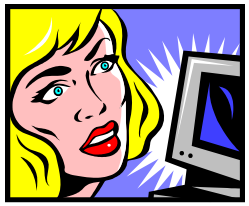
The EU DataGrid
Fabric Management

The European
DataGrid Project Team

http://www.eu-datagrid.org

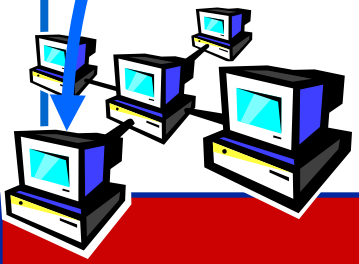
EDG Tutorial Overview

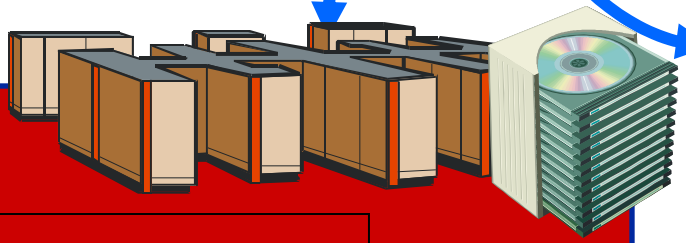


Workload Management Services

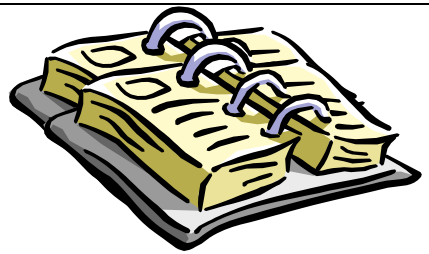
Data Management Services

Networking





Information Service



Fabric Management

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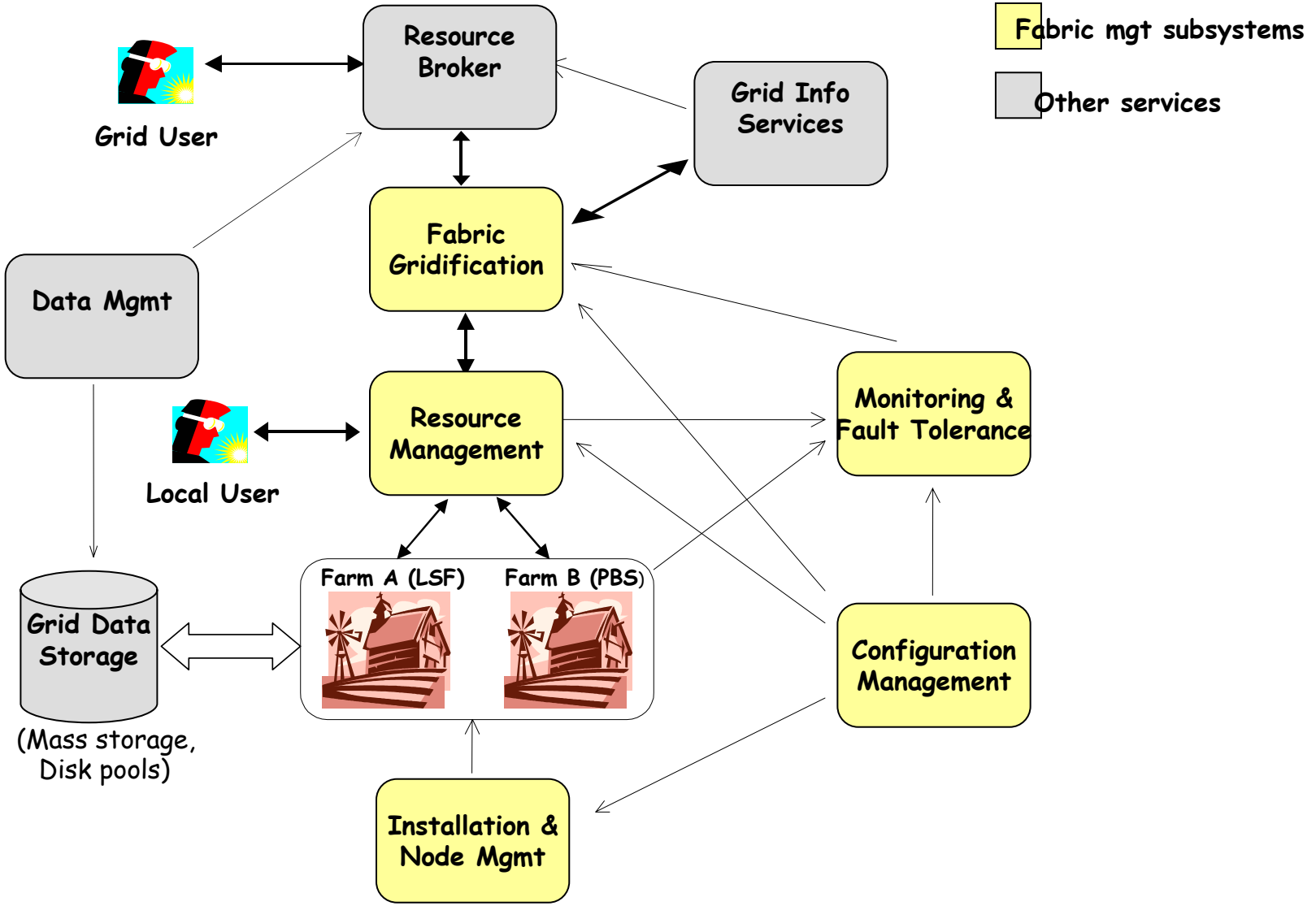
- Definition
- Fabric Management architecture overview
- User job management overview
- Present status (R2.0)
  - LCFG
  - LCAS + edg_gatekeeper
  - Fmon (Fabric MONitoring)
  - RMS (Resource Management System)

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



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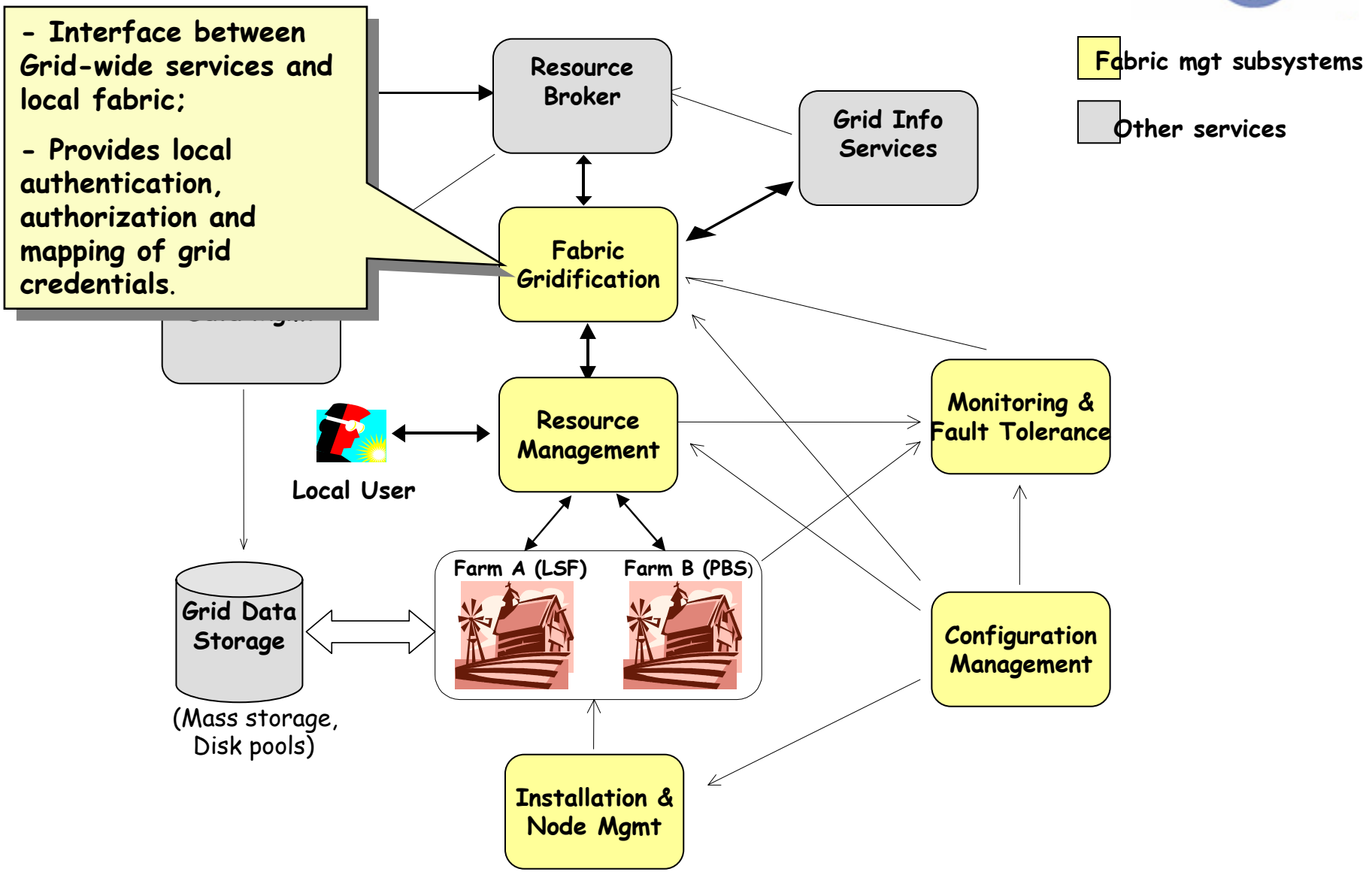

