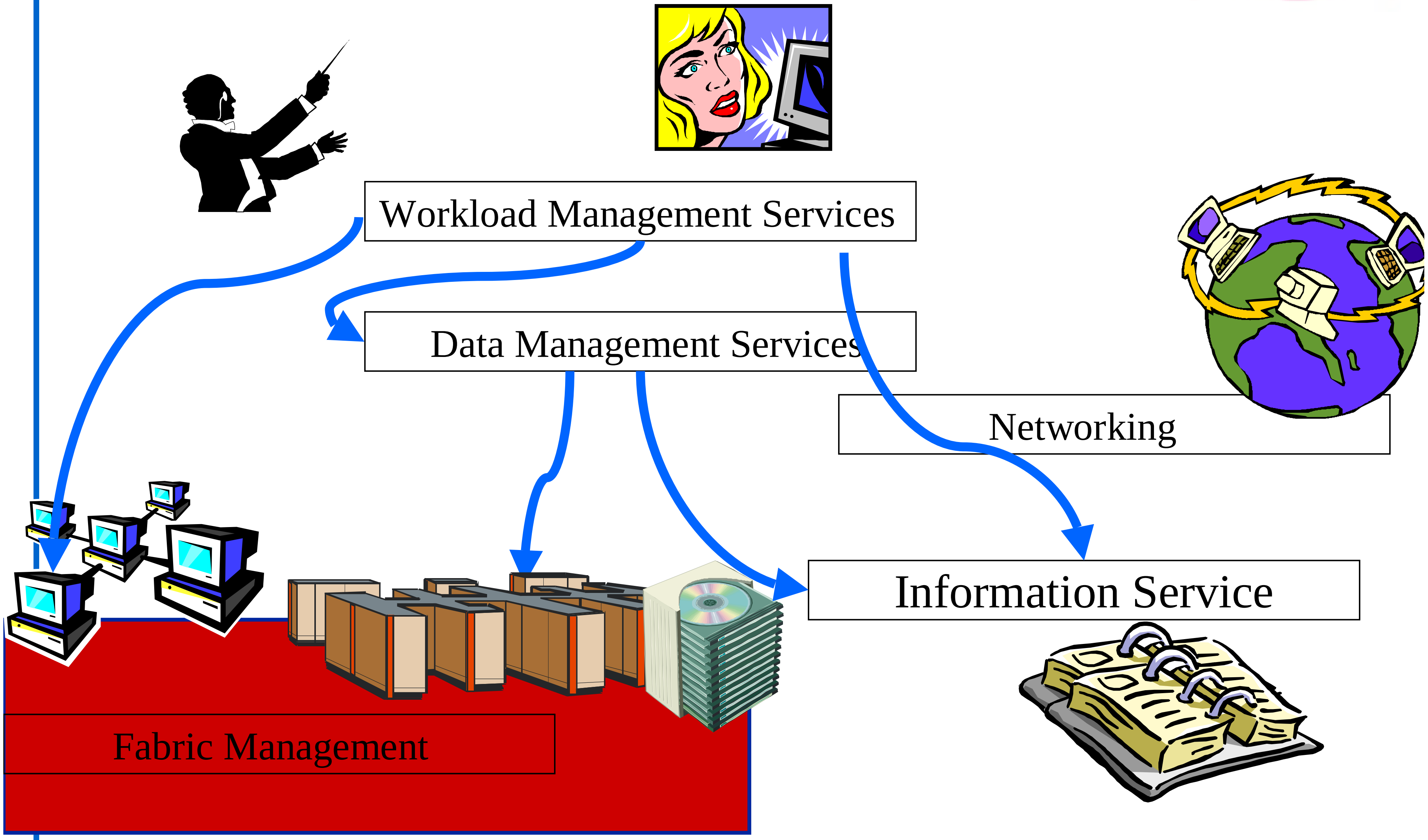
The EU DataGrid Fabric Management

The European DataGrid Project Team

http://www.eu-datagrid.org

EDG Tutorial Overview



Workload Management Services

Data Management Services

Networking

Information Service

Fabric Management

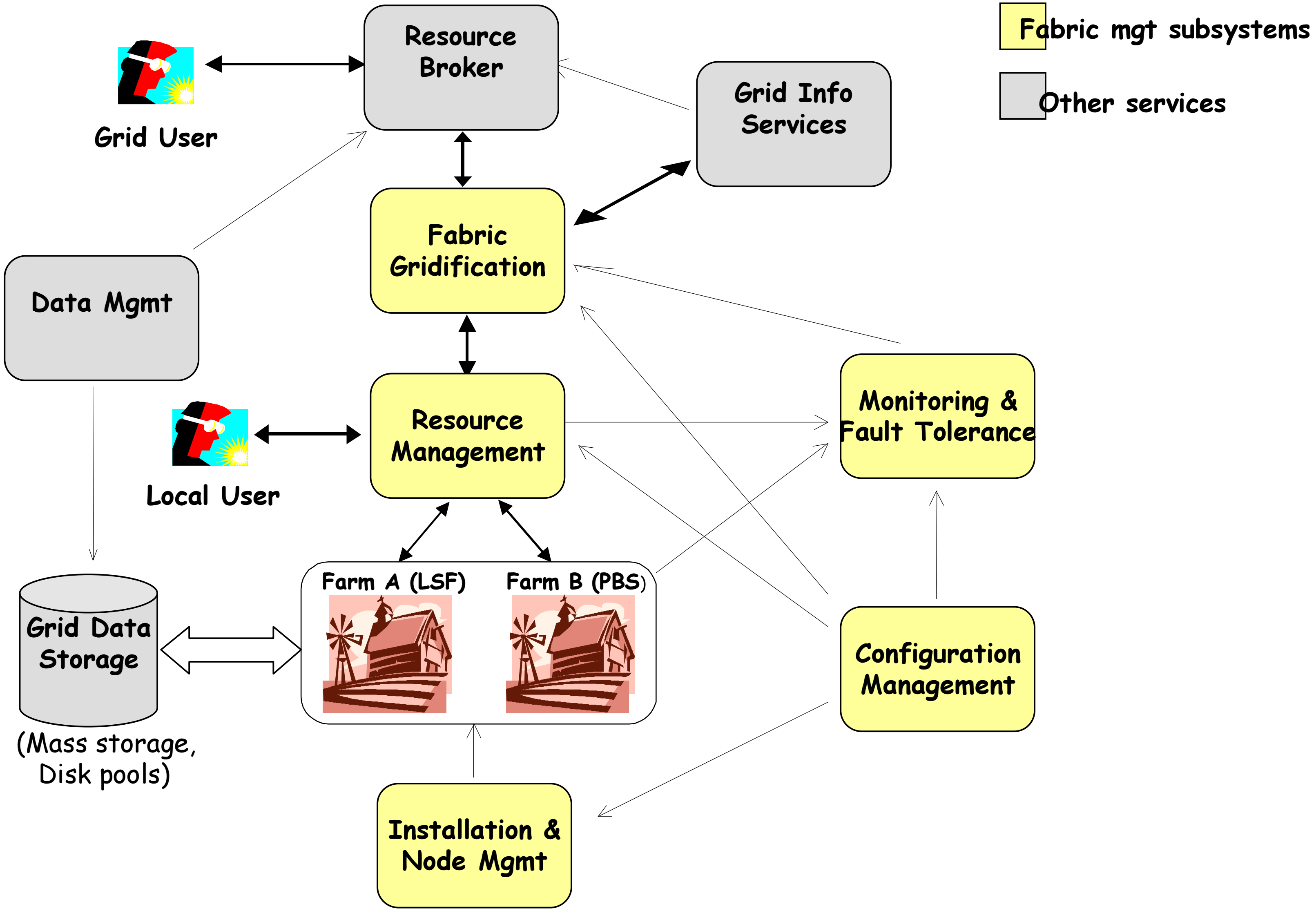
Contents

- Definition
- Fabric Management architecture overview
- User job management overview
- Present status (EDG2.0)
  - LCFG
  - LCAS + edg_gatekeeper
  - Fmon (Fabric MONitoring)
  - RMS (Resource Management System)

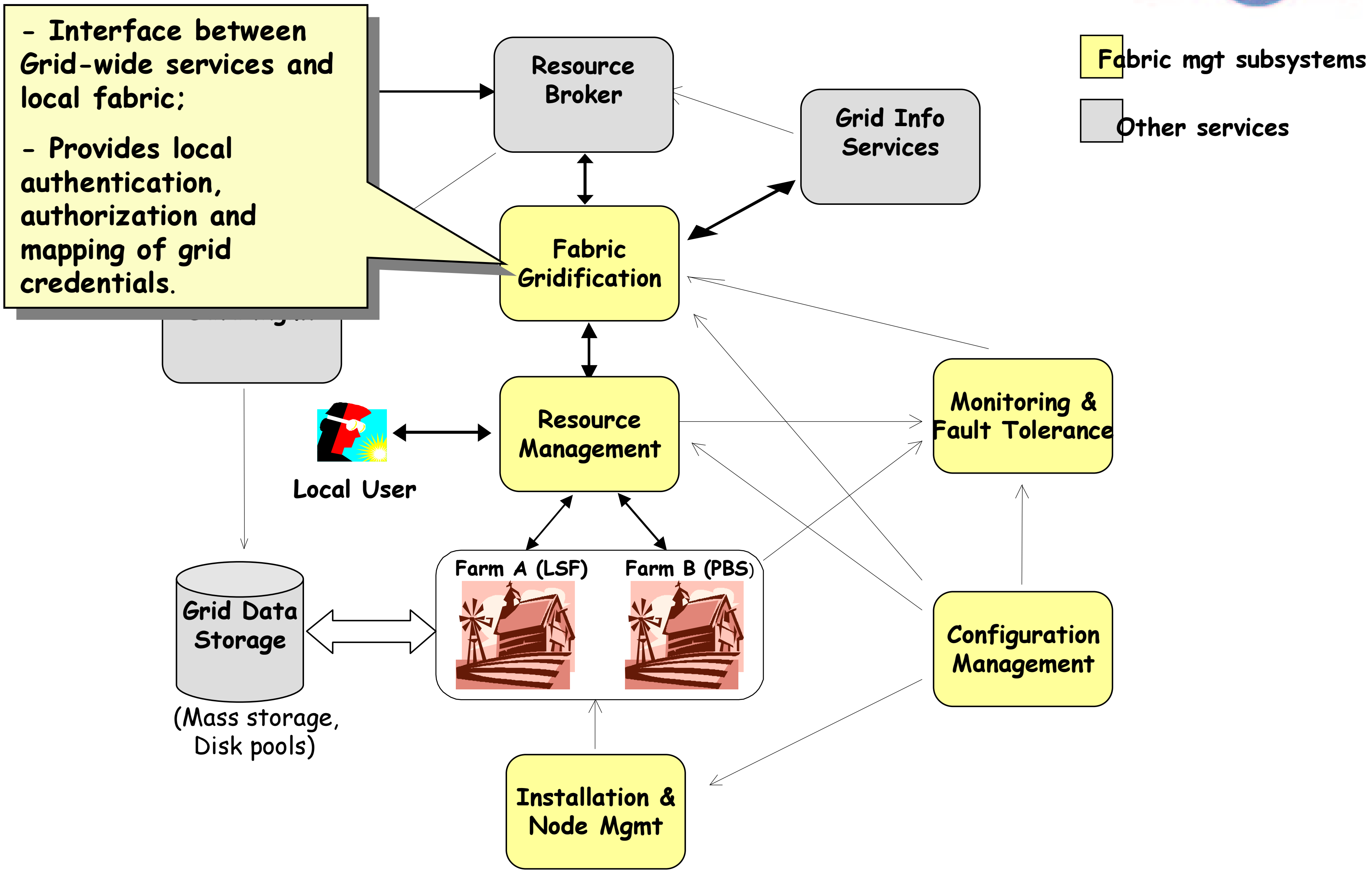
What is Fabric Management

- Definitions:
  - Cluster (or Farm): “A collection of computers on a network that can function as a single computing resource through the use of tools which hide the underlying physical structure“.
  - Fabric: "A complete set of computing resources (processors, memory, storage) operated in a coordinated fashion with a uniform set of management tools".
- Functionality:
  - Enterprise system administration – scalable to ~10K nodes
  - Provision for running grid jobs
  - Provision for running local jobs

