Job Invocation Interoperability between **NAREGI Middleware Beta** and **gLite**

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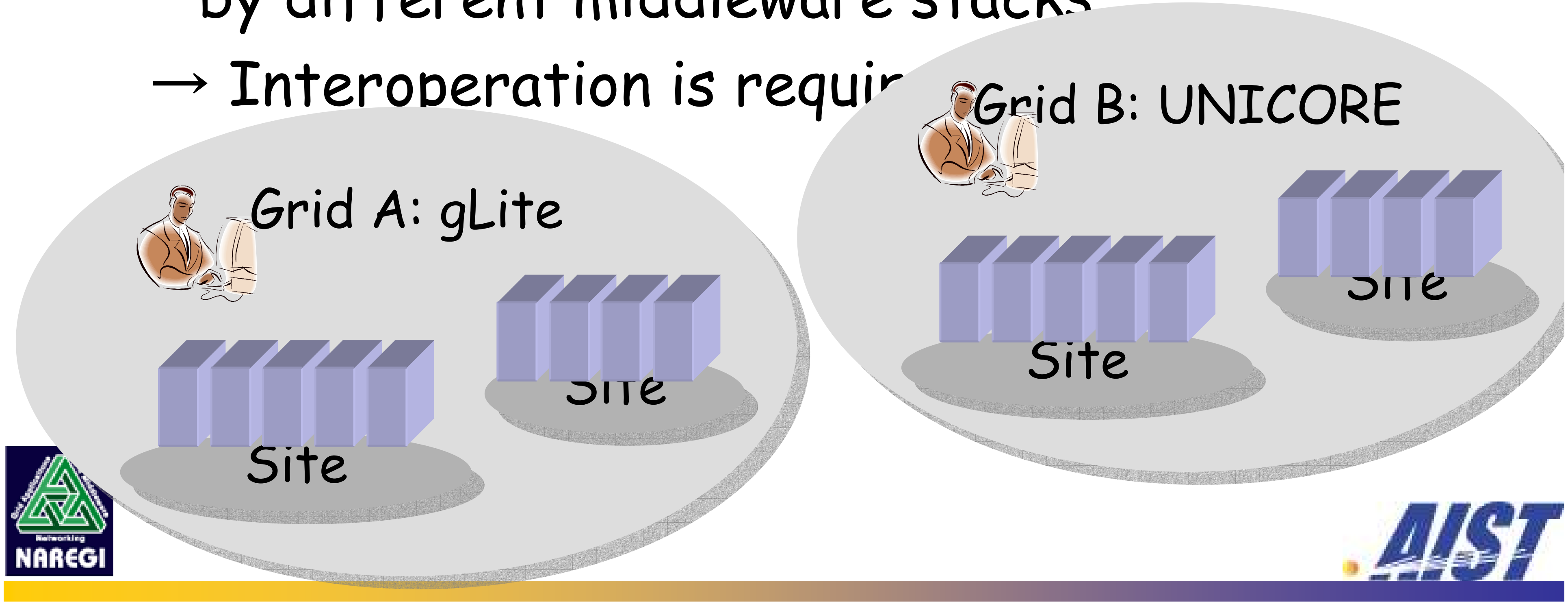
Background

- **Recent development of Grid middleware stacks**
  - ►Globus, UNICORE, NAREGI Middleware, gLite
  - ►Some of them are used in production grids
  - ►Resources cannot be shared by grids operated by different middleware stacks

→ Interoperation is requir



Background (2)

- **OGF(Open Grid Forum) GIN-CG**
  - Grid Interoperation Now Community Group
  - Try to make grid middleware stacks interoperable using currently available technologies

Goal

- **As a part of GIN-CG, perform interoperation experiments between the following two grid middleware stacks**
  - NAREGI Middleware Beta
  - gLite from EGEE

- **Interoperability**
  - Security Mechanisms
  - Information Service
  - Job Submission
  - Large-scale Data Transfer

Outline

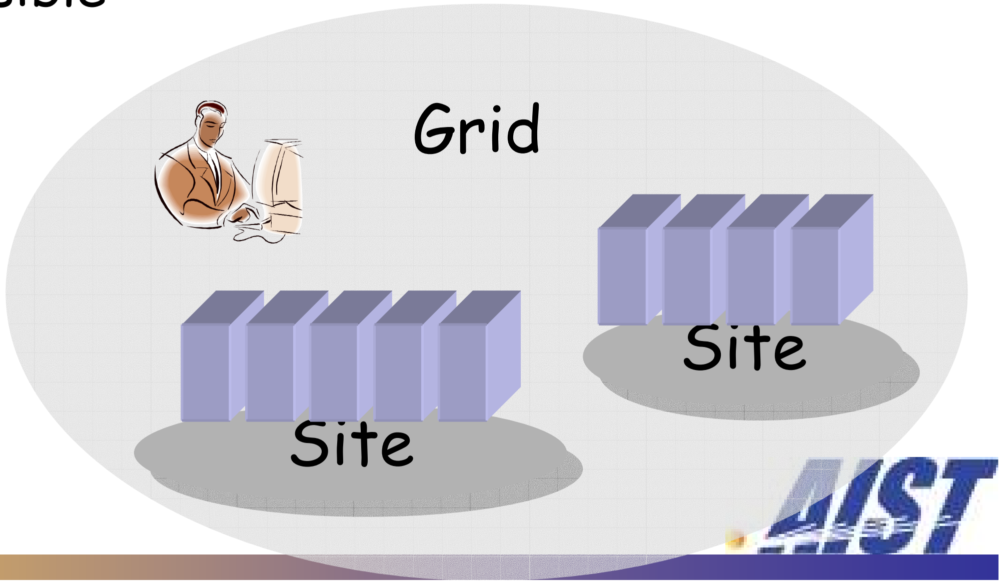
- **Architecture of the Grid middleware stacks**
  - NAREGI Middleware beta
  - gLite

