



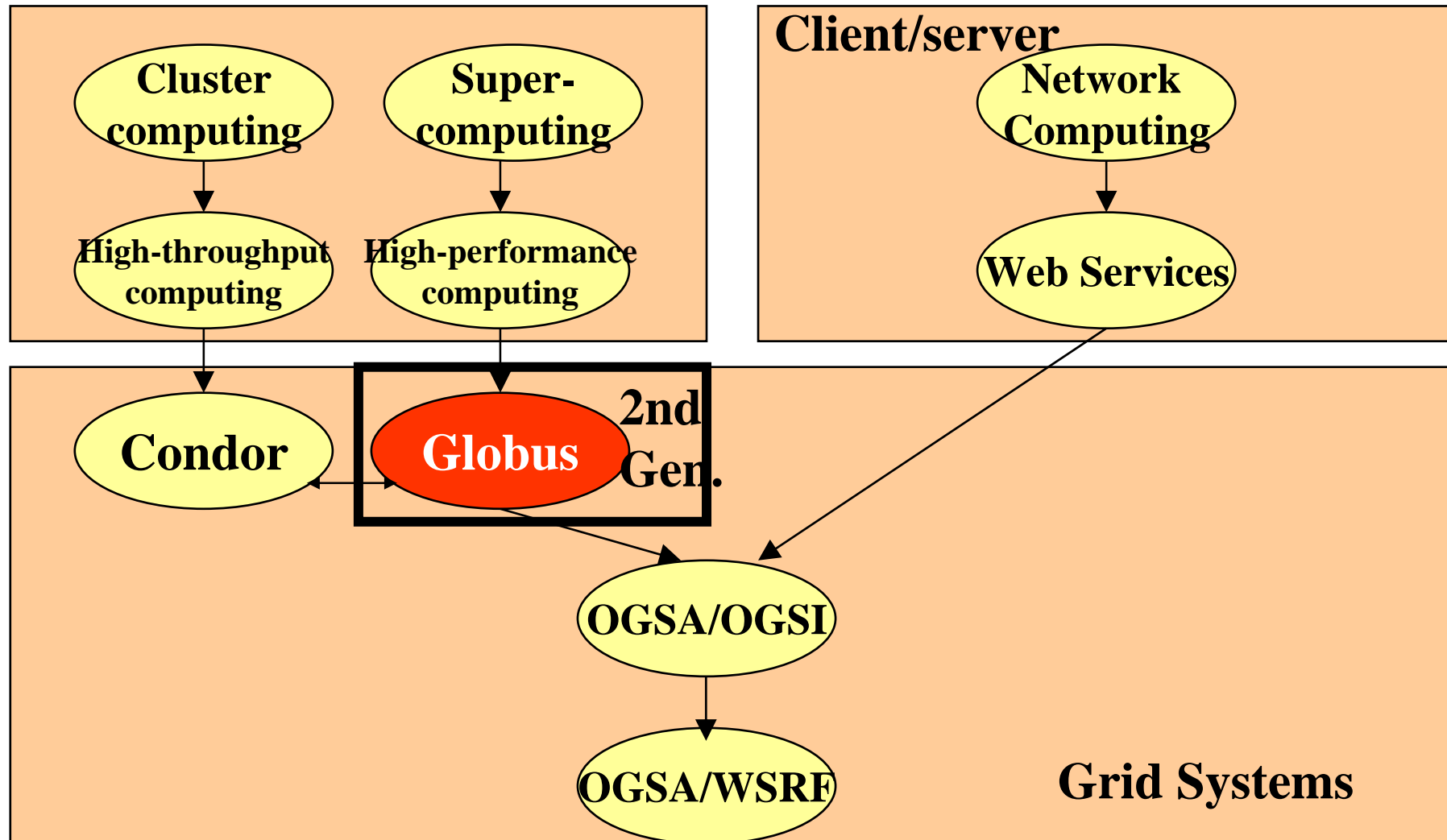
# Globus Toolkit 2

Peter Kacsuk – Sipos Gergely

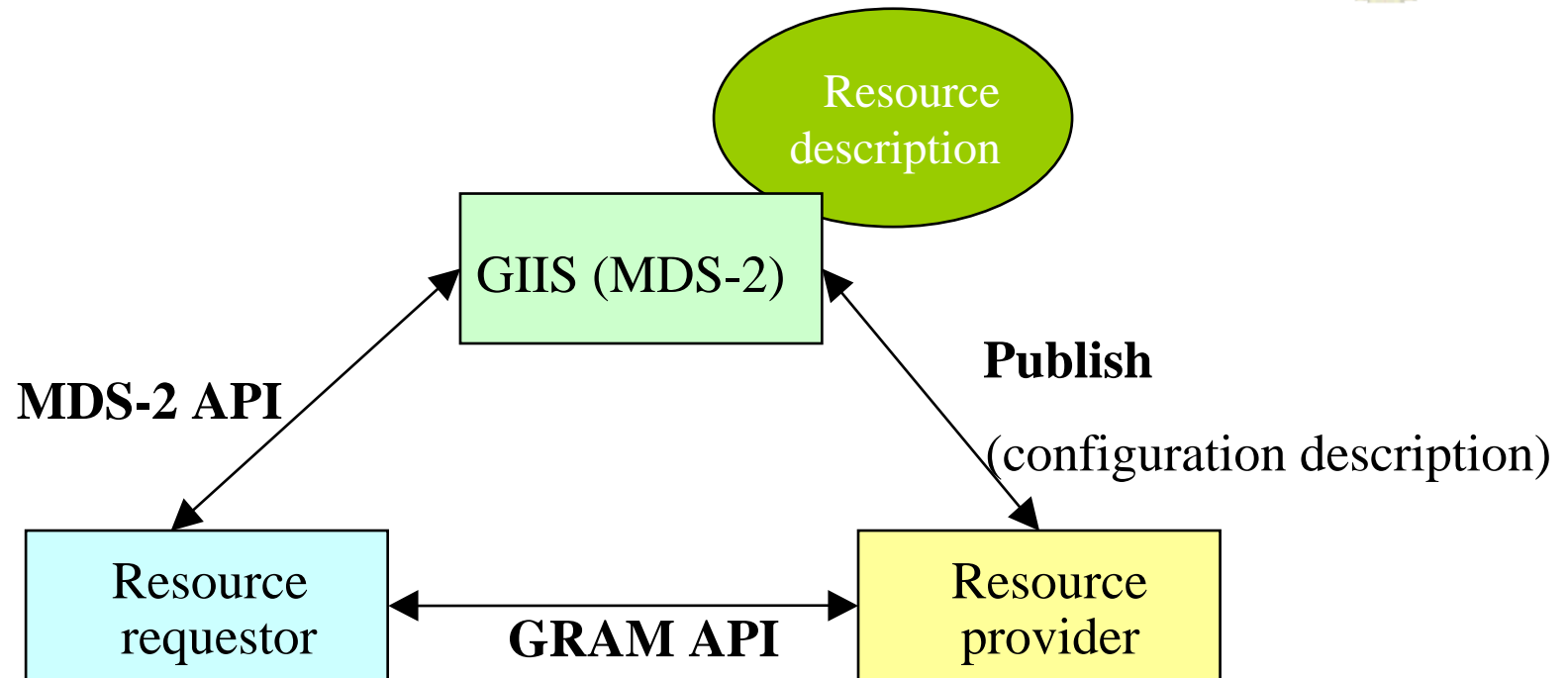
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# Progress in Grid Systems



# The Globus-2 model



**Client program moves to resource(s)**



**Security is a serious problem!**

# Solutions by Globus (GT-2)



- **Dynamic** creation of Virtual Organizations (VOs)
- Clients can directly choose resources
- **Standard protocols** are used to connect Globus sites
- Security issues are basically solved
  - **Firewalls are allowed** between Grid sites
  - PKI: CAs and X.509 certificates
  - SSL for authentication and message protection
