LHCCP Working Session on Middleware

Participants:
D. Myers, C.-H. Sicard, U. Epting,
K. Kostro, J.-J. Gras, I. Laugier, A. Risso,
E. Ciapala, F. Calderini, V. Baggiolini
Outline

• **Scope** of the working session
  – Definition of “Middleware”

• **Inventory** of ongoing middleware activities
  – Clients & Users
  – Middleware initiatives

• How to achieve “seamless data exchange”
  – Scope & Requirements
  – Solution approaches
  – Issues & Challenges

• **Organization**
  – Division of work
  – Collaborations

• Required **decisions & activities**

• Conclusions
Scope of the session

• Middleware (Definition for this session:)
  – “communication glue between distributed software components”
  – functionality to exchange data and commands between different parts of a distributed control system
  – functionality for information diffusion

• We did not discuss
  – Database access
  – Software development environment
  – Hardware platforms
  – Network & Fieldbus infrastructure
  – etc. etc.

• No detailed technical discussions
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Inventory: Middleware Clients & Users (1)

- **LHC/VAC**: (I. Laugier) Control of all vacuum equipment
  - Communication with 3 vacuum systems; Mobile systems
  - 50 readings/sec, precise timestamps,
  - Data exchange with cryogenics and beam measurement
  - Introducing PLCs now

- **SL/RF** (E. Ciapala): RF System for LHC
  - Acceleration, Damping and Beam control
  - Monitoring & control, various data formats, large blocks of data
  - Access control, control priorities, tracing of actions
  - PLCs and in-house equipment controllers
  - Users of PS/SL middleware
Inventory: Middleware Clients & Users (2)

• **SL/BI** (J.-J. Gras): Beam Instrumentation Software
  – GUIs, Server software, drivers; Logging & RT feedback
  – Communication *between the above and with external world*
  – Want to use PS/SL middleware and **contribute to its success**
  – Will develop own facilities (only when needed)

• **Alarms** SL/CO (F. Calderini): CERN-wide alarm distribution
  – Use case: users subscribe to groups of fault states (“subjects”)
  – **Reliability, availability, traceability**; Bursty traffic, not time critical
  – 3-tier architecture using open message-oriented middleware
  – Active collaboration with PS/SL middleware project & LDIWG

• (There are certainly others...)
Inventory: Middleware Initiatives (1)

• **ST/MO**, (U. Epting) Technical Infrastructure Monitoring
  – TCR: Monitoring 24h/day; 365days/year; troubleshooting coordin.
  – Integration of many diverse systems (in-house, PLC, SCADA)
  – Data exchange with external world
  – message-oriented middleware; Participation in LDIWG

• **JCOP**: Controls for LHC experiments
  – Distributed control system based on SCADA
  – Middleware: OPC for industrial; DIM for custom developments
  – Communication with LHC machine, Safety system, Cryogenics, etc => LDIWG

• **PS/SL Middleware project**: MW for PS&SL accelerators
  – Requirements from PS/SL equipment groups
  – Selection of technology: CORBA & Message-Oriented Middleware
  – Elaboration of Architecture and Interfaces
  – Prototypes for Summer ‘00, first production software December 00
Inventory: Middleware Initiatives (2)

- LHC Data Interchange WG (C.-H. Sicard):
  - CERN-wide LHC data exchange
  - Participants: Accelerators, Experiments, ST, Cryogenics, etc.
  - Requirements for LHC data exchange
    - Communicating entities
    - Data exchanged & Traffic characteristics
  - Overall Architecture
  - Phase 2: strategies for implementation
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Seamless Data Exchange Requirements

- CERN has several (middleware) **Domains**
  - Accelerators, Techn. Infrastructure, Experiments, Cryogenics
- Communication **requirements**
  - *Inside* a domain: mostly equipment monitoring & control
  - *Between* domains: mostly information diffusion

==> Two logical levels of Middleware
Intra-domain vs. Inter-domain: Requirements

**Intra-domain**
- Monitoring & Control
- High traffic rate
- Low latency required
- Specialized, “agreed-on” data
- Close coupling between communicating entities

**Inter-domain**
- Information diffusion
- Lower traffic rate
- Higher latency acceptable
- Self-describing data
- Loose coupling between communicating entities
Inside Domain: Present Approach

- Each domain uses their own Middleware solution
  - Accelerator Complex: PS/SL middleware project
  - Experiments: JCOP
  - ST/MO: Technical Infrastructure Monitoring (TIM)
  - Cryogenics: Turn-key solution
- Also different solutions for:
  - Data model (Device-oriented or Channel-oriented)
  - Architecture & APIs
  - Technology & Implementations
- Common solutions might be possible
Between Domains: Proposed Approach

- A single Middleware solution (Data Interchange Bus) accepted by all domains
- A single interface to domains
- Maybe gateways needed!

- Might use technology from one of the existing MW initiatives
Issues & Challenges

• Mapping between data models
  – channel-oriented <=> device-oriented <=> “subject-oriented”

• Common naming schemes
  – (what are naming schemes?)

• Definition of common interfaces
  – Agree on: APIs, Protocols, data representations

• Integration of different entities & technologies
  – Industrial/OPC + Unix/CORBA/MoM

Organizational (“human”) aspects are more difficult than technical ones!
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• Work Organization
  – Division of work
  – Collaborations
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Work Organization

• **Division** of Middleware work
  – Inter-domain Middleware => LDIWG-2
  – Accelerator Middleware => PS/SL Middleware project
  – Infrastructure monitoring Middleware => ST/MO TIM
  – Experiment Middleware => JCOP
  – Alarms, Cryo, Vac, Equipment Grps => **Choose your MW partner!**

• **Collaboration** areas
  – Definition of (inter-domain) **Interfaces**
  – Naming conventions
  – Selection & support of middleware **technology**
  – Gateways OPC – Corba/MoM
  – Implementation of components

• **An organizational structure** has to be put in place!
  – LDIWG-2? LHC-CP sub-project? Other?
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Decisions & Activities (Incomplete List)

• Decisions required
  – Define future of LDIWG
  – Define organizational scope of “LHC Middleware” (CERN groups)
  – Create organizational structures

• Activities
  – Review PS/SL Middleware User Requirements in the light of LHC
  – Integrate other (e.g. LHC/VAC) requirements somewhere
  – Define functional scope of LHC Middleware (latency/throughput)
  – Find out about deadlines for outsourced systems
  – Agree on Interfaces with Inter-domain middleware
  – Agree on a naming scheme
Conclusions

• A lot has been already done
  – Intra-domain: Requirements, Technology selection, Architecture
  – Inter-domain: Requirements and Architecture (LDIWG)

• 3 Practical Middleware Initiatives with man-power
  – TIM (ST/MO), JCOP, PS/SL Middleware

• Accelerator Domain: PS/SL Middleware is the candidate

• Organization
  – Work distribution is relatively straight-forward
  – Collaborations are possible but need to be encouraged
  – Organizational structure is required

• Many Thanks to the working session participants!