- **Strategies for interoperation and implementation**

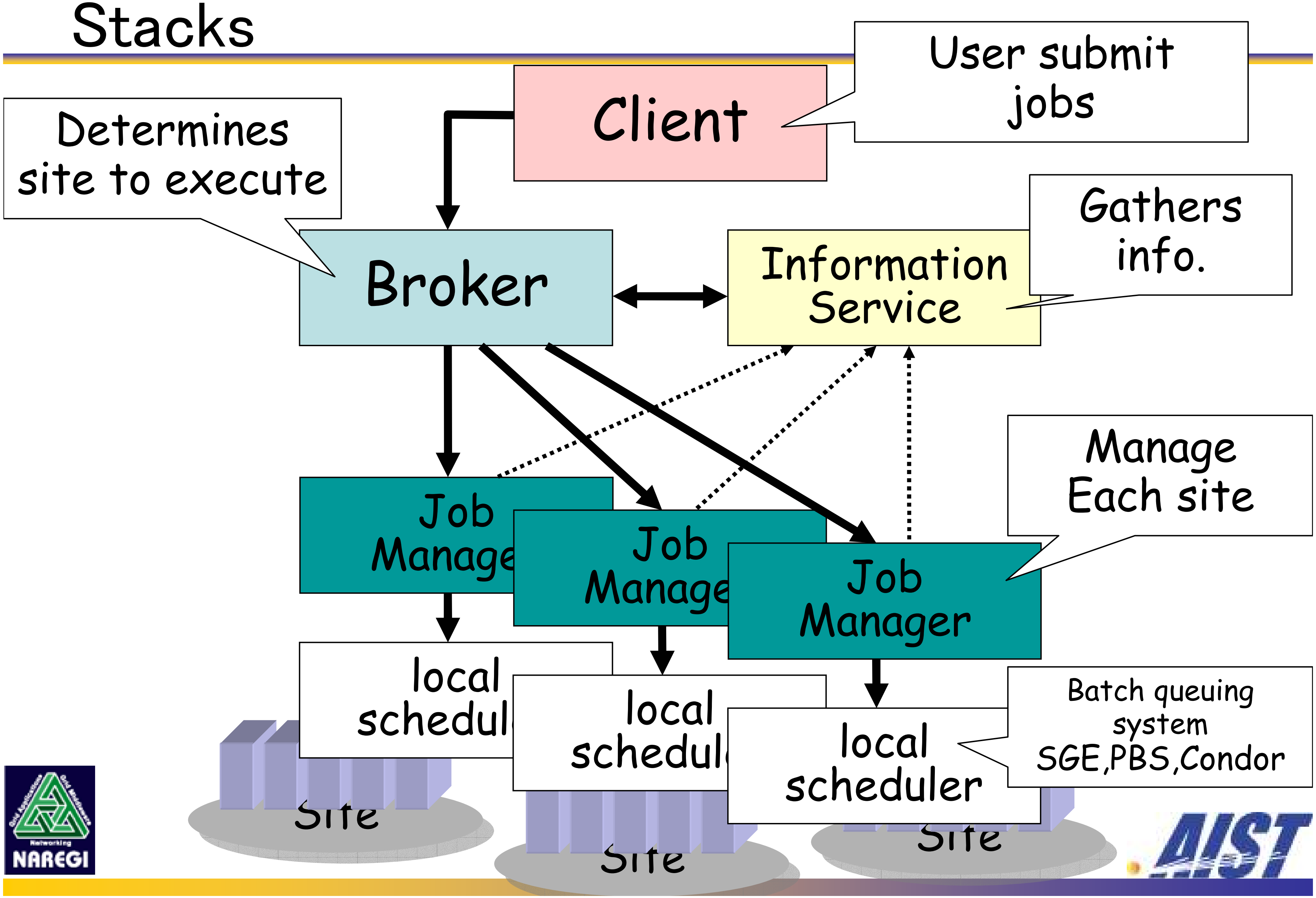
- **Measurement Results**

What are ‘grid middleware stacks’

- **Assumptions**
  - Each ‘grid’ involves several ‘sites’.
  - Each ‘site’ has several computers managed by some kind of ‘local scheduler’
- **Grid middleware stacks**
  - Get job execution request from users and dispatch them to ‘proper’ site, securely.
    - ‘Proper’ - load distribution, Virtual Organization Management
    - ‘Secure’ – Authentication, Authorization
  - Local schedulers are responsible for load distribution inside the sites.



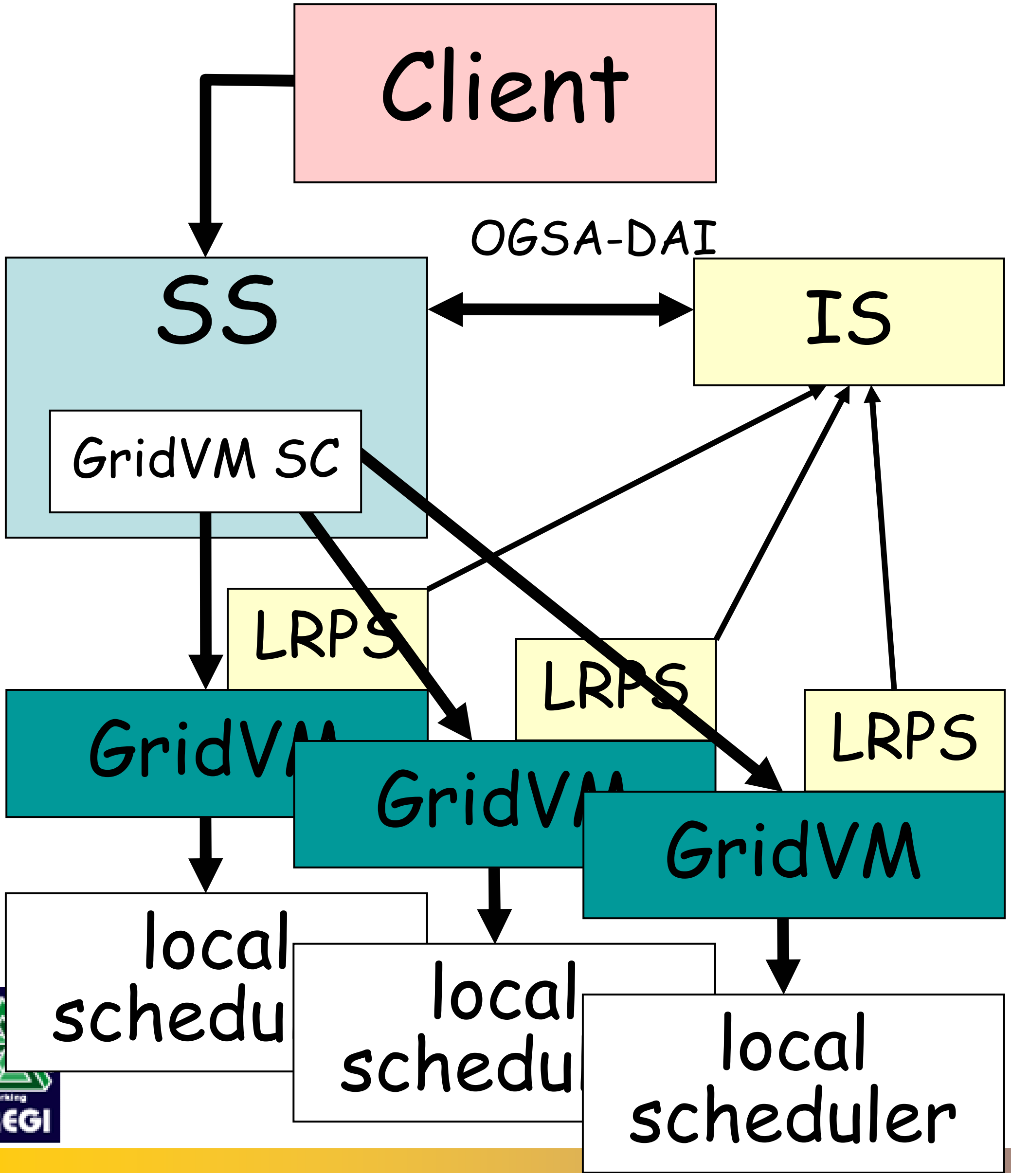
General configuration of Grid Middleware Stacks



