glideinWMS

A pilot-based (PULL) approach to the Grid

by Igor Sfiligoi

Why use pilots on the Grid?

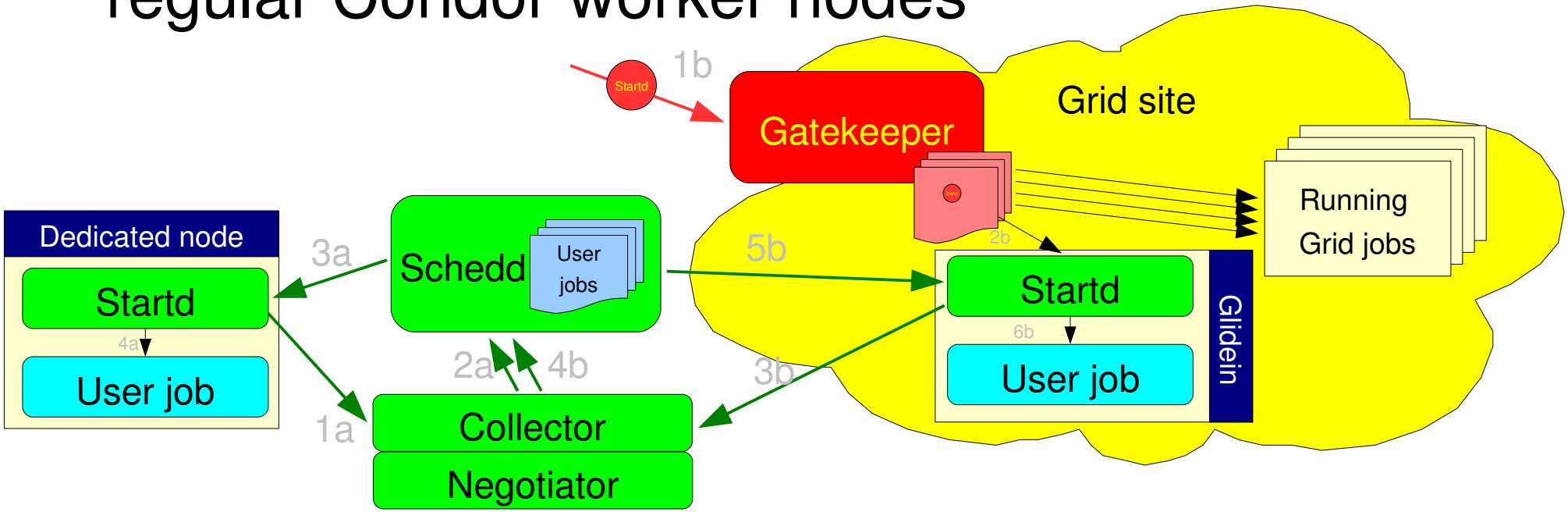
- Grid based on a loose aggregation of resources
  - Users have no say on how the resources are managed
  - The probability of at least one resource being broken at any given time is very high
- Pilots can verify the resource before pulling a user job
  - Difficult to have complete and reliable information about the resources
- Pilots can do full matchmaking based on complete info
  - Managing priorities inside the resource pools difficult if not impossible
- Pilot aggregator can internally manage priorities

Why using Condor for pilots?

- Condor is a very widely used system
  - Mature and well known
- Has an active development team
  - ... that listen to their users
  - A new condor release every few months
- Condor architecture distributed by design
  - Started as a project to gather unused CPU cycles
  - A concept similar to the Grid paradigm

What are the “glideins”?

- Glideins are just properly configured, regular Condor daemons submitted as batch jobs
- From the user point of view, they look like regular Condor worker nodes

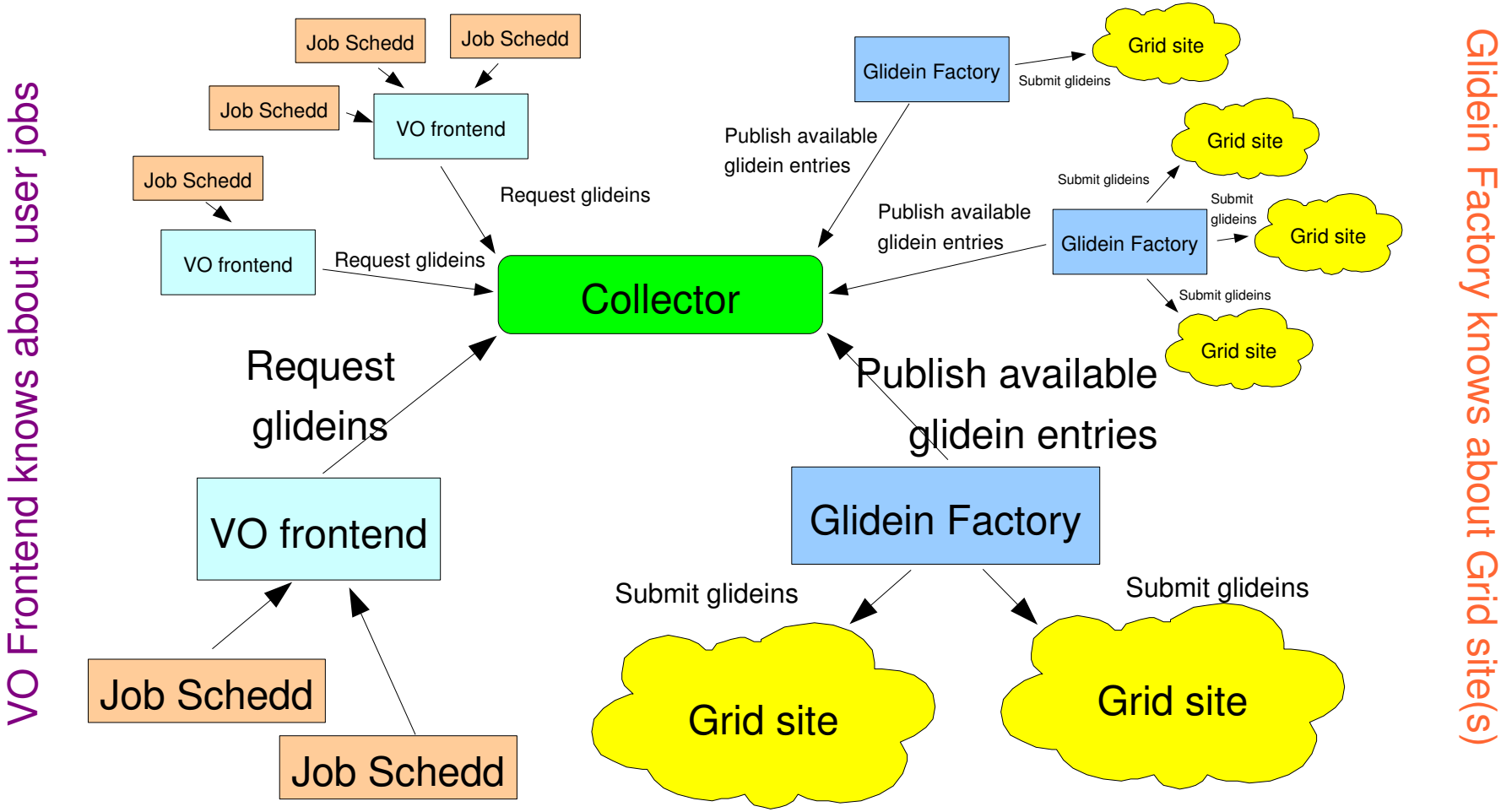


How do we create a WMS out of it?

