

Instrument Element

Accessing Remote Instruments in Grid Environment

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OGF 28
Munich, Germany
March 17, 2010



Introduction



- A number of solutions have been proposed to access (scientific) instrumentation and sensors in a Grid environment:
 - **GTCP** (Globus Tele-operation Control Protocol) by C.Kassleman and L.Pearlman
 - **CIMA** (Common Instrument Middleware Architecture) at Indiana University
 - **Instrument Element** - originally by the GRIDCC project; Reimplemented and maintained by ELETTRA and the DORII project
- **OGC** proposes standards for describing sensors and measurement processes (Sensor Web Enablement standards suite)

Overview



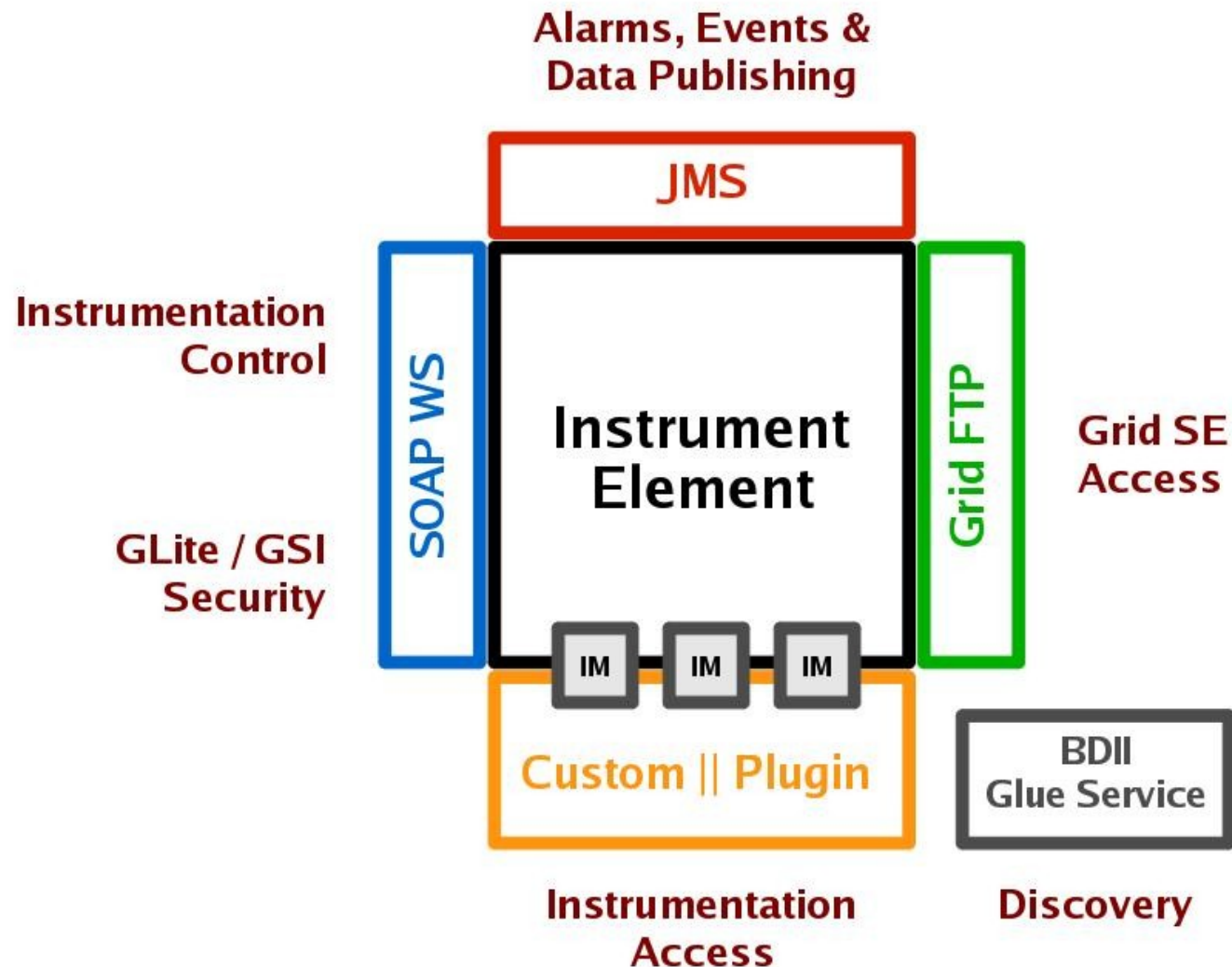
- Instrument Element (IE) represents a **virtualization of data sources** in a Grid Environment
- **IE is an open source**, pure Java, framework that runs as an Axis WS in a Tomcat Servlet Container
- IE adds a possibility to include such devices as scientific instruments and sensors in the data elaboration process
- IE provides a flexible solution for connecting a large variety of devices to the Grid

