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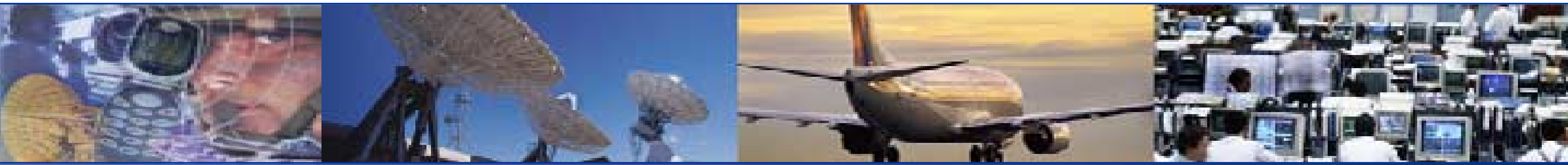
Distributed Software Infrastructure

CORBA /DDS, COMPETING or COMPLEMENTING THECHNOLOGIES ?



OMG Real-time and Embedded Systems Workshop

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Motivation

- Can I use CORBA to distribute data on the network ?
- Is the notification service able to provide similar functionalities as DDS?
- Can I use DDS as a Request Broker ?
- Can I use CORBA with DDS?
- Can DDS interwork with CORBA effectively ?
- When Shall I use CORBA and when shall I use DDS ?

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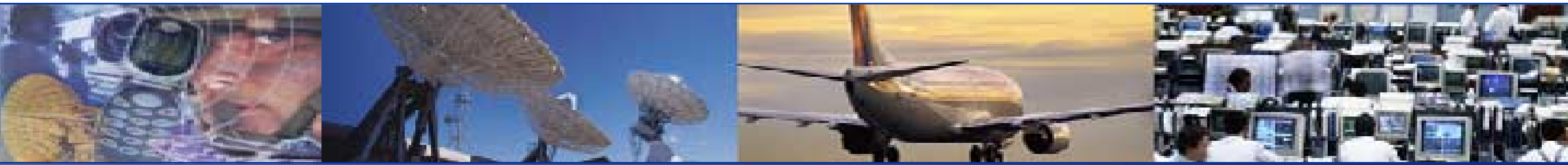
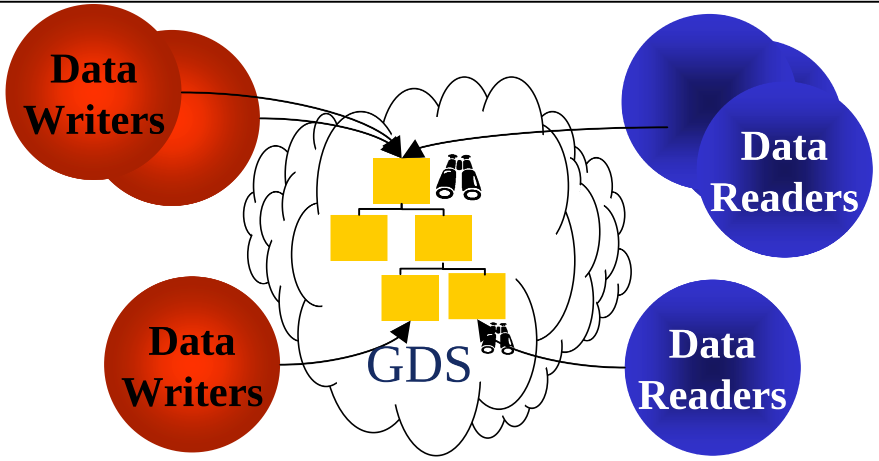
DDS Genesis

