Multiple HLA Federate Processes in Grid Environment

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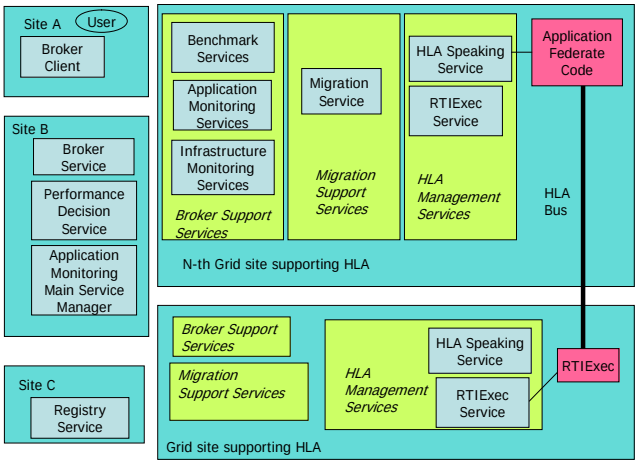
High Level Architecture (HLA)	GRID
+ used for building interactive simulations + connects geographically distributed nodes + time management (for time- and event-driven simulations) + data management (tuple space)	+ designed to coordinate resources that are not subject to centralized control + uses standard, open, general-purpose protocols and interfaces + Web Services concept of abstract interfaces allows for modular design
– no mechanisms for managing execution according to the dynamically changing conditions of computing resources. – no implementation with dynamic discovery	– general approach, so no support for interaction

Conclusion: we need **support** for execution of HLA-based **distributed interactive** simulations in the **Grid** environment

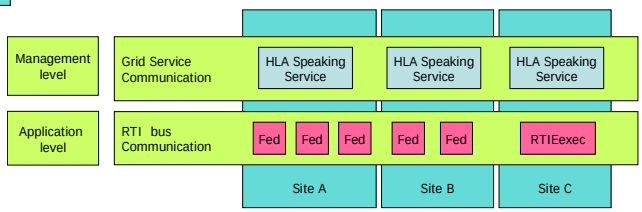


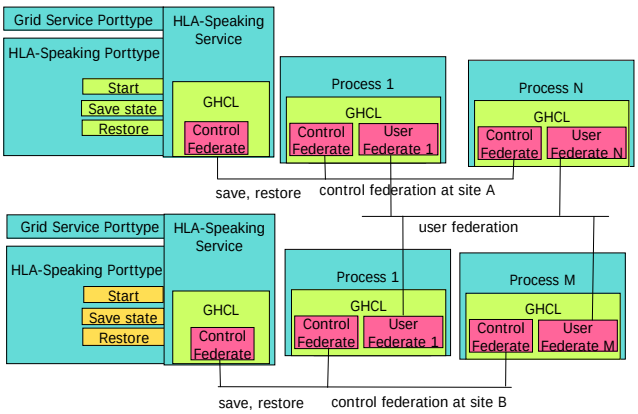
Grid HLA Management System (G-HLAM)

- **HLA management services**
  - HLA-speaking Service for managing federates
  - RTIExec Service for managing RTIExec (coordination process in RTI)
  - Broker for setting up a federation and making migration decisions
- **Broker decision services**
  - Registry for storing location of HLA-speaking services
  - Application Monitoring for monitoring performance
  - Infrastructure Monitoring/Benchmarks for checking environment of HLA services
- **Migration support services**
  - Migration Service for performing migration

HLA-Speaking Service

- Manages execution of legacy HLA federates on a single site
- Submits federates on its site and forwards saving/restoring requests
- Two kinds of HLA-Speaking Services were created:
  - For single federate process (presented in [3])
  - For multiple federate processes (presented here)





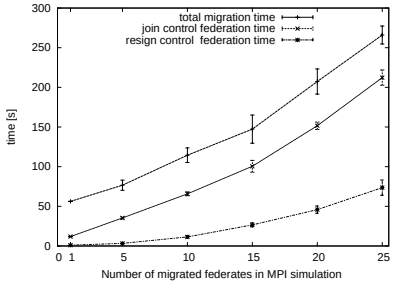
HLA-Speaking Service for multiple processes

- Command for submission based on globus RSL
- GRAM used for actual submission
- Control federation for sending save and restore commands
- GridHLA Controller library as an interface between user code and G-HLAM

GHCL contains functions to:

- Start up and connect to RTI API classes
- Check if external (Migration Service) save/restore request came
- Check if internal (RTI) save/restore request came
- Save/restore user values

Overhead of migration stages



Conclusions

HLA-Speaking Service enables efficient management of the execution of HLA federates on the Grid:

- provides universal interface for user HLA federates to G-HLAM,
- used for running, saving and restoring one or more federate processes on the Grid site on which it resides,
- the whole Grid site is efficiently used by taking advantage of GRAM interface to local job manager,
- GridHLAController library is an easy to use API for interaction of user codes with the HLA-Speaking Service,
- HLA standard advanced features useful for distributed simulation are ported to the Grid,
- legacy HLA applications are adapted to the Grid environment in a robust and efficient way.

References:

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2. K.Rycerz, M.Bubak, M.Malawski, and P.M.A. Sloot. A Framework for HLA-Based Interactive Simulations on the Grid SIMULATION, 81(1):67-76, 2005,
3. K.Zajac, M.Bubak, M.Malawski, and P.M.A Sloot. Towards a Grid Management System for HLA-Based Interactive Simulations. In S.J. Turner and S.J.E. Taylor, editor, Proceedings Seventh IEEE International Symposium on Distributed Simulation and Real Time Applications (DS-RT 2003), pages 4-11, Delft, The Netherlands, October 2003. IEEE Computer Society.

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