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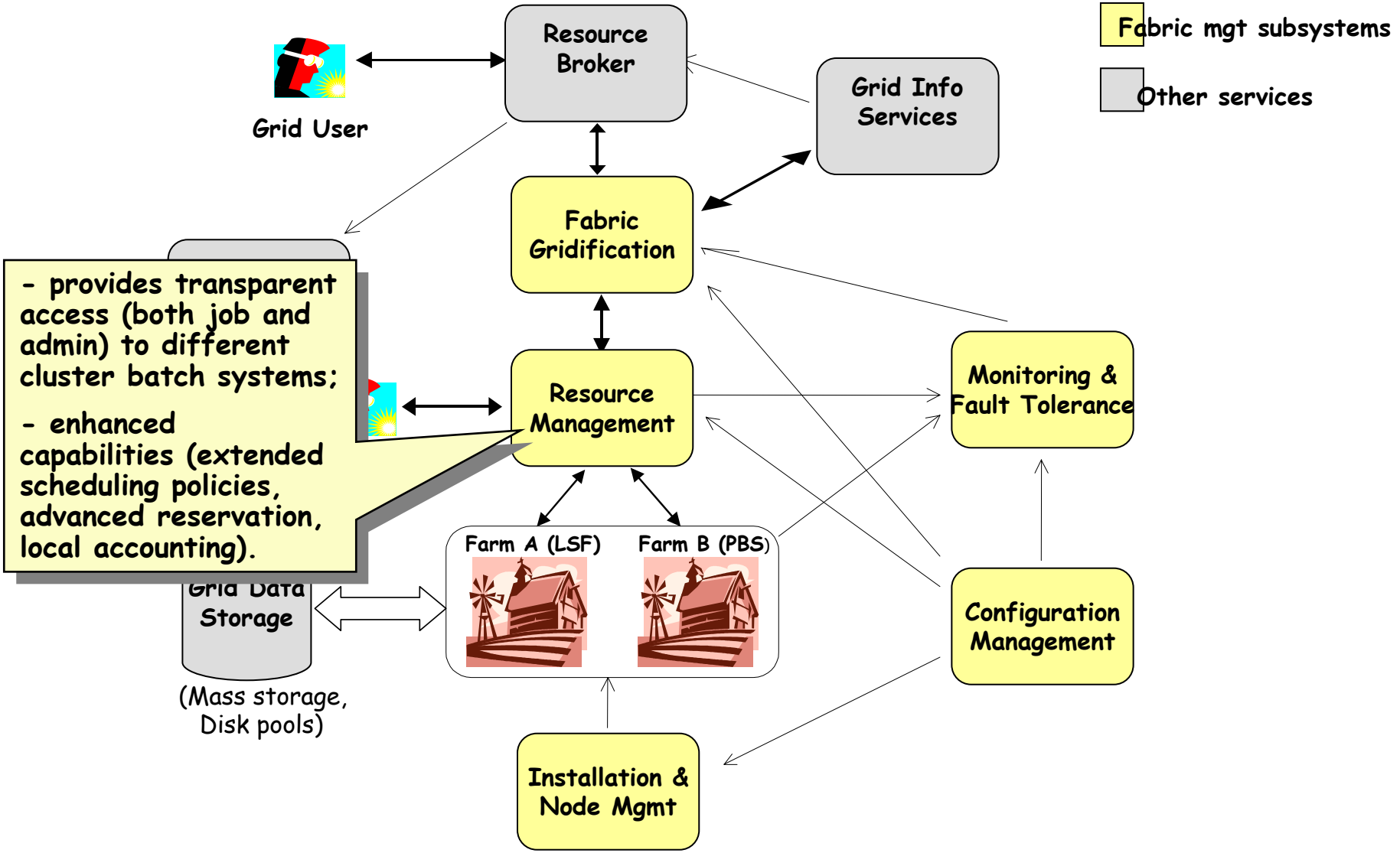

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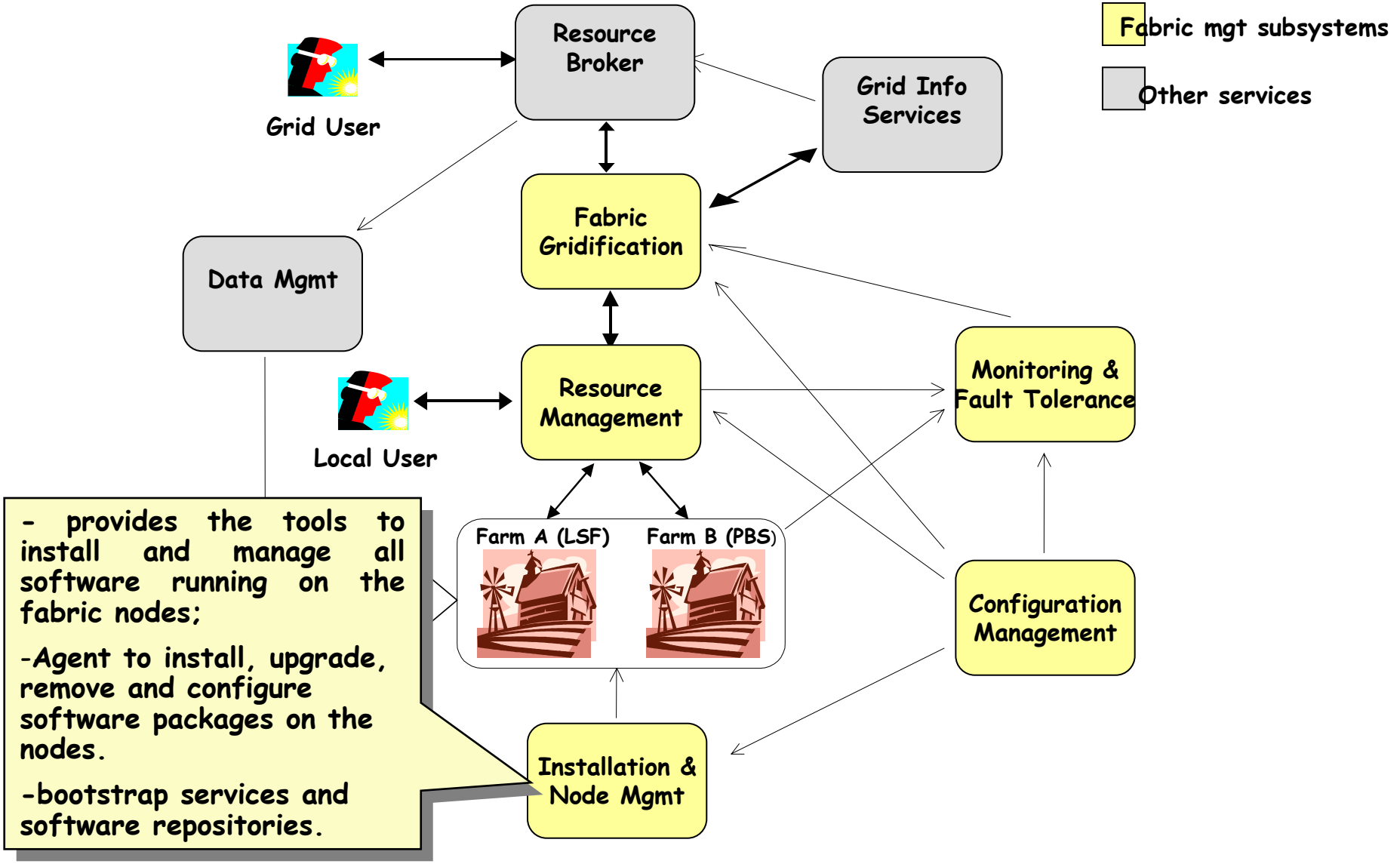

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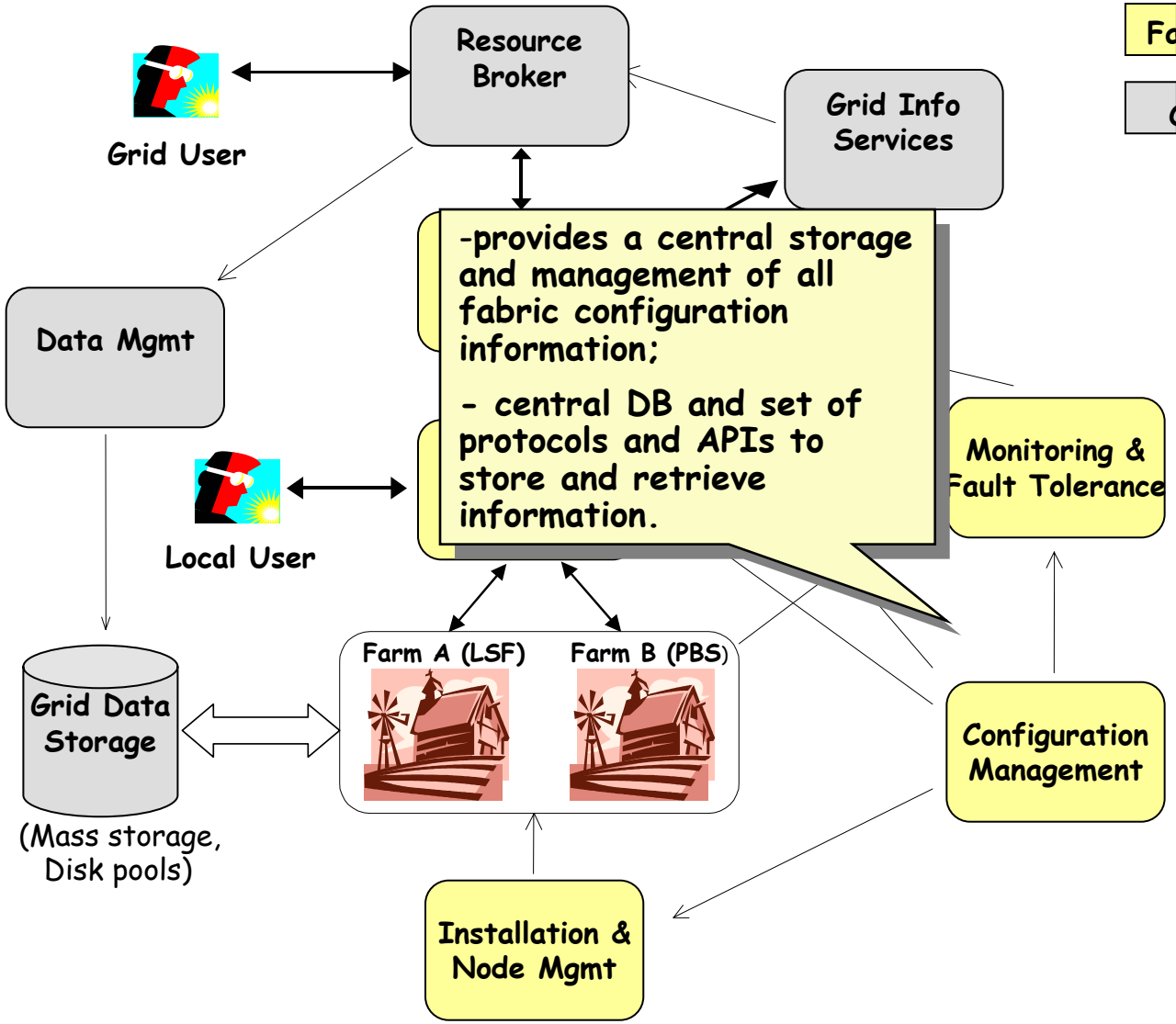