- The client does not need account on every Globus site:
  - Proxies and delegation for secure **single Sign-on**
- Still:
  - provides metacomputing facilities (MPICH-G2)
  - **Not service-oriented either**

# Globus Layered Architecture



Applications

Application Toolkits

DUROC

MPICH-G2

globusrun

Condor-G

Nimrod/G

GAT

Basic Grid Services – Globus Toolkit 2

GRAM

MDS-2

GSI

GSI-FTP

GASS

Replica  
Mngt

Condor

MPI

Grid Fabric

TCP

UDP

LSF

PBS

NOE

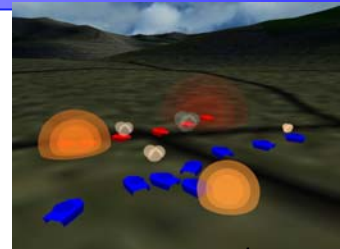
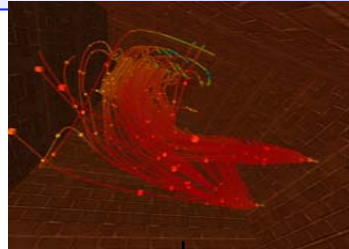
Linux

NT

Solaris

DiffServ

# The Role of Grid Middleware and Tools



Collaboration Tools

Data Mgmt Tools

...