Architecture logical overview



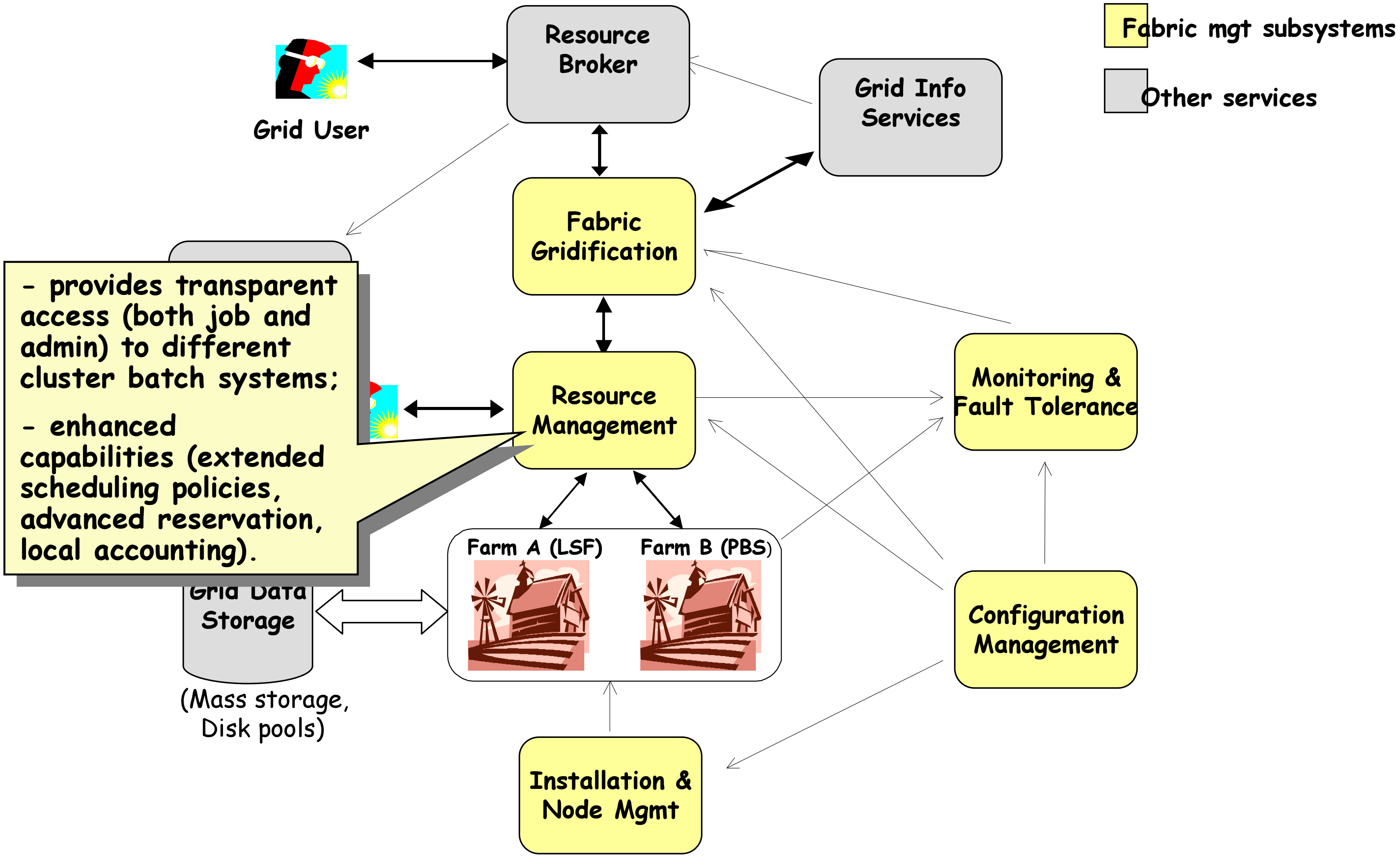
Architecture logical overview



- Interface between Grid-wide services and local fabric;

- Provides local authentication, authorization and mapping of grid credentials.

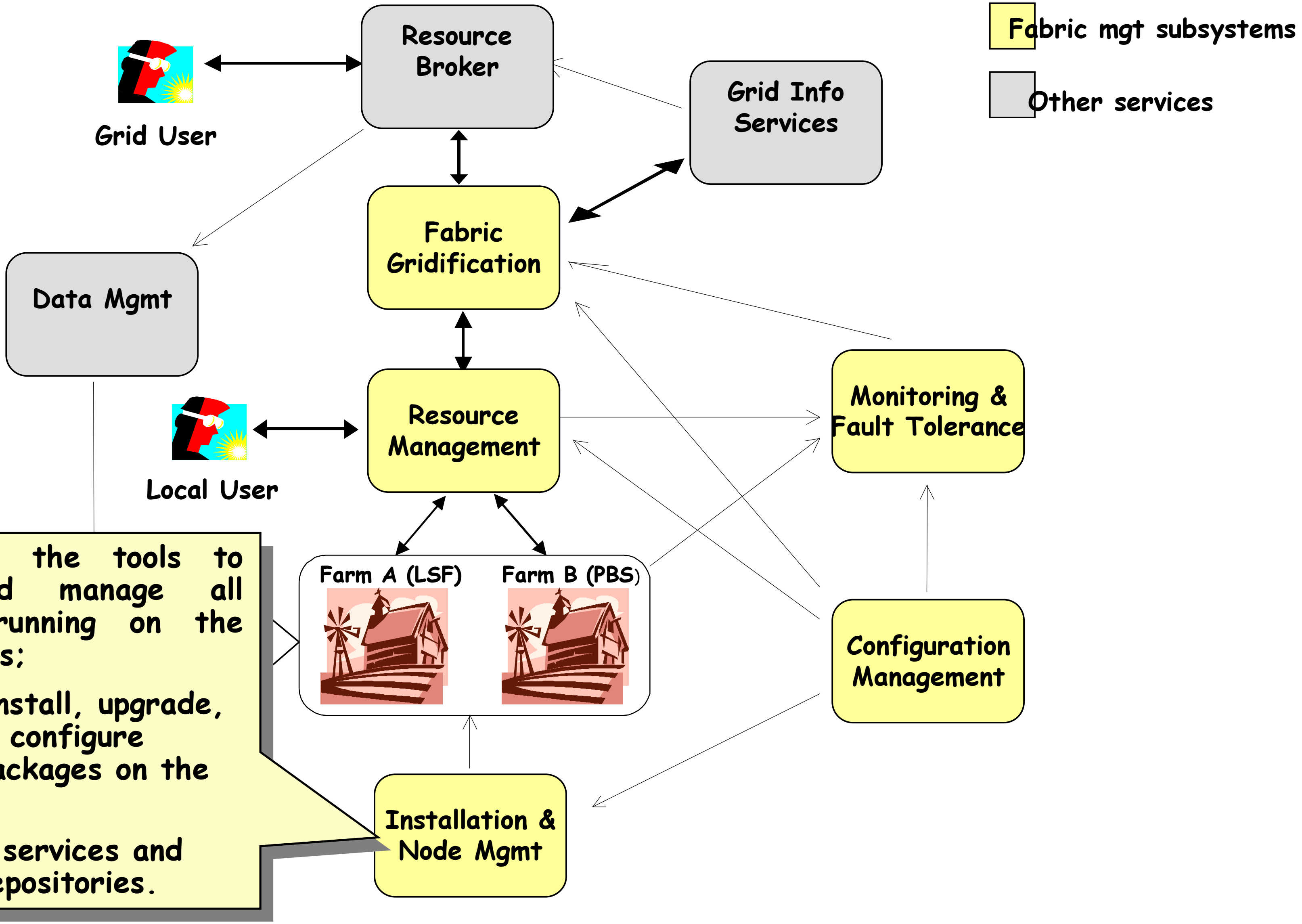
Architecture logical overview



- provides transparent access (both job and admin) to different cluster batch systems;

- enhanced capabilities (extended scheduling policies, advanced reservation, local accounting).

Architecture logical overview

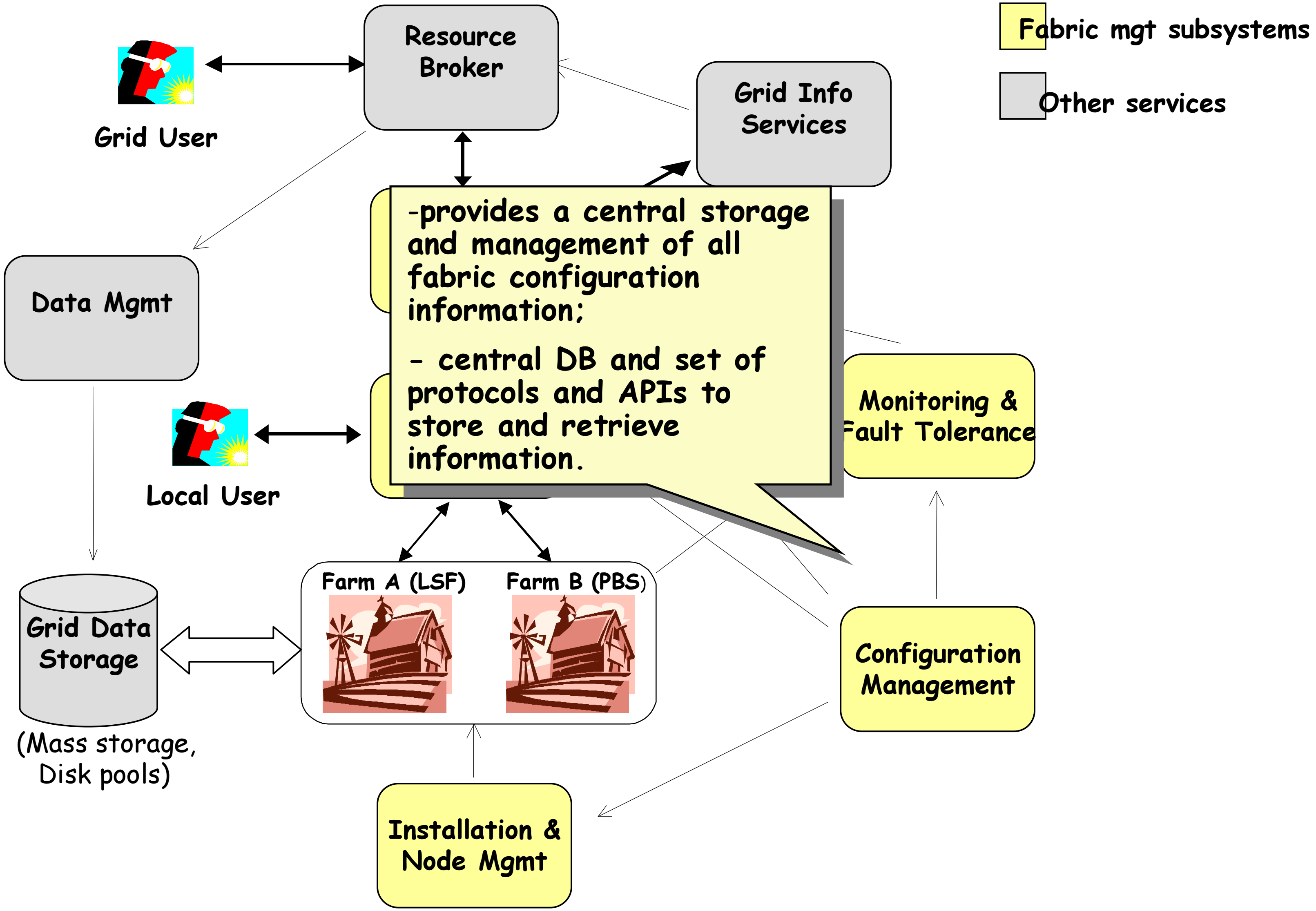


- provides the tools to install and manage all software running on the fabric nodes;

-Agent to install, upgrade, remove and configure software packages on the nodes.

-bootstrap services and software repositories.