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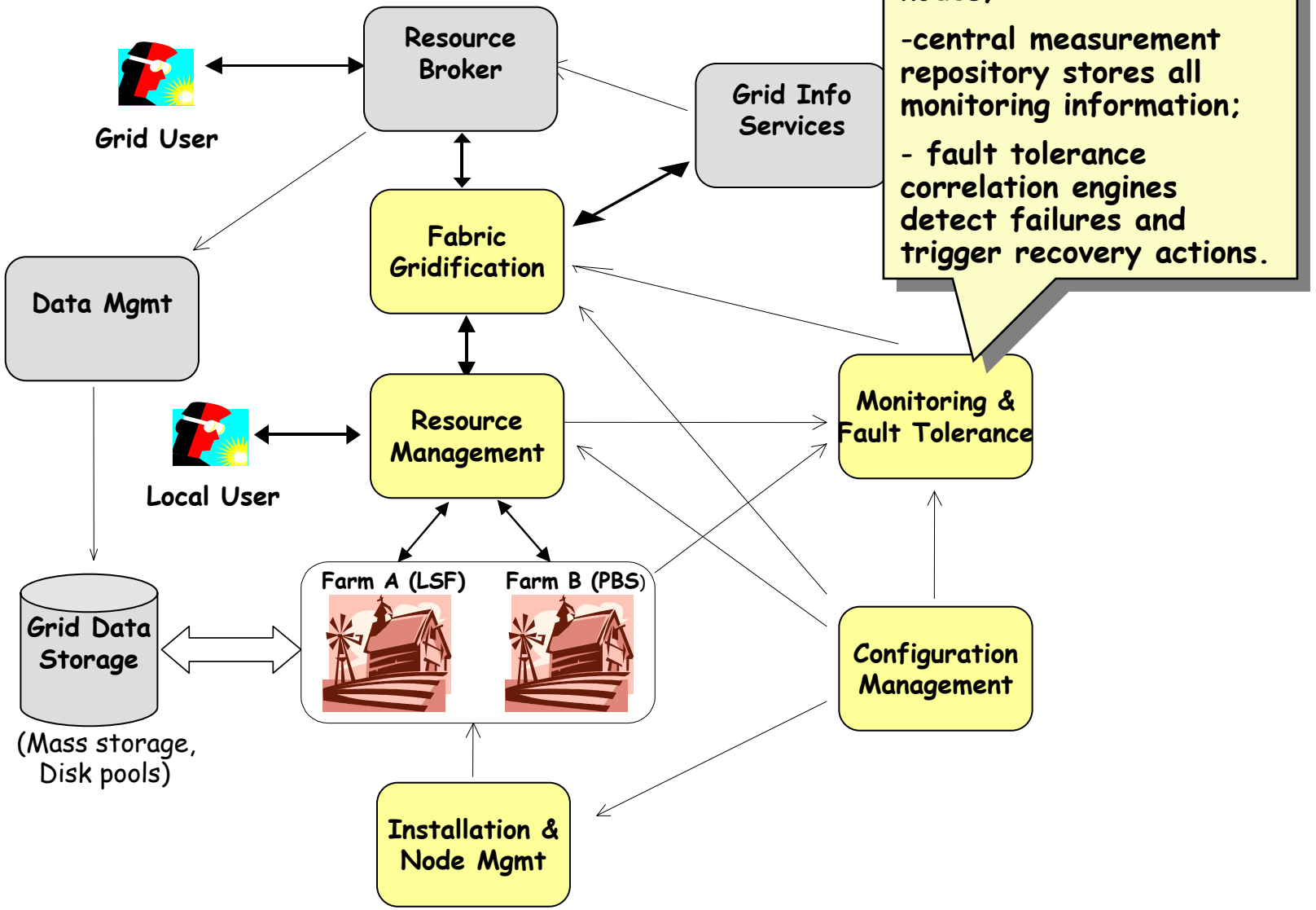
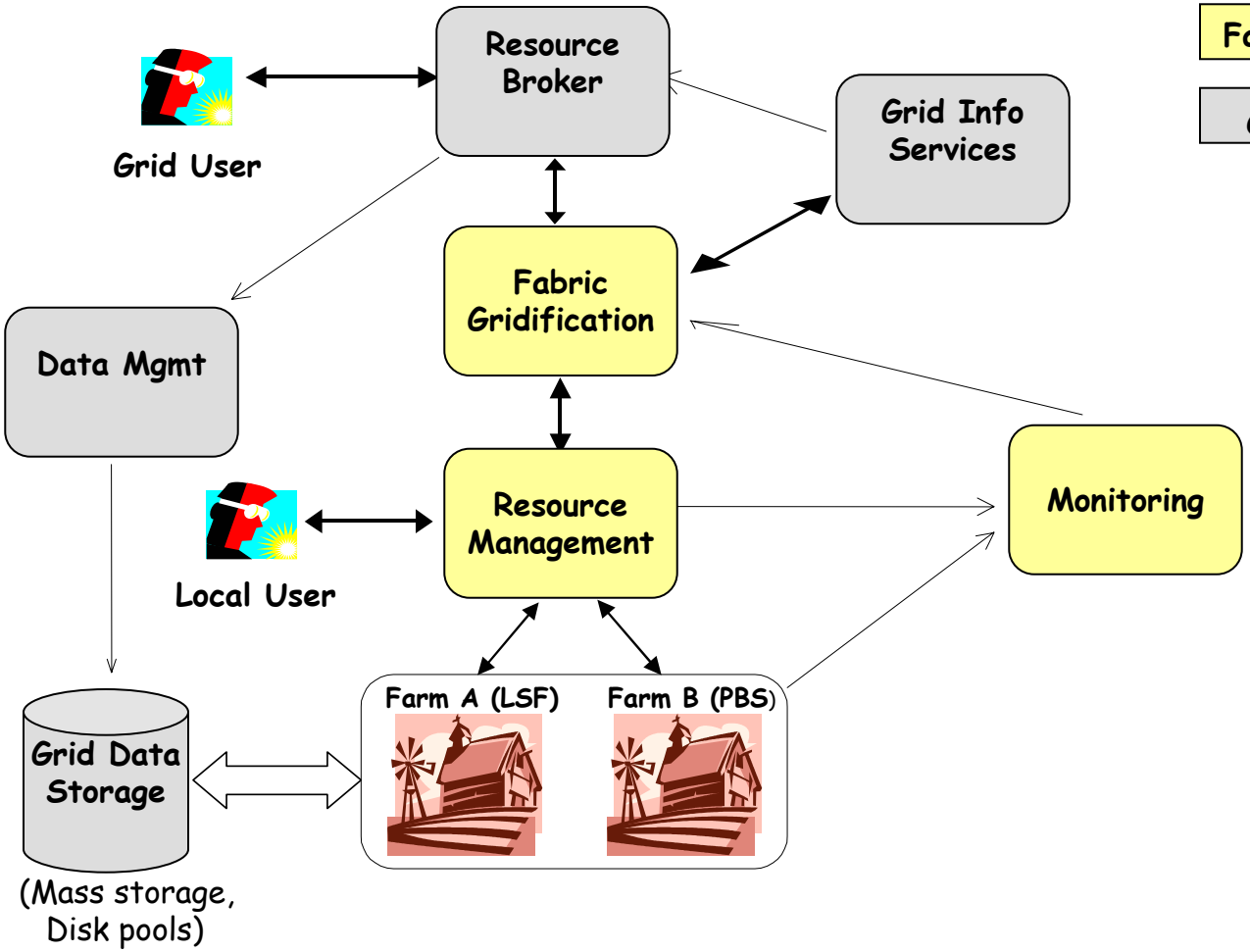


User job management (Grid and local)



