DORII: Deployment of Remote Instrumentation Infrastructure

An Overview

Andrea Del Linz, Milan Prica, Roberto Pugliese
andrea.dellinz | milan.prica | roberto.pugliese @elettra.trieste.it

ELETTRA Sincrotrone Trieste S.C.p.A

Cyclops 2nd Workshop, 5-7 May 2008
Chania, Greece


http://www.dorii.eu/

Summary

- Introduction
- Motivations
- Objectives
- Target applications
- State of the art
- Some more details about the IE and the VCR
- Demo

What is DORII?

- The DORII project aims to deploy e-Infrastructure for new scientific communities.
- We deal with a scientific group of users with experimental equipment and instrumentation, which is not integrated or integrated only partially with the European infrastructure
- We plan to deliver will make a new kind of e-Infrastructure, equipped with sensor networks, synchrotron and free electron lasers, high bandwidth networks, computational, visualization resources and data storage systems.

DORII
Deployment of Remote Instrumentation Infrastructure

Concepts

- Research infrastructure: refers to facilities, resources and related services that are used by the scientific communities to conduct top-level research in their respective fields.
- e-Infrastructure: aims at developing a new research environment, building upon the ICT capabilities of existing infrastructures, in which all scientists have easy-to-use controlled access to unique or distributes scientific facilities, regardless of their type and location in the world.

Motivation (1/2)

- Scientific community:
  - The ICT technology is still not present at the appropriate level
  - Demand from the users to empower the daily work processes
- Scientific groups of users manifest strong interest in the Remote Instrumentation:

  e-Infrastructure: this is the reference for DORII, with experimental equipment and instrumentation

Motivation (2/2)

- We collected requirements from various owners of equipments, selected scientific disciplines
- The capital investment, collected since a few years and coming from many international and national projects, where we were co-operating together:
  - 7+ years experience
- High interests worldwide:
  - RISGE – OGF research group
  - Instrumenting the Grid 2007

Objectives (1/2)

- Integration of instrumentation and selected applications with e-Infrastructure and maintenance on production level
- Adaptation of e-Infrastructure across selected areas of science and engineering:
  - Step forward in accessing scientific instruments;
  - Combine the experimental science community and its research facilities with the support given by e-Infrastructure;

Objectives (2/2)

- Deployment and operation of persistent, production quality, distributed instrumentation integrated with e-Infrastructure:
  - To provide added values of e-Infrastructure in the integrated environment of scientific and engineering instrumentation, networking, visualization and computational infrastructures
- Generalize and deploy a framework environment that can be used for fast prototyping:
  - To use expertise and demands collected from various groups/owners of scientific instrumentation;
  - To integrate selected functionalities from infrastructure and ICT-oriented project

Selected areas of interest

- DORII is focused on the following selected scientific areas:
  1) Earthquake community with various sensor networks
     1) Network-centric seismic simulations
     2) Earthquake early warning system design and simulation
  2) Environmental science community
     1) Oceanographic and coastal observation and modeling Mediterranean Ocean – an integrated system from sensors to model predictions
     2) Oceanographic and coastal observation and modeling using imaging
     3) Monitoring inland waters and reservoirs
  3) Experimental science community, like synchrotron and free electron lasers facilities.
     1) On-line data analysis in experimental science coming from increased efficiency of the light sources (synchrotron and free electron lasers) and of the detectors with higher and higher resolution and faster readouts.

Why these areas?

- Because:
  - They are not integrated or integrated only partially with e-Infrastructure, so their daily activities will benefit greatly by this opportunity;
  - They are representatives of much bigger European (and sometime international) wide communities, supported by numerous projects and consortia.

State of the art

- Significant experience for almost 7 years in all strategic areas:
  - Interactivity in grids and distributed environment (Int.EU.Grid, BalticGrid, CrossGRID)
  - Visualization (Int.EU.Grid, CrossGrid)
  - Collaborative tools (GRIDCC, Int.EU.GRid)
  - Steering, monitoring and accessing remote instrumentation (GRIDCC, RINGrid, VLab, CRIMSON)
  - Building software frameworks for fast prototyping and easy adaptation (g-Eclipse, Int.EU.Grid, CrossGrid)
  - Workflows (VLab)
  - Networking, Quality of Service and bandwidth on demand (GEANT2 project)

Overview on... Int.EU.Grid

- What was the Int.EU.Grid goal?
  - Deploying and operating an inter-operable production-level e-Infrastructure for demanding interactive applications that will impact the daily work of researchers.
- What does it offer?
  - Distributed Parallel (MPI) Interactive Computing and Storage at the Tera level
  - User Friendly Access through a Grid Interactive Desktop with powerful visualization
  - Supporting Virtual Organizations at all levels: setup, collaborative environment, grid enhancement of applications, execution and monitoring tools, discussion of results.