Main Features



- The main goal of the middleware is to provide users with a simple way of attaching their scientific instrumentation to gLite-based grids
- The IE framework provides support for:
 - secure access control
 - concurrency control
 - simple Grid storage access
 - JMS publishing
 - common interface for accessing instrumentation

Schema (Architecture)



WS Interface & Auth



- IE presents a **SOAP web service interface** for client access.
- The interface contains methods for controlling the Instrument Managers and thus the devices behind them
- The interface contains also the authentication methods
- User authentication is performed using the **gLite/GSI security model** based on user's proxy delegation
- Fine-grain authorization control through **VOMS** (Virtual Organization Membership Service) attributes.
- Multiple virtual organizations (VO) are supported

Multi User Support



- IE assures multiple user support through concurrency control and locking
- Instruments can be explicitly locked by a single user for a certain time period, e.g. to perform a set of operations on the device
- Locking and unlocking of the instrument managers is triggered by user-issued commands
- Instruments are locked automatically by the framework during the execution of commands that change the state of the instrument or its parameters and attributes
- Reservation (scheduled locking) still missing

JMS Support



- IE offers the possibility to use Java Message Service (JMS) for asynchronous monitoring of instrument variables
- The way instrument variables are checked depends on the caching policy defined by its Instrument Manager
- Another important use of the JMS in the IE framework is for signaling alarms and events to the users
- Alarms and events are raised by the Instrument Manager code and propagated as JMS messages to all the clients subscribed to the given topic
- IE has been tested with the Narada Brokering, OpenJMS and the IBM's RMM

Instrument Manager



- **Java** client for the Instrument; runs in IE framework
- Fully described by the **XML descriptor**
 - Possible IM states (→ State Machine), details about Commands, Parameters and Attributes.
- Java classes implement Commands (Transactions) Parameters and Attributes
 - **Attributes** are instrument variables
 - **Parameters** regard instrument settings
 - **Commands** are instructions to be passed to the instrument (interface). May include input parameters
 - **Transactions** are commands that trigger state change

Other Features



- The framework provides a Grid-FTP based utility that allows Instrument Managers to save their outputs to Grid storage elements or load data and settings from there
- Instrument Managers can be grouped inside the Instrument Element in logical units called contexts, and contexts can be further grouped in other contexts creating a tree-like structure that improves visibility and organization
- Instrument Elements are made discoverable by the Information System when registered in the BDII as Glue services

Open Issues (Future Work)



- Sessions handling and proxy renewal policies
- Refactoring:
 - Internal data structures (both at the IE and IM levels)
 - Service threads
- Data types: should be extended?
- Return types for execute command?
- OGC's SOS Integration (g-OWS, RISGE)
- Other Issues?

Feedback most welcome!



- Instrument Element is a working implementation of the (gLite) Grid-aware middleware for accessing remote instrumentation
- OGC standards are very detailed in describing both the sensors and the collected data, however very complex
- There is lot of space for defining a new standard for accessing remote instrumentation in Grid environment
- In particular, we believe we should find an acceptable “common denominator” among existing standards that will address a wide variety of real-life use cases

Questions?



Thank you!