Distributed simulation

Information services

Resource mgmt

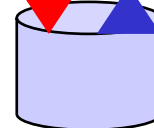
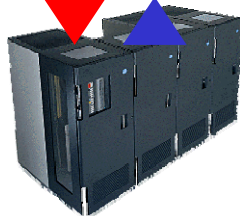
Data mgmt

...

Remote access



Remote monitor



net



Credit to Ian Foster

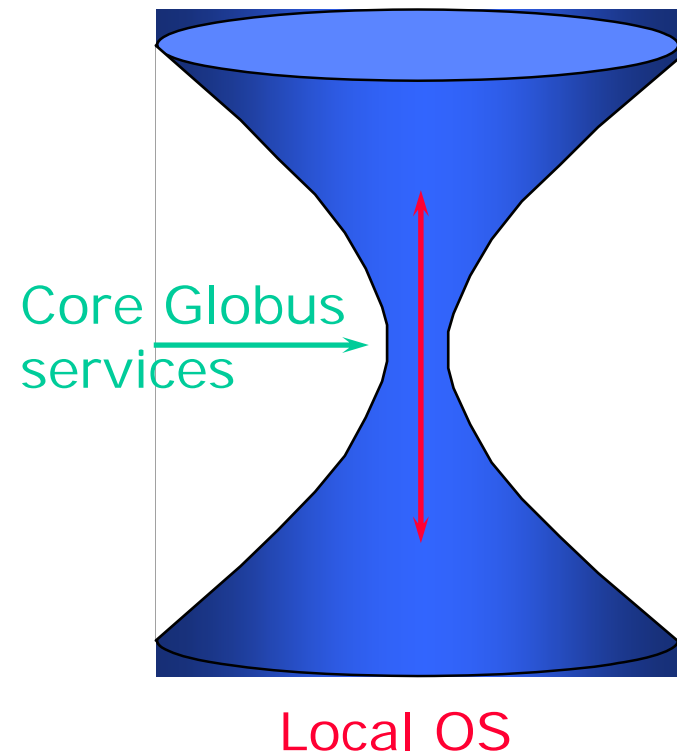
# Globus Approach



- Focus on architecture issues
  - Provide implementations of grid protocols and APIs as basic infrastructure
  - Use to construct high-level, domain-specific solutions
- Design principles
  - Keep participation cost low
  - Enable local control
  - Support for adaptation

## Applications

Diverse global services



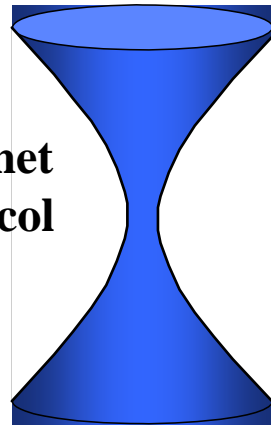
# Globus Approach: Hourglass



## High-level services

TCP, FTP,  
HTTP, etc.

Internet  
protocol

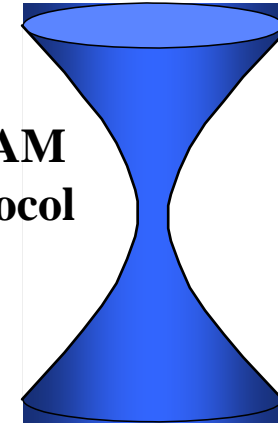


Ethernet, ATM,  
FDDI, etc.