NAREGI Middleware beta

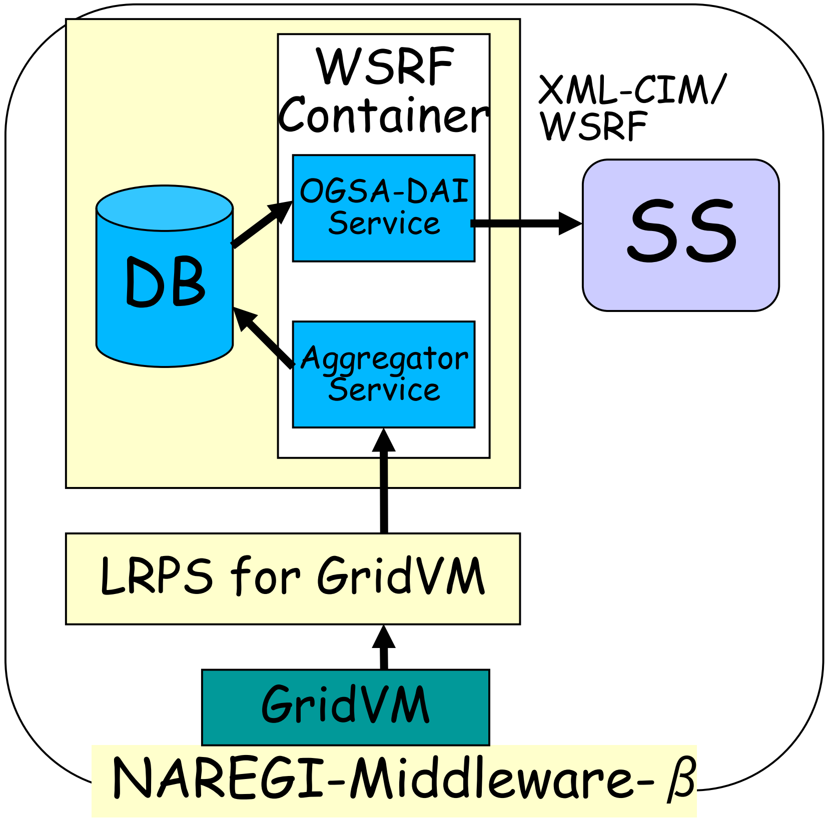
- **The second generation of the grid middleware developed by NAREGI**
  - alpha: developed in 2004
    - Based on UNICORE
  - beta: developed 2005 -
    - Based on WSRF
    - Conforms OGF standards
- **Outstanding features**
  - Workflow management
  - Parallel job execution over multiple sites
    - Automatic job partitioning and resource allocation

NAREGI Middleware beta overview



- **SS (Super Scheduler)**
  - Broker
  - Workflow engine
- **IS (Information Server**
  - Information aggregation
  - DB wrapped by OGSA-DAI
- **GridVM**
  - Cluster management
  - Based on GT4
  - Note: not the 'real virtual machine'

Overview of NAREGI Information Service



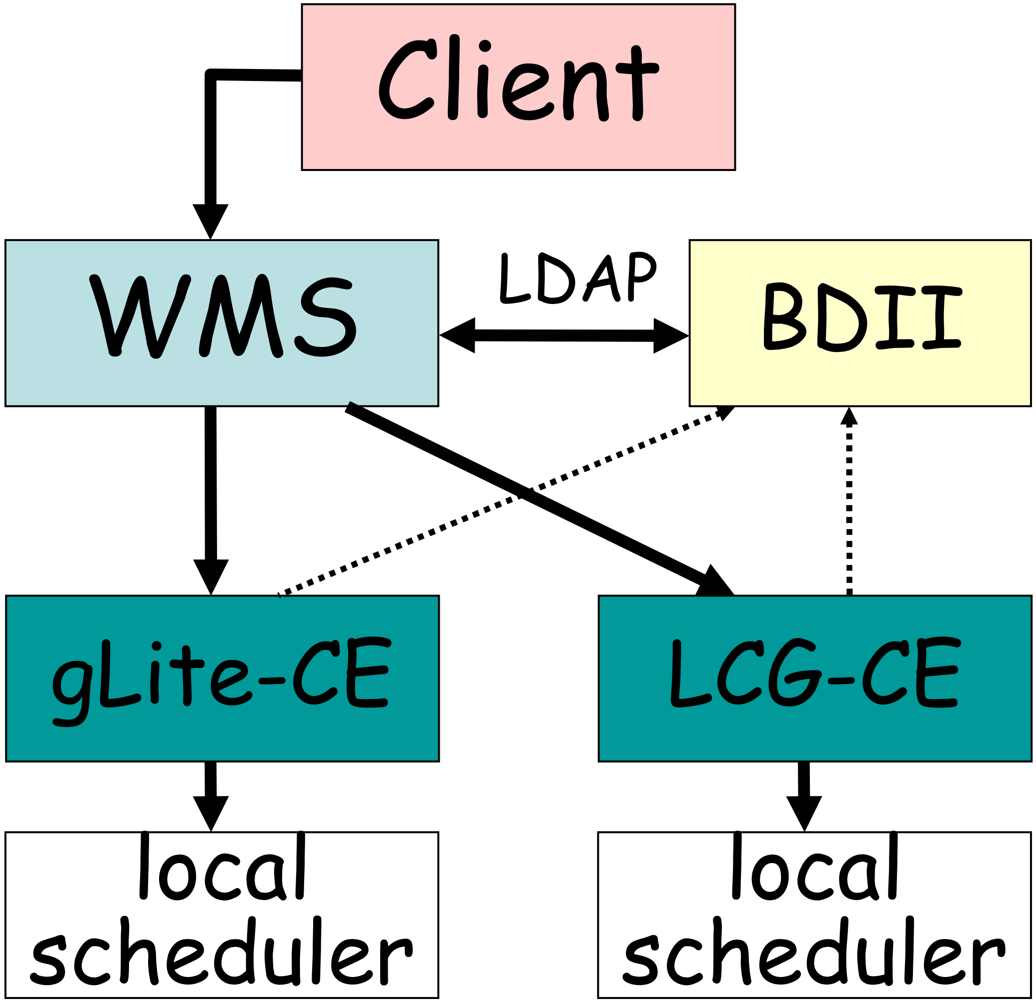
- **CIM scheme based**
  - Stores in a DB
- **Information Collection**
  - LRPS(Local Resource Provider Service)
- **Information Aggregation**
  - Aggregator Service
- **Lookup**
  - OGSA-DAI
    - WSRF based Data base access protocol

Overview of EGEE gLite

- **Grid middleware stack from EGEE (Enabling Grids for E-Science in Europe)**

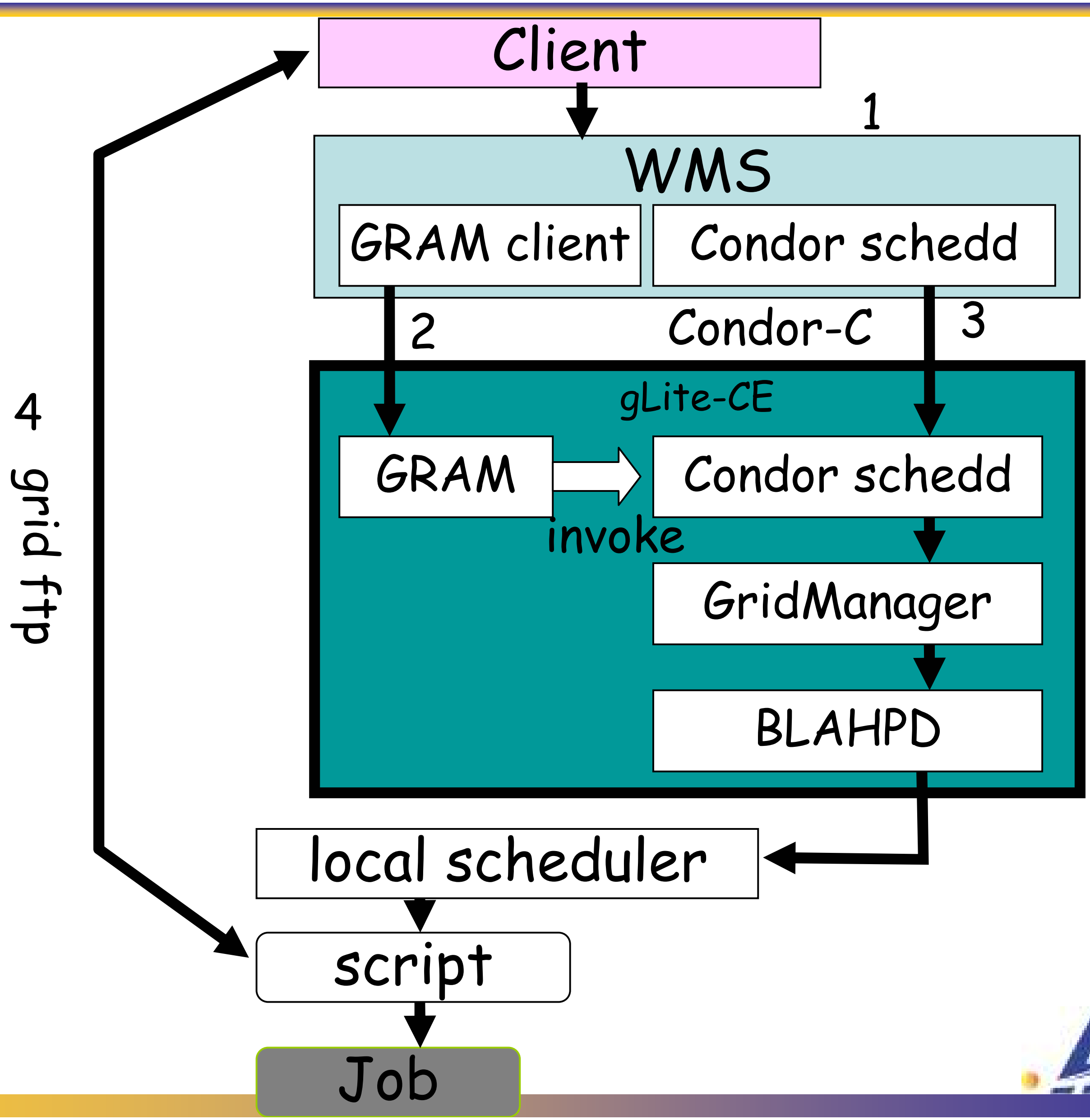
- **Employs Condor modules in several way**
  - Condor
    - Batch queuing system developed by Wisconsin Univ.
  - Brokering based on Condor 'Match making'
  - Job submission by Condor-C