- Glideins should be submitted on demand
  - The WMS must know about the characteristics of the user jobs
- Different Grid sites may need different configurations
  - The WMS must know the details of the Grid sites

Divide et impera

- Split the task between different processes

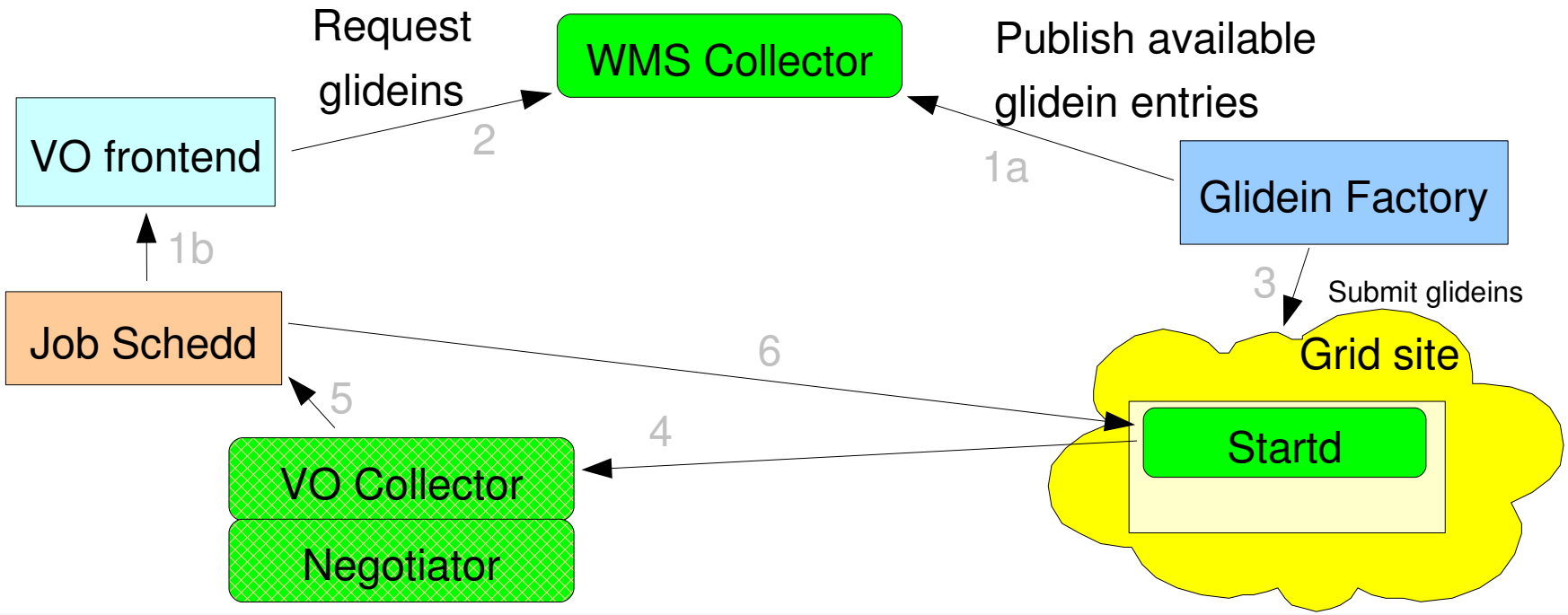


Divide et impera (2)

- VO frontend
  - User/VO specific
  - A reasonably generic implementation provided for simple use cases
- Customizable
  - Looks only for a known subset of jobs
  - Can process custom attributes
- Glidein Factory
  - Completely generic
  - The default implementation should suit most tasks
  - The same factory could in principle serve several VOs

Communication between processes

- Using standard Condor Class-Ads
  - The Collector defines the WMS
    - Security implemented at Condor level
  - This Collector is usually different than the VO Collector



Communication between processes(2)

- Each Glidein Factory Entry Point publishes:
  - CE attributes
  - list of parameters it accepts

Published classad

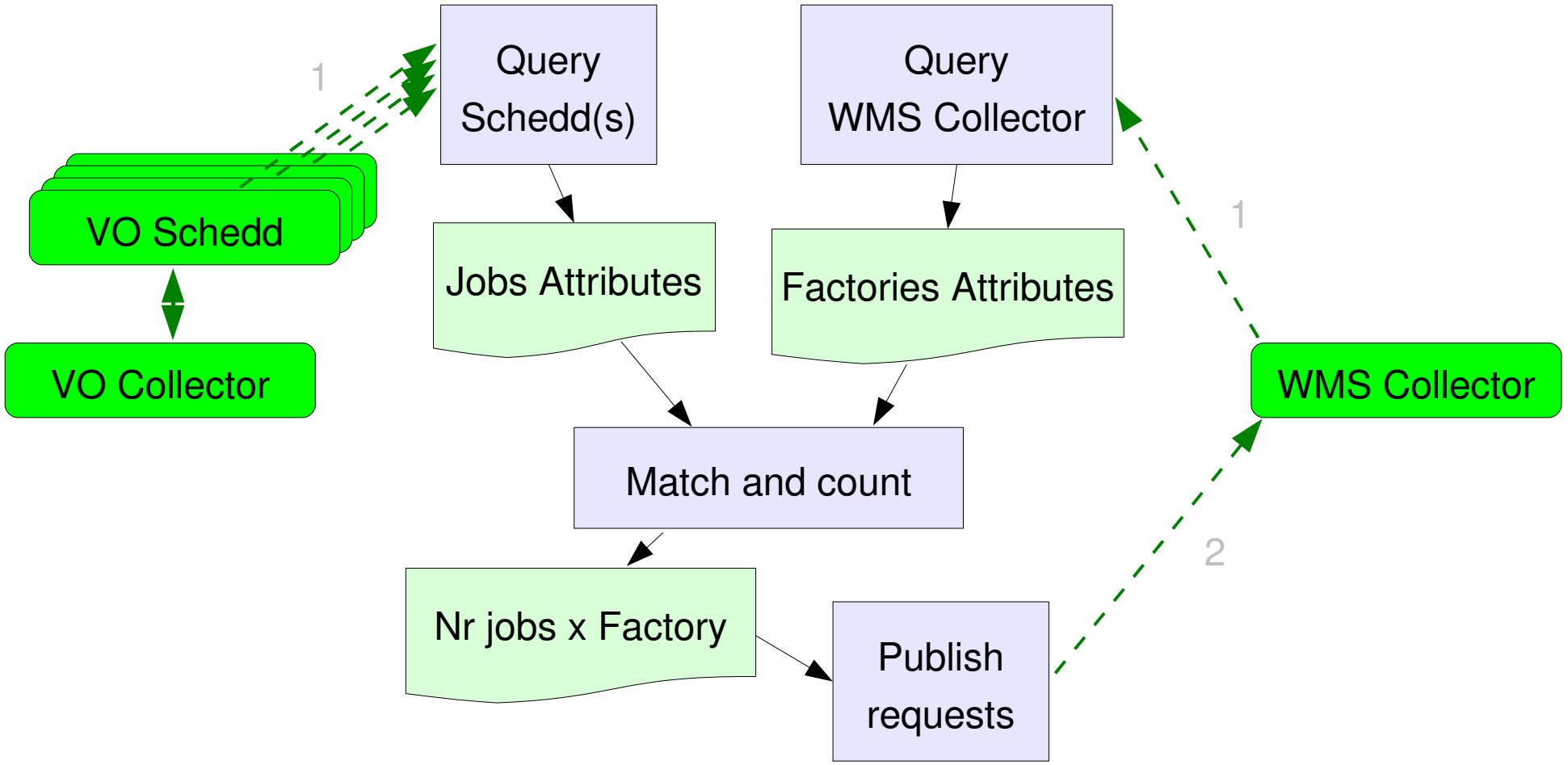
MyType="glidefactory"
Name="entry@factory"
FactoryName="factory"
GlideinName="entry"
Attribute1="..."
...
AttributeN="..."
GlideinParamXXX="val1"
...
GlideinParamYYY="valN"

- Each VO Frontend replies a ClassAd containing:
  - The target Entry Point
  - VO parameters (a subset of the above)
  - Number of idle glideins to keep in the queue
  - In the future, max running glideins and max submission rate