Resource  
brokers,  
Resource co-  
allocators

GRAM  
protocol



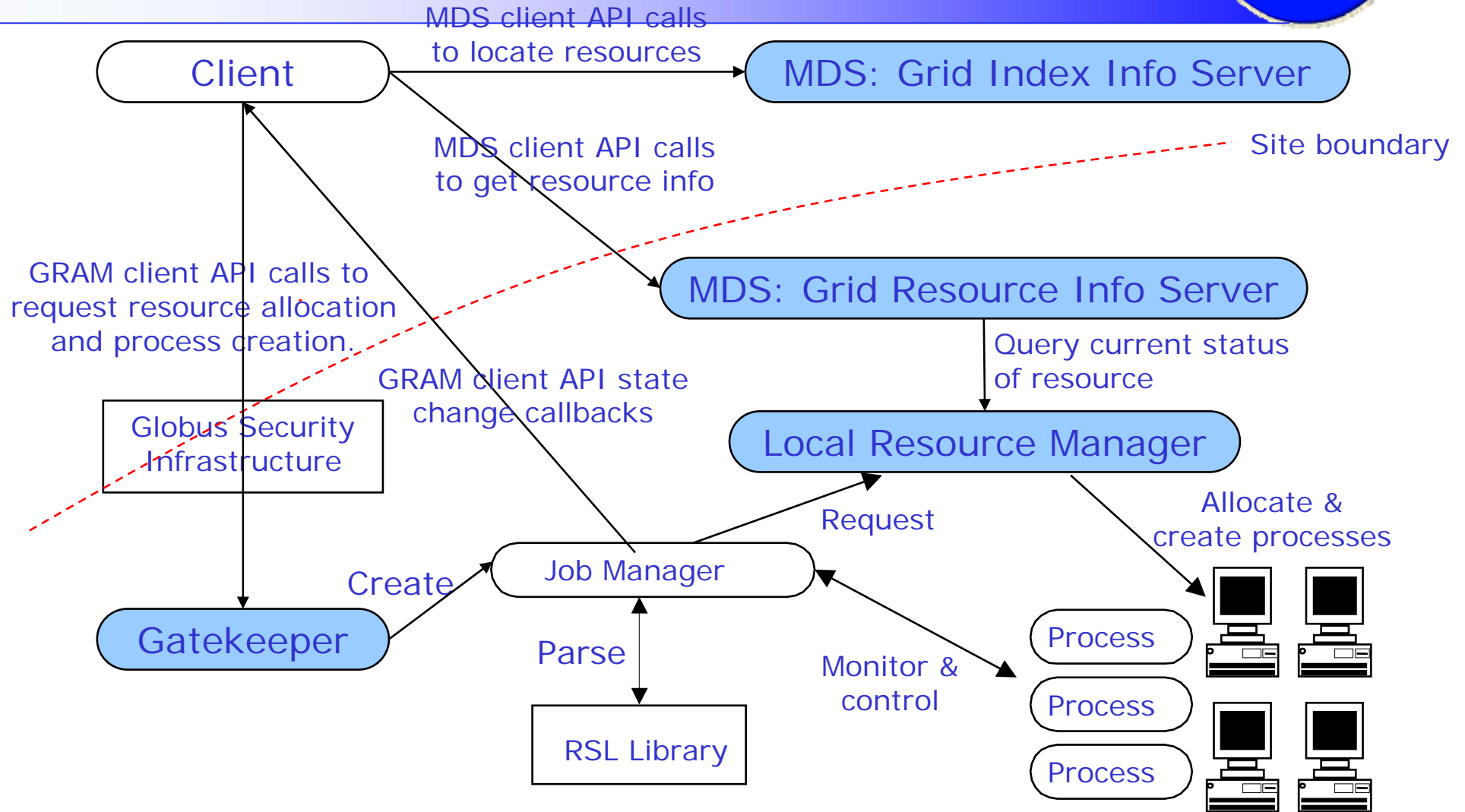
Condor,  
LSF, NQE,  
LoadLeveler, etc.