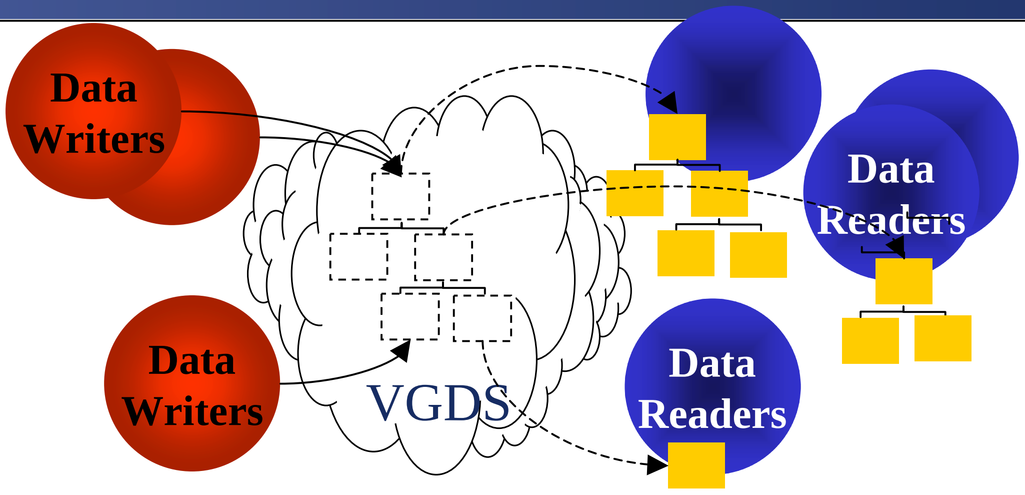


Data Centric Canonical Models



- Data writers and Readers accessing to a common Global Data Space (GDS)
  - GDS can be:
    - Shared Memory,
    - Centric or Replicated Databases,
    - Distributed Databases.
  - Writers and Readers can share a unique view of data or they can have their own dataview
- Having a unique GDS Holder for the whole system leads to
  - Single point of failure,
  - Decrease scalability and performance,
- Distributed DBMSs are heavy and inappropriate for reactive and near realtime systems
  - Don't offer standard behaviors to synchronize and notify readers on data availability etc …
  - Don't offer enough data lifecycle control,
  - Involves heavy mechanisms to guaranty high level data consistency (distributed transactions, distributed locking protocols etc …),

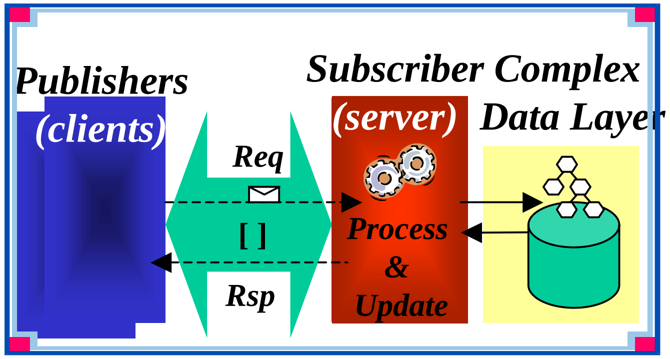
Data Centric Publish and Subscribe middleware



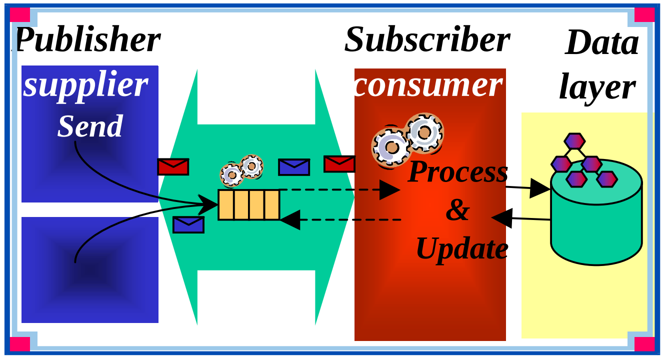
- Virtual GDS should be managed and maintained by a Data Centric Middleware which is able to split and publish the right dataview, to the right reader at right time.
  - Data Centric Pub-Sub
    - Virtual Global Data Space is split in a multitude of data views or topics
    - DCPS Purpose: QoS Driven Distributed Data management
- The Data Centric Middleware must be able to reconstruct the data using the Reader's own native information model
  - Object Oriented model,
  - Relational Model, etc …
  - Data Local Reconstruction Layer
    - DLRL Purpose: provide an OO-model to access data as Local Objects
- DDS : DCPS + DLRL

The Data Distribution Paradigm

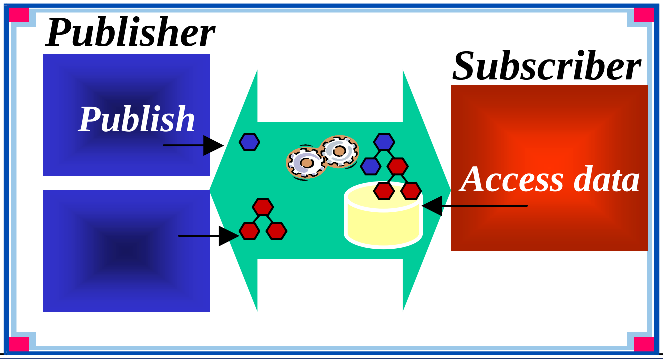
- **DDS is used for Information centric rather Service centric applications**
  - Focusing on **data** *instead of Processing and Services*
  - Model your information exchange using **high level data Models** *instead of exchanging elementary data units (Messages, Events…)*
  - **Delegate** Information dissemination, processing and management to the Middleware
    - Specify your **own view on data schema** and **let the middleware build it for you !**