Overview of gLite



- **WMS**
  - Workload Management System
  - Brokering based on 'classad'
- **BDII (Berkley Directory Information Index)**
  - LDAP based information repository
- **CE (Compute Element)**
  - gLite-CE
    - Complicated module that use Condor-C
  - LCG-CE
    - Globus GRAM2
    - Carried over from LCG (LHC Computing Grid) project

gLite-CE job Submission Details



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- **Strategy for interoperation and implementation**
- **Measurement Results**
- **Conclusion**

Requirements for mutual job submission

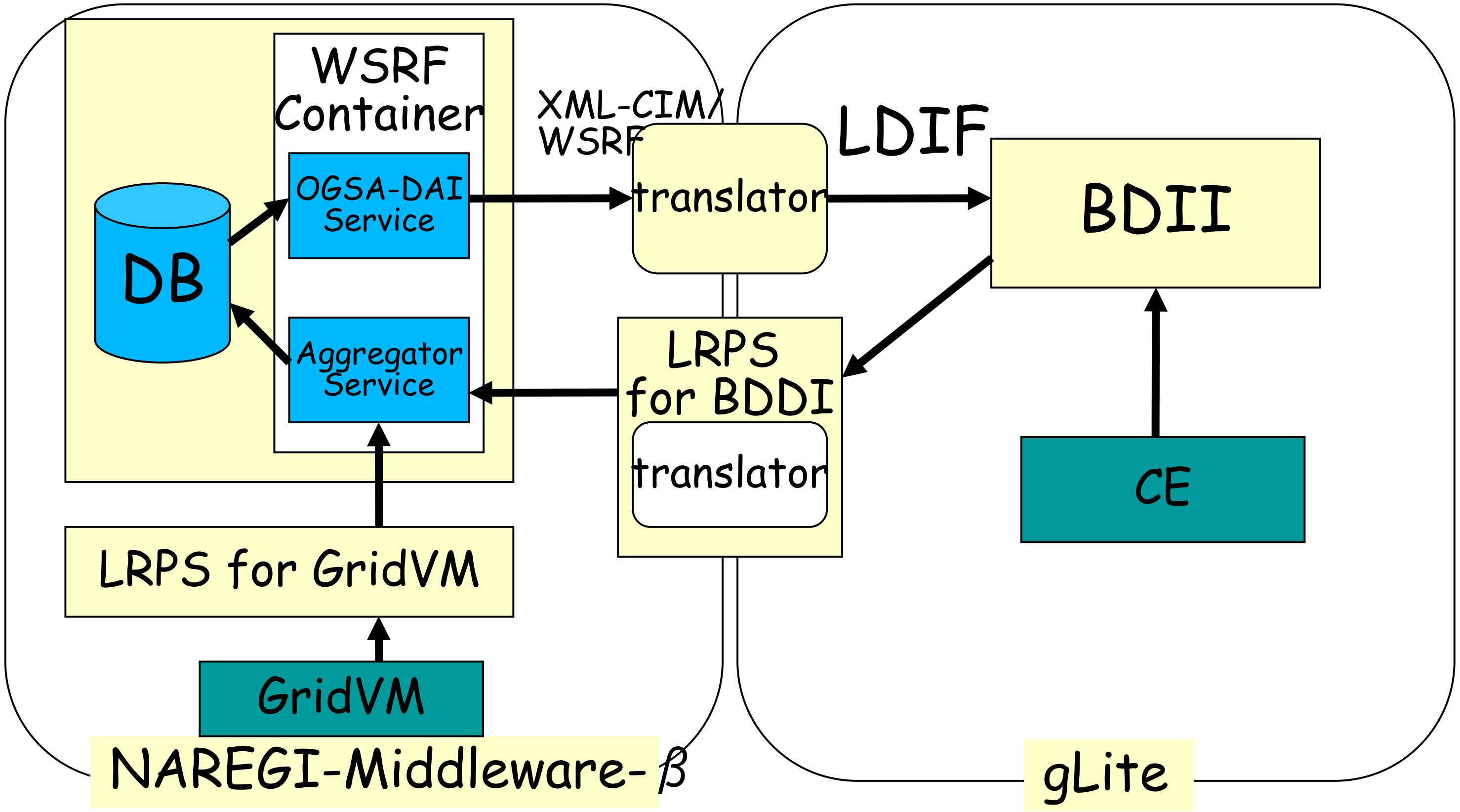
- **Authentication and Authorization Interoperation**
  - Security Infrastructure
  - All the other components relies on it
    - Crucial for interoperation
- **Information Service Interoperation**
  - Look up the resources on the other middleware stack
- **Job Submission Interoperation**

Authentication, Authorization Interoperation

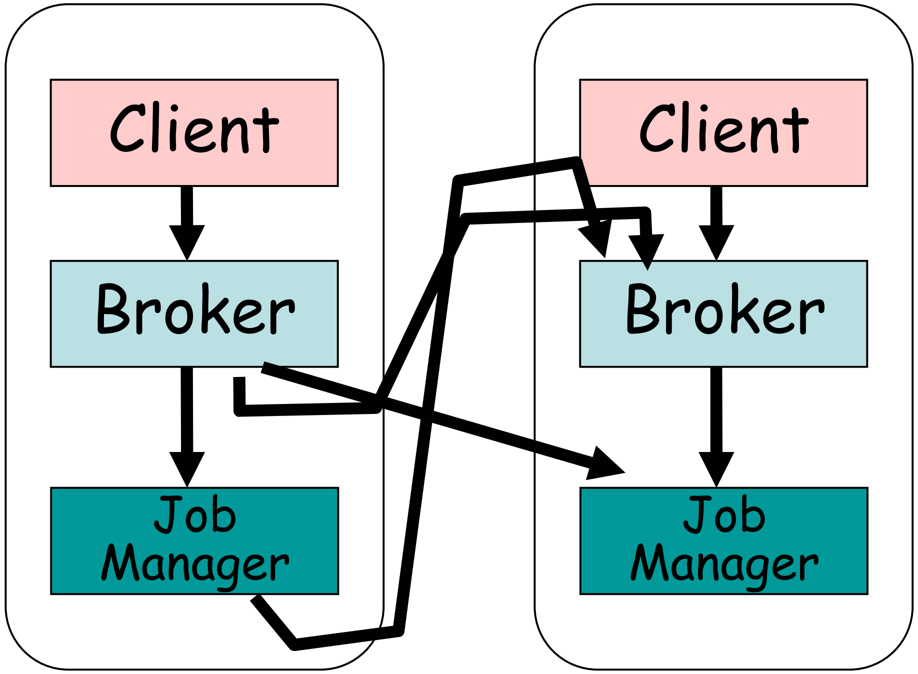
- **Authentication**
  - ‘Who are you’
  - PKI based authentication is generally used
- **Authentication**
  - ‘What can you do’
  - Virtual Organization Management