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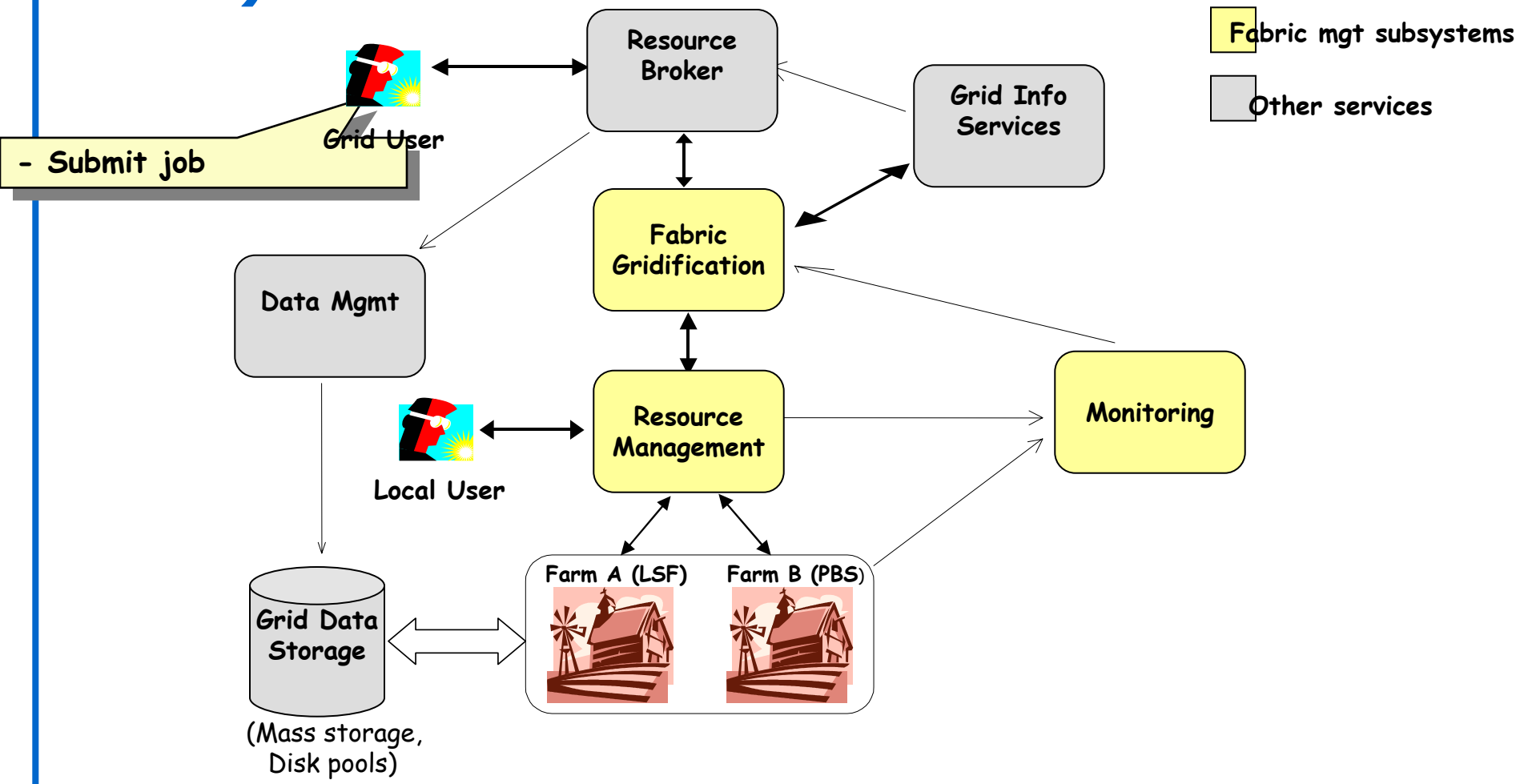

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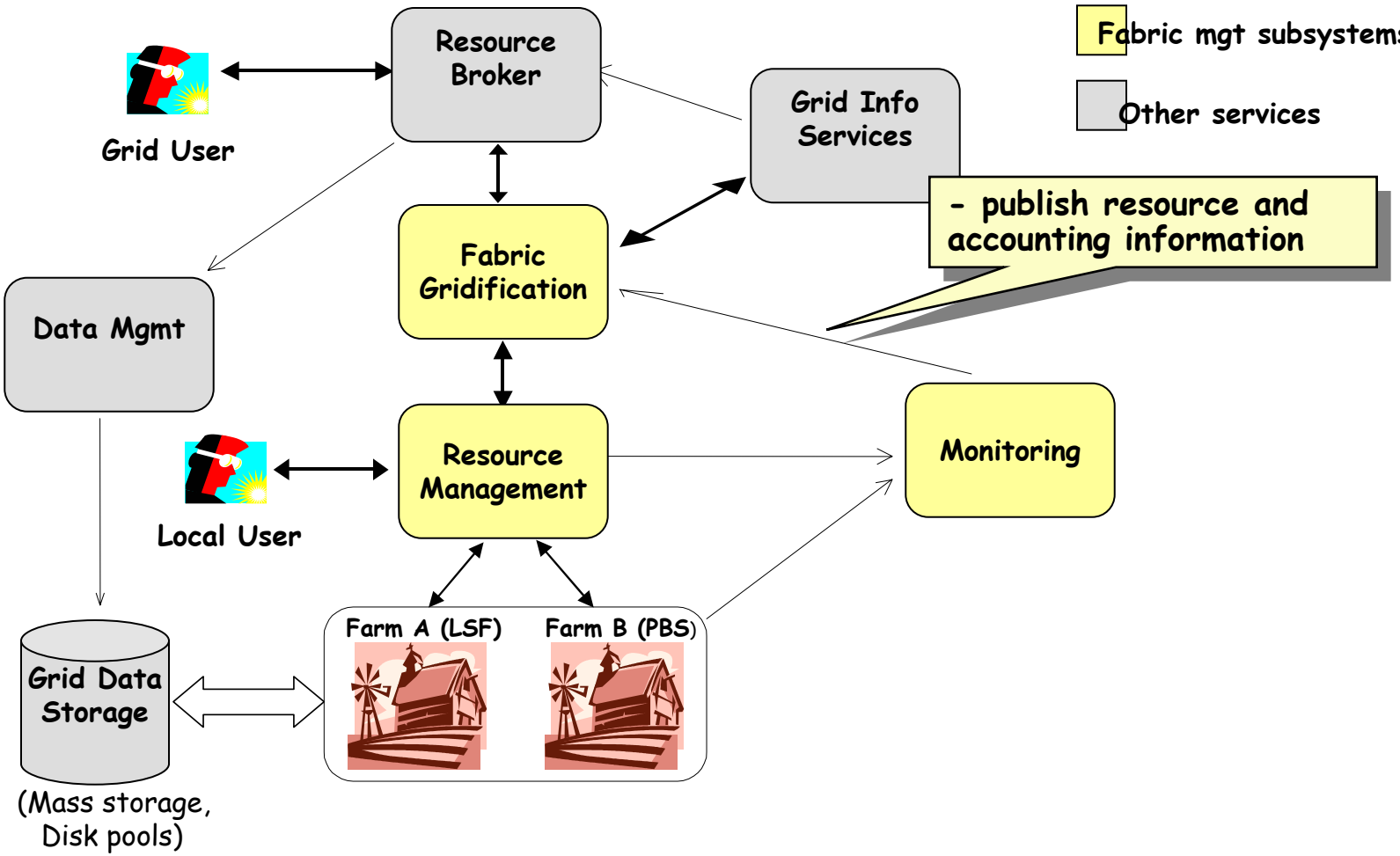

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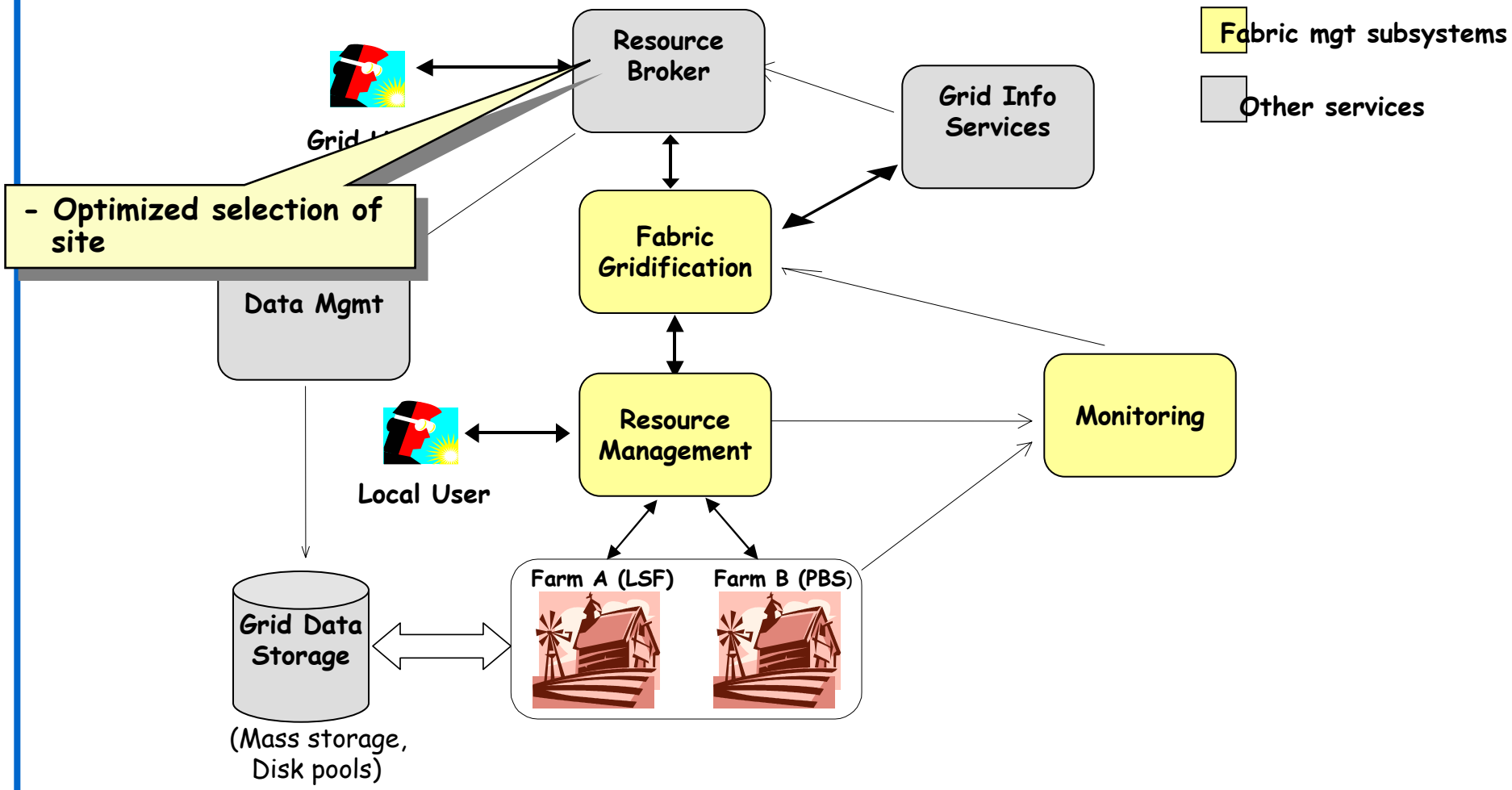