Published classad

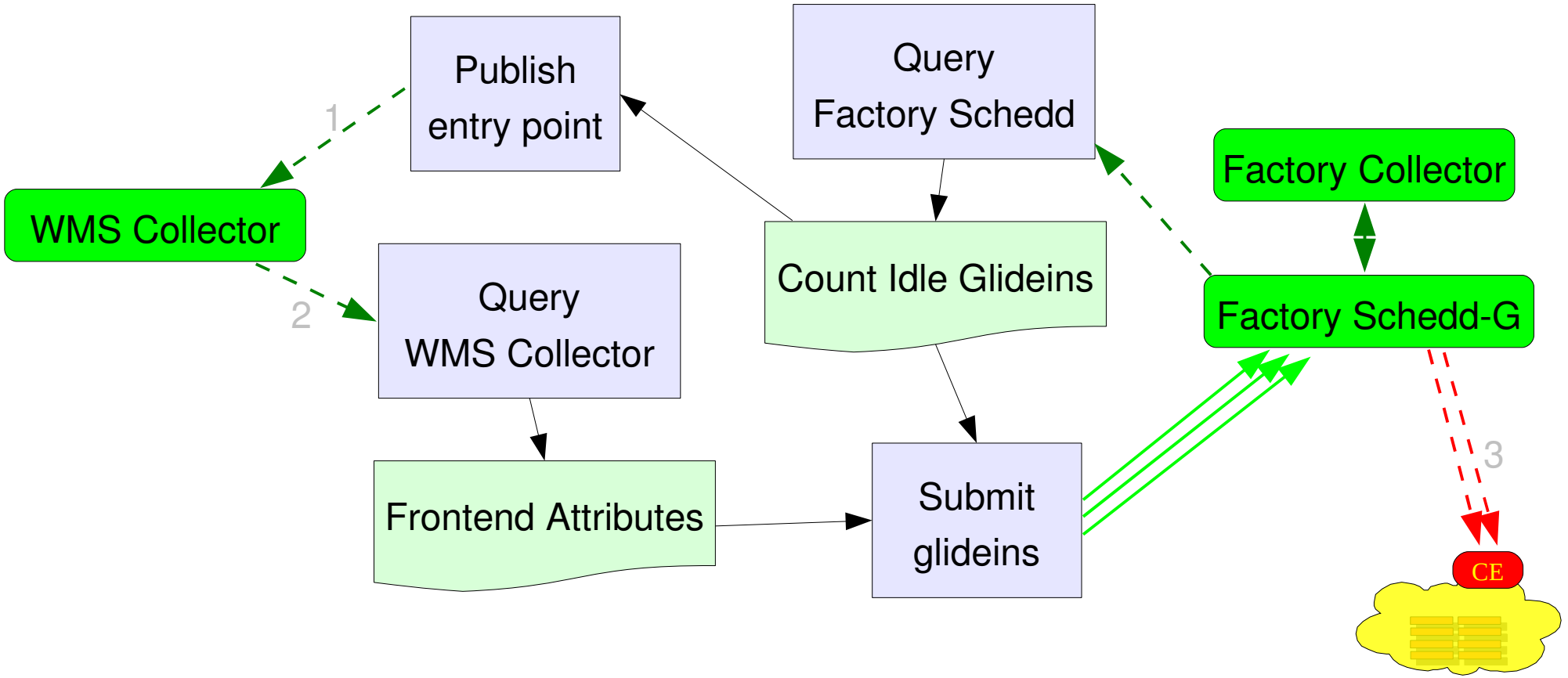
MyType="glideclient"
Name="reqX@client"
ClientName="client"
ReqName="reqX"
ReqGlidein="entry@factory"
ReqIdleGlideins=nr
ReqMaxRun=nr
ReqMaxSubmitXHour=nr
GlideinParamWWW="val1"
...
GlideinParamZZZ="valY"

VO Frontend Acts as a Matchmaker



Glidein Factory blindly executes orders

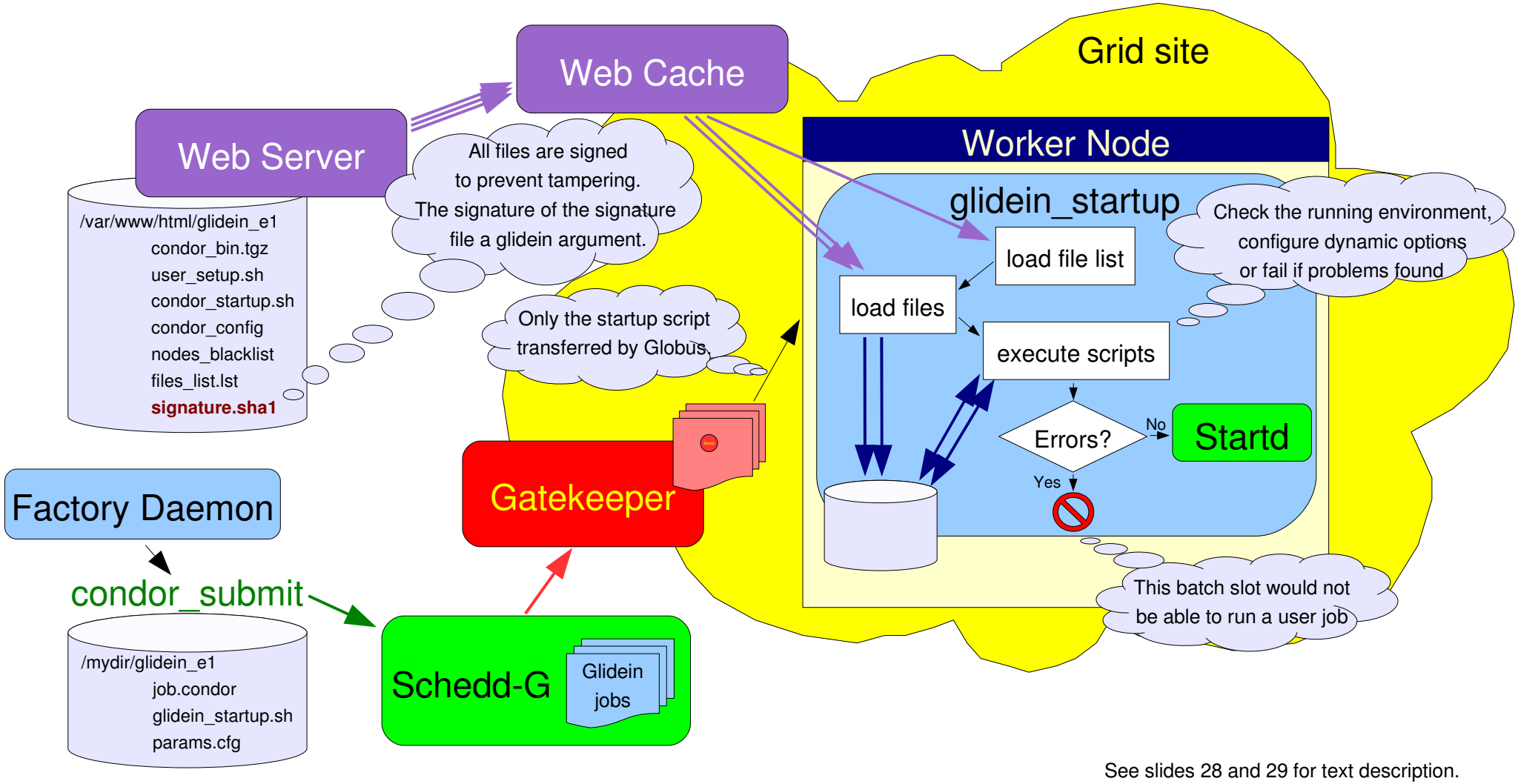
- Essentially a publish-read-submit loop



Glidein factories and Grid sites

- The current implementation requires manual configuration of the Glidein Factory
  - Factory admin must provide CE name and other site specific info
    - Thus a site can be verified before being used
- May not scale with hundreds of sites
  - Some integration with Grid information services will be needed
    - Will try to reuse ReSS information gathering tools

Glidein implementation



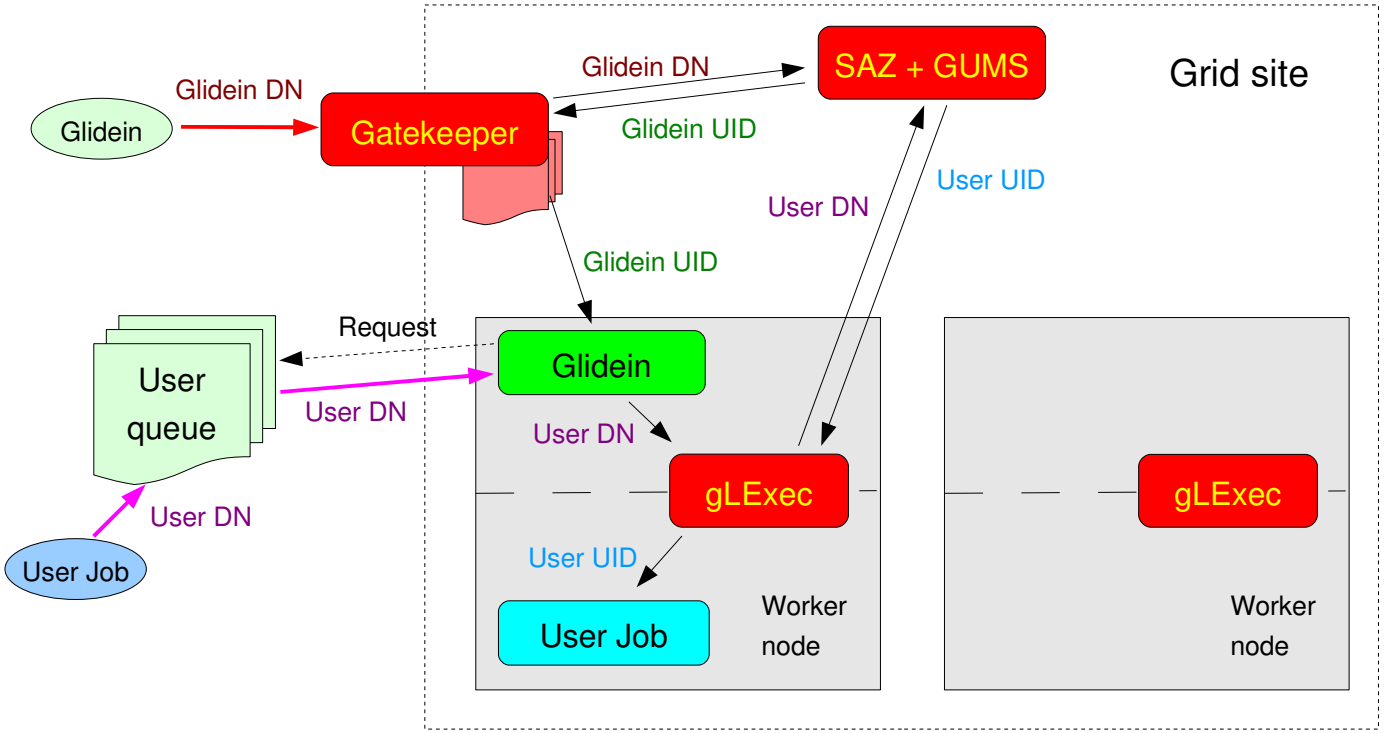
See slides 28 and 29 for text description.