- **Fortunately, we did not have any issues on this.**
  - Authentication – GSI is used
  - Virtual Organization Management - VOMS
    - NAREGI [illegible] EGEE’s VOMS [illegible]

Interoperability for Information Service



3 ways for mutual job submission



- **Broker -> JobManager**
  - (relatively) faster
  - The callee grid policies might be ignored
  - Information service interoperability is mandatory
- **Broker -> Broker**
  - (relatively) slower
  - **Easy to enforce callee grid policies**
- **JobManager -> Broker**
  - Slowest
  - **Easy to enforce callee grid policies**

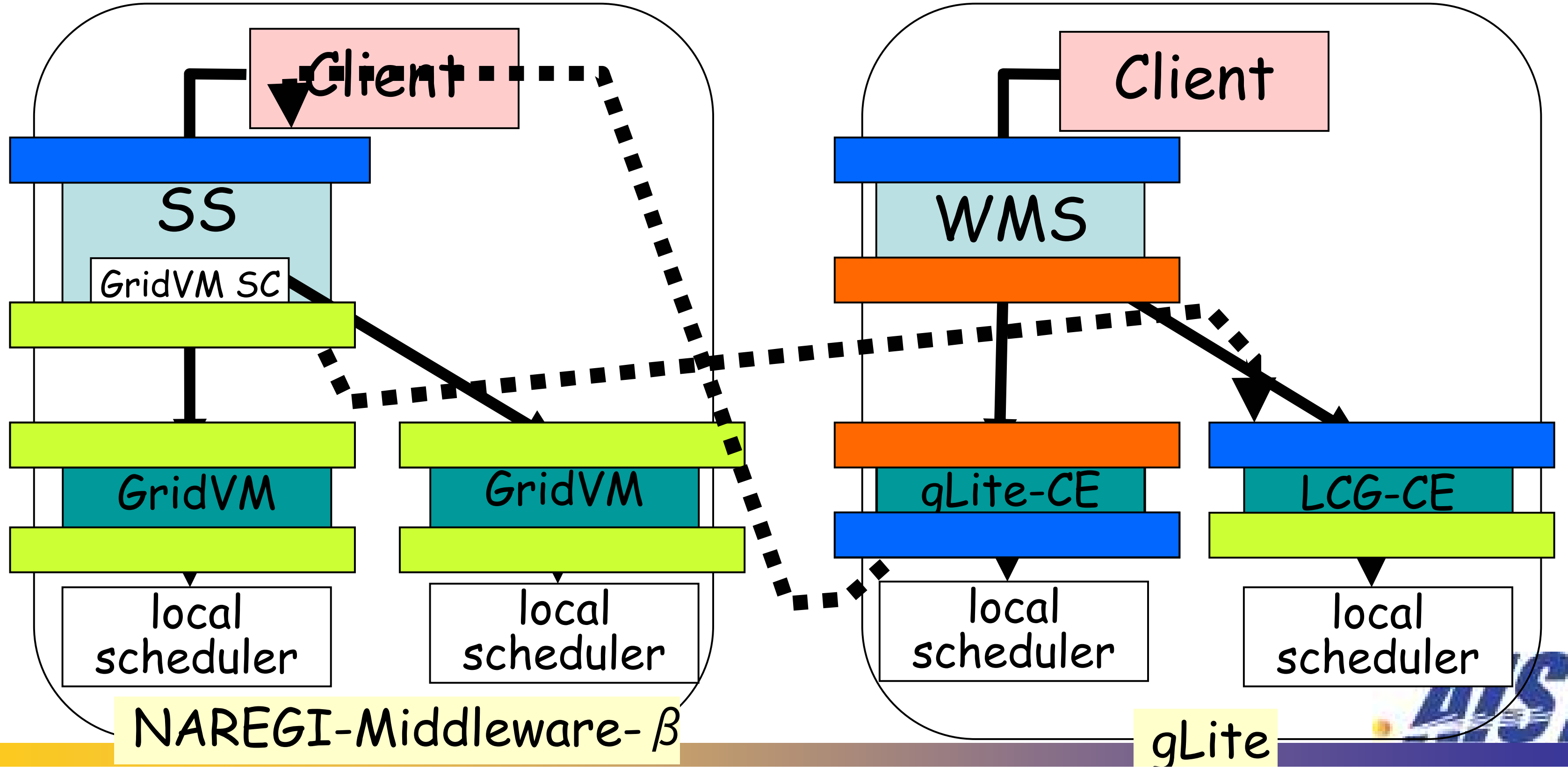
Design of mutual job submission

- **Where to have bridges?**
- **Points that have standard interface are preferable**