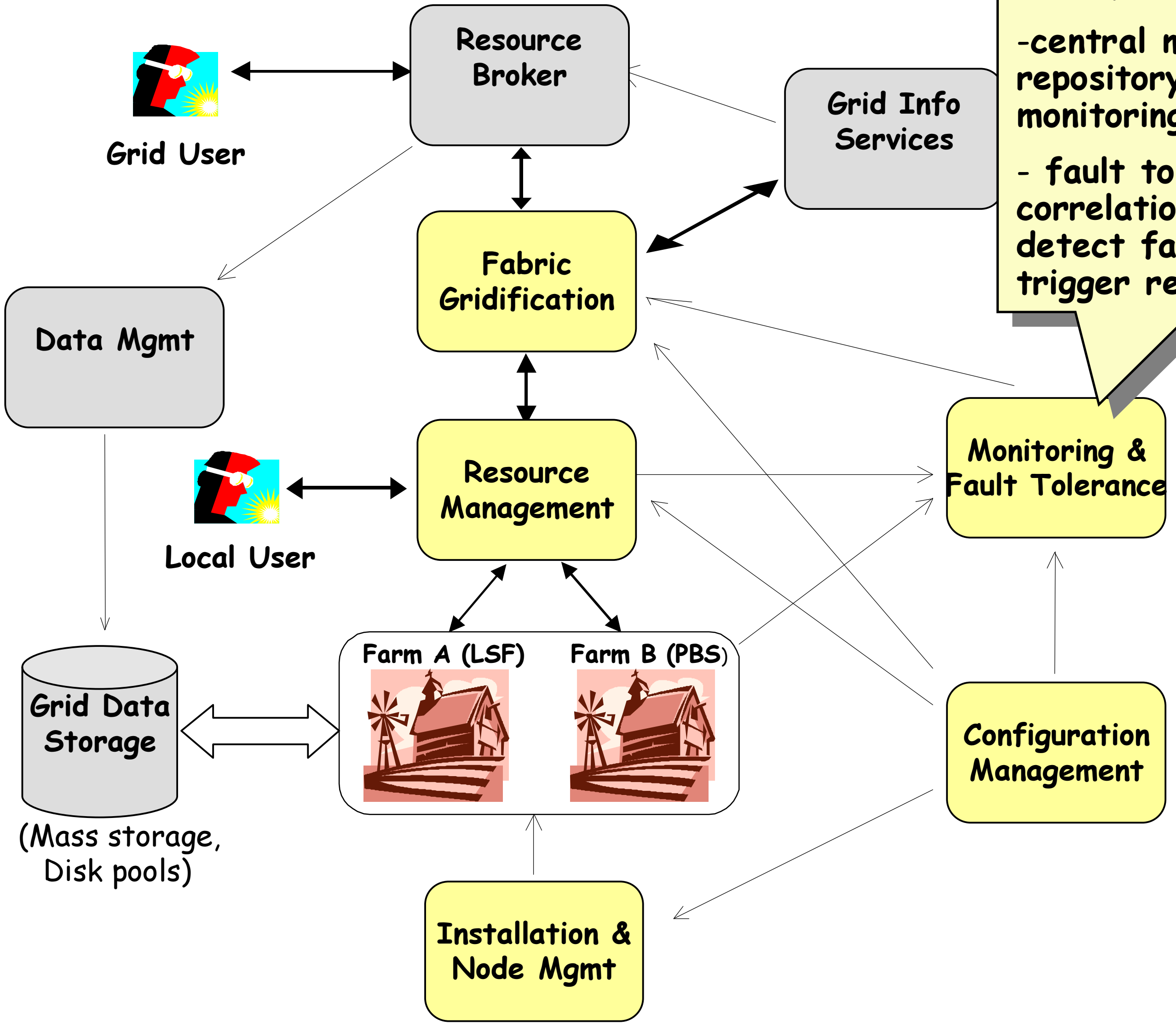
Architecture logical overview



-provides a central storage and management of all fabric configuration information;

- central DB and set of protocols and APIs to store and retrieve information.

Architecture logical overview



- provides the tools for gathering monitoring information on fabric nodes;

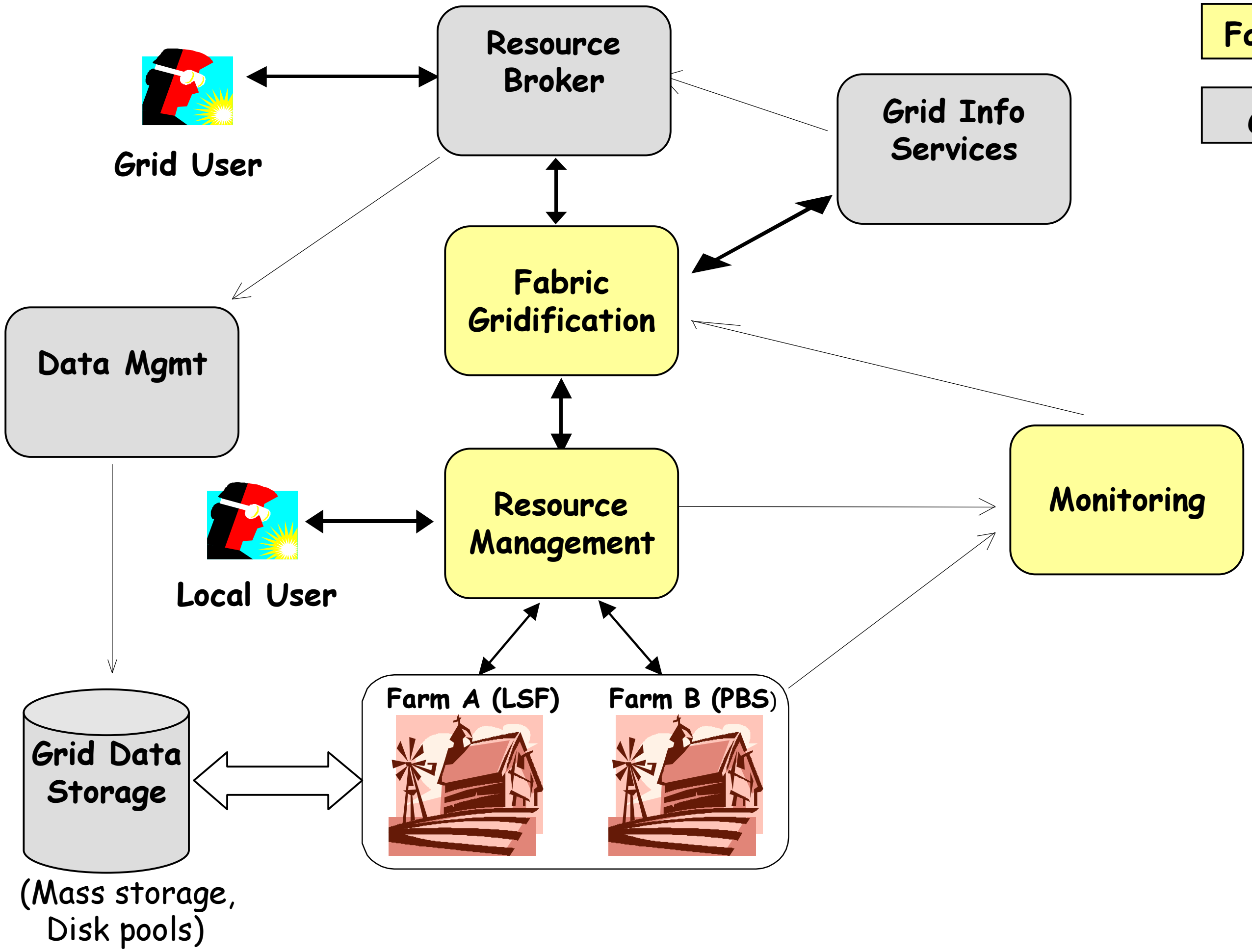
-central measurement repository stores all monitoring information;

- fault tolerance correlation engines detect failures and trigger recovery actions.

User job management (Grid and local)

🟨 Fabric mgt subsystems

⬜ Other services



Resource Broker

Grid User

Grid Info Services

Fabric Gridification

Data Mgmt

Monitoring

Local User

Resource Management

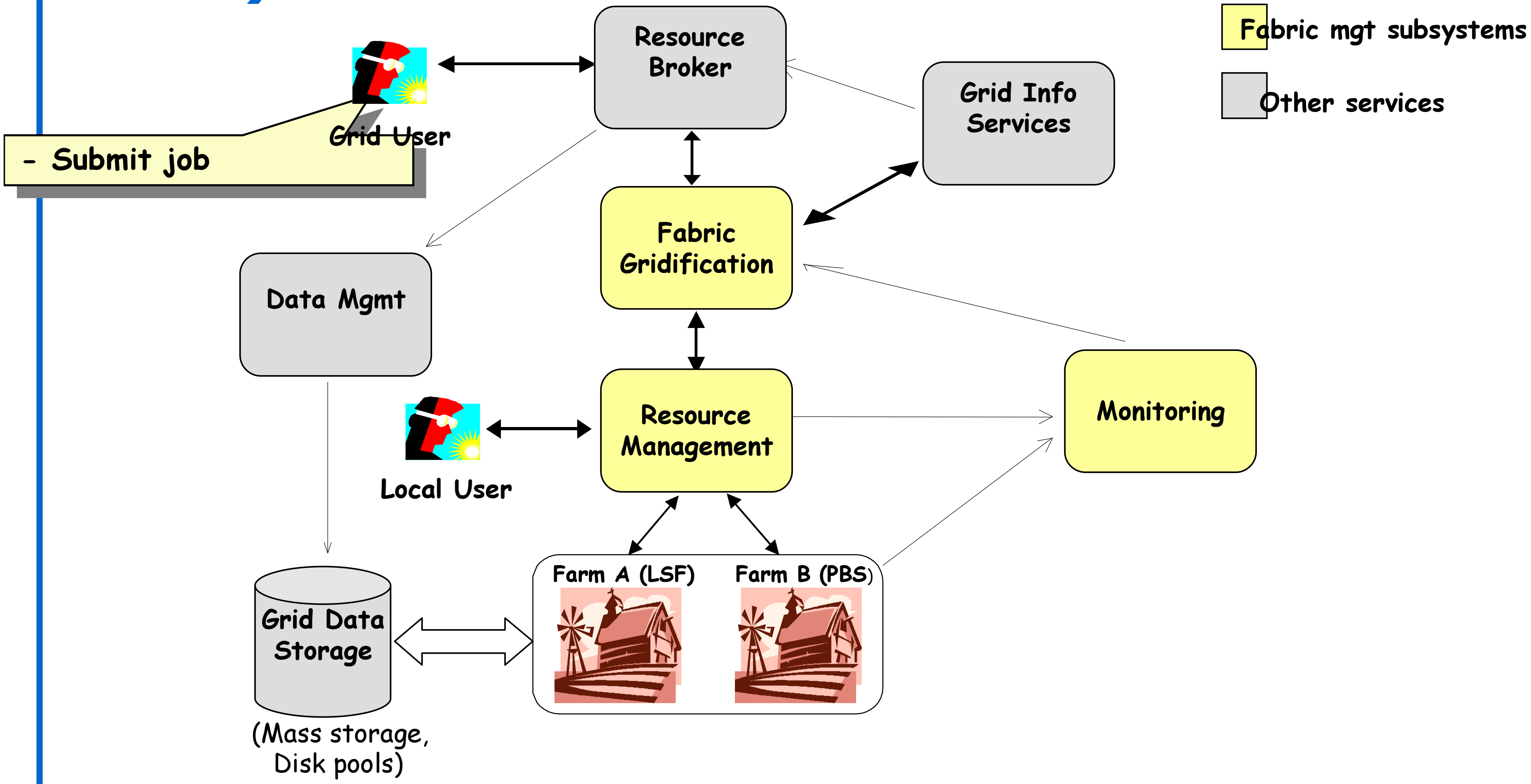
Farm A (LSF)

Farm B (PBS)