Overview on... CrossGRID

- What is the CrossGRID?
  - It is a project oriented towards compute and data intensive applications that are characterized by the interaction with a person in a processing loop. Such applications require a response from the Grid to an action by a human agent in different time scales.
- It is involved with Int.EU.Grid to Migration Desktop project.

Overview on... VLab

- What is the Virtual Laboratory (VLab)?
  - It's an exemplary implementation of a remote instrumentation system;
  - It will facilitate and automate building new laboratories using existing modules with their functionalities.
- What does it offer?
  - Workflow Manager (WMF) that is a part of the VLab architecture: users may design their experiment workflow in an easy and intuitive way.
  - Possibility of adding new resources, which are then controlled by WFM
  - Job submission system

Overview on... g-Eclipse (1/2)

- What is the g-Eclipse?
  - It's a framework that allows fast prototyping and application development.
  - It is an integrated workbench framework to access the power of existing Grid infrastructures.
- What does it offer?
  - Information access
  - Data management
  - Job management

Overview on... g-Eclipse (2/2)

Some details more:

- Grid command line console:
- Grid job management (using gLite 3.0 middleware)
- Grid file management (LFC, SRM, GsiFTP, FTP, SSH)
- Grid visualization
- Grid benchmark
- Grid application monitoring
- Grid workflow builder

Second part

Some details more about:

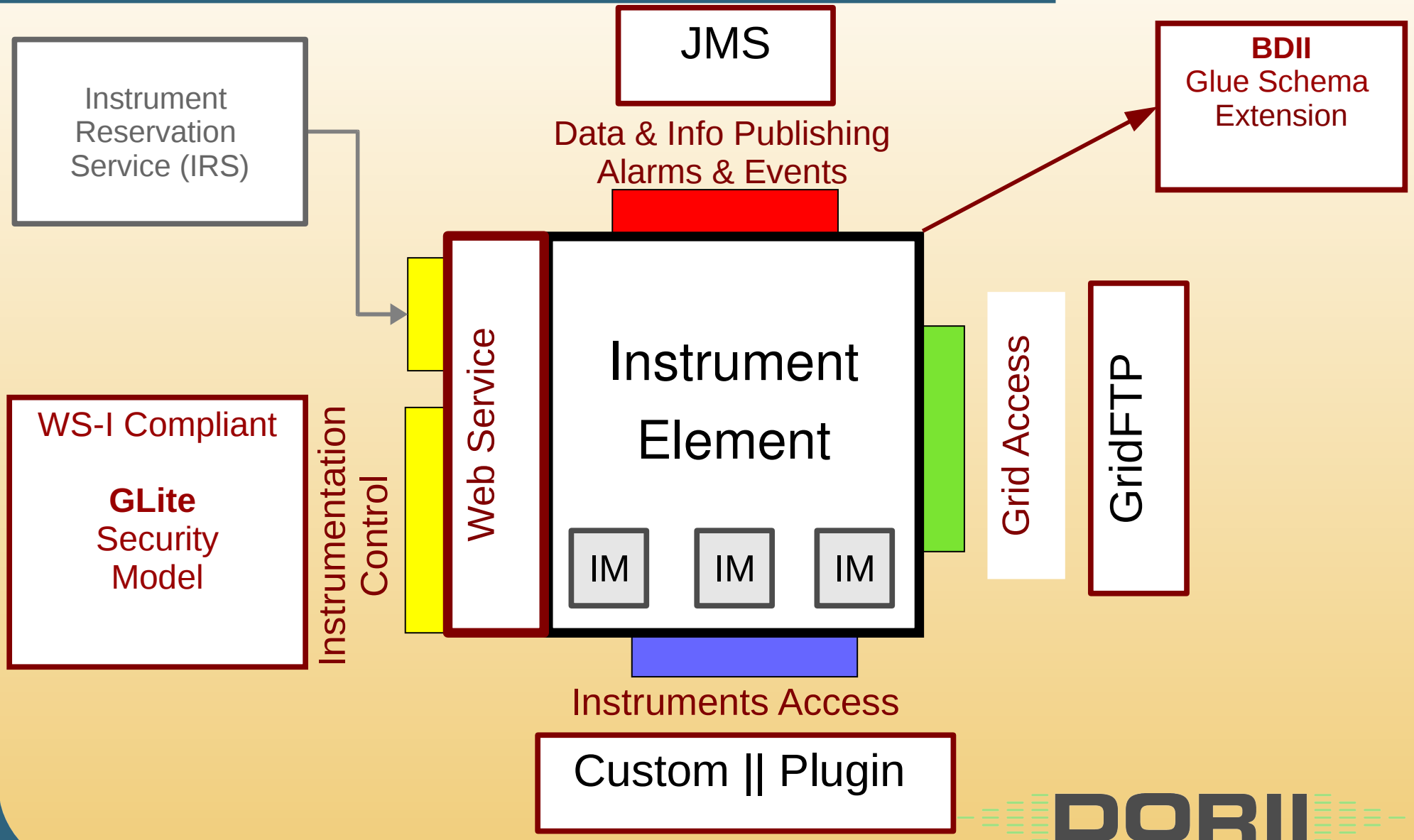
Instrument Element (IE)
and
Virtual Control Room (VCR)