Service Oriented Middleware



Event/ Messaging Oriented Middleware



Information Centric Oriented Middleware

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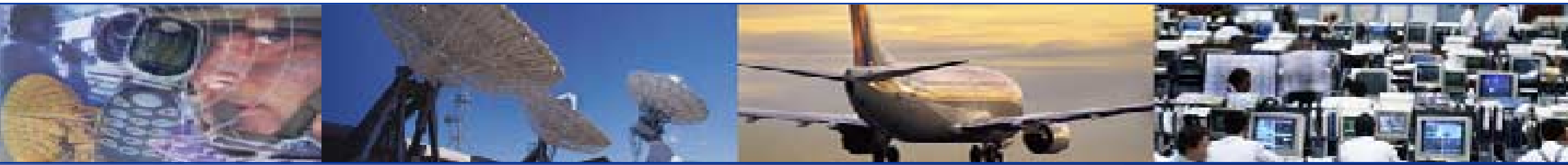
DDS and CORBA, congruous or incongruous?



congruous or incongruous?

- As an MDA compliant OMG Spec, DDS is CORBA independent but not CORBA-incompatible,
  - DDS PSM is in CORBA IDL
  - DCPS data model can be represented with IDL data types and structures
    - Strcut, Object by Values etc …
- CORBA and DDS have more than Common Data Representation and IDL in common

CORBA and DDS Underlying Concepts *Similarities and Differences*

- **DDS Concepts**
- Handle, manage and dispatch complex data models.
  - Portability, language and platform transparency
  - Platform independent Data-model
  - Strongly typed interfaces,
  - Realtime,
  - QoS Management,
  - Location Transparency
  - Data Integrity Control and Filtering
  - Domain managements
  - Data History
  - Fault tolerance (implementation dependent)

- **Equivalent CORBA Concepts**
  - Handle and manage most of the distributed objects interactions aspects, including objects state (data)
    - Interoperability, Portability, language and platform transparency
    - Platform independent Object model
    - Dynamic and Strongly typed interfaces
    - Relatime
    - QoS management
    - Location Transparency
    - Specialized Filtering and domain management capabilities applying to event driven communication only
    - Security, Transaction, Time, Fault tolerance, Openess (Interworking with other technologies)

DDS and CORBA Design Principles,
Great Differences in Design

- DDS more than a Pub/Sub Middleware
  - *DDS is a data broker and a data manager*
  - Design principle, the **Integration** of data distribution, data management, and data location fucntions
  - Data management functions are defined as profiles
    - Data LifeCycle,
    - Data Query,
    - Local Object Relationship management,
    - Data Concurrency (ownership),
    - Data Persistency,
    - Data (topic) discovery,
    - Data Dissemination …

- CORBA more than a Request Broker
  - CORBA manage Object states too (data)
  - Design principle, the **Separation** betweer Object management functions
  - Object management functions are defined as Common Object Services
    - LifeCycle CoS,
    - Query CoS,
    - Object Relationship CoS,
    - Concurrency CoS,
    - Persistent CoS,
    - Naming/Trading CoSs
    - Notification, Event and Logging CoSs

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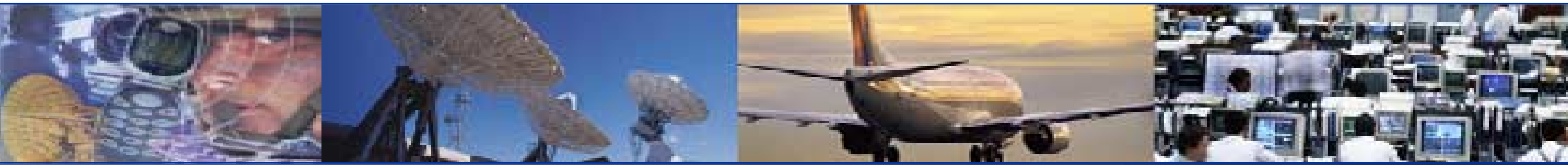