## Low-level tools





# GRAM Components



# Resource Specification Language

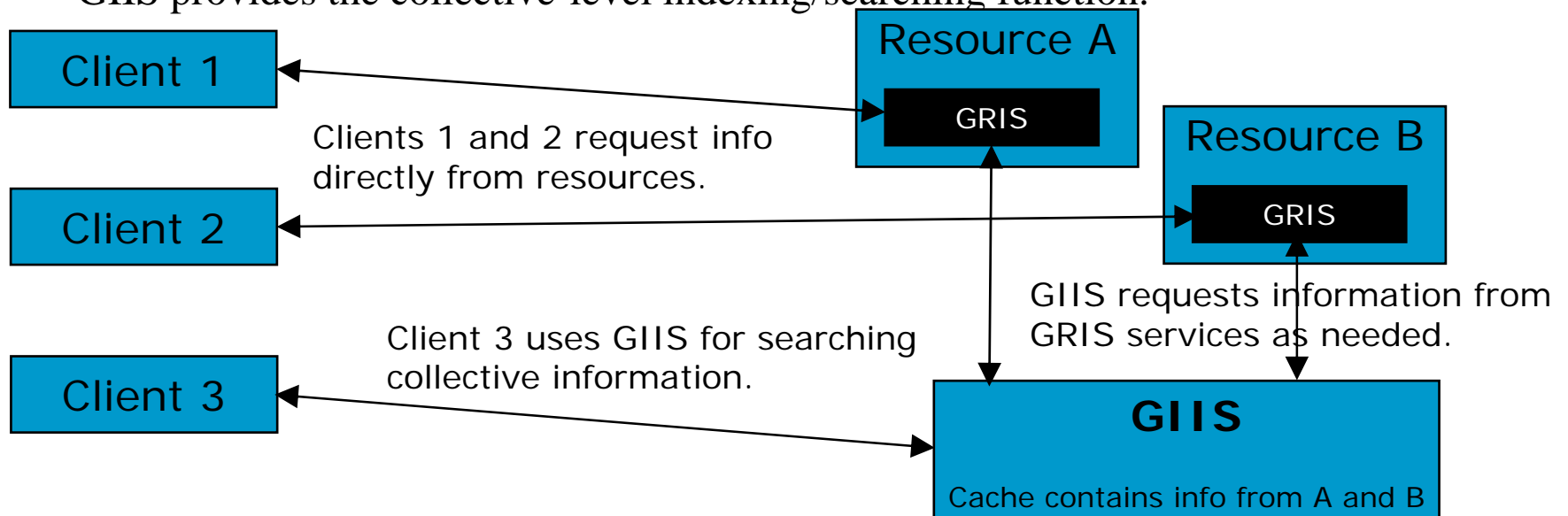


- Much of the power of GRAM is in the RSL
- Common language for specifying job requests
- A conjunction of (attribute=value) pairs
- GRAM understands a well defined set of attributes

# “Standard” MDS Architecture (v1.1.3)



- Resources run a standard information service (GRIS) which speaks LDAP and provides information about the resource (no searching).
- GIIS provides a “caching” service much like a web search engine. Resources register with GIIS and GIIS pulls information from them when requested by a client and the cache as expired.
- GIIS provides the collective-level indexing/searching function.



# GASS Architecture for file staging



Execution machine

Submit machine

```
main( ) {
  fd = globus_gass_open(...)
  ...
  read(fd,...)
  ...
  globus_gass_close(fd)
}
```

&(executable=https://...)

*(b) RSL extensions*

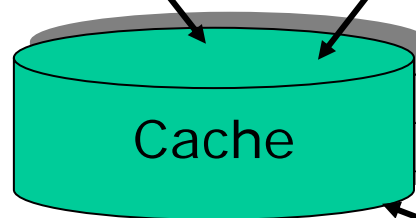
GRAM

GASS Server

HTTP Server

FTP Server

*(a) GASS file access API*



Cache

*(c) Remote cache management*

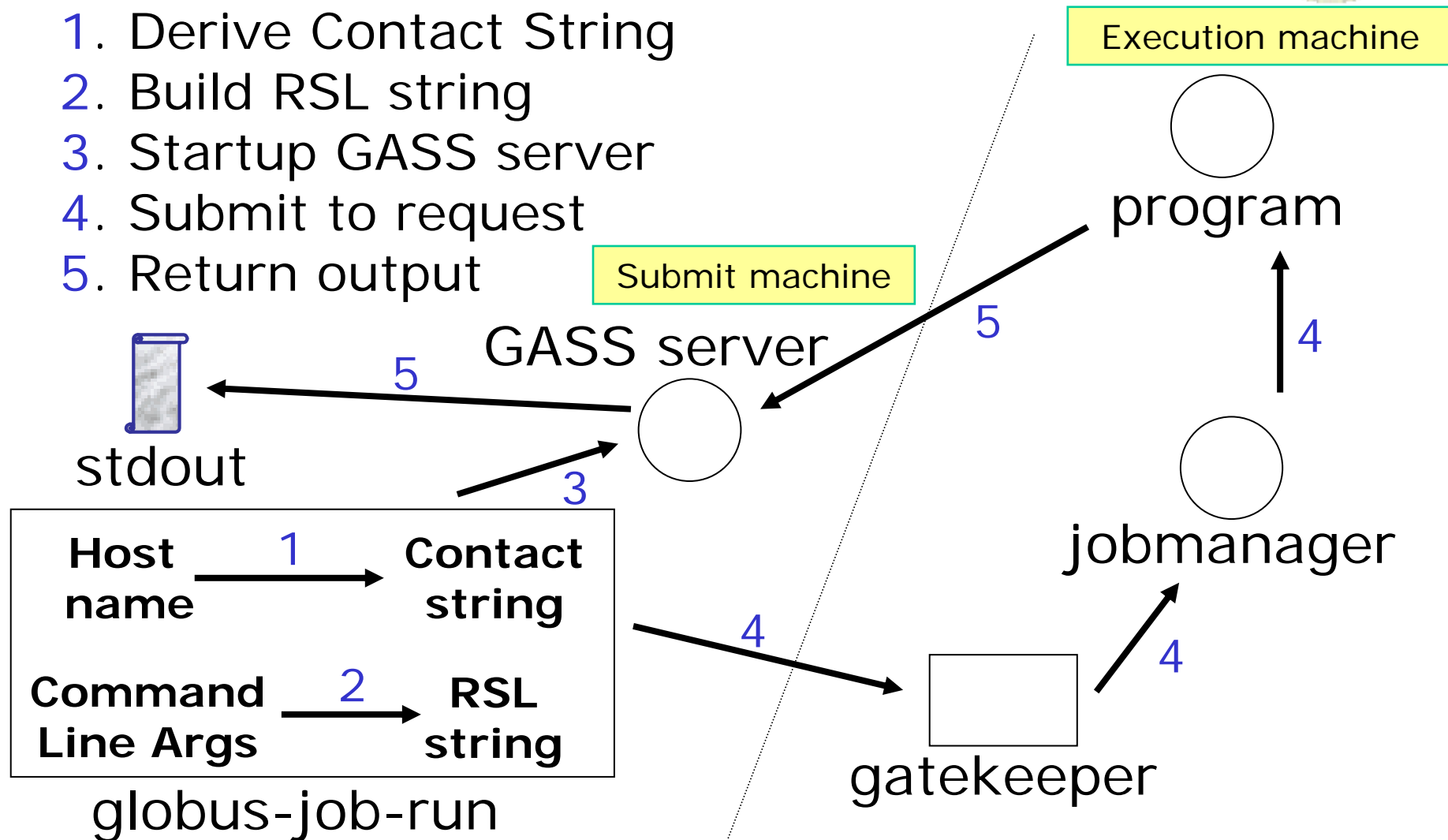
*(d) Low-level APIs for customizing cache & GASS server*