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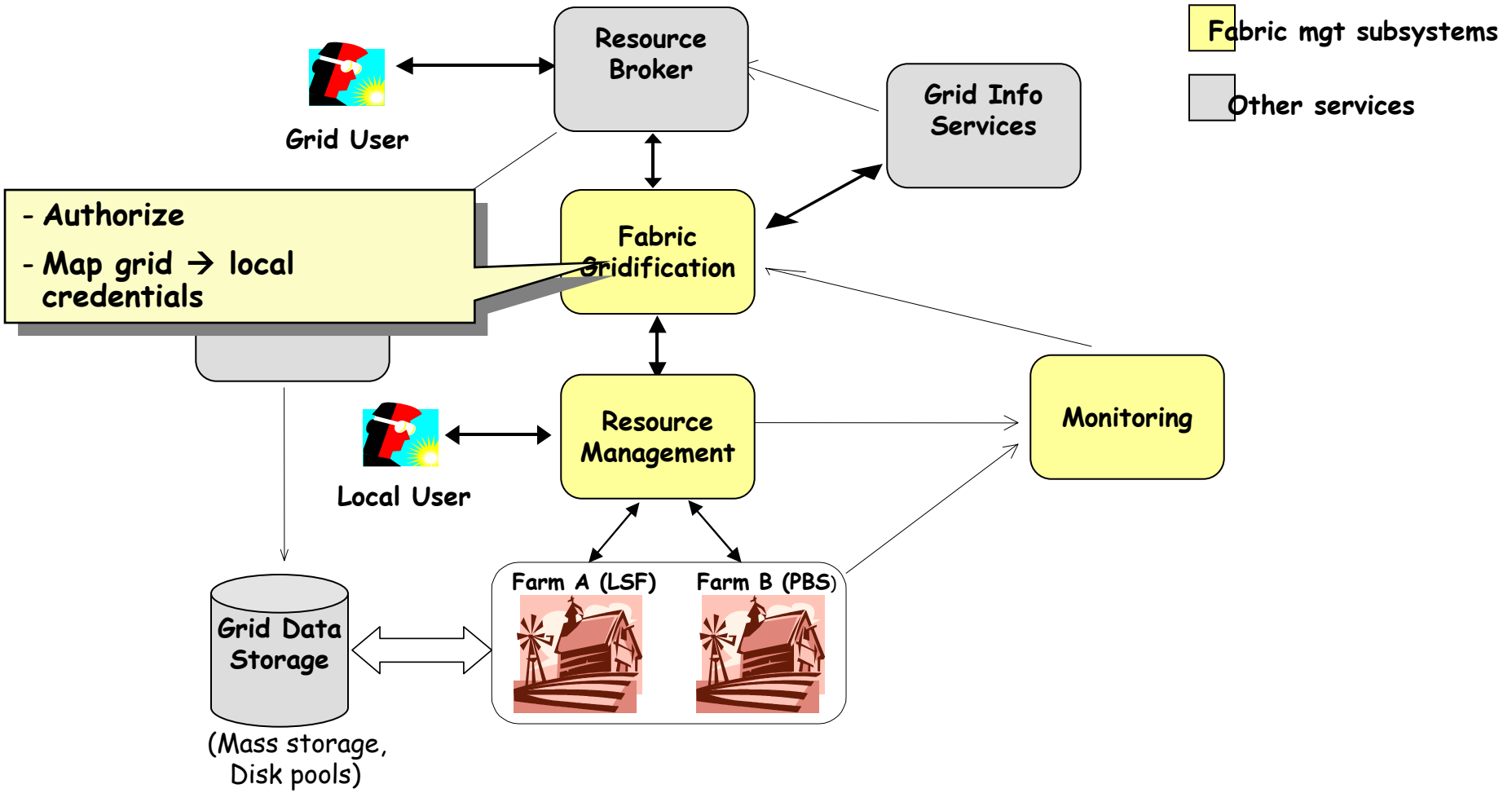

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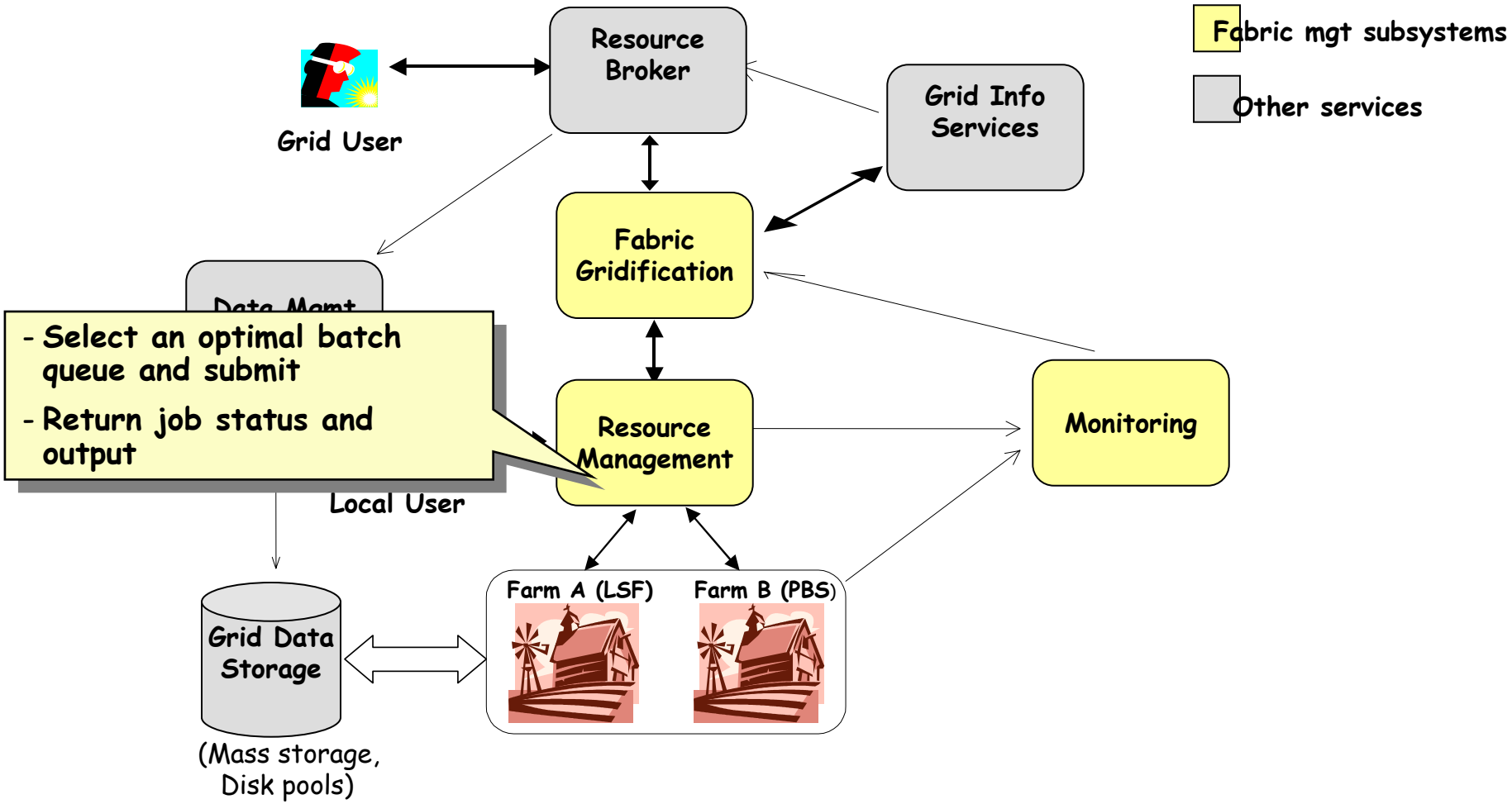


Fabric Management @ Release 2.0

- Installation and configuration:

  LCFG (Local ConFiGuration system)

- Gridification:

  LCAS + edg_gatekeeper

- Monitoring

  FMON

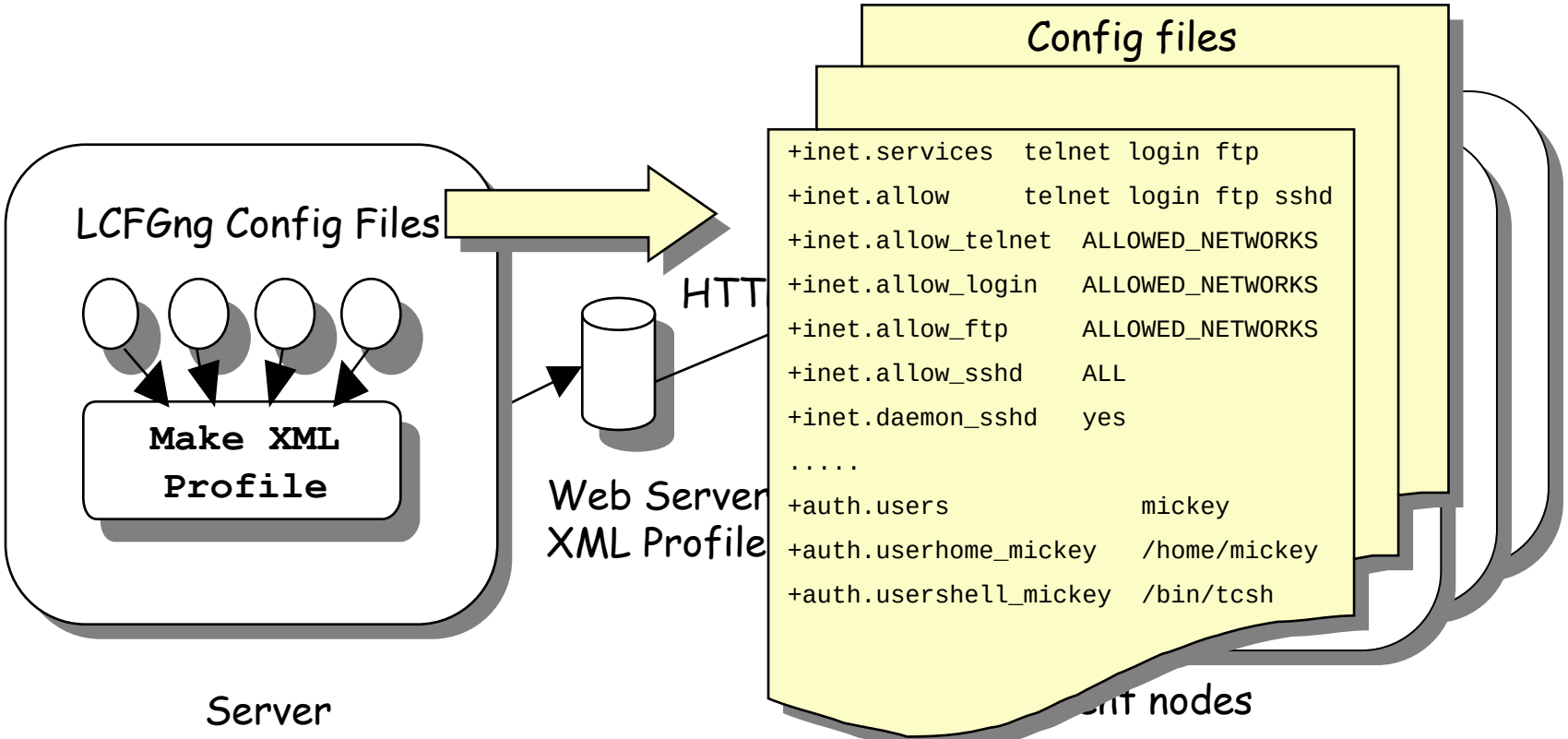
- Resource Management

  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

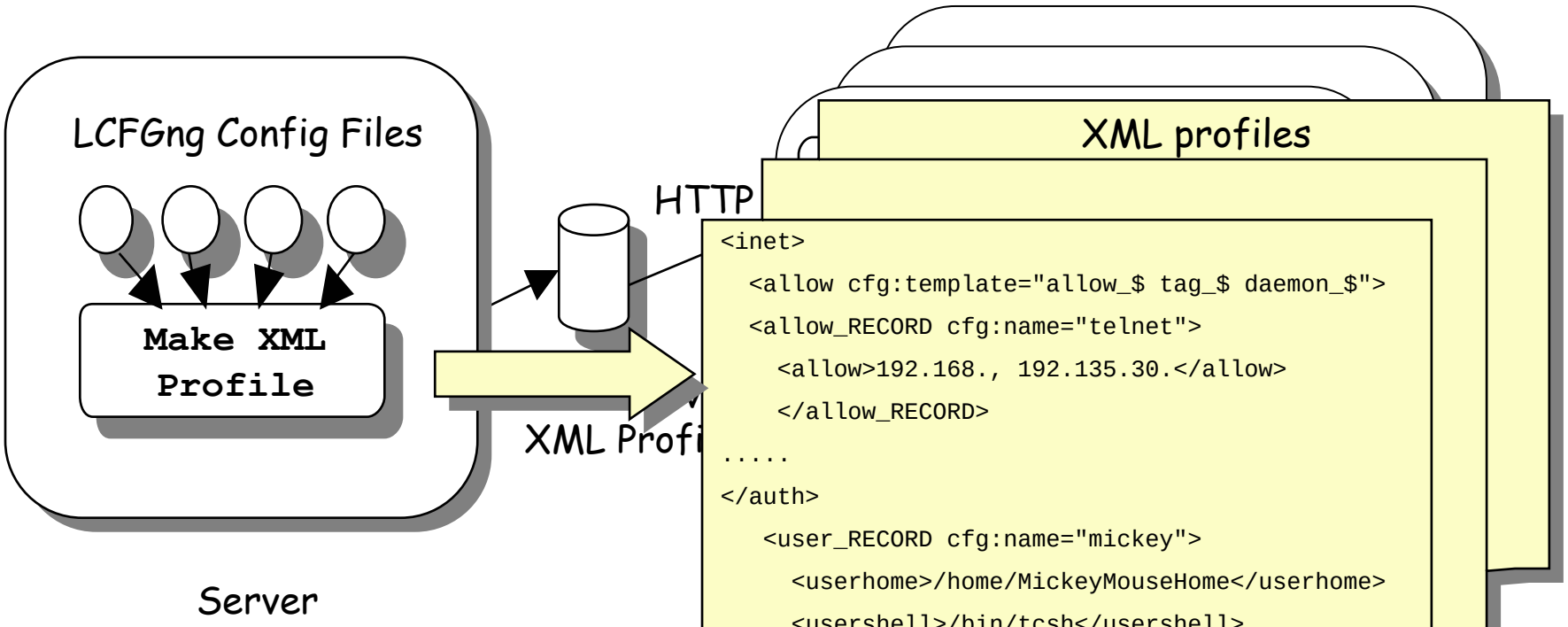
LCFGng system architecture



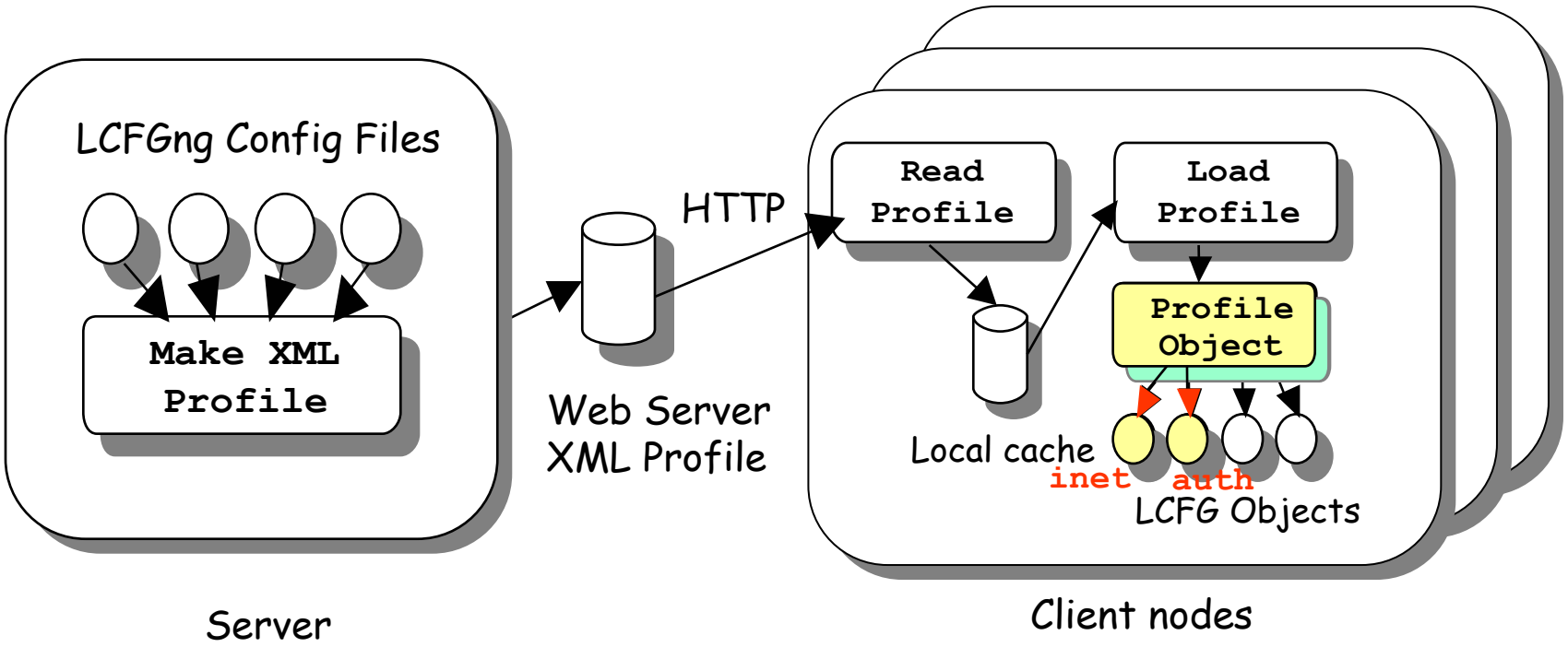
Abstract configuration parameters for all nodes stored in a central repository