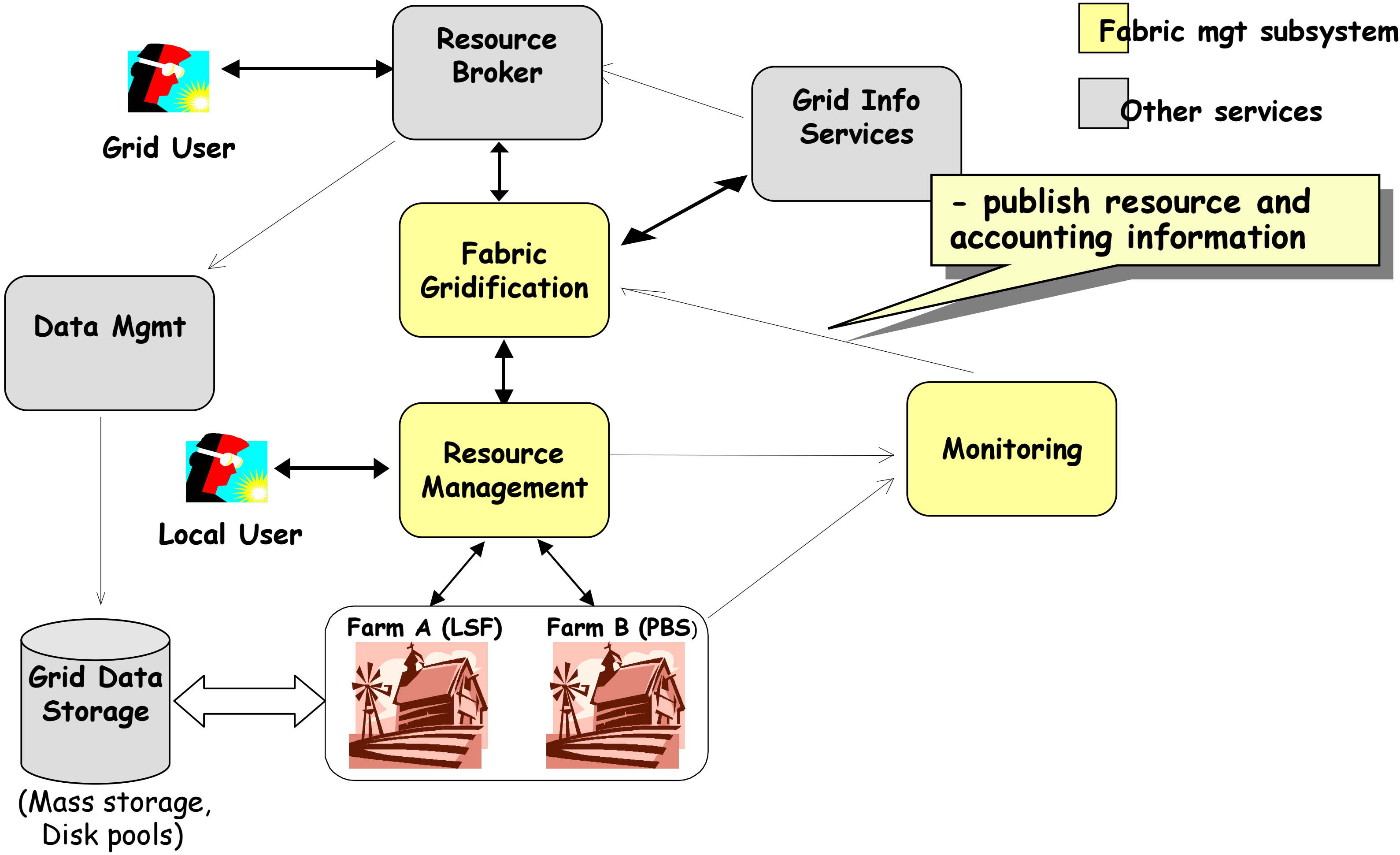
Grid Data Storage

(Mass storage, Disk pools)

User job management (Grid and local)

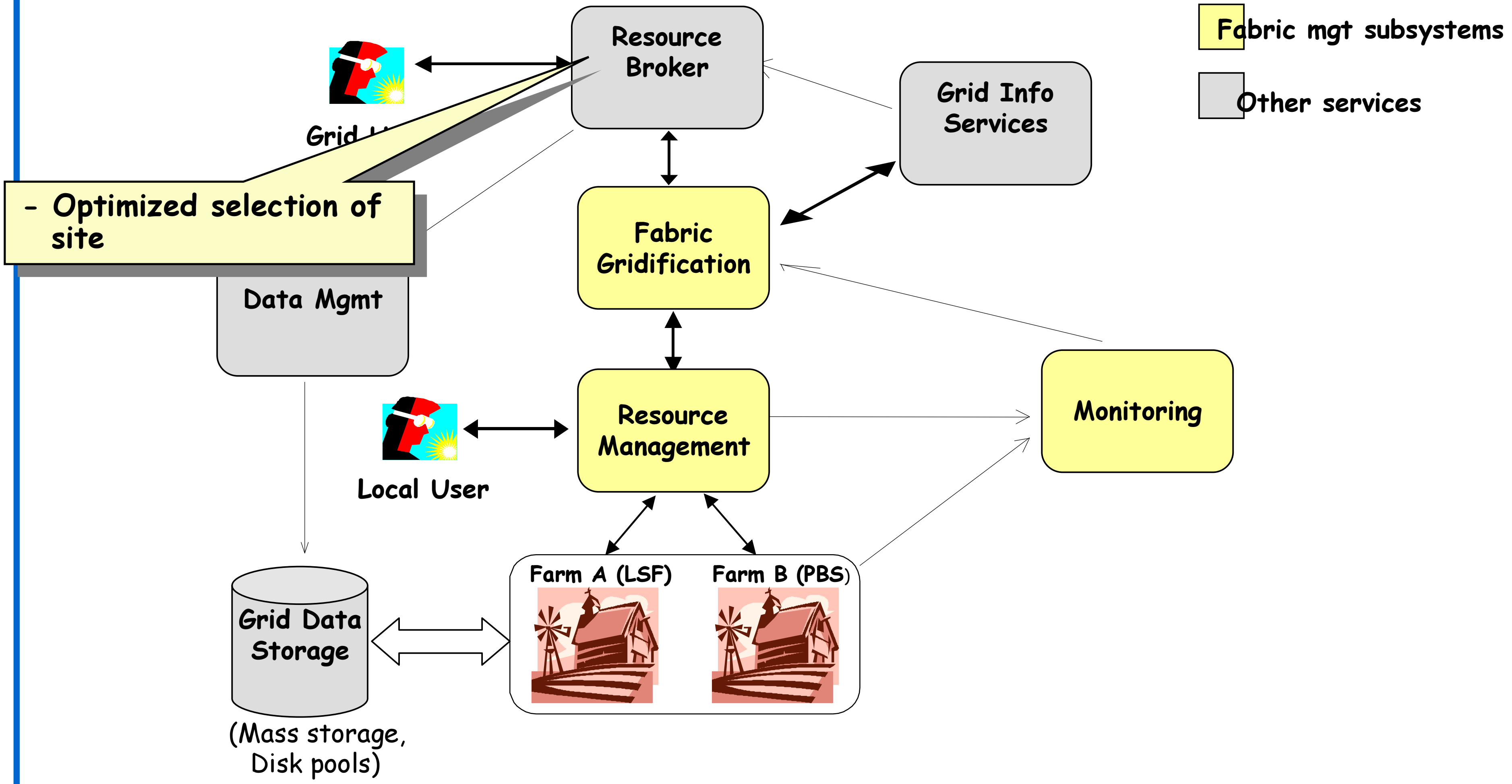


User job management (Grid and local)



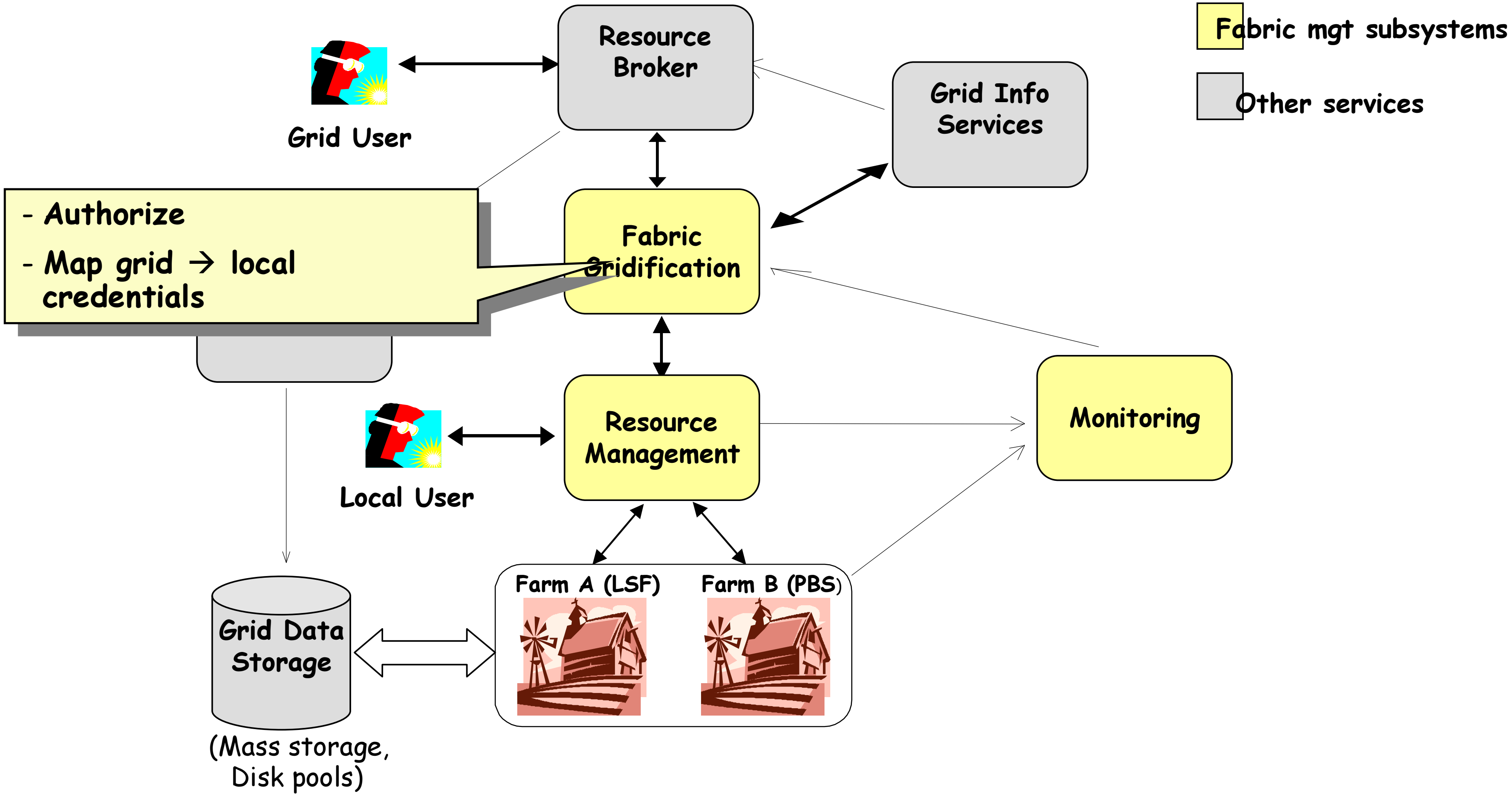
- publish resource and accounting information

User job management (Grid and local)



