

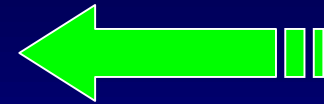
LHCCP Working Session on Middleware

Participants:

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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**

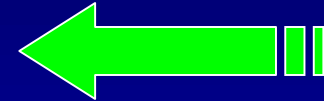


Scope of the session

- 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

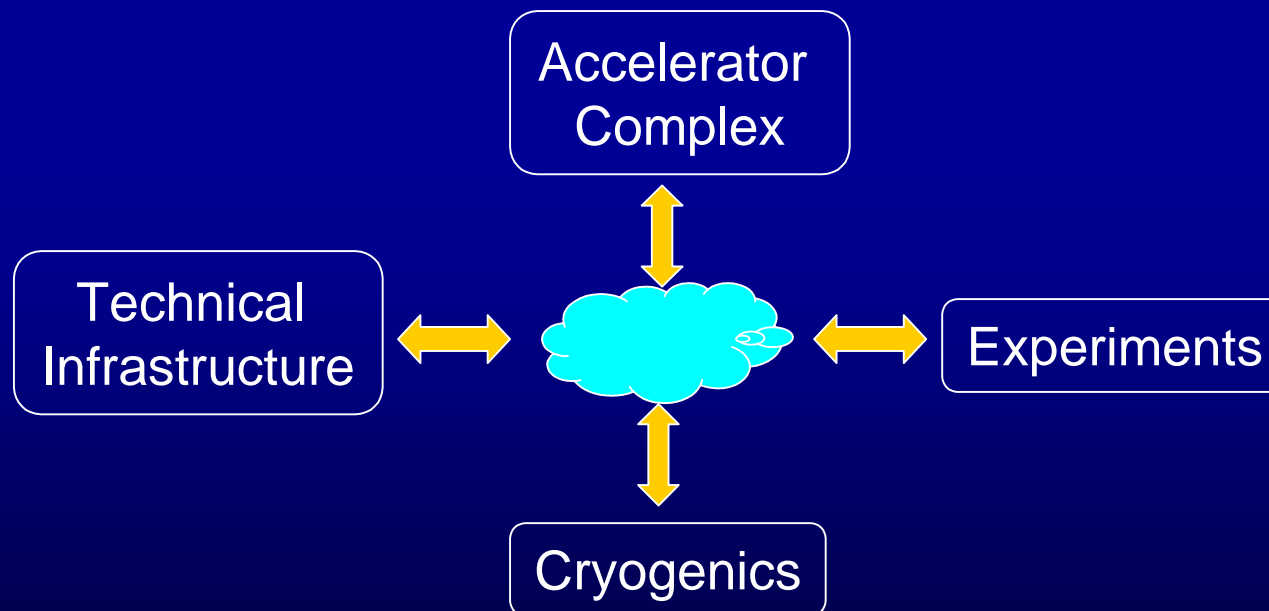
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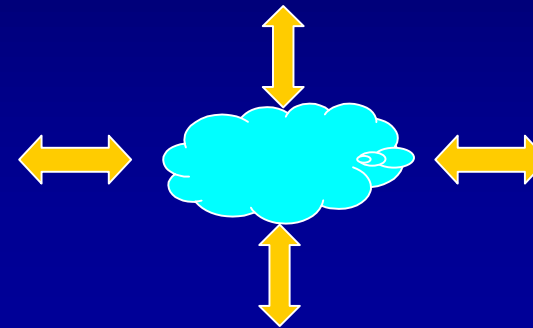
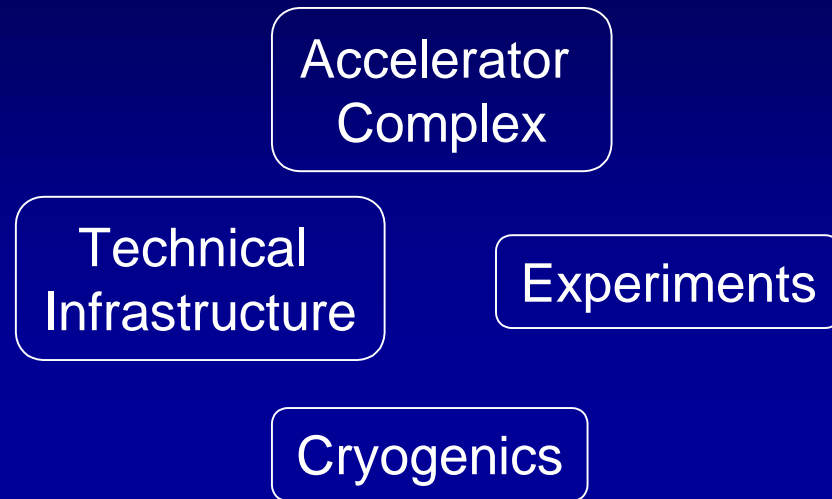
Seamless Data Exchange Requirements