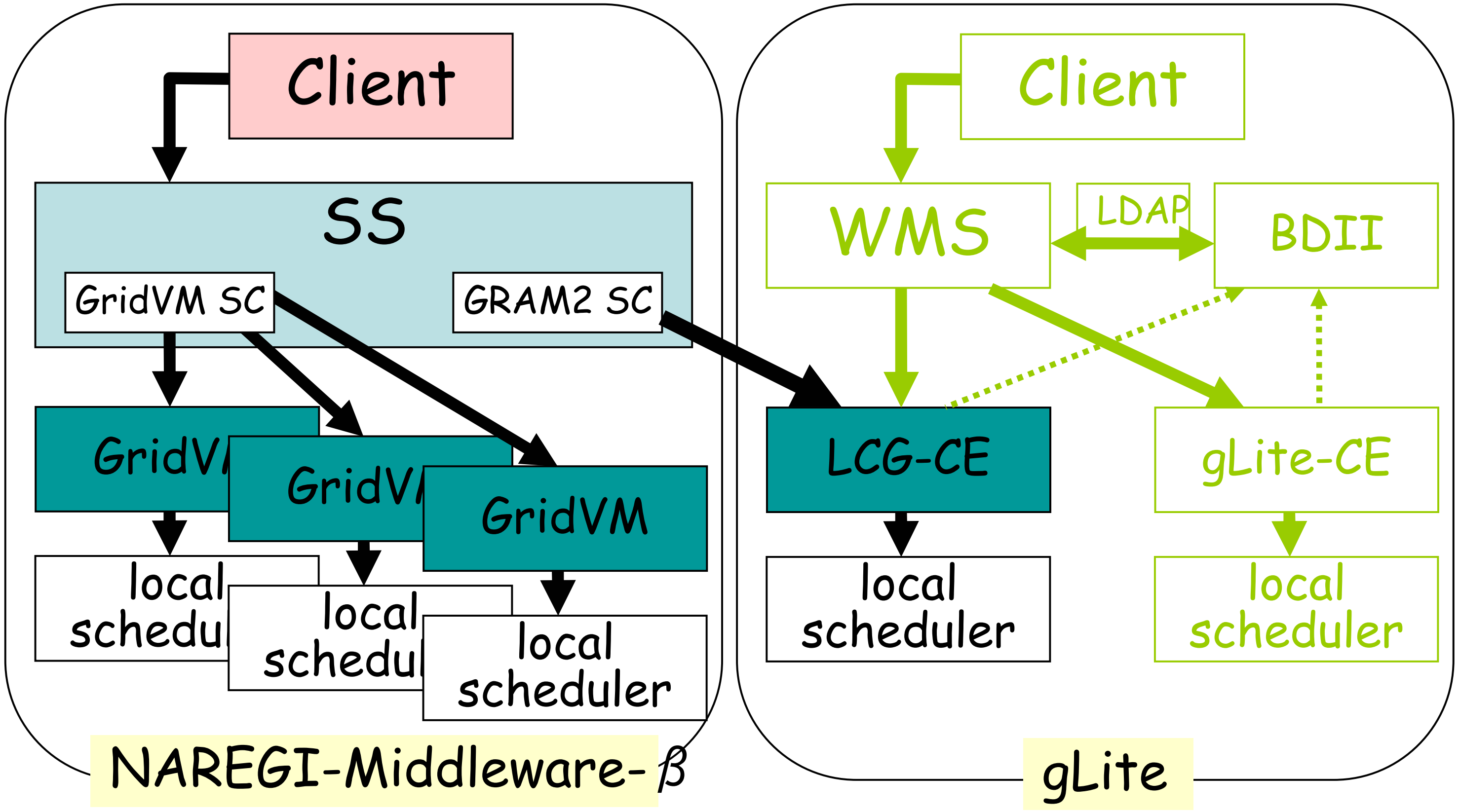
🟦 Library is available

🟩 Interface is defined and published

🟧 Proprietary interface



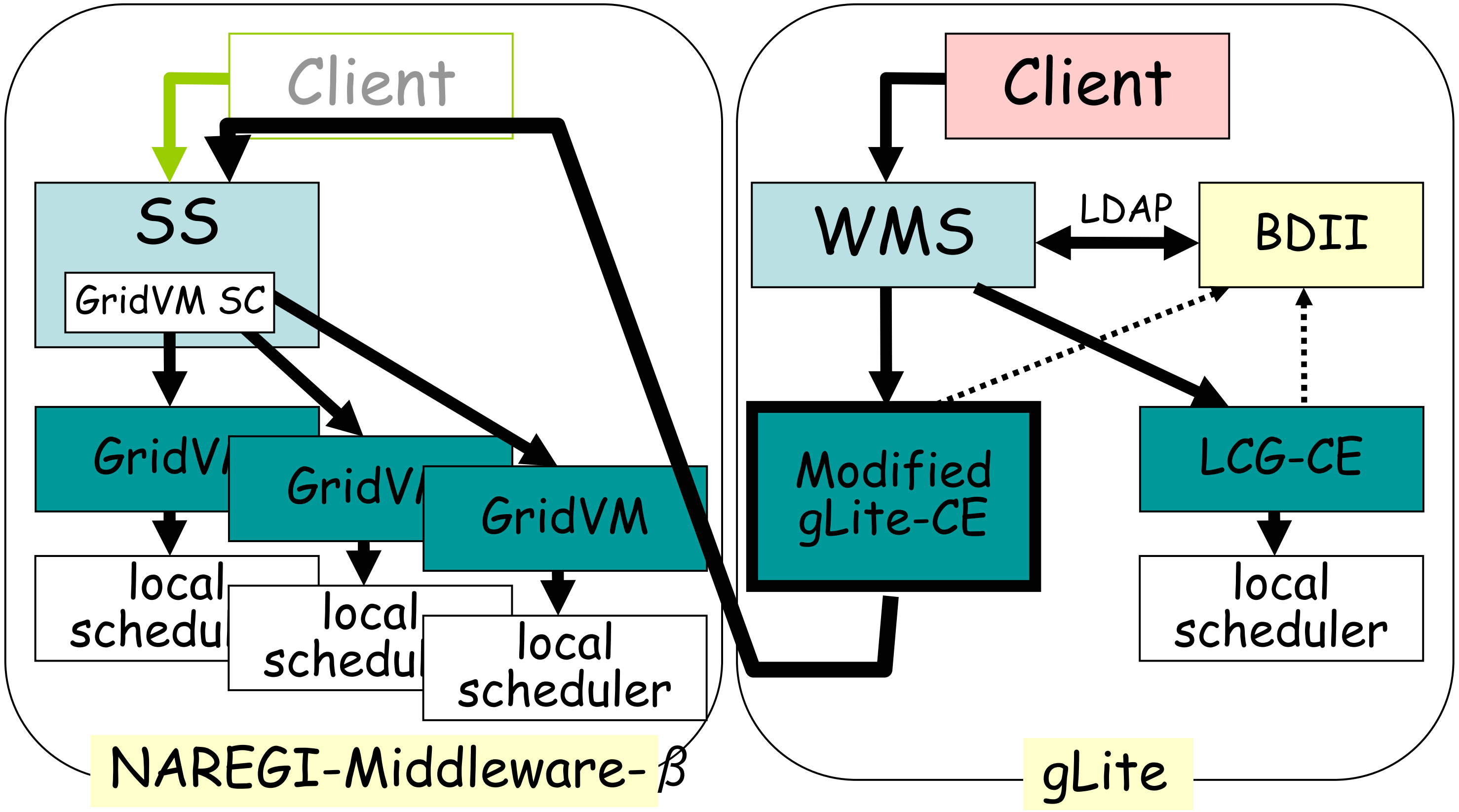
NAREGI→gLite



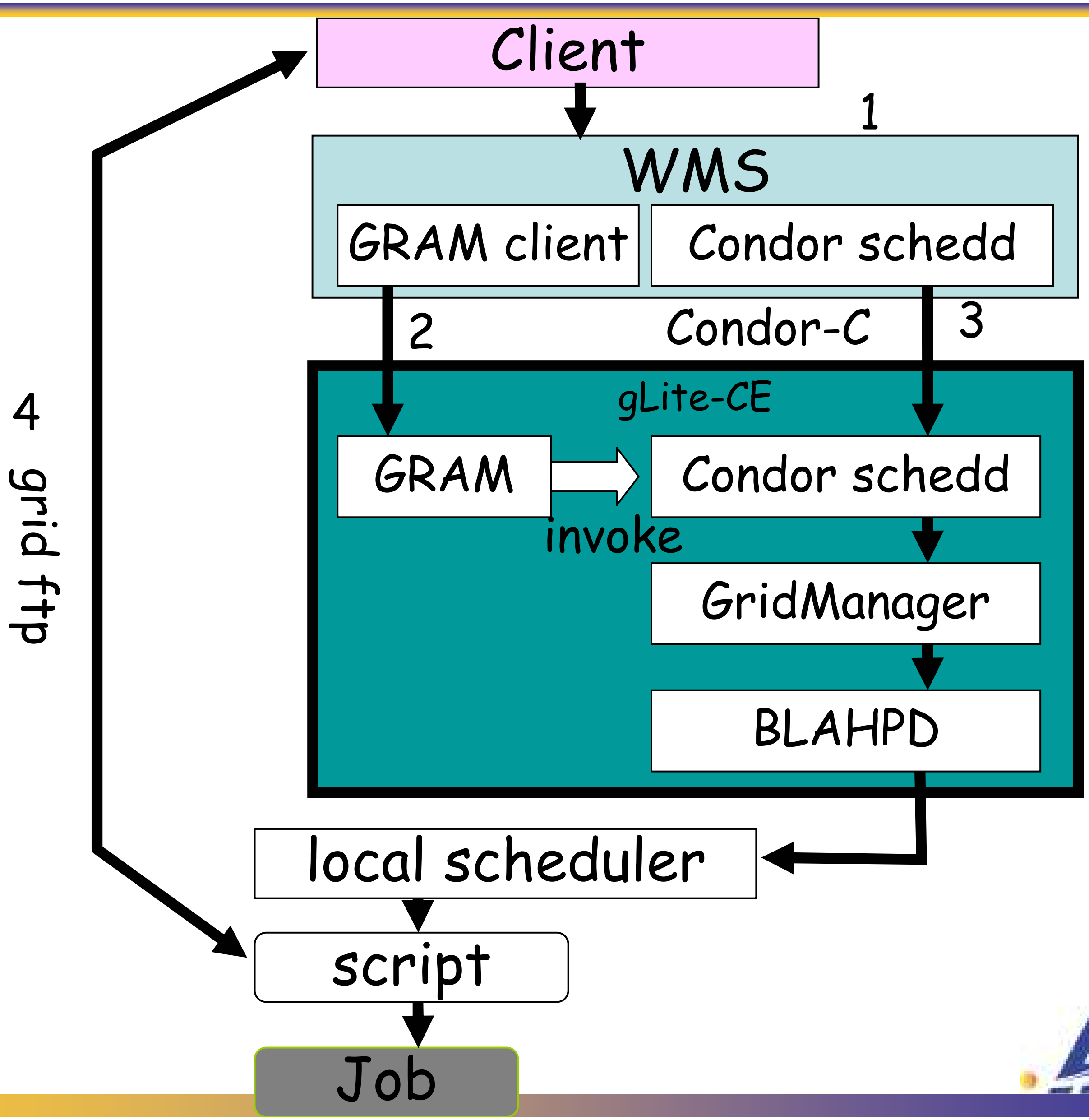
NAREGI→gLite

- **Developped a SC that calls LCG-CE(GRAM2) instead of GridVM**
  - SCs are designed as dynamically loadable independent modules