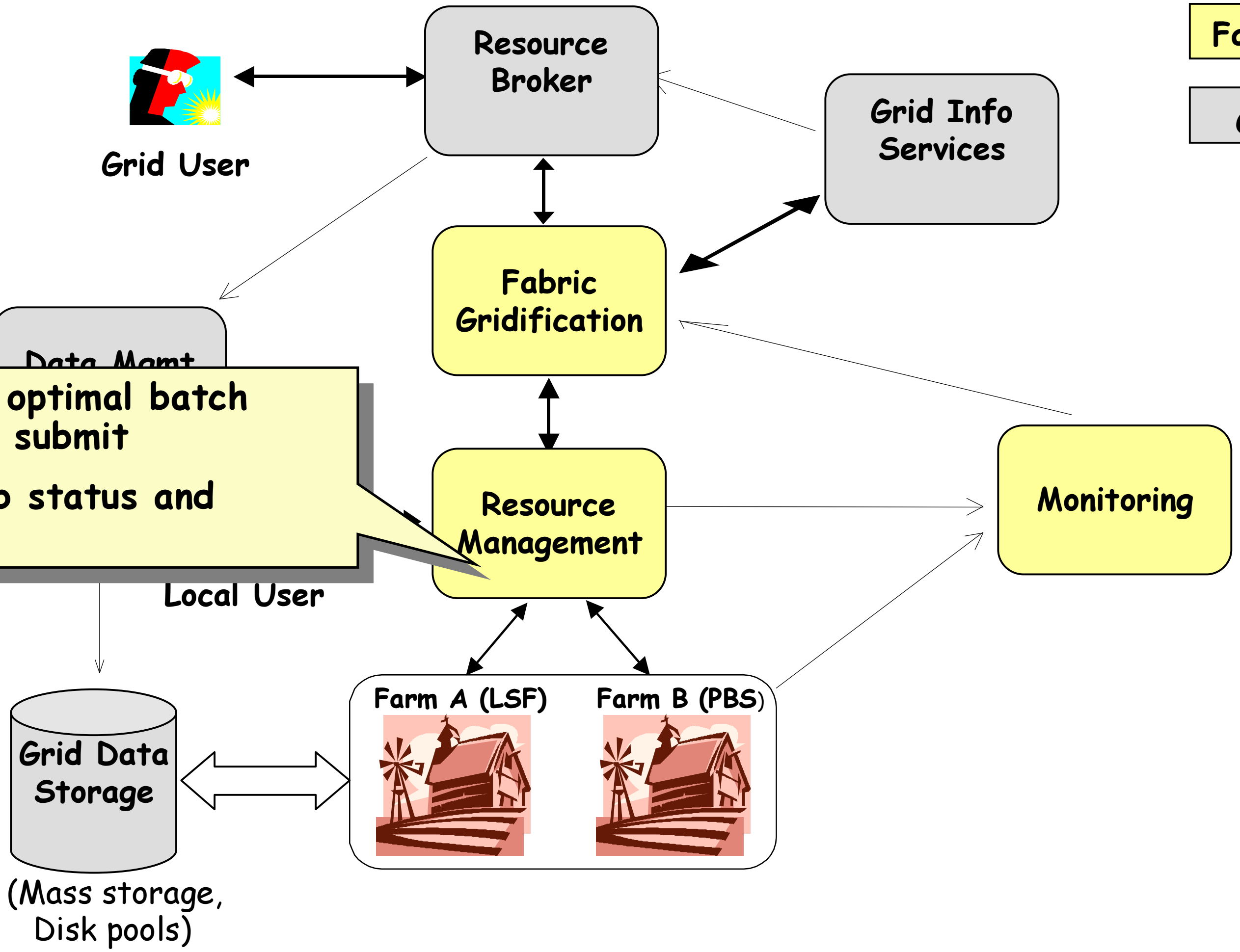
- Optimized selection of site

User job management (Grid and local)



- Authorize
- Map grid → local credentials

User job management (Grid and local)

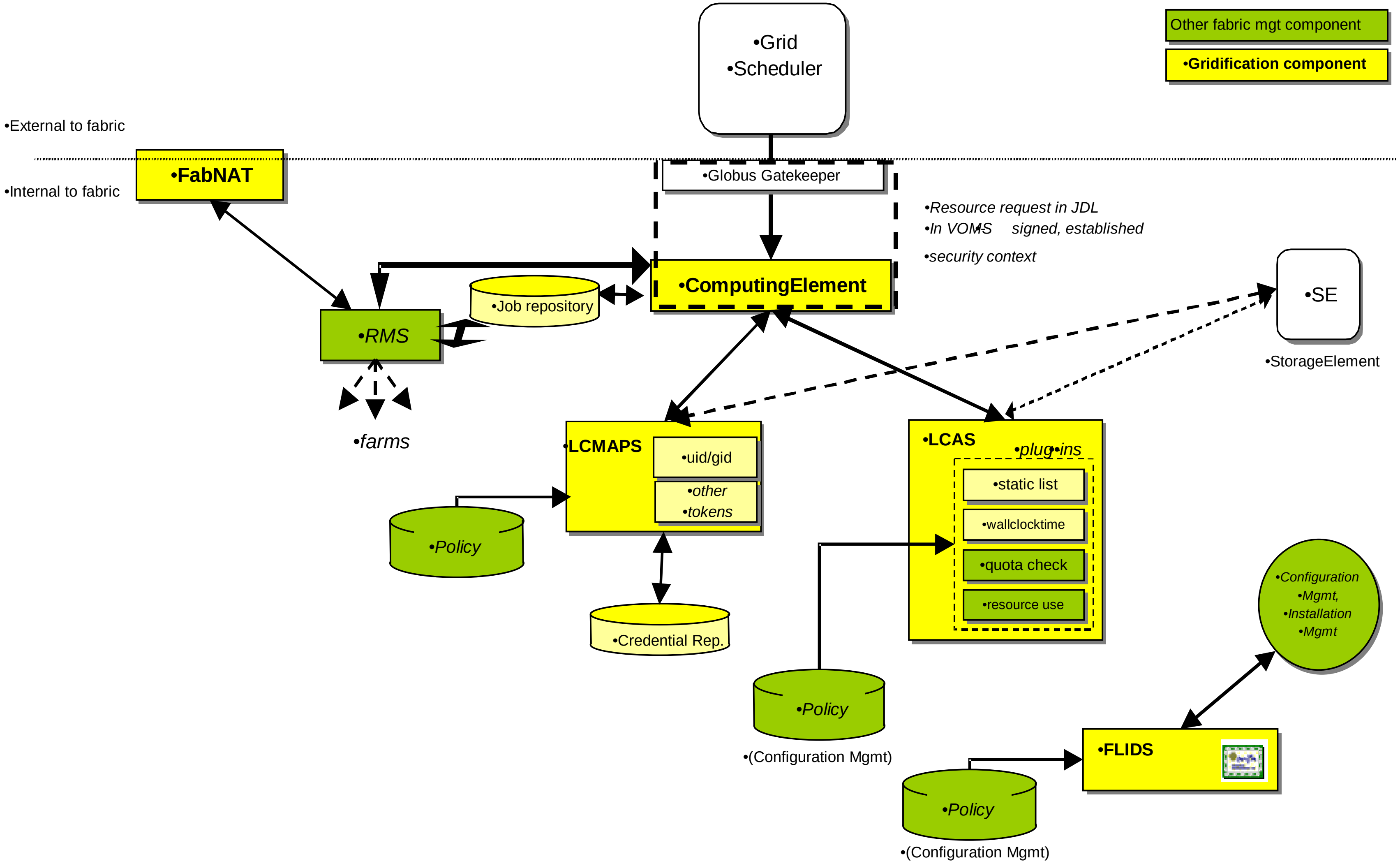


🟨 Fabric mgt subsystems

⬜ Other services

- Select an optimal batch queue and submit
- Return job status and output

Gridification Architecture



🟩 Other fabric mgt component

🟨 •Gridification component

•Grid
•Scheduler

•External to fabric

•Internal to fabric

•FabNAT

•Globus Gatekeeper

•Resource request in JDL
•In VOMS signed, established
•security context

•ComputingElement

•Job repository

•RMS

•farms

•SE

•StorageElement

•LCMAPS

•uid/gid

•other
•tokens

•Policy

•Credential Rep.

•LCAS

•plug•ins

•static list

•wallclocktime

•quota check

•resource use

•Policy

•(Configuration Mgmt)

•Configuration
•Mgmt,
•Installation
•Mgmt

•FLIDS

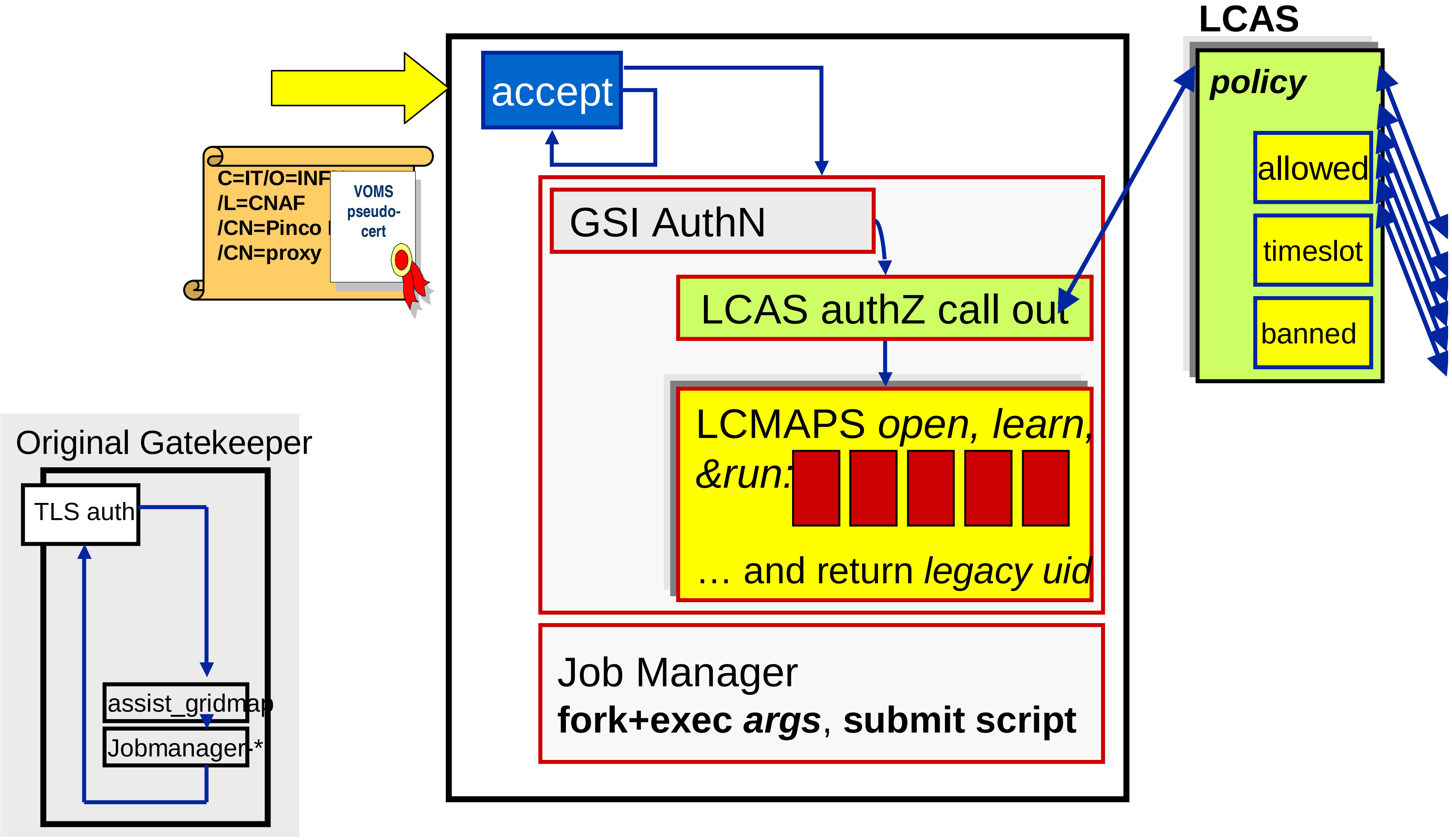
•Policy

•(Configuration Mgmt)

LCAS 1.0 (EDG release 1.2)

- The Local Centre Authorization Service (LCAS) handles authorization requests to the local computing fabric.
- Authorization plugin framework, library.
- The authorization decision of the LCAS is based upon the users' proxy certificate and the job specification in RSL (JDL) format. The certificate and RSL are passed to (plug-in) authorization modules, which grant or deny the access to the fabric. Three standard authorization modules are provided by default:
  - lcas_userallow.mod, checks if user is allowed on the fabric (currently the gridmap file is checked).
  - lcas_userban.mod, checks if user should be banned from the fabric.
  - lcas_timeslots.mod, checks if fabric is open at this time of the day for datagrid jobs.