About IE

From GRIDCC:

- Definitions:
  - Instrument Element describes a set of services that provide the needed interface and implementation that enables the remote control and monitoring of physical instruments.
  - Instrument Managers they are the parts of the instrument element that performs the actual communication with the instruments. (Protocol Adapters.)
- WSDL interface

IE architecture



DORII
Deployment of Remote Instrumentation Infrastructure

IE framework (from/to instruments and sensors)

Provides utilities to manage your instruments and sensors:

- Data validation: it checks data types for input attributes, parameters and command parameters;
- Cache functionality: for attributes reading;
- Data publishing: attributes can be published via JMS;
- (both Alarm and Event publishing: send events and alarms using JMS from wherever you want in your IM implementation)

IE framework (to SE)

Provides utilities to use Storage Elements:

- Write just one code line in your IM and enjoy to move data over the Grid;
- Ensures authorization using proxy certificates delegated by IE clients (GSI model, as used by GLite);
- Connecting data sources (instruments and sensors) directly to SE allows for the development of complete workflows.

IM - Concepts

- IM defines the bridge between your instrument/sensor and the Instrument Element
- It describes the instrument/sensor using a set of concepts:
  - Attributes and parameters: to describe instrument/sensor variables
  - Commands: to describe action on instrument/sensor
  - Status: to describe the state machine

IM - Development

A completely new IM creation process:

- Developer defines an XML descriptor file containing:
  - Possible states;
  - Attributes;
  - Parameters;
  - State transition commands and regular commands;
- Developers implement a set of classes that define the instrument and its attributes, parameters and commands, by extending the classes provided by the framework

IM – XML descriptor file (1/2)

Contains all informations about instrument/sensor:

- A list of possible status (required): a string list with status identifiers;
- A list of attributes: name, description, implementation class name, unit, lockable, access type (R, W, RW), subscribable and enableInStatus;
- A list of parameters: name, description, implementation class name, unit, lockable;
- A list of commands: name, description, implementation class name, lockable, initial, final and error status. Each command can have zero, one or more command parameters. They have the same fields as parameters (except the implementation class name), moreover they have the a field called 'mandatory'.

IM – XML descriptor file (2/2)

- For attributes, parameters and command parameters you have to specify the data type (short, integer, long, float, double, string, enumeration, vector, calendar). You can also add information about default value, a minimum and/or a maximum value;
- For attributes and parameters you have to specify the caching policy, too. It can be disabled, it can be managed by IE or it can be controlled by the user;

Conceptually important fields:

- Subscribable: if true, when the attribute value changed a JMS message with new value is sent by IE;
- Lockable: you can reserve yourself to be the only user allowed to do setAttribute/Parameter or executeCommand.

IM – Java Implementation

- What do you have to implement?
  - You have to extend the Instrument Manager class which will be your main class;
  - You have to extend the Attribute, Parameter and Command framework classes, at least once, for each concept that you have used in the XML descriptor file.
- For each instrument/sensor you should provide the Java API in order to connect to the instrument.

IE Plug-ins

- Considerations:
  - You have to provide both XML file descriptor and a set of Java classes for each instrument;
  - Most instrument are of the same kind
- Solutions:
  - A single implementation of an IM may fit a large number of instruments/sensors of the same type. (Simply provide a different ID for each IM, instrument instance.)
  - You could have one plug-in for all instruments/sensors that are controlled by a single API.

VCR

What's the Virtual Control Room?

- It's a portal, so:
  - You should have only a browser and a Java Virtual Machine to use it!
  - Easily customizable for each Virtual Organization
- Combines collaboratory environment and the control of remote infrastructures:
  - Manage grid components (SE, CE, IE);
  - Share info with the other members of your VO.

VCR – Features (1/3)

- Integrated collaborative tools:
  - Chat (JMS based),
  - Log Book,
  - Calendar (with both shared and private dates),
  - People Browser (see who is on-line, or find a telephone number, etc.)
  - Hooked to a number of external programs (like Skype, VRVS or mail clients).

VCR – Features (2/3)

- Grid in the browser:
  - You can manage CE, SE (using LFC too) and IE (at the moment it's the only IE client, ;));
  - You can use a script editor to develop simple workflows that use the grid components (Scripting language is Jython, that is Python with Java libraries);
  - Share your jobs and scripts among users as applications.

VCR – Features (3/3)

- Export what could not be (or is not yet) fully integrated with the VCR:
  - Software components without the web interface: export the screen and view it in the VCR!
  - Web server that are available only on a private network... navigate them through the VCR!

  Based on HTTPS tunneling technology:
  - Basically, make available services on machines on private networks to Internet through VCR.

Thank you for your attention!

Enjoy the demo and...

...good appetite!