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

LCFGng system architecture



LCFGng system architecture



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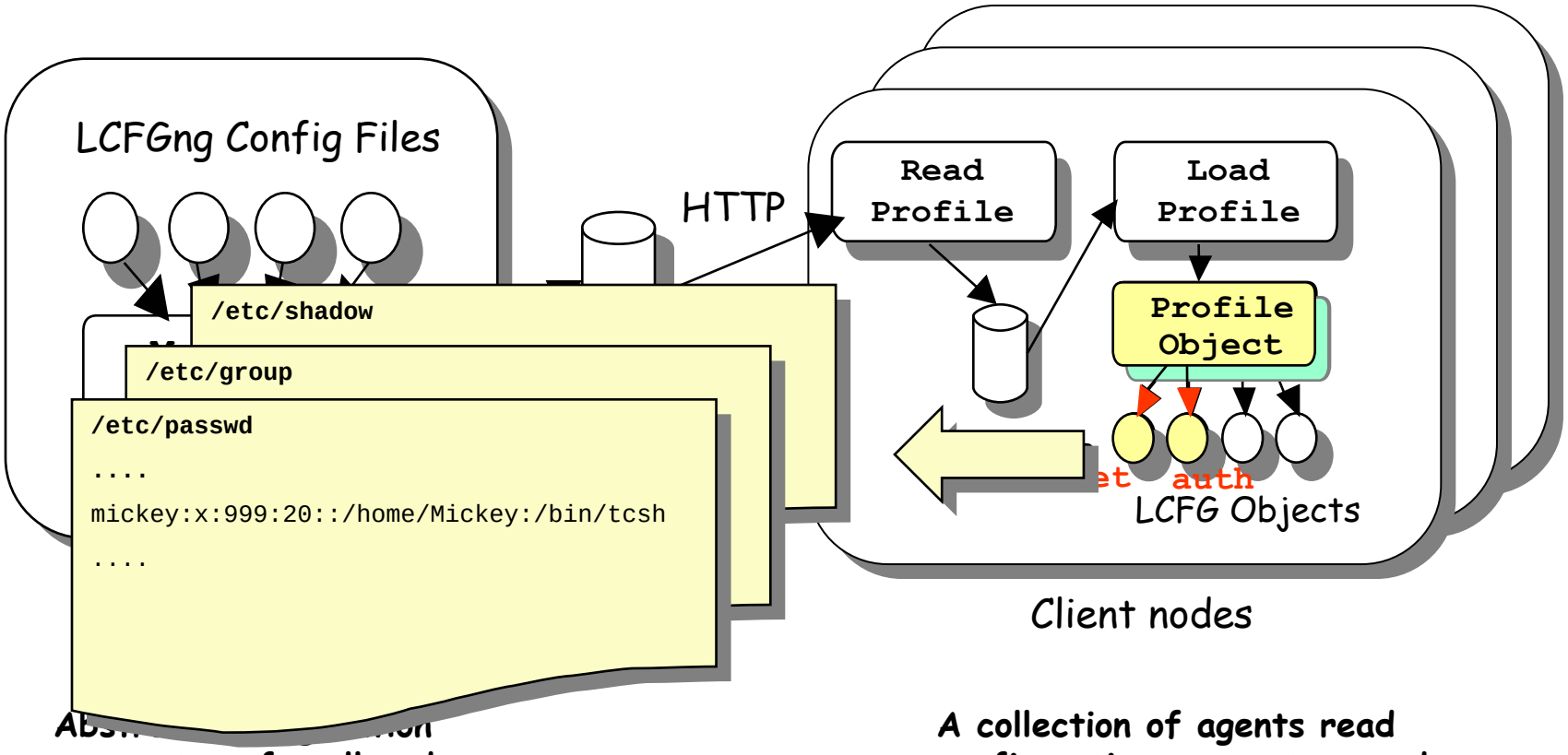

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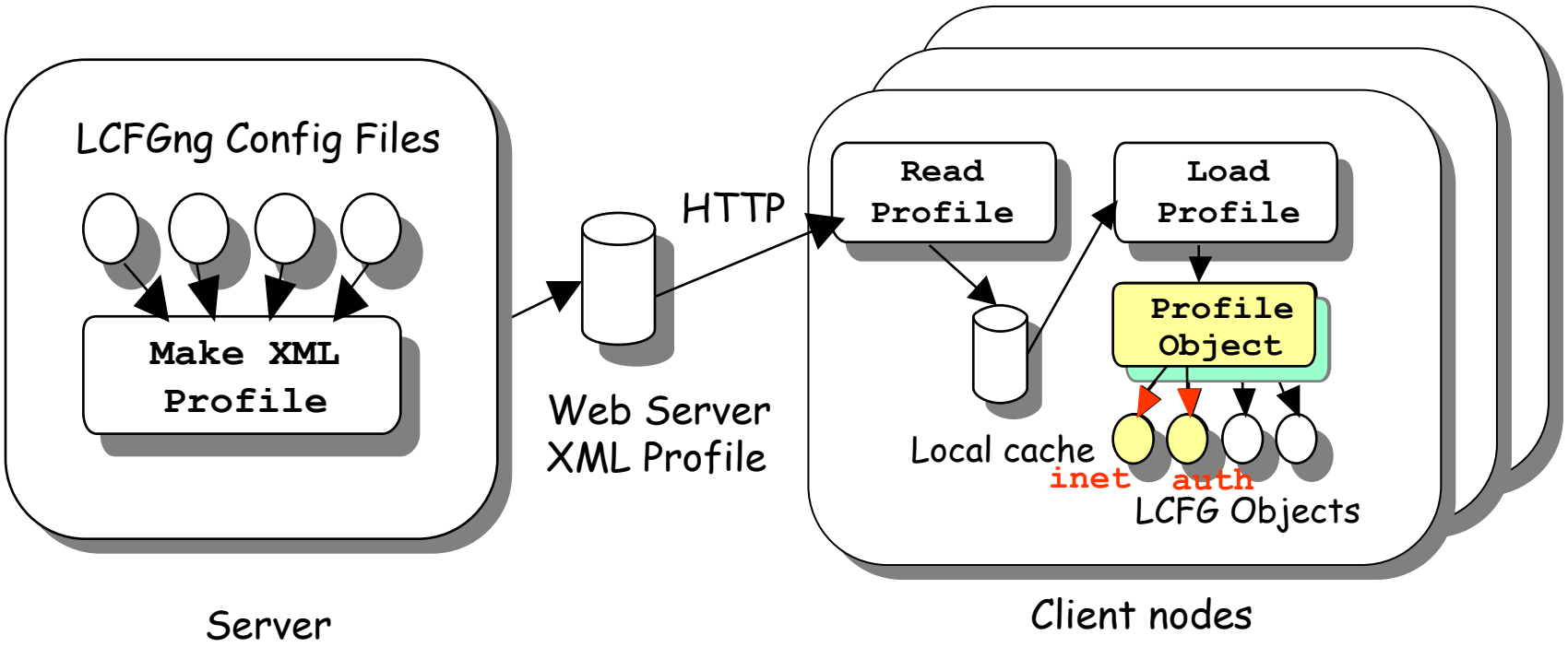


Abstract configuration parameters for all nodes stored in a central repository

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)

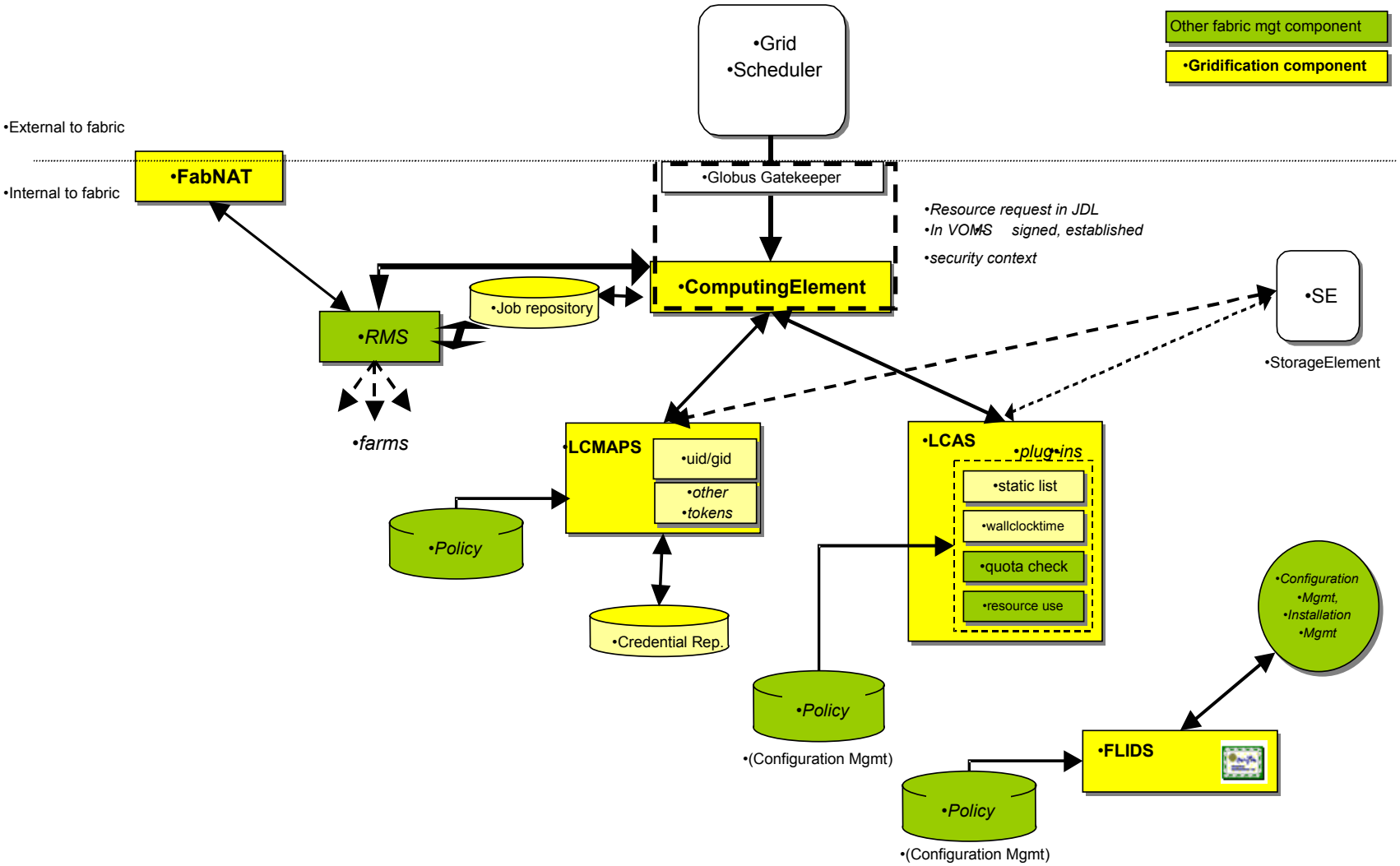
Component: Configure() method. Third part: copy config file, restart service

```
 # 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)

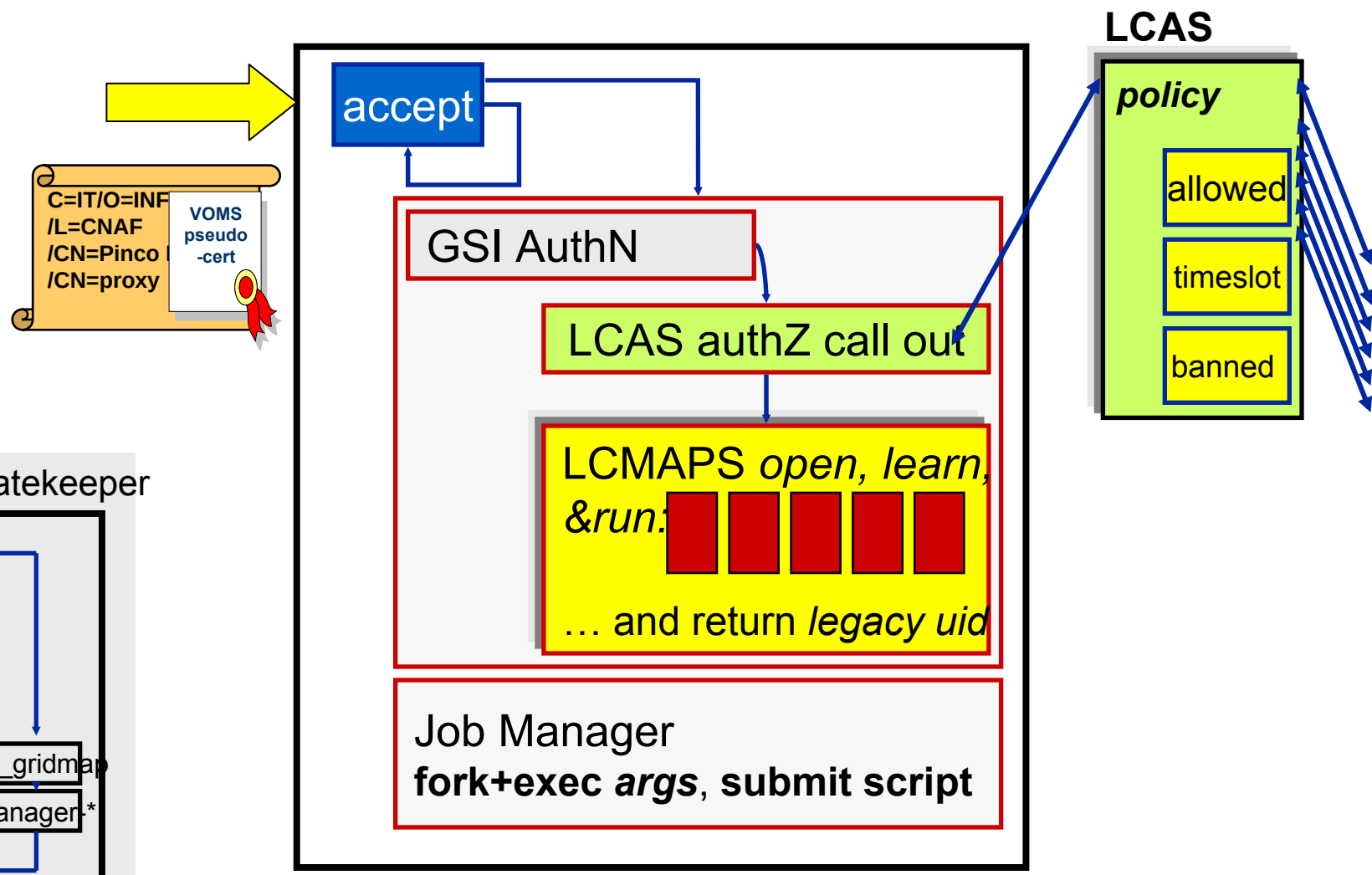
Gridification Architecture



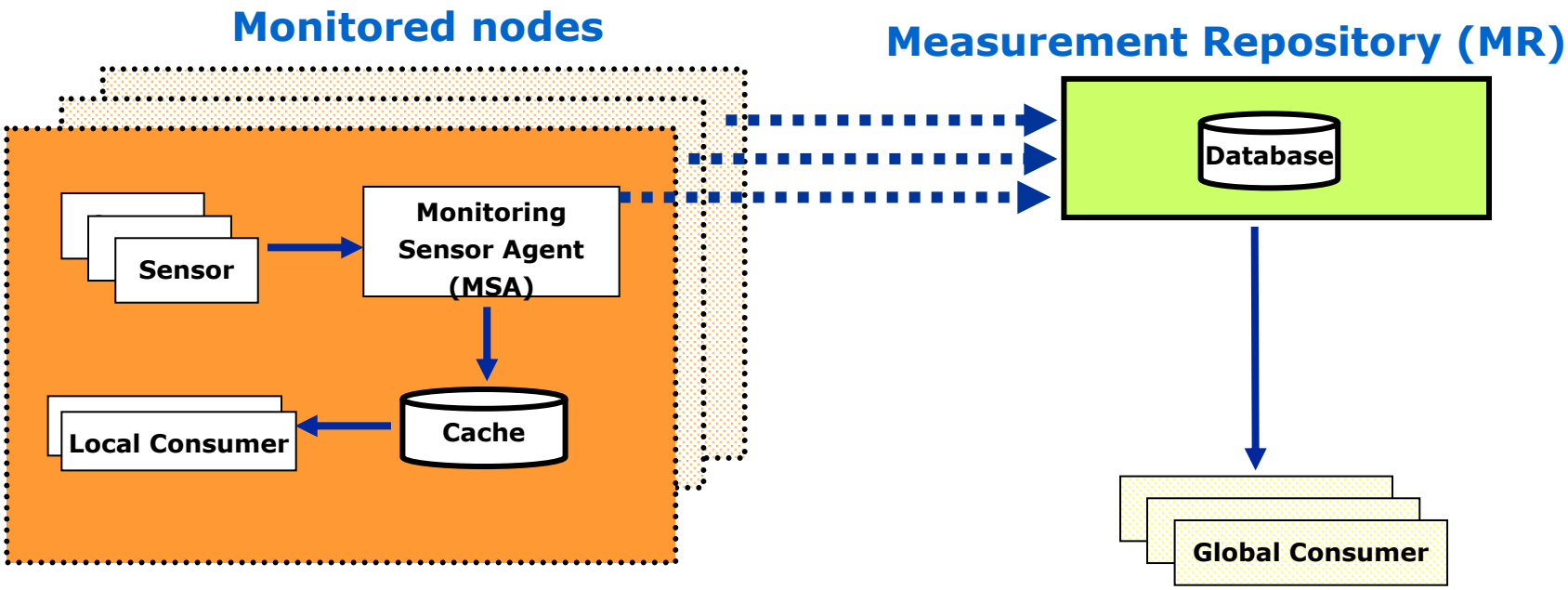
LCAS 1.0 (EDG release 1.2)

- 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



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

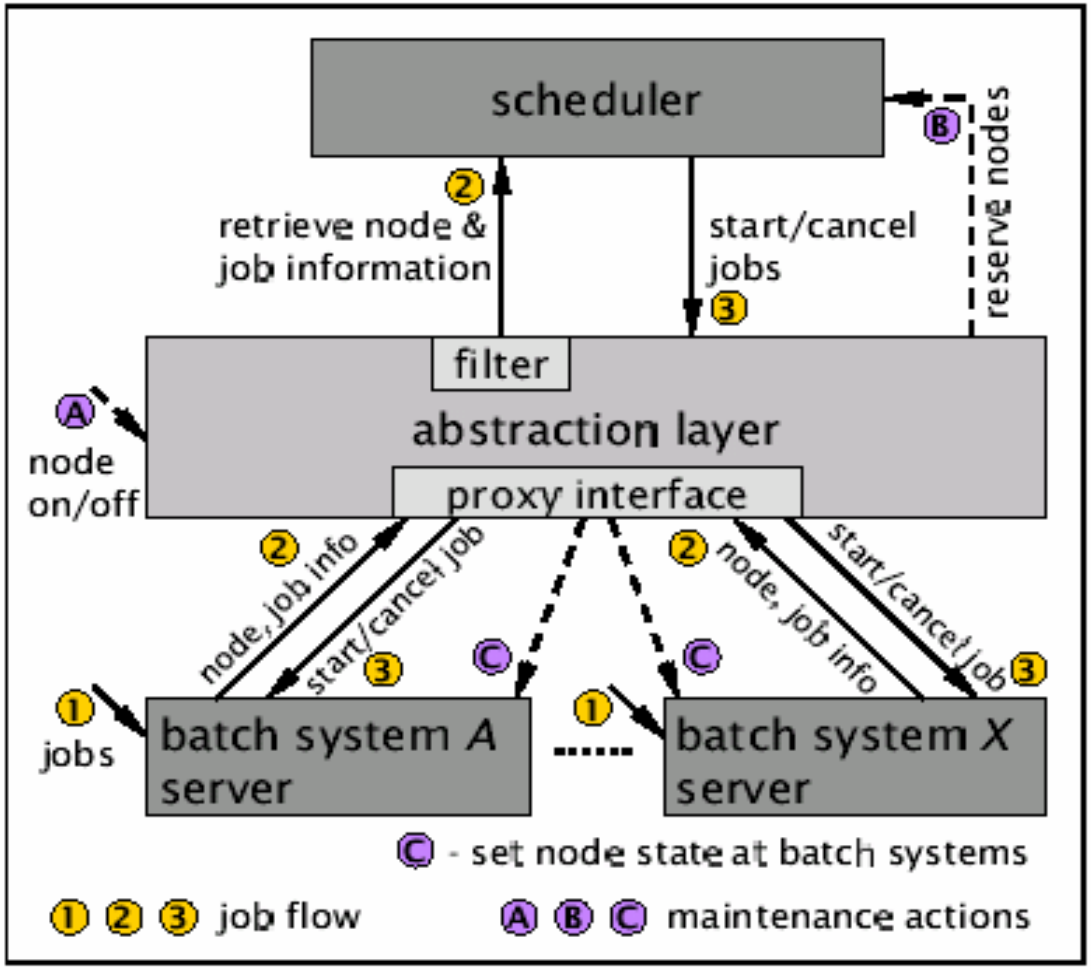


Figure 1: Architecture of the resource management framework

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

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