Authentication control flow EDG gatekeeper



C=IT/O=INF
/L=CNAF
/CN=Pinco
/CN=proxy

VOMS pseudo-cert

accept

GSI AuthN

LCAS authZ call out

LCMAPS *open, learn, &run:*

… and return *legacy uid*

Job Manager
fork+exec *args*, submit script

LCAS

policy

allowed

timeslot

banned

Original Gatekeeper

TLS auth

assist_gridmap

Jobmanager-*

RMS architecture

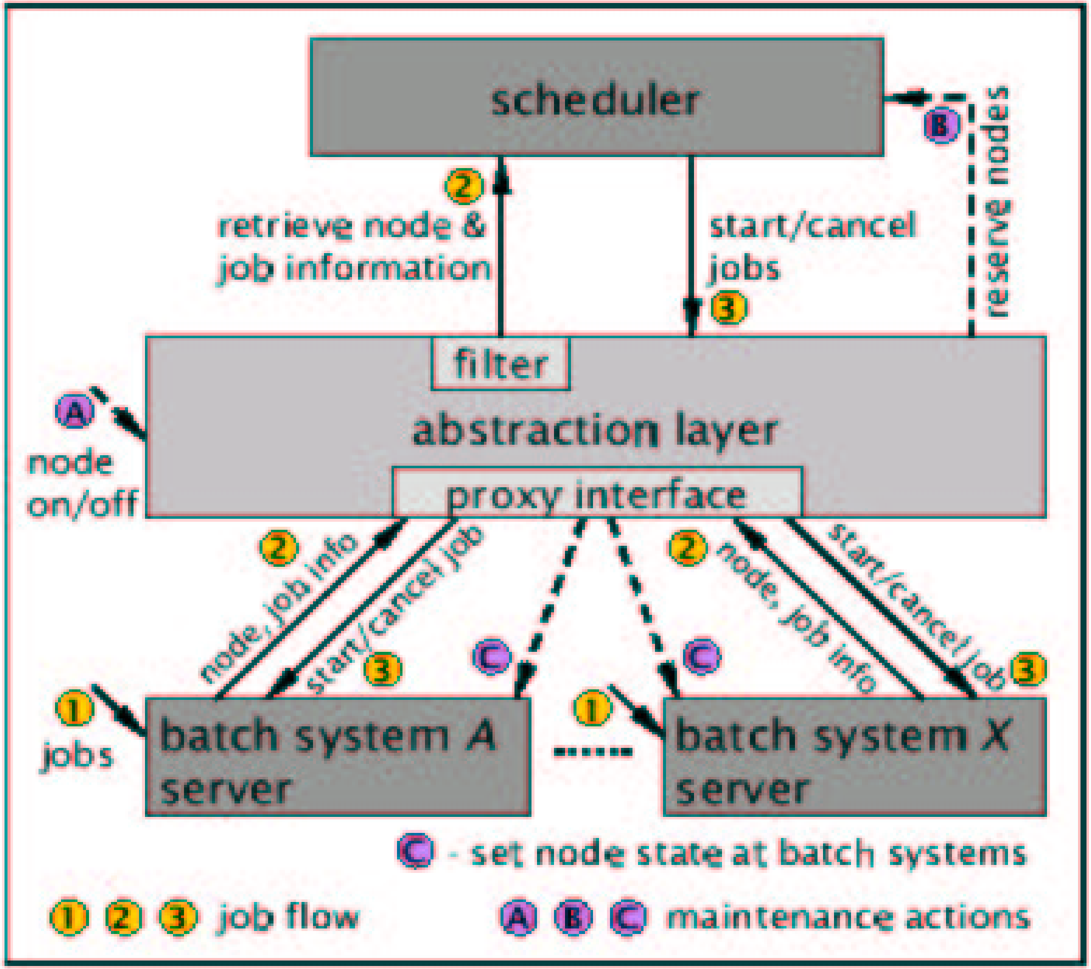
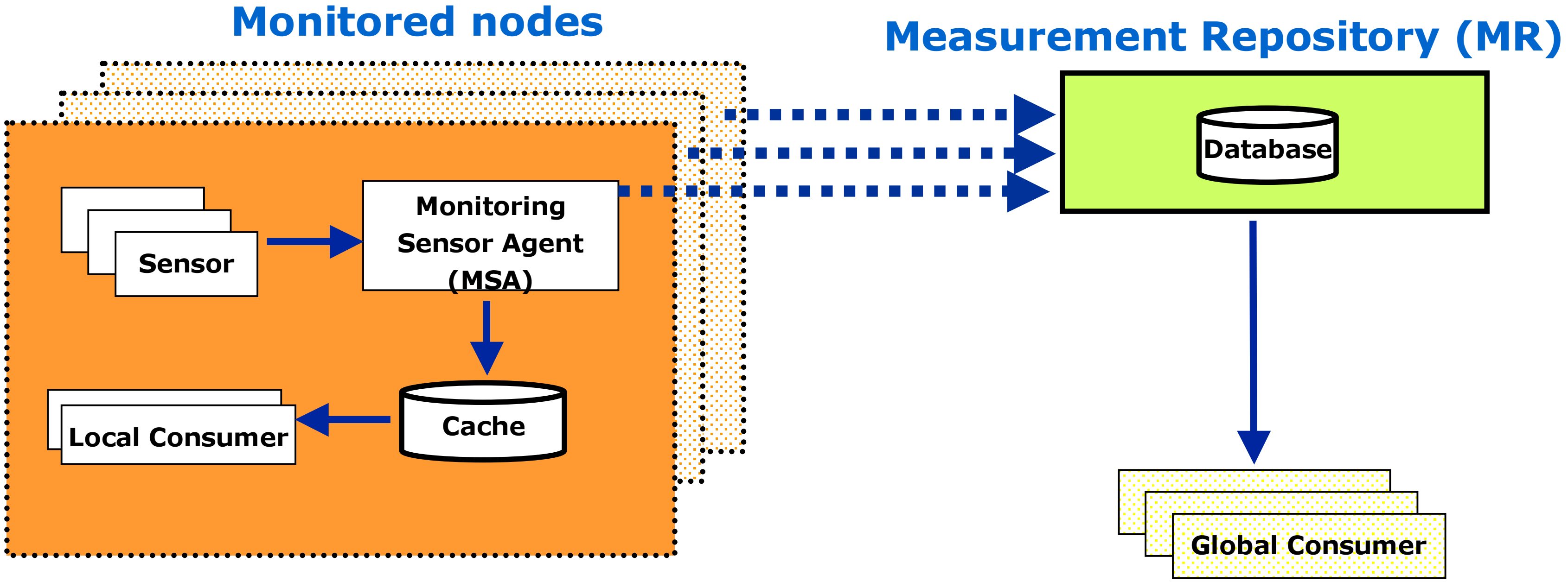


Figure 1: Architecture of the resource management framework

Fabric Monitoring architecture



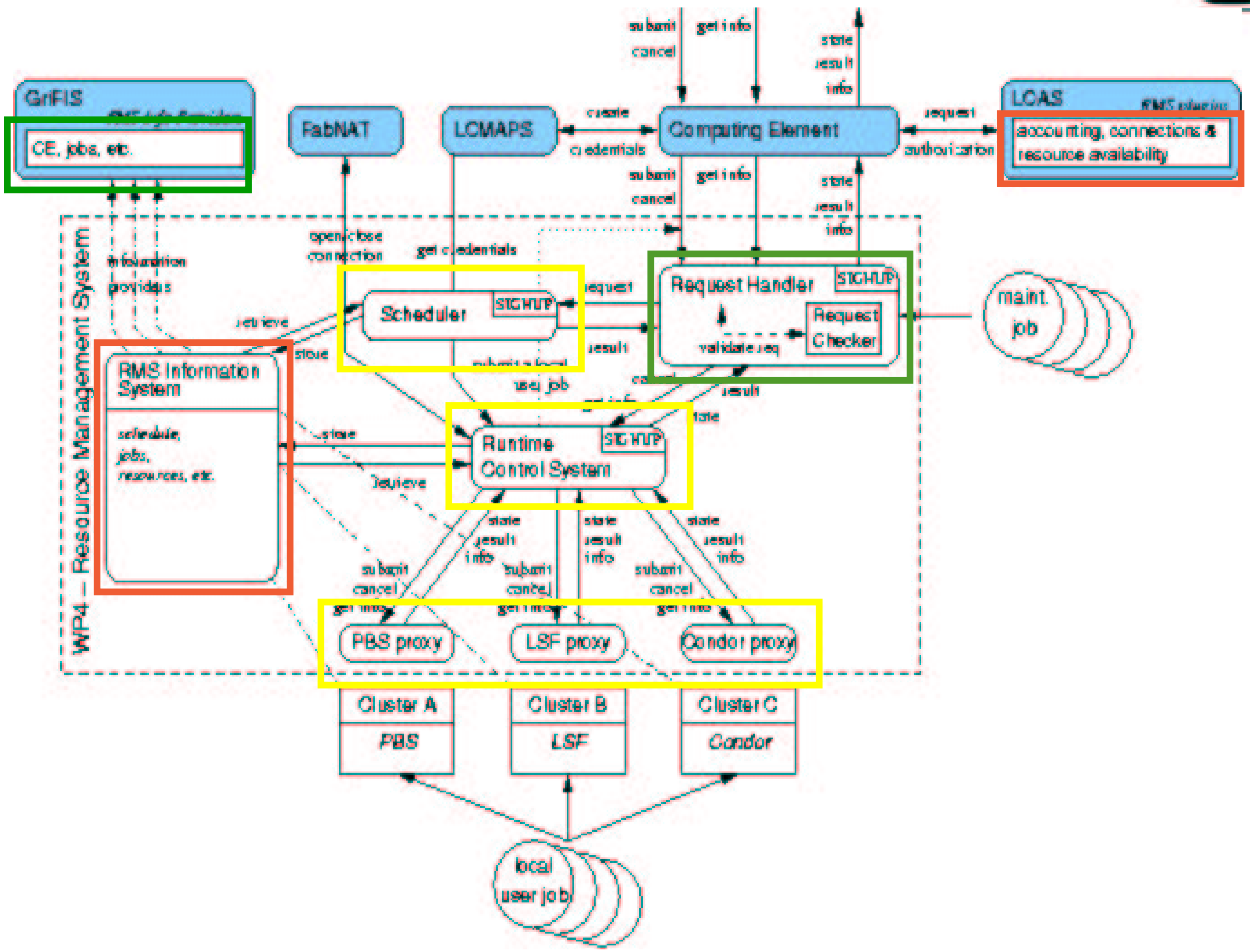
Monitored nodes

- Sensors measure Metrics mainly locally: CPU utilization, network throughput, daemons status, etc.
- MSA – Monitoring Sensor Agent:
  - collects sensors data, stores them in a local cache and sends them to the central repository
  - triggers measurements according to the configured schedule.
- Local Cache: allows local consumers to have fast access to monitoring information. Data can be collected even if the node istemporally isolated from central repository.
- Outgoing data consist of a value associated to a metric identifier (what), a timestamp (when), a target identifier (where), and an agent identifier (who).