  - Problem: GRAM2 does not provide reservation capability
    - Solution : SC just pretend to make reservation
- **Automatic selection of SC, based on information provided by the information service**
  - Hidden from users

gLite -> NAREGI



Implementation details



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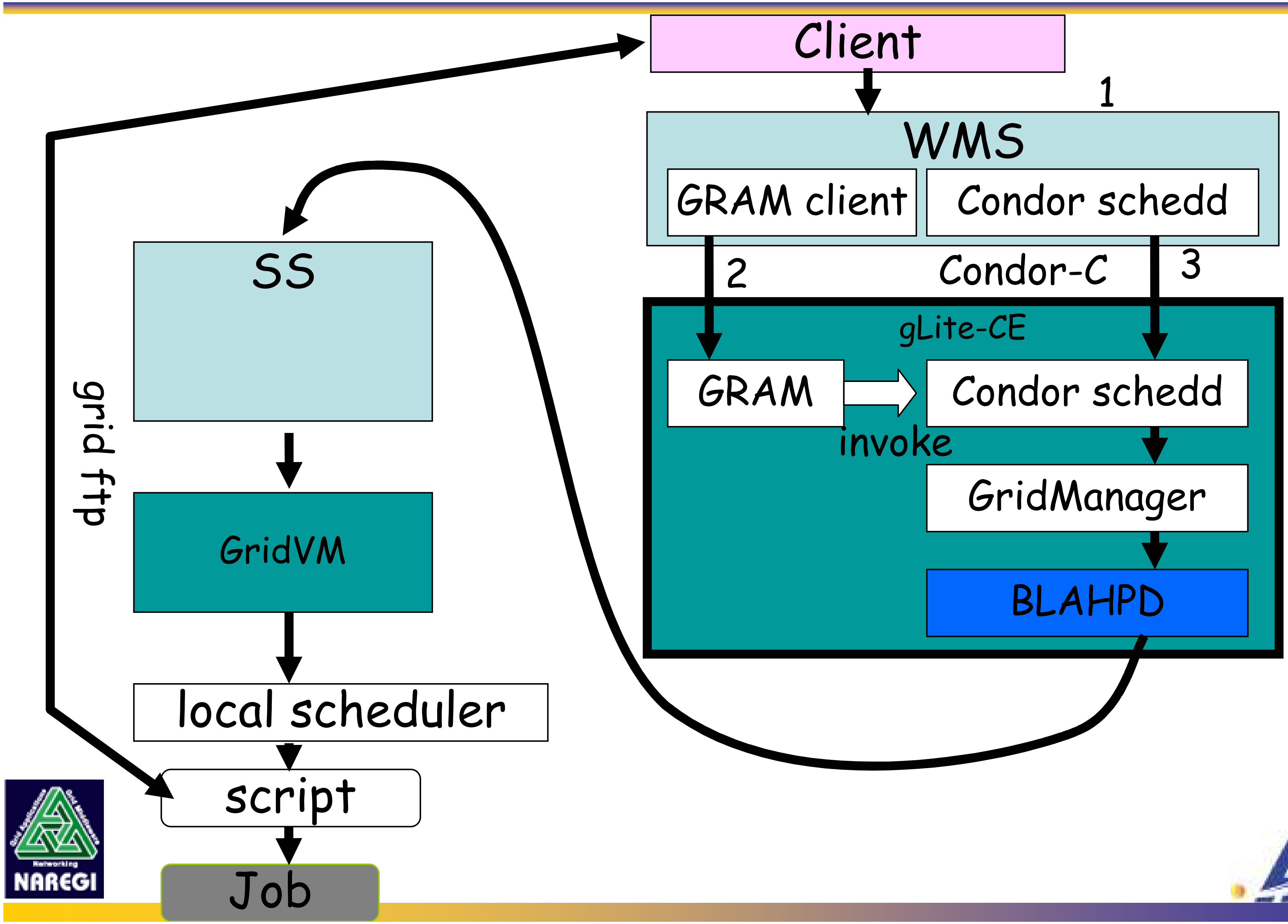
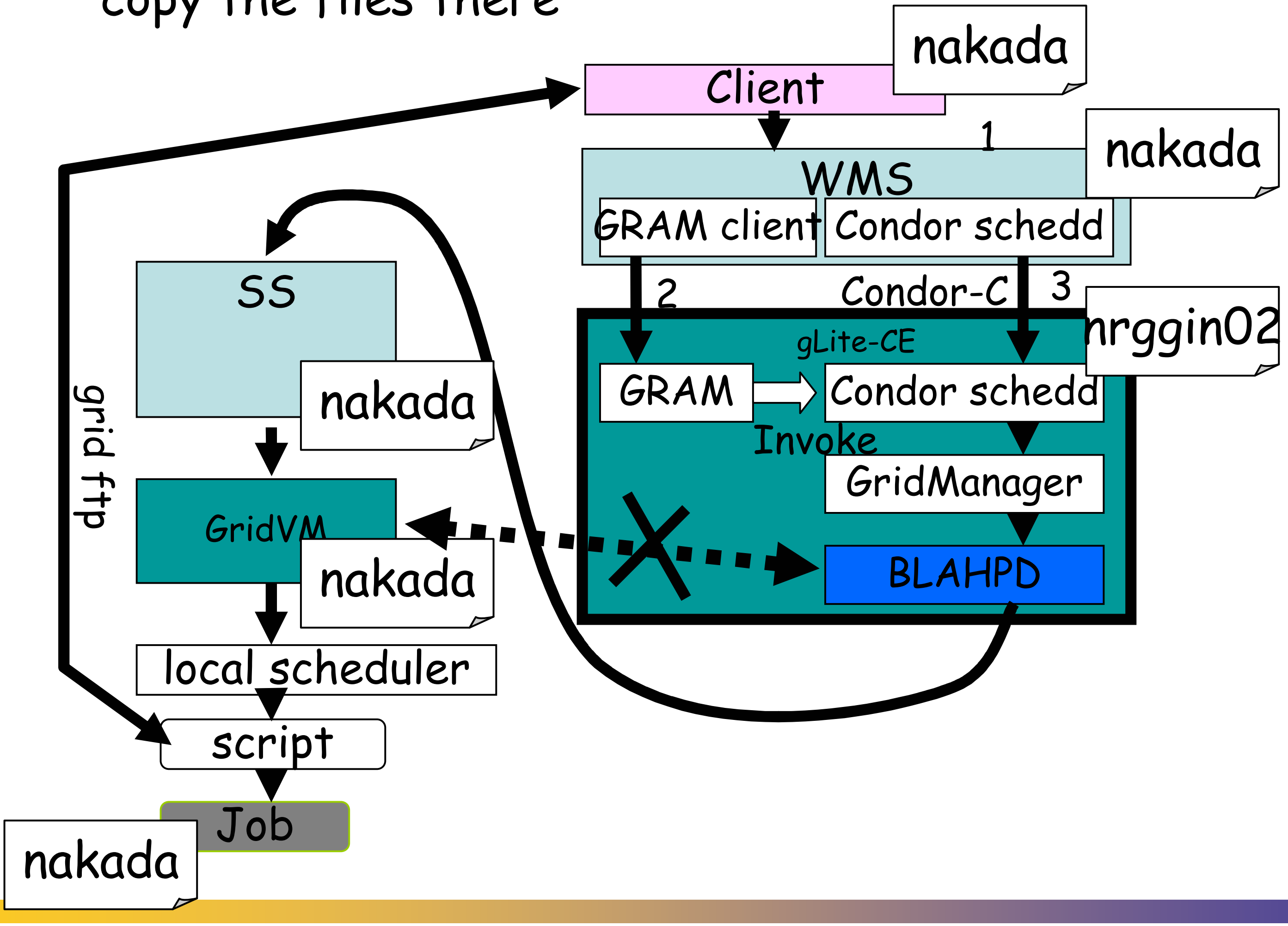