% globus-gass-cache

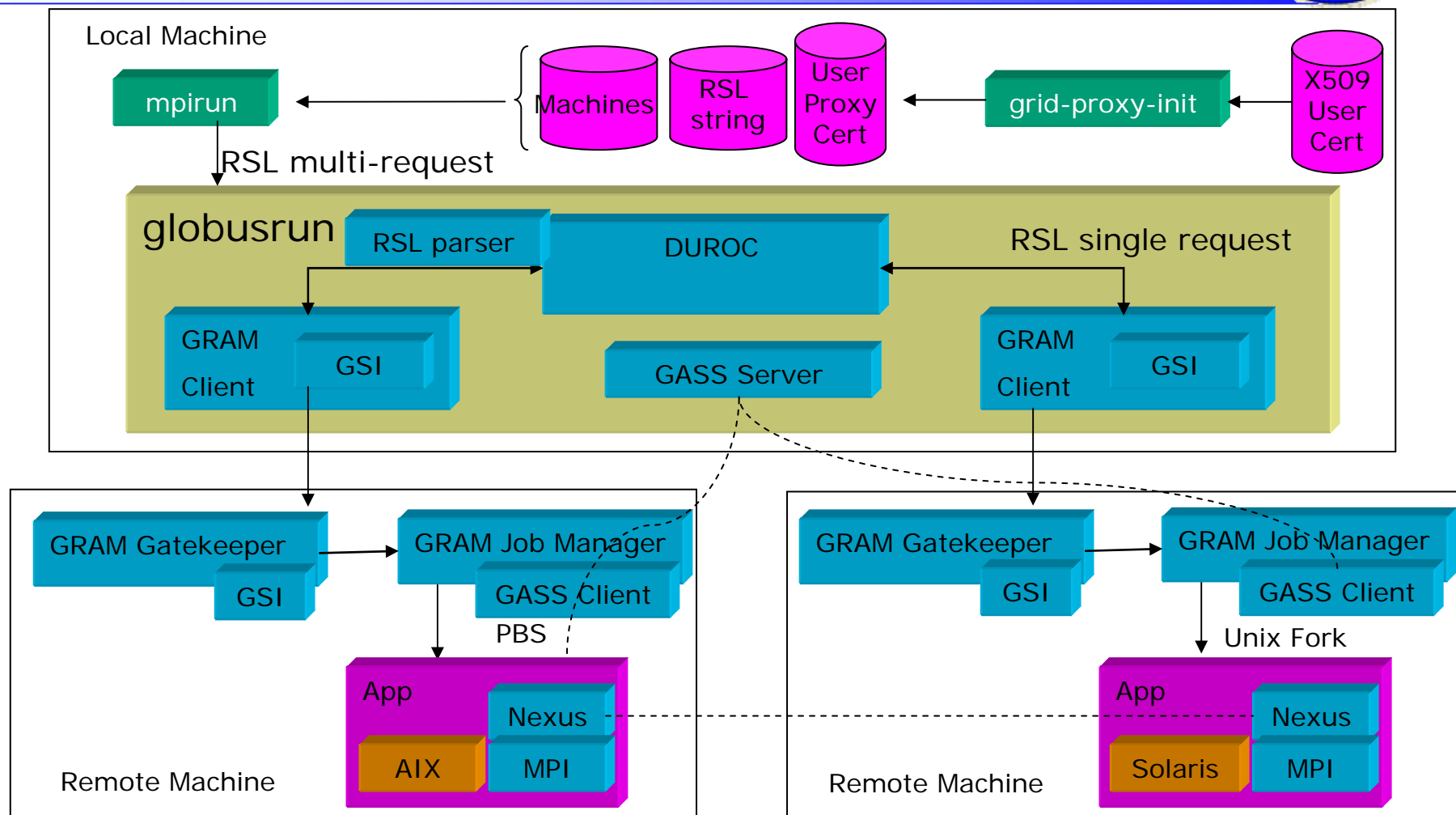


# GRAM & GASS: Putting It Together

1. Derive Contact String
2. Build RSL string
3. Startup GASS server
4. Submit to request
5. Return output



# Globus Components In Action



# What is Condor-G?



- Condor-G is a Personal-Condor enhanced with Globus services
- It knows how to speak to Globus resources via GRAM
- It can be used to submit jobs to remote Globus resources
- It makes Condor keep track of their progress

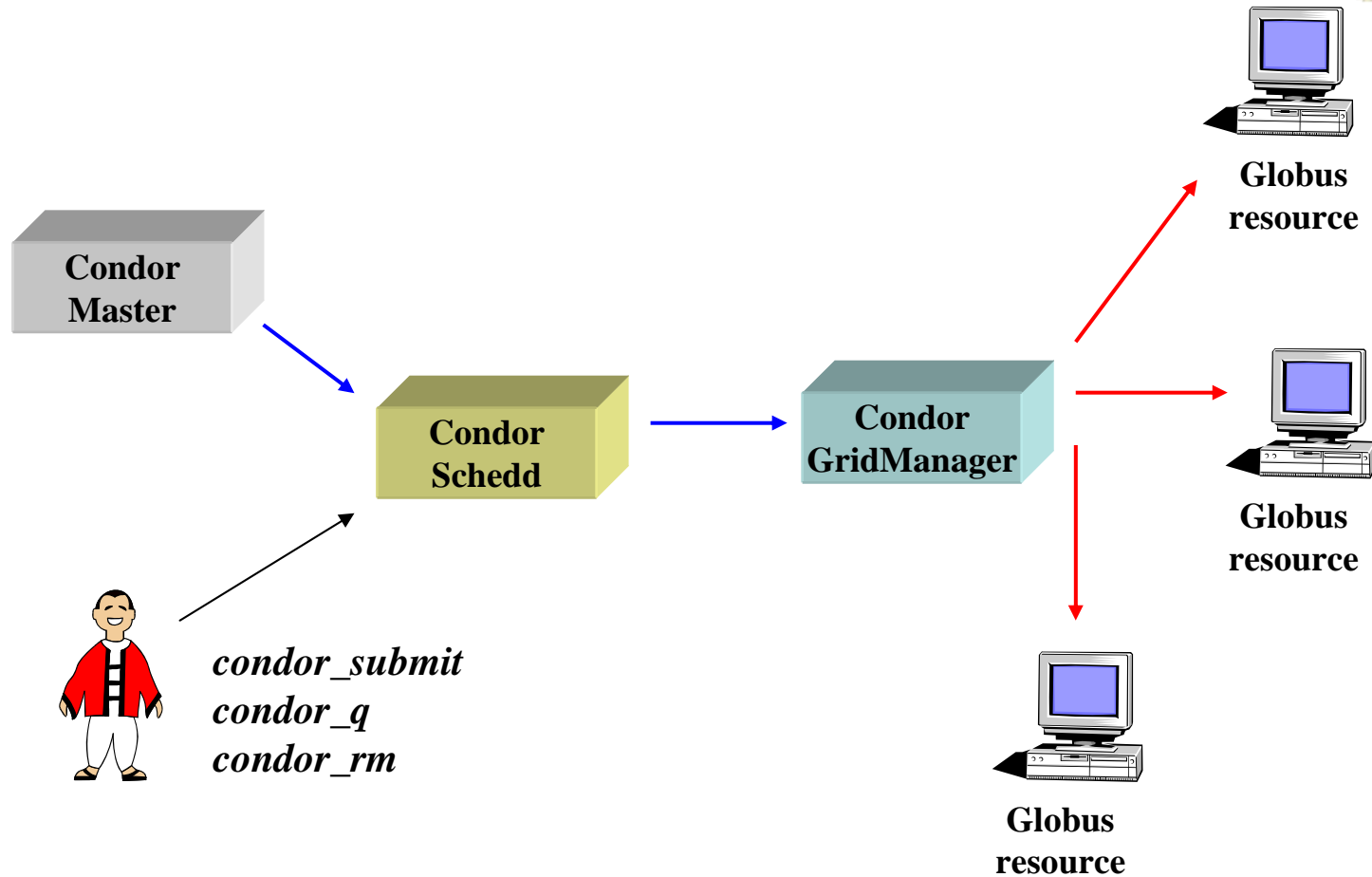
# Condor-G: Condor for the Grid



- Condor is a high-throughput scheduler
- Condor-G uses Globus Toolkit libraries for:
  - Security (GSI)
  - Managing remote jobs on Grid (GRAM)
  - File staging & remote I/O (GASS)
- Grid job management interface & scheduling
  - Robust replacement for Globus Toolkit programs
    - To implement a reliable, crash-proof, checkpointable job submission service
  - Supports single or high-throughput apps on Grid
    - Personal job manager which can exploit Grid resources