Measurement Repository

- Receives samples from all the nodes
- Stores data:
  - Plain text DB
  - Oracle DB
- Follows data up to subscribers
- Answers queries
- information
- Consumers can subscribe to metrics and receive notification when new samples are available

RMS - Resource Management System



RMS functionality

- The Resource Management System (RMS) is responsible for the management of local user jobs, grid user jobs and maintenance jobs within a site, that is build of one to many clusters.
- It enhances capabilities of the Globus Toolkit job management that submits jobs to a specific resource.
- The enhancements enabled by the RMS include:
  - advanced scheduling mechanisms, e.g. backfill, fair share
  - support for advance reservations
  - support for maintenance tasks, e.g. node on/off.
  - Support to the EDG grid accounting infrastructure

Fabric Management @ Release 2.0

- Installation and configuration:

  LCFG (Local ConFiGuration system)

- Gridification:

  LCAS + edg_gatekeeper

- Monitoring

  FMON

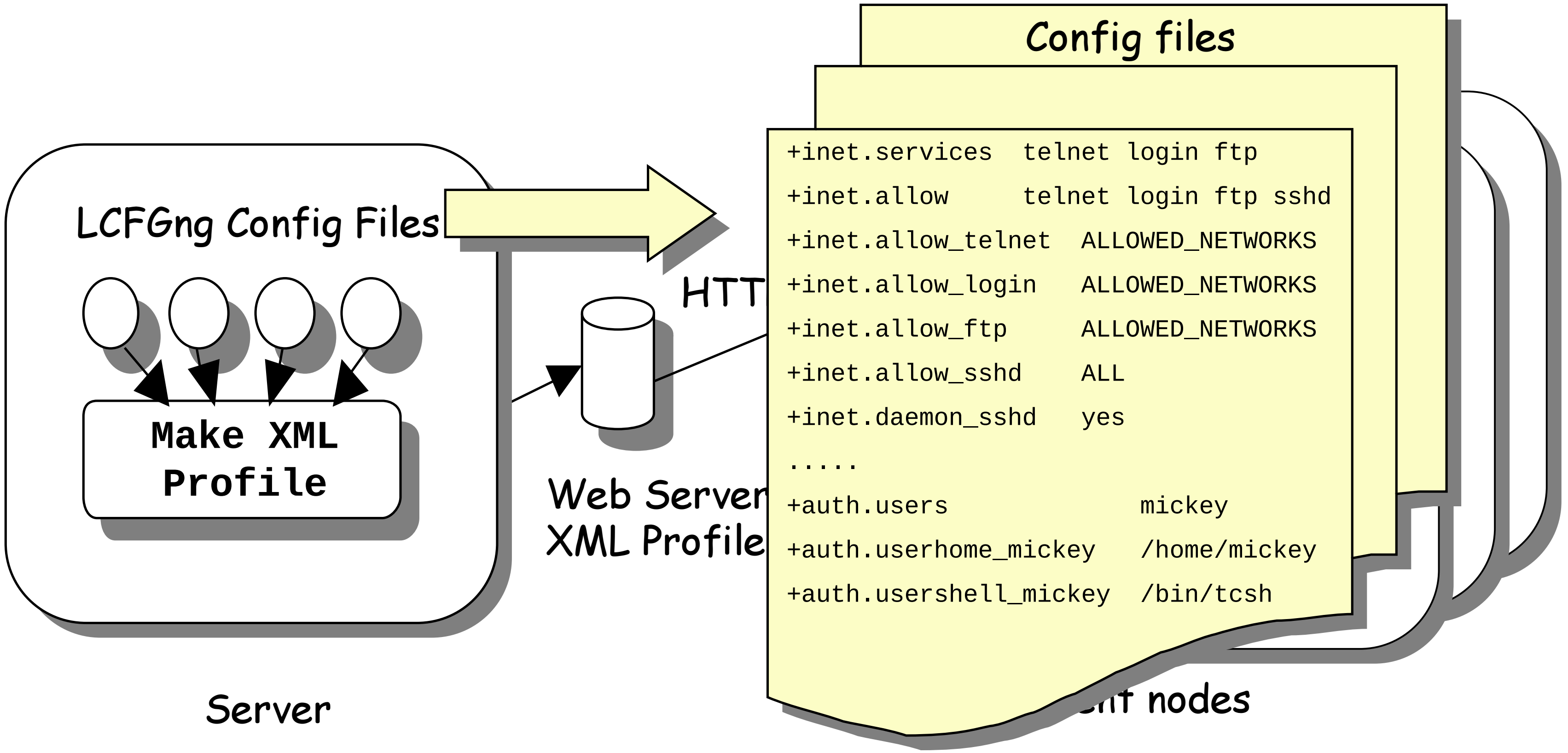
- Resource Management

  RMS

LCFG (Local ConFiGuration system)

- LCFG is originally developed by the Computer Science Department of Edinburgh University
- Widely used fabric management tool, whose purpose is to handle automated installation and configuration in a very diverse and evolving environment
- Basic features:
  - automatic installation of O.S.
  - installation/upgrade/removal of all (rpm-based) software packages
  - centralized configuration and management of machines
  - extendible to configure and manage EDG middleware and custom application software
- LCFGng: updated version of LCFG, customized to EDG needs. This is the version used at EDG 2.0

LCFGng system architecture

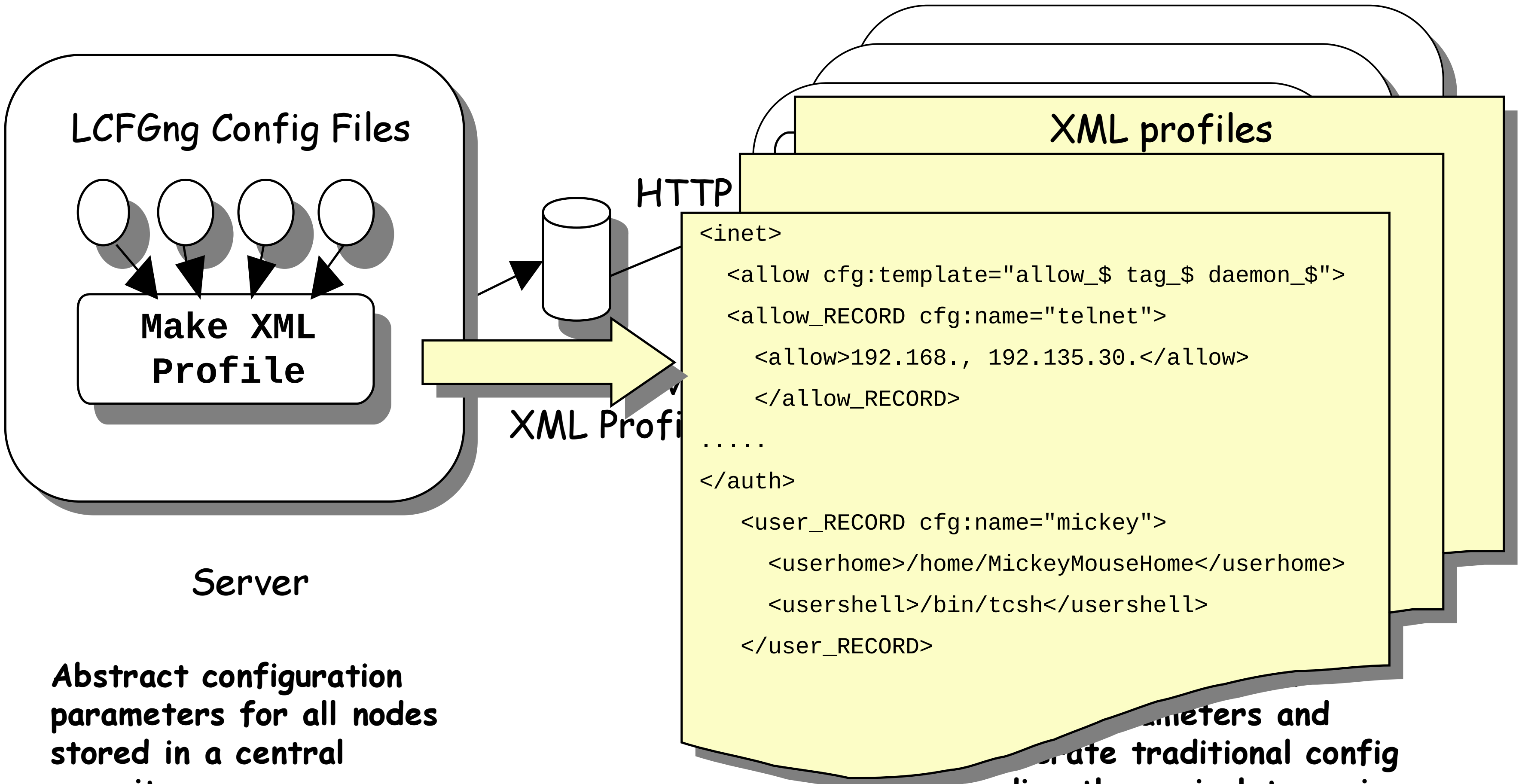


```
+inet.services   telnet login ftp
+inet.allow      telnet login ftp sshd
+inet.allow_telnet   ALLOWED_NETWORKS
+inet.allow_login    ALLOWED_NETWORKS
+inet.allow_ftp      ALLOWED_NETWORKS
+inet.allow_sshd     ALL
+inet.daemon_sshd    yes
.....
+auth.users              mickey
+auth.userhome_mickey    /home/mickey
+auth.usershell_mickey   /bin/tcsh
```

Abstract configuration parameters for all nodes stored in a central repository

A collection of agents read configuration parameters and either generate traditional config files or directly manipulate various services

LCFGng system architecture



```
<inet>
  <allow cfg:template="allow_$ tag_$ daemon_$">
  <allow_RECORD cfg:name="telnet">
    <allow>192.168., 192.135.30.</allow>
    </allow_RECORD>
.....
</auth>
   <user_RECORD cfg:name="mickey">
     <userhome>/home/MickeyMouseHome</userhome>
     <usershell>/bin/tcsh</usershell>
   </user_RECORD>
```

Abstract configuration parameters for all nodes stored in a central repository

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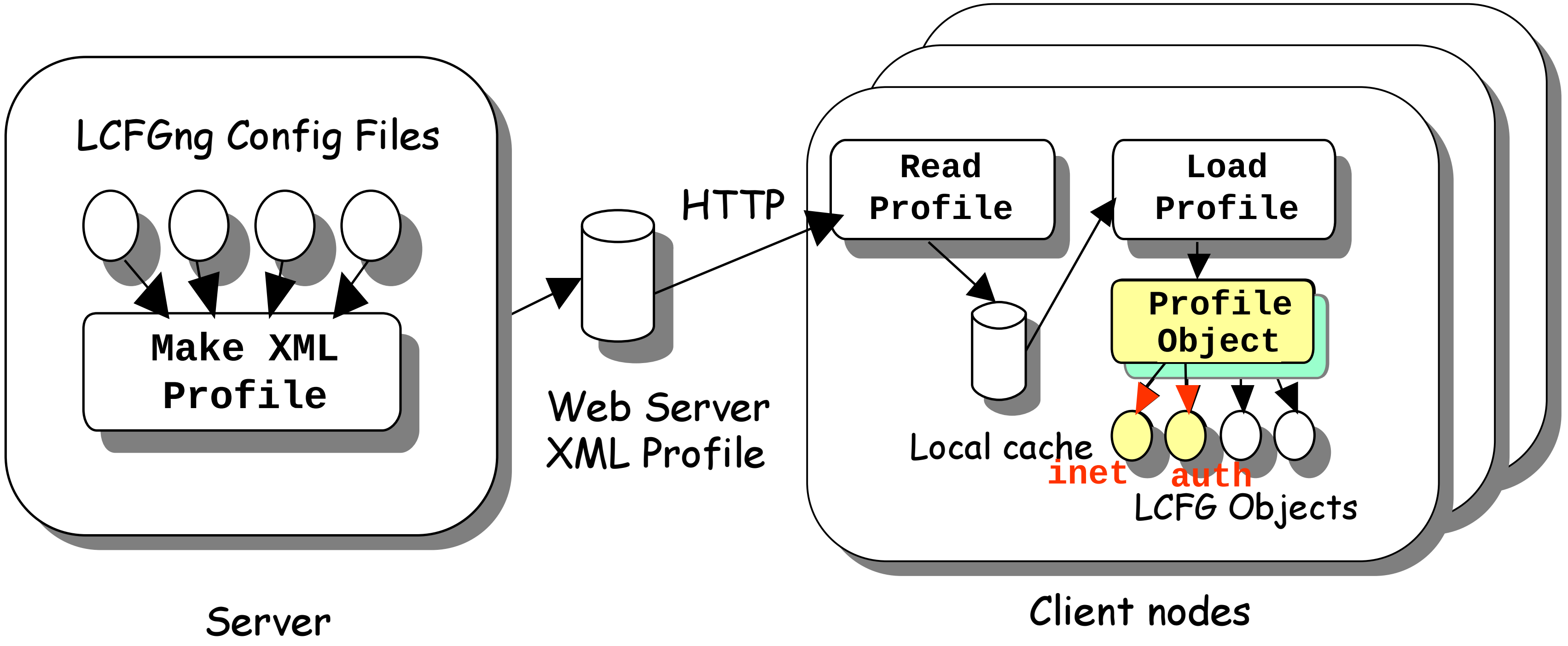
LCFGng system architecture