- 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

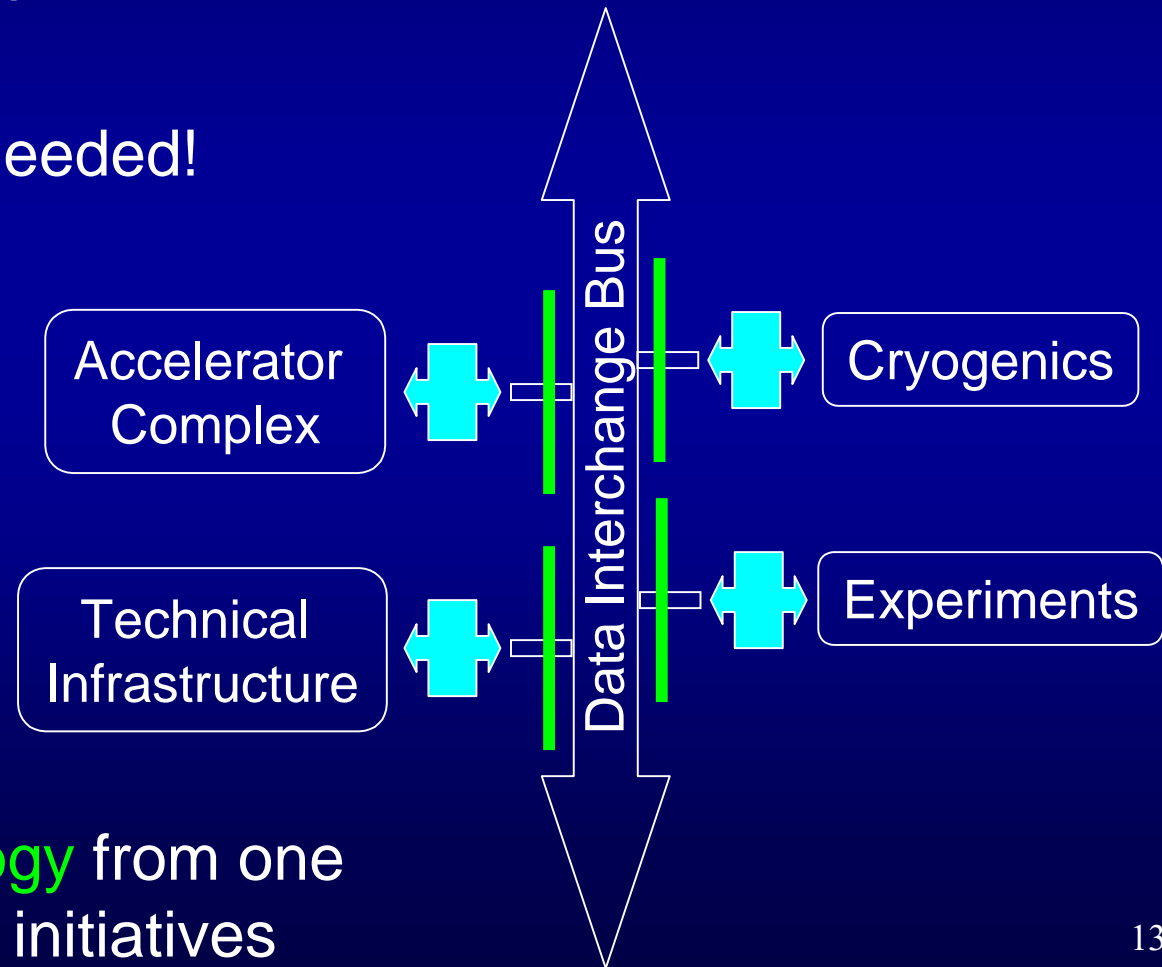
- Information diffusion
- Lower traffic rate
- Higher latency acceptable
- Self-describing data
- Loose coupling between communicating entities

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 \Leftrightarrow device-oriented \Leftrightarrow “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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 - **Division of work**
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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!