Network security

- Most security handled by Condor
  - Both between
    - VO Frontend and Glidein Factory
    - Startd and Collector/Schedd
  - Condor supports strong authentication, integrity checks and encryption for privacy
- HTTP-accessed data checked via SHA1 checksums

Security on the WN

- gLExec needed to ensure proper security
  - Grid site controls who is really running
  - Pilot infrastructure shielded from the user



glideinWMS Monitoring

- Glidein Factory monitoring implemented
  - VO frontend will follow soon
- Two time dimensions:
  - Last snapshot
  - Historical archives, up to one year
- Three formats
  - XML
  - rrd databases
  - images

```
<frontends updated="1173376587">
  <frontend name="G1_v9_ultralight8@cmssrv13.fnal.gov@cms11_20">
    <Status Held="2" Idle="100" Running="1440"/>
    <Requested Idle="100"/>
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```
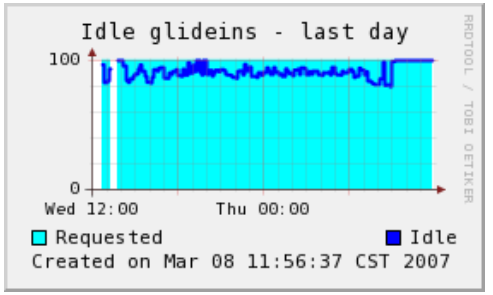
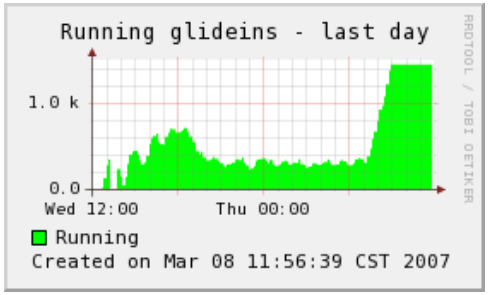
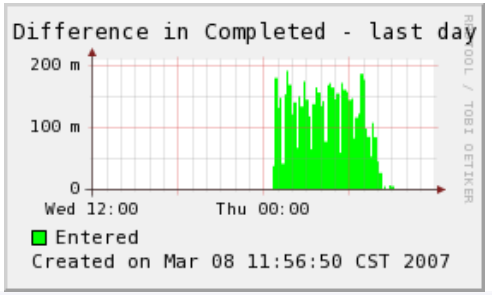







Conclusion

- glideinWMS in good shape
  - Ready to be integrated with USCMS production and analysis tools
  - USATLAS Panda expressed interest in using it
- Counting on having gLExec deployed with the next OSG release
- With more real-world experience will certainly come new requirements

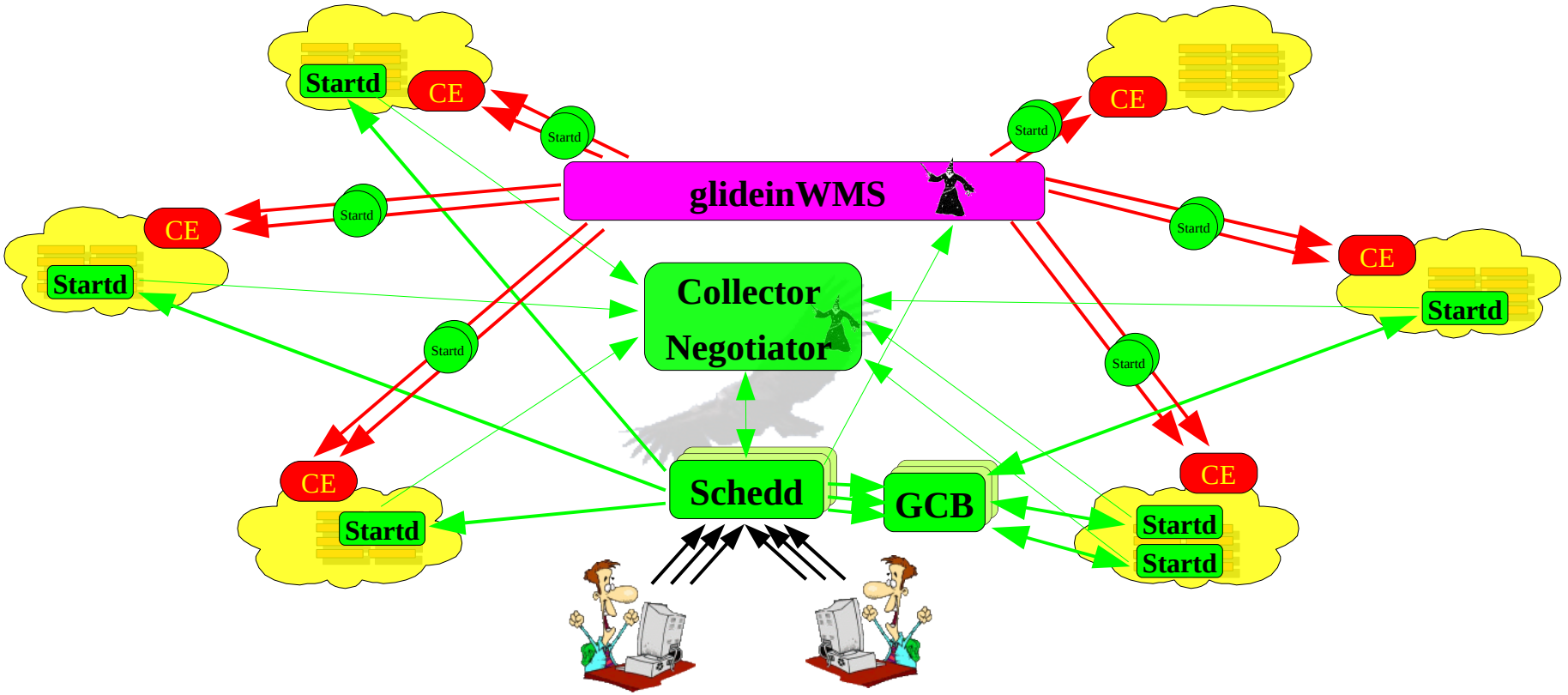
Backup slides

Project overview

- Sponsored by USCMS
