from local port 1234 to our SmartSockets proxy running on client

```
$> ./bin/xwsubmit wget http://localhost:1234 --xwforwardaddresses  
"192.168.1.14-50163#32.1f.1b.46.10.7b.00.00.4c.1b.34.65.22.ff.be.fff:  
3000@192.168.1.14-4329#86.a4.19.46.10.7b.00.00.df.  
40.df.b0.c5.c9.69.08~root#,1234"  
xw://new-host.home/a1d885ab-42e9-4d90-92a5-cac21448a0df
```

# INTERNODE COMMUNICATIONS

## Example 2 : connect a job running on volunteer resource to a service

### 2.4) retrieve our results

```
$> ./bin/xwresults xw://new-host.home/a1d885ab-42e9-4d90-92a5-cac21448a0df  
    UID='a1d885ab-42e9-4d90-92a5-cac21448a0df', STATUS='COMPLETED'  
Downloaded to : 35445471-1ae8-4899-9481-  
de98d81ada06_ResultsOf_a1d885ab-42e9-4d90-92a5-cac21448a0df.zip  
  
$> more stderr.out  
--2011-08-26 15:18:23-- http://localhost:1234/  
Connexion vers localhost|127.0.0.1|:1234...connect'e.  
...  
Saving to: `index.html'  
  
      0K ...                                100% 79.9M=0s  
  
2011-08-26 15:18:24 (79.9 MB/s) - << index.html >> sauvegard'e [3769/3769]  
  
$> more index.html  
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"  
     "http://www.w3.org/TR/html4/loose.dtd">  
<html>  
  <head>  
    <title>Apache Jackrabbit JCR Server</title>  
    <link rel="stylesheet"  
          href="/css/default.css"  
          type="text/css"/>
```

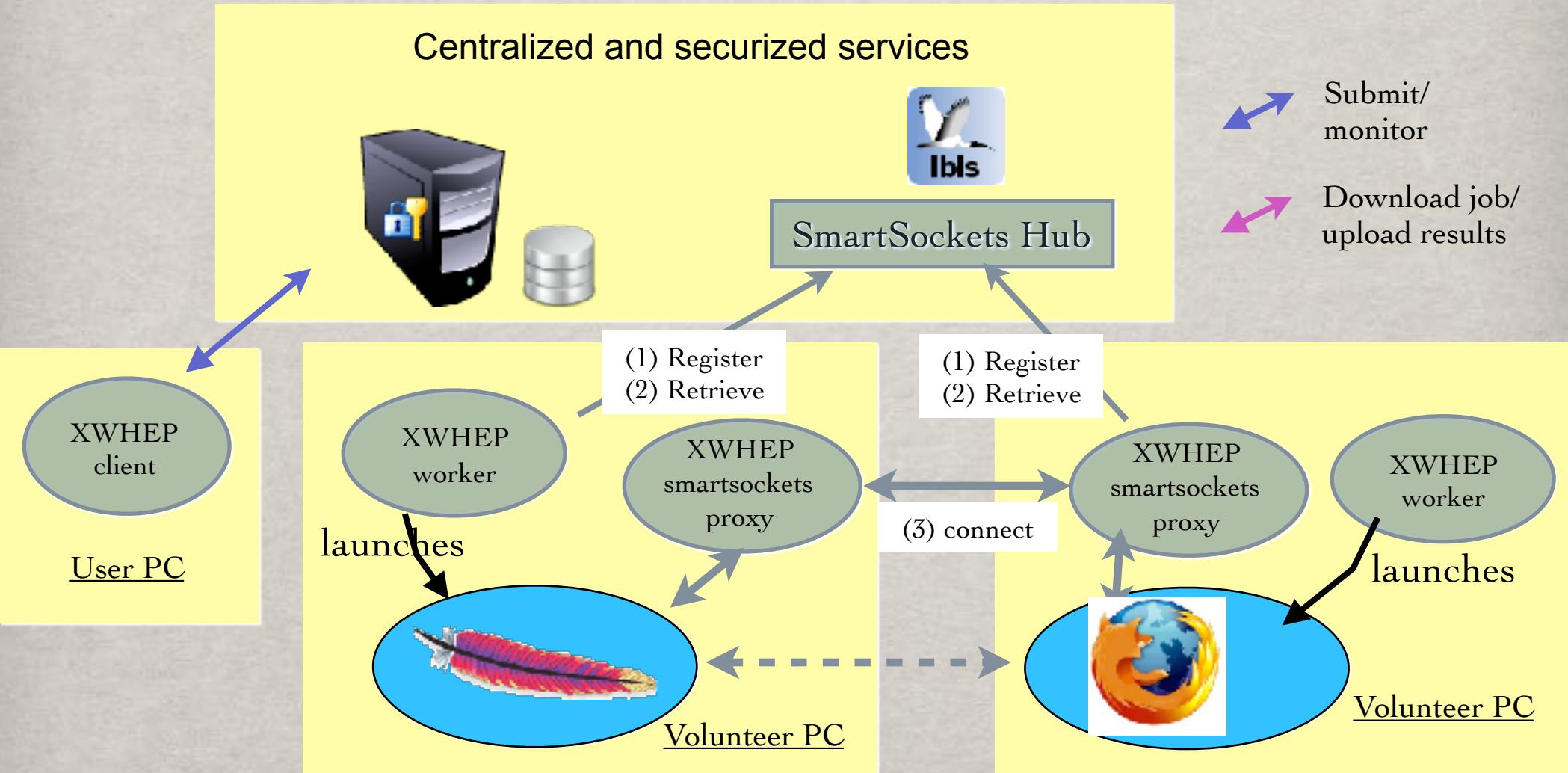
## INTERNODE COMMUNICATIONS

Example 3 : interconnect jobs running on volunteer resources

E.G. : interconnect wget and jackrabbit running on volunteer resources

# INTERNODE COMMUNICATIONS

## Example 3 : interconnect jobs running on volunteer resources



## INTERNODE COMMUNICATIONS

### Example 3 : connect a job running on volunteer resource to a service

This consists of a mix of examples 1 and 2

1. Submit jackrabbit as 1.2)
2. Retrieve jackrabbit proxy (JRP) as 1.3)
3. Submit wget providing JRP as 2.3)

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# DISCUSSION

<http://www.xtremweb-hep.org/>

<http://www.flyinggrid.org/>