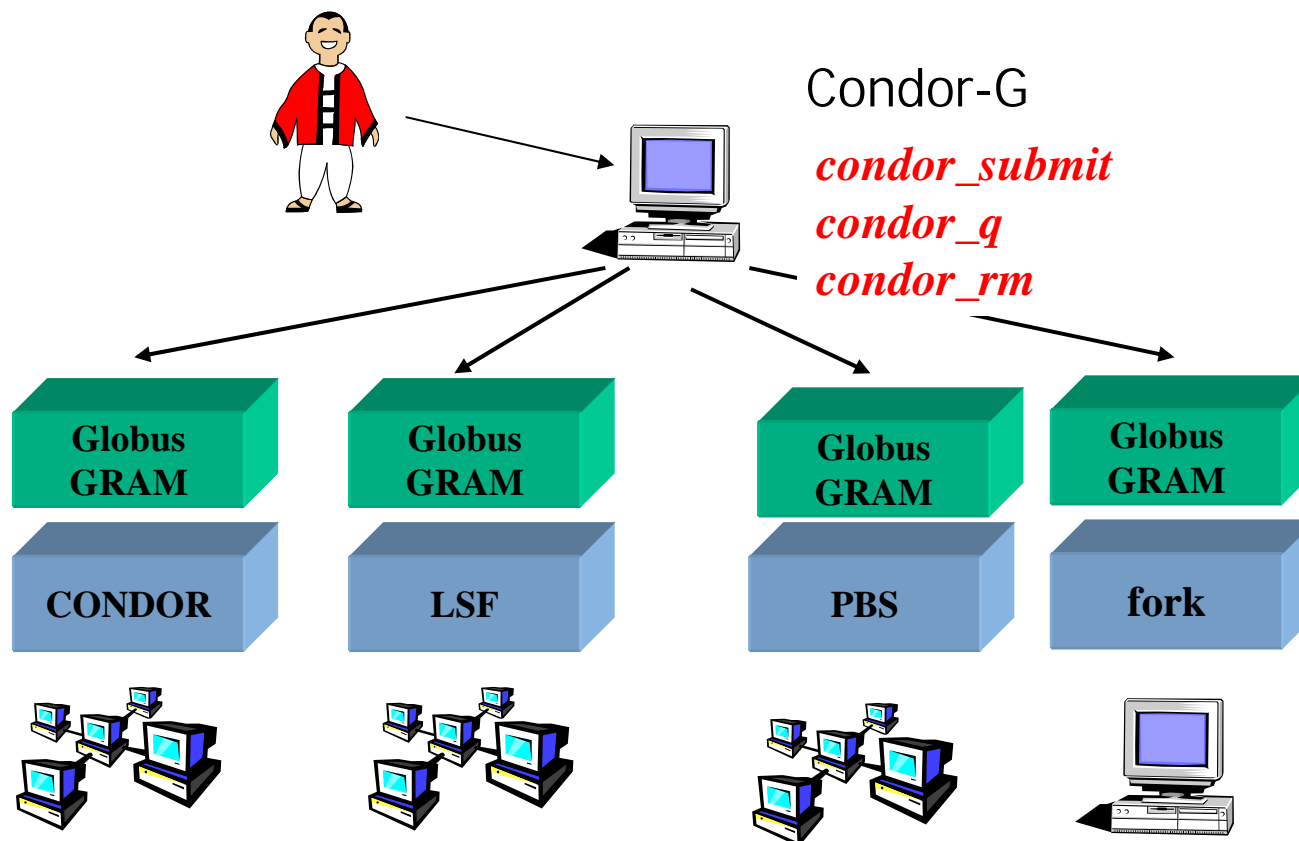


# The Use of Condor-G





# Condor-G as user job submission service



# Globus-based production Grids



- **LHC Grid (LCG-2)**
  - A **homogeneous** Grid developed by CERN
  - **Restrictive policies** (global policies over rule local policies)
  - A **dedicated** Grid to the Large Hydron Collider experiments
  - Works 24 hours/day and used in EGEE
- **UK-NGS**
  - A **homogeneous** Grid deployed in the UK
  - **Restrictive policies**
  - **Non-dedicated**
  - Works 24 hours/day