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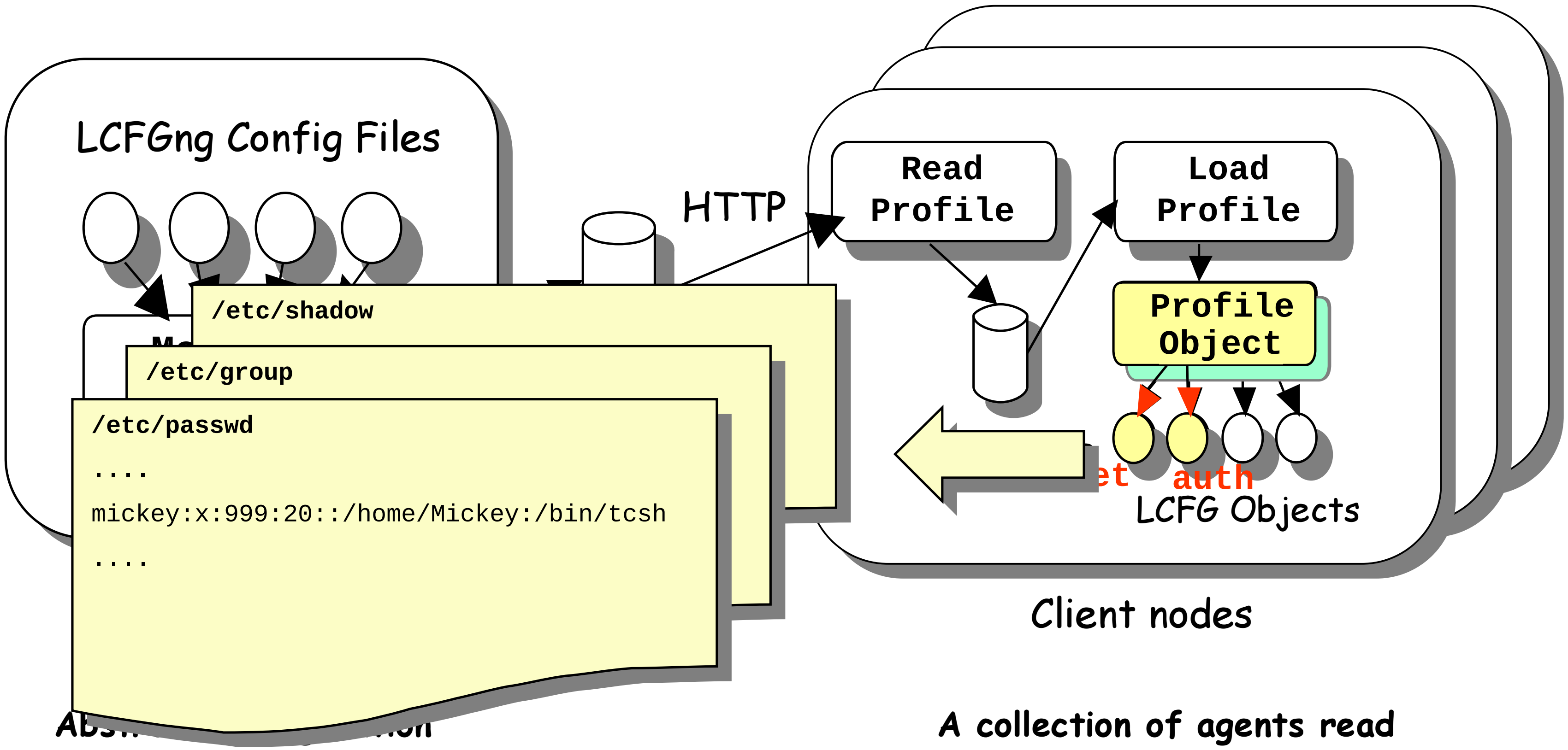
LCFGng system architecture

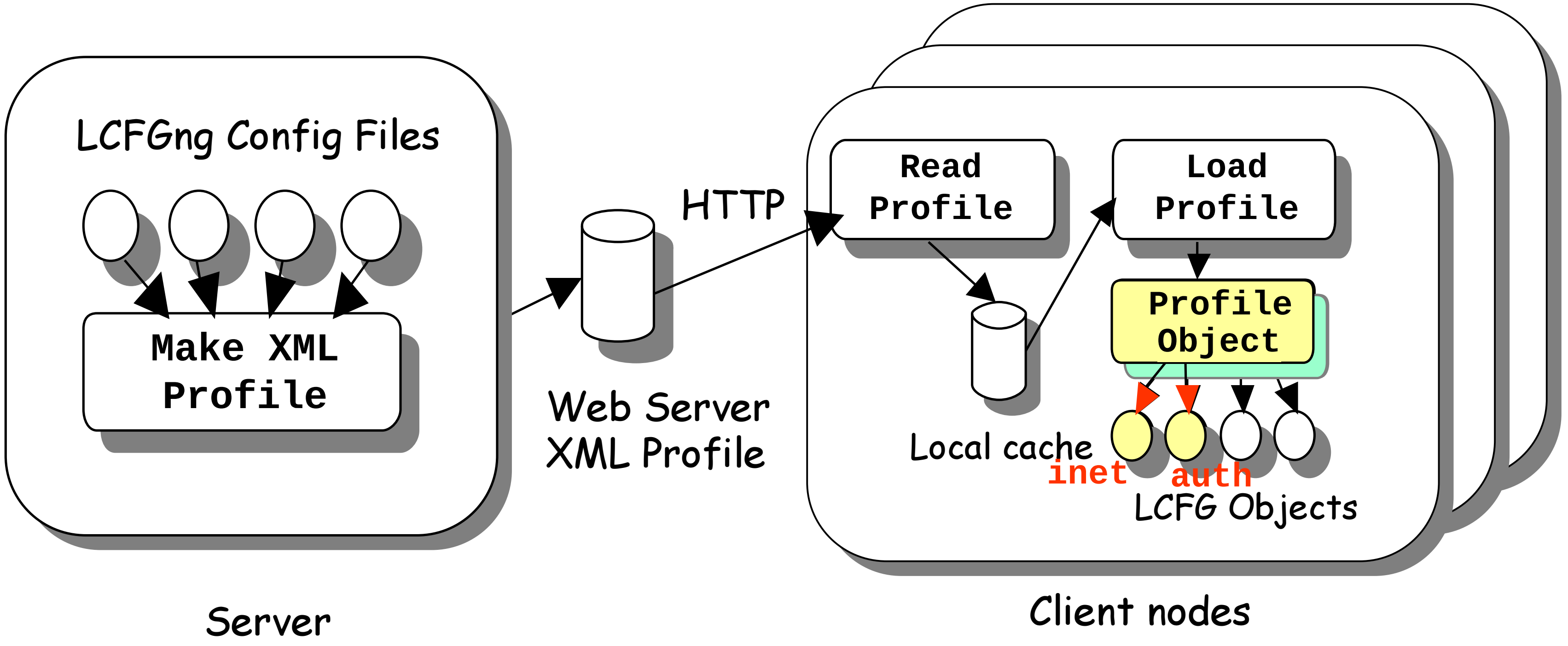


```
/etc/shadow
/etc/group
/etc/passwd
....
mickey:x:999:20::/home/Mickey:/bin/tcsh
....
```

Abs ion parameters for all nodes stored in a central repository

A collection of agents read configuration parameters and either generate traditional config files or directly manipulate various services

LCFGng system architecture



Abstract configuration parameters for all nodes stored in a central repository

A collection of agents read configuration parameters and either generate traditional config files or directly manipulate various services

LCFGng: what’s a component?

- It's a simple Perl script
- Each component provides a Configure() method invoked on startup or when configuration changes
- A simple and typical component behavior:
  - Started when notified of a configuration change
  - Loads its configuration (locally cached)
  - Configures the appropriate services, by translating config parameters into a traditional config file and reloading a service if necessary (e.g. restarting a init.d service).
- LCFGng provides components to manage the configuration of services of a machine: inet, auth, nfs, cron, ...
- Admins/mw developers can build new custom components to configure and manage their own applications

LCFGng component template

```
#!/usr/bin/perl-w
package LCFG::MyComp;
@ISA = qw(LCFG::Component);

use strict;
use LCFG::Component;
use LCFG::Config; # EDG specific

sub Configure($$@) {
  my ($self,$res) = @_;
  my $config=LCFG::Config->new($res);
  my $age=$config->getValue('/persons/John/age');
  $self->Fail( "too young") unless ($age>18);
}
new LCFG::MyComp() -> Dispatch();
```

LCFGng component template (II)

- Configure() method:

```
# Do the configuration
sub Configure($$@) {
  my ($self,$res) = @_;
  my $config=LCFG::Config->new($res);
  # do whatever is necessary to reconfigure your
 service
}
```

LCFGng Component Example (I)

Edg-lcfg-syslog – configures /etc/syslog.conf

.def file:

```
@additions add_$

Additions

add_$
```

Resources defined on server:

```
syslog.additions             monitoring kernel

syslog.add_monitoring        local3.*
  |/var/obj/tmp/monitor.fifo

syslog.add_kernel            kern.*    /var/log/kernel.log
```

LCFGng Component Example (II)

Component: Configure() method. First part: template generation

```
sub Configure($$@) {

   my ($self,$res,@args)=@_;
    my $config=LCFG::Config->new($res);

    my $syslogconf='/etc/syslog.conf';

    my $status = LCFG::Template::Substitute
      ( '/usr/lib/lcfg/conf/syslog/template',
        '/var/obj/conf/syslog/config', 0, $res );

    unless (defined($status)) {
      $self->LogMessage($@);
      $self->Fail( "failed to create config file (see
  logfile)");
    }
```

LCFGng Component Example(III)

Component: Configure() method. Second part: add missing resources

```
   #extra values from 'additions', using NVA API

  my $additions=$config->getElement('/additions');
  my @add_array=();
  while ($additions->isNextElement()) {
    my $add=$additions->getNextElement();
    my $add_el=$config>getElement('/additions/'.$add.'/add');
    push(@add_array,$add_el->getValue());
  }


  if (scalar (@add_array)) {
    open (CFG, '>>/var/obj/conf/syslog/config') ||
      $self->Fail('cannot open config file (see
logfile)');
    print CFG join("\n",@add_array)."\n";
    close (CFG) ||
      $self->Fail('cannot close config file (see
logfile)');
  }
```

LCFGng Component Example(IV)

Component: Configure() method. Third part: copy config file, restart service

```
# copy over to definitive location if files are different

 if (system("/usr/bin/cmp -s $syslogconf
/var/obj/conf/syslog/config")){
   $self->LogMessage("updating config file");

   system('cp -f '.$syslogconf.' '.$syslogconf.'.old');
   system('cp -f /var/obj/conf/syslog/config '.$syslogconf)
     && $self->Fail("copying template to $syslogconf: ". $?);

  # restart service
   if (system('/sbin/service syslog restart')) {
     $self->Fail('init.d syslog restart failed: '. $?);
   }
 }

 return 1; #OK

}
```

Software distribution with LCFGng

- It is done with an LCFGng tool called updaterpms.
- The standard system packaging format is used: **rpm** for Linux
- It is managed via an LCFGng component.
- Functionality:
  1. Compares the packages currently installed on the local node with the packages listed in the configuration
  2. Computes the necessary install/deinstall/upgrade operations
  3. Orders the transaction operations taking into account rpm dependency information
  4. Invokes the packager (RPM) with the right operation transaction set
- Packager functionality:
  1. Read operations (transactions)
  2. Downloads new packages from repository
  3. Executes the operations (installs/removes/upgrades)

Summary

- Fabric management components deployed on release 2.0:
- Installation and Configuration management functionality:
  - LCFG (Local ConFiGuration system): handles automated installation, configuration and management of machines.
- Gridification functionality:
  - LCAS (Local Centre Authorization Service) + edg_gatekeeper: handle authorization requests to the local computing fabric.
- Fabric monitoring functionality:
  - FMON: provides a client (MSA) running sensors on each node to monitor, and a central server to collect data.
- Resource Management functionality:
  - RMS: management of local user jobs, grid user jobs and maintenance jobs within a site, built from one to many clusters