BLAHP Protocol

- **Text-based protocol for intermediate processes**
  - Based on GAHP, with command set
  - GAHP(Globus Ascii Helper Protocol) – initially desinged to call Globus modules from Condor
- **Based on UNICORE GAHP(Nakada '04) Command set**
  - BLAH_JOB_SUBMIT
  - BLAH_JOB_STATUS
  - BLAH_JOB_CANCEL
- **We could 'reuse' UNICORE GAHPD codes**

Problems solved (1)

- **File staging to NAREGI failed because gLite-CE uses virtual users on the node**
  - Create a readable temporary directory for each job and copy the files there



Problems solved (2)

- **Limitation for proxy certificates delegation times**
  - Proxy certs. – uses intermediated CA mechanism internally
  - **Theoretically, there is no limitation for delegation times**
  - Gridftp implementation by Globus has a bug
    - openssh library used in Globus had the default limitation number of intermediate CAs
    - Can be easily fixed
- **Solution**
    - Patched the gridftp

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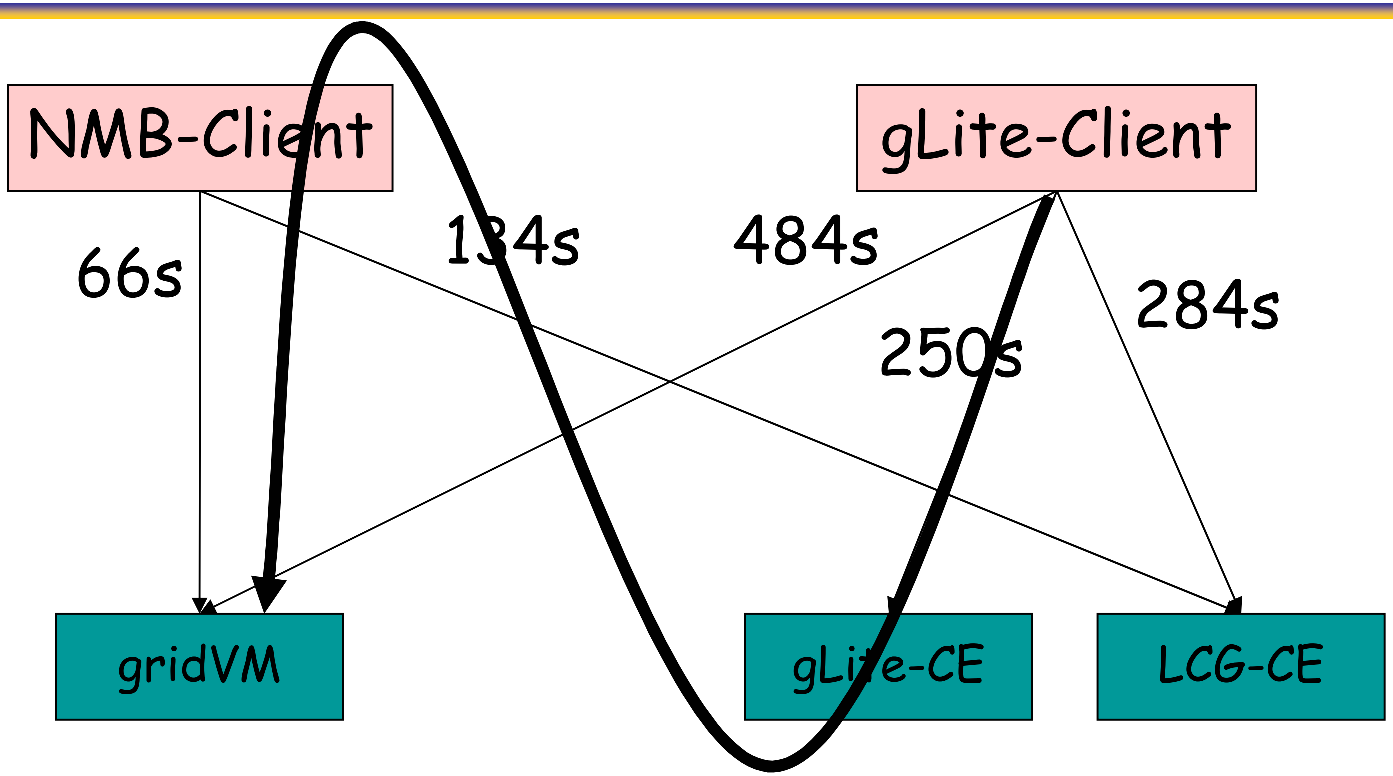
Experiments

- **Measured elapsed time for mutual job submission.**
  - Also measured job submission with in each middleware stacks
  - Average time of 10 measurements

- **Environment**
  - All the nodes are located in a NAREGI campus

Experimental results



- **Setups**
  - Pentium 4 Xeon 3GHz dual, Mem. 1Gbyte, RedHat 8
  - Network 1000base-T

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Conclusion

- **Performed job submission interoperation experiments between NAREGI Middleware beta and EGEE gLite**
  - No issues on certs. and VO management
  - Differences in information service layer could be managed
  - Mutual job submission could be successfully performed with proper bridging modules

Future Work

- **Precise measurement and analysis**
- **Experiments on Production systems**
  - Confirm interoperability using VOMS in production
  - Investigate effects of latency between Japan and Europe
- **More sophisticated mutual job submission**
  - Having NxN bridges are not good idea
  - To have standardized Job submission interface will be the best

Thank you

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