- Effort involved: 0.25FTE (I. Sfiligoi)
- Currently being used with USCMS
  Test Harness only
  - Evaluating feasibility and scalability
- About to start integration with other USCMS tools
  - Evaluate feasibility and scalability

The glideinWMS

- Essentially a standard Condor pool, with startds started in a dynamic way



Glidein factory ClassAd

Published classad

MyType=”glidefactory”

Name=”entry@factory”

FactoryName=”factory”

GlideinName=”entry”

Attribute1=”...”

...

AttributeN=”...”

GlideinParamXXX=”val1”

...

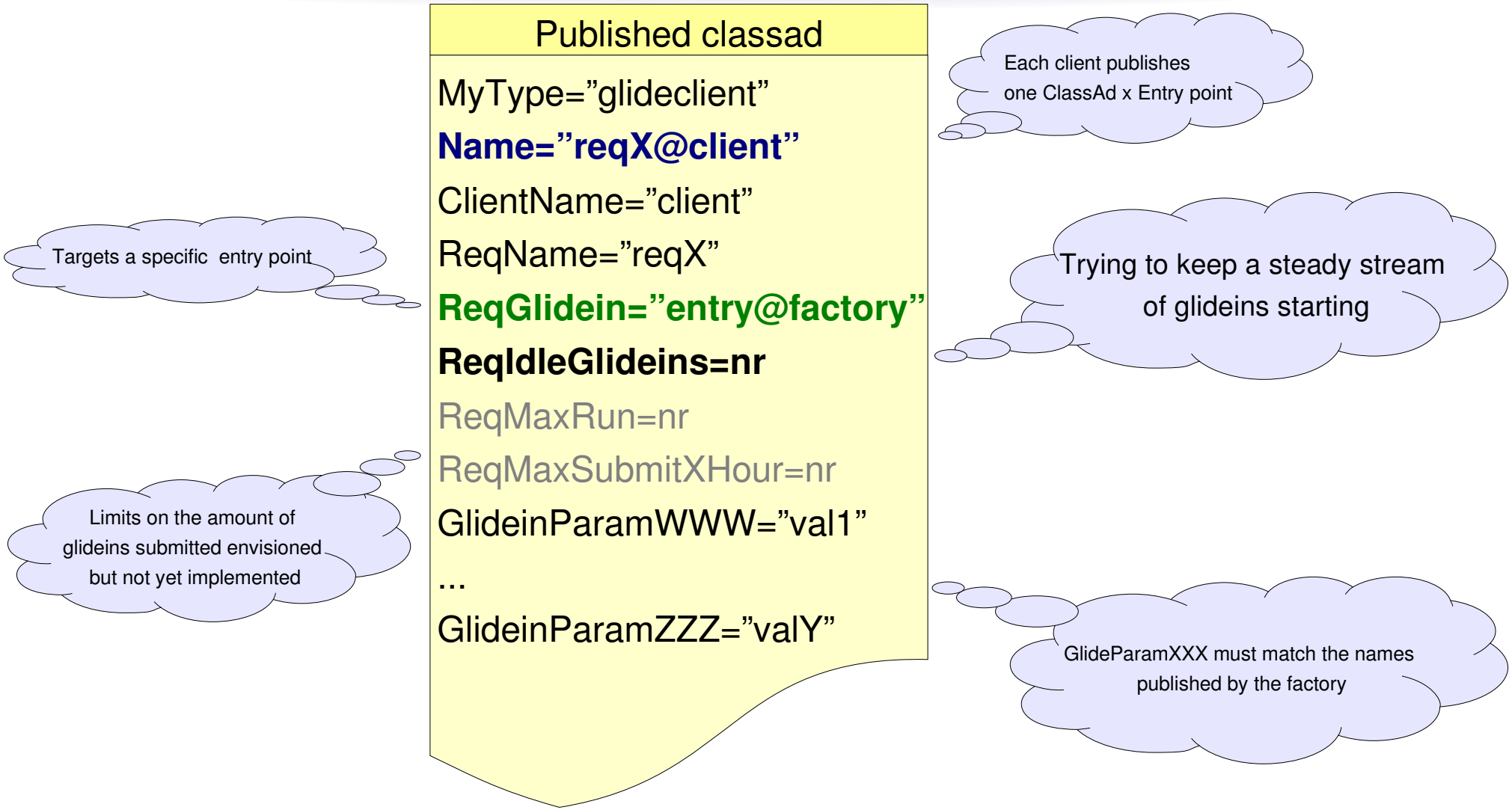
GlideinParamYYY=”valN”

One ClassAd x Entry point

Attributes describe the glidein
like:
ARCH=”INTEL”, MaxHours=72, Site=”Florida”

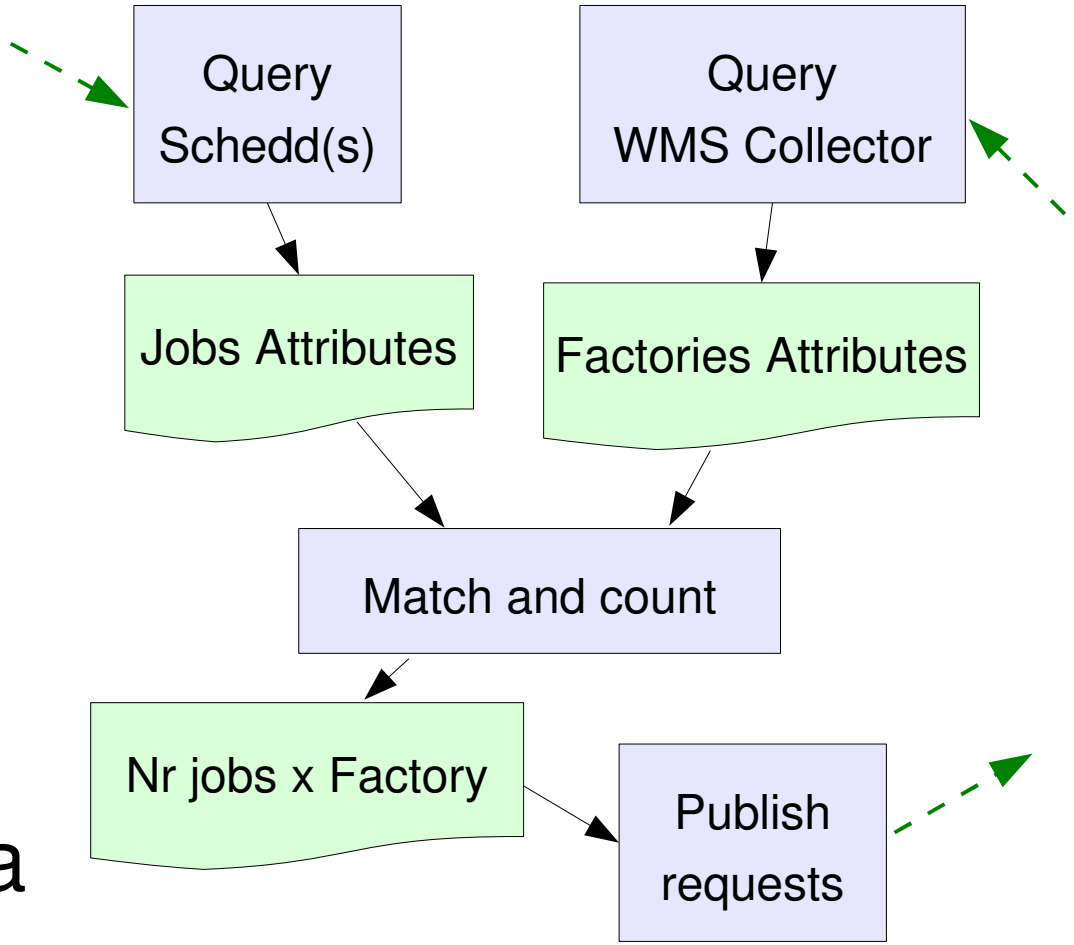
Parameters set glidein parameter defaults
like:
CONDOR_HOST=”UNDEFINED”,SEC_DEFAULT_ENCRYPTION=OPTIONAL
MinDisk=16G, CheckFilesExist=”/tmp/CMS,$DATA/OSG”

Frontend ClassAd

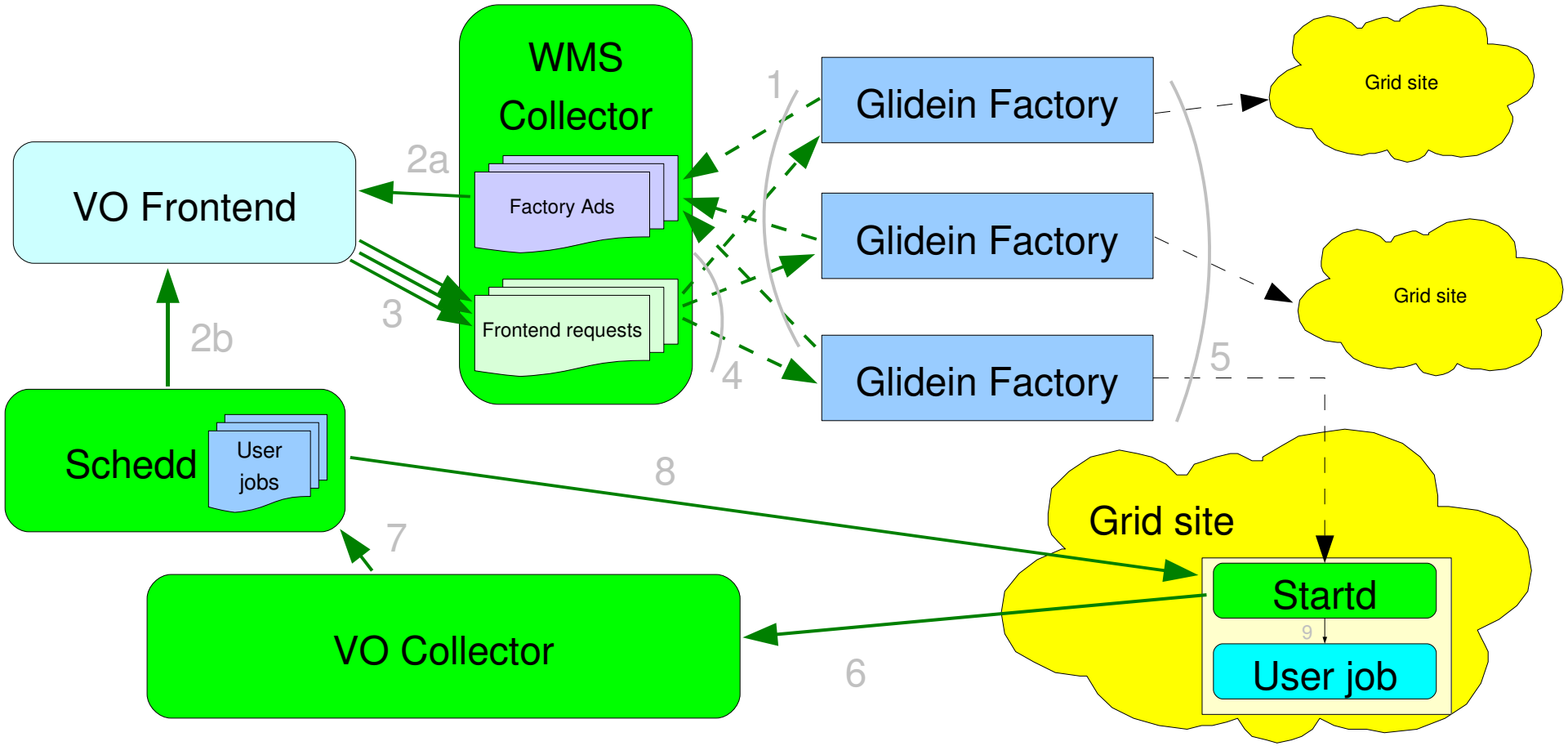


VO Frontend logic

- Essentially a Matchmaker
- Will match user job attributes to factory attributes
- A scaled back count is then published as a request

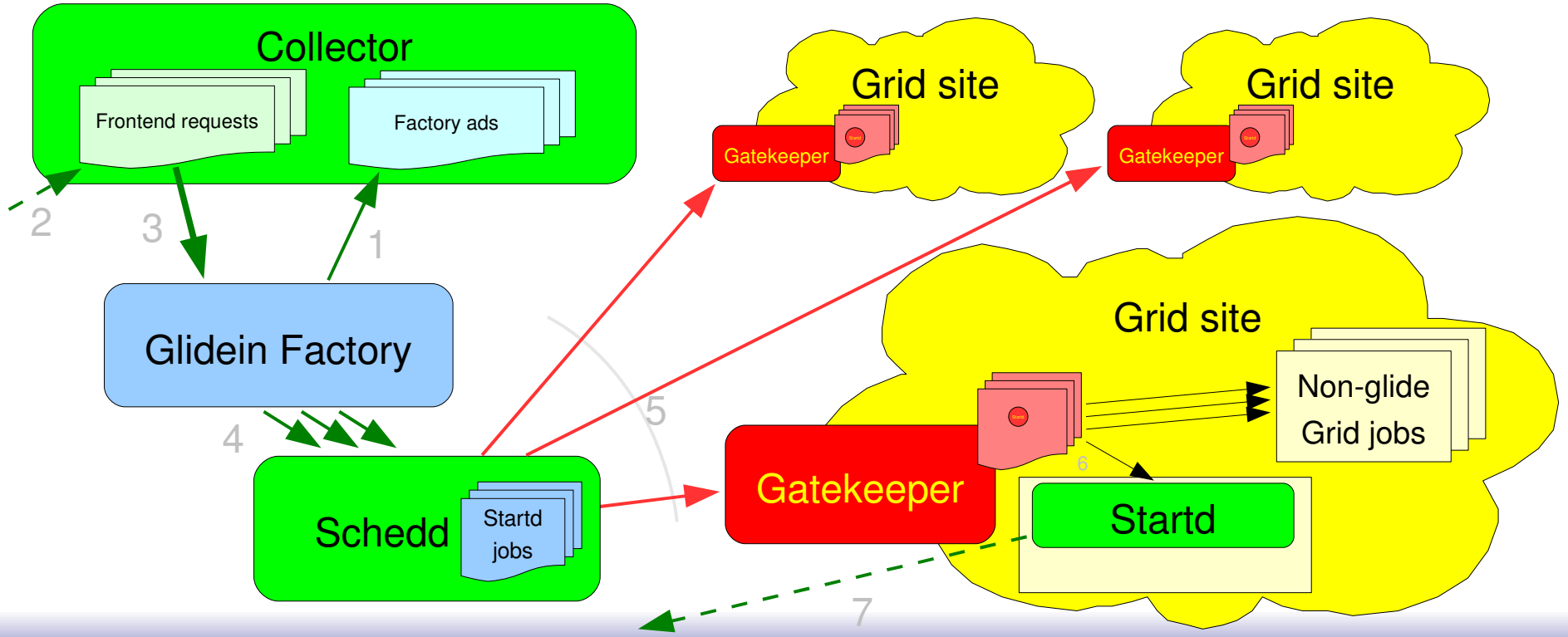


VO Frontend in the bigger picture



Glidein Factory Logic

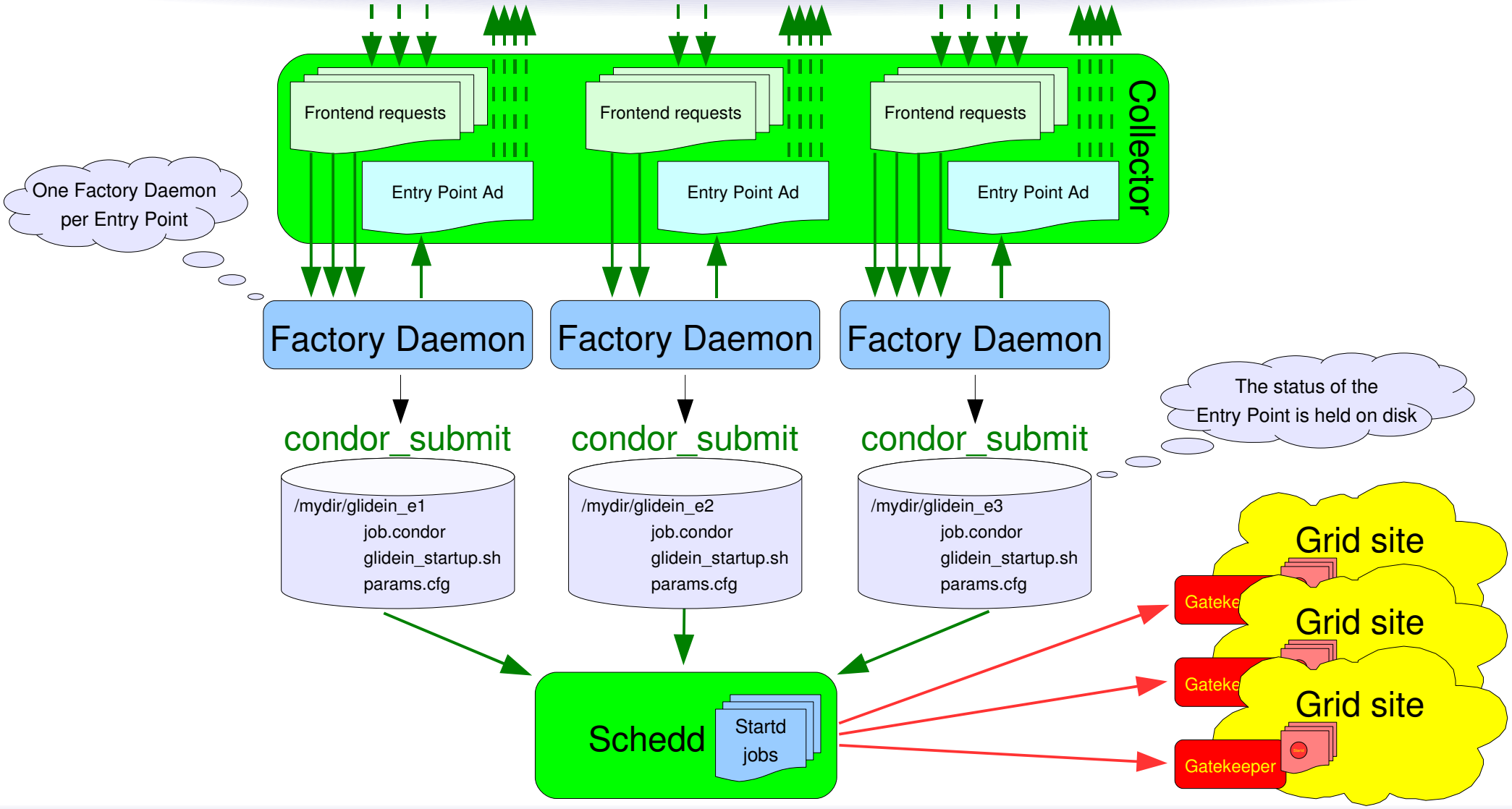
- Essentially a publish-read-submit loop
  - Blindly execute orders
  - Security implemented at Collector level



Glidein Factory Internals

- Made of multiple Entry Points
  - Each Entry Point an independent process
  - Implements the publish-read-submit loop
- Entry Points do the real job
  - The Glidein Factory is just a logical object
  - Management tools that act on the whole factory (i.e. several entry points at a time) envisioned, but not yet implemented

Entry points at a glance



Glidein implementation

- Dummy startup script
  - Just loads other files and execute the ones marked as executable
- File transfer implemented using HTTP
  - Easy cacheable, standard tools available (Squid)
  - Proven to scale, widely used in Industry
- All sensitive file transfers signed (SHA1)
  - Prevent tampering, as HTTP travels in clear

Glidein implementation (2)

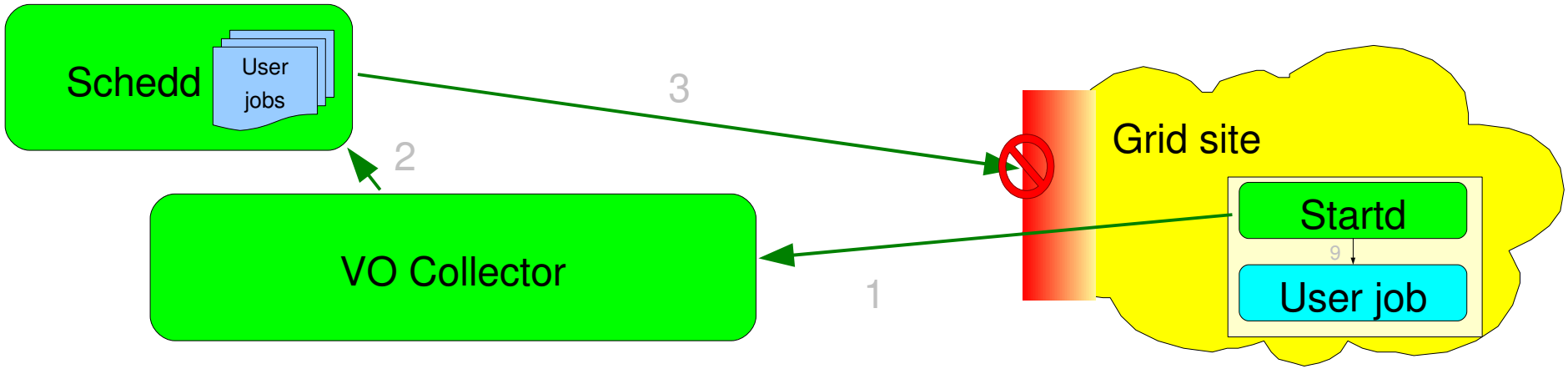
- Standard sanity checks provided
  - Disk space constraints
  - Node blacklisting
- Generic Condor configure and startup script provided, too
- Factory admins can easily add their own customization scripts (both for checks and configs)
  - Allowing Frontends to add custom scripts envisioned, but not yet implemented

Security

- Traffic between the Collector and Schedd, and the Grid sites cannot be trusted
  - WAN is insecure by definition
- Strong authentication needs to be used
  - The startd has access to the service X509 proxy, so that is used for authentication
  - Supported natively by Condor

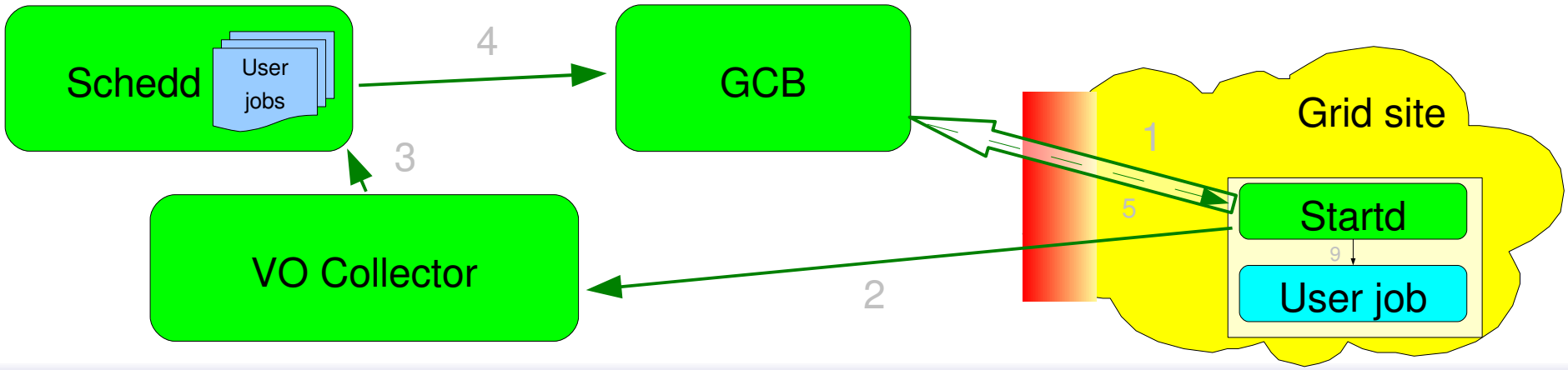
Private networks and firewalls

- Condor developed with LAN in mind
  - All daemons require bi-directional networking
- Default mode fails with firewalls and private networks
  - Incoming traffic on WNs almost never allowed



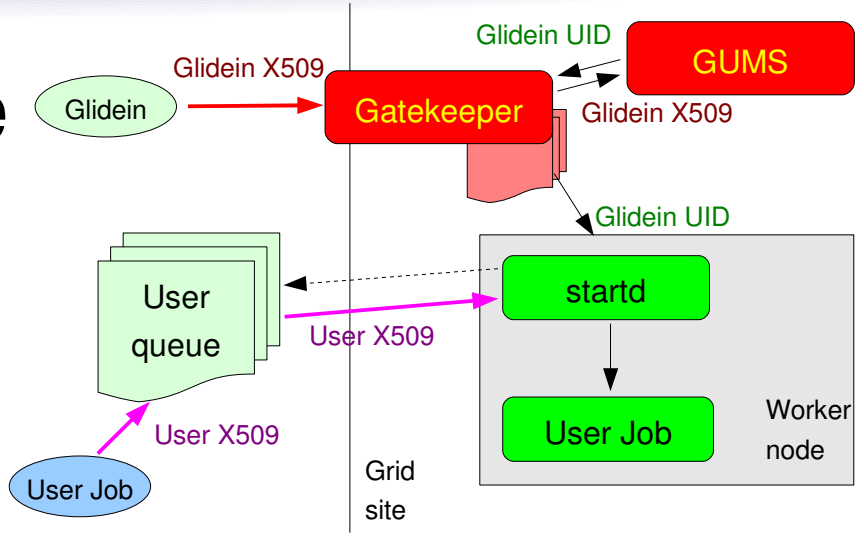
Using Condor GCB

- Adding Condor GCB to the mix solves the problem
  - Startd keeps a permanent TCP connection with GCB
  - Only outgoing connectivity used from WN
- Adds complexity to the system, but is needed
  - One GCB server can handle ~2k glideins



Integration with Grid-local security infrastructure

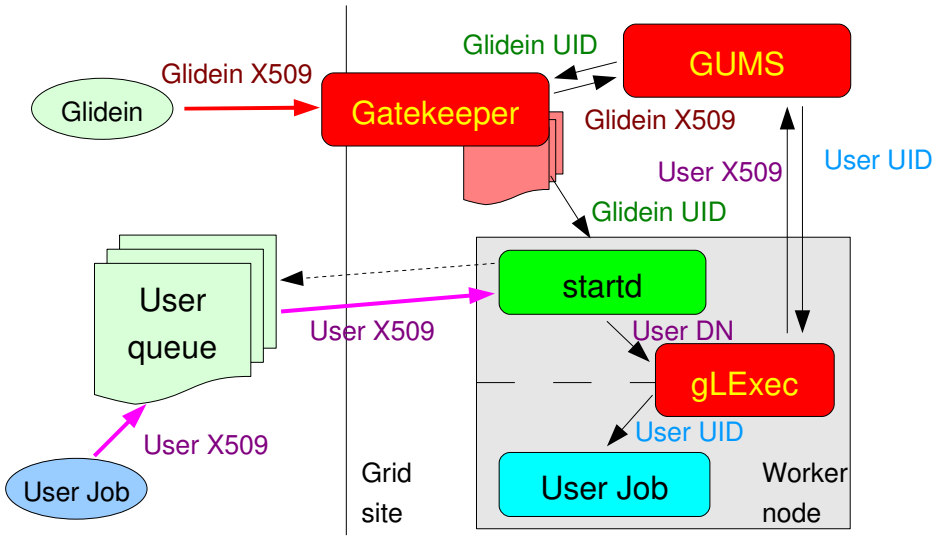
- Default pilot operation mode breaks Grid security rules
  - The real user job is pulled in without local consent
  - Grid site knows only about the glideins



- The default mode also a security risk for the VO
  - User jobs run under the same UID as the condor daemons
    - Users have access to the service X509 proxy

Condor integration with gLExec

- gLExec started to be deployed on OSG WNs
  - Will change UID based on X509 proxy
- Condor natively supports it as of v6.9.0
  - Glidein factory have the necessary config script
- Solves both problems at once



Monitoring data

- When last updated
- List of all served requests, and for each request
  - What attributes were requested
  - What is the status of the requested attributes
  - Other attributes can be present, but not required

Entry Point Static Example

```
<frontends updated="1173376587">
  <frontend name="G1_v9_ultralight8@cmssrv13.fnal.gov@cms11_20">
    <Status Held="2" Idle="100" Running="1440"/>
    <Requested Idle="100"/>
  </frontend>
  <frontend name="G1_v9_ultralight8@cmssrv13.fnal.gov@cms11_21">
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    <Requested Idle="100"/>
  </frontend>
  <frontend name="G1_v9_ultralight8@cmssrv13.fnal.gov@cms11_22">
    <Status Held="0" Idle="100" Running="0"/>
    <Requested Idle="100"/>
  </frontend>
</frontends>
```

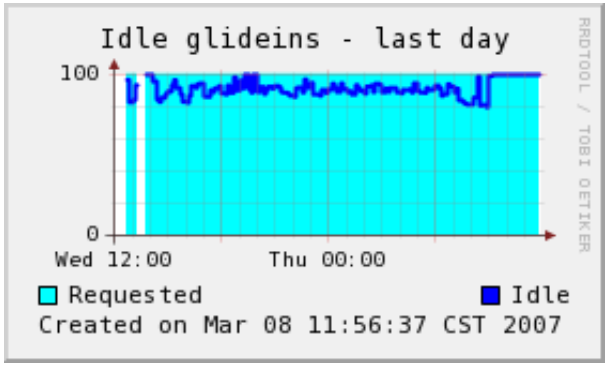
Dynamic example

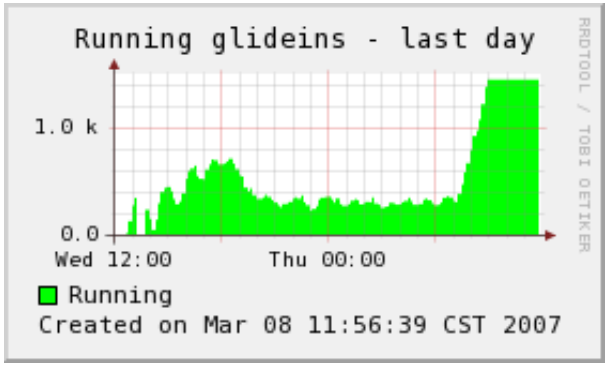
Status_Attribute_Running.hour.xml

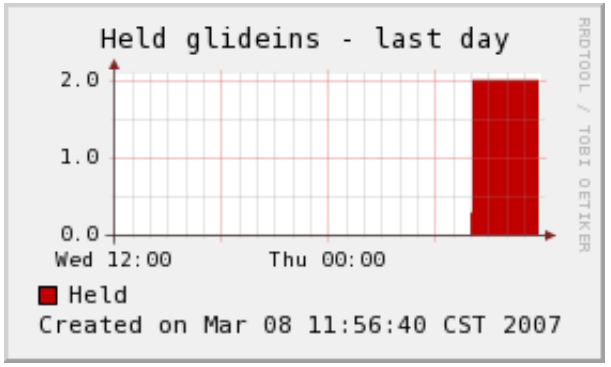
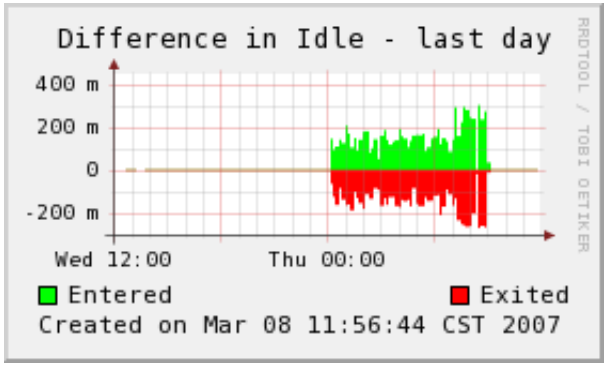
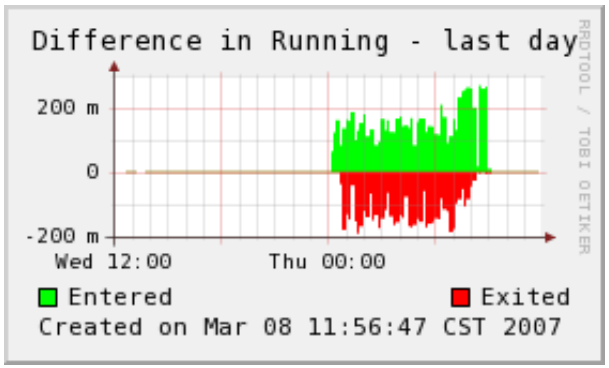
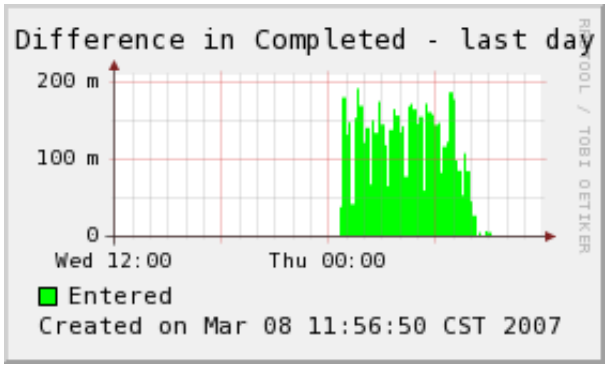
```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xport>
 <meta>
  <start>1173373200</start>
  <step>300</step>
  <end>1173376800</end>
  <rows>13</rows>
  <columns>1</columns>
  <legend>
   <entry>Running</entry>
  </legend>
 </meta>
 <data>
  <row><t>1173373200</t><v>1.4400000000e+03</v></row>
  <row><t>1173373500</t><v>1.4300000000e+03</v></row>
  <row><t>1173373800</t><v>1.4200000000e+03</v></row>
  <row><t>1173374100</t><v>1.4150000000e+03</v></row>
  <row><t>1173374400</t><v>1.4200000000e+03</v></row>
  <row><t>1173374700</t><v>1.4100000000e+03</v></row>
  <row><t>1173375000</t><v>1.4300000000e+03</v></row>
  <row><t>1173375300</t><v>1.4400000000e+03</v></row>
  <row><t>1173375600</t><v>1.4400000000e+03</v></row>
  <row><t>1173375900</t><v>1.4300000000e+03</v></row>
  <row><t>1173376200</t><v>1.4250000000e+03</v></row>
  <row><t>1173376500</t><v>1.4300000000e+03</v></row>
  <row><t>1173376800</t><v>NaN</v></row>
 </data>
</xport>
```

Graphs

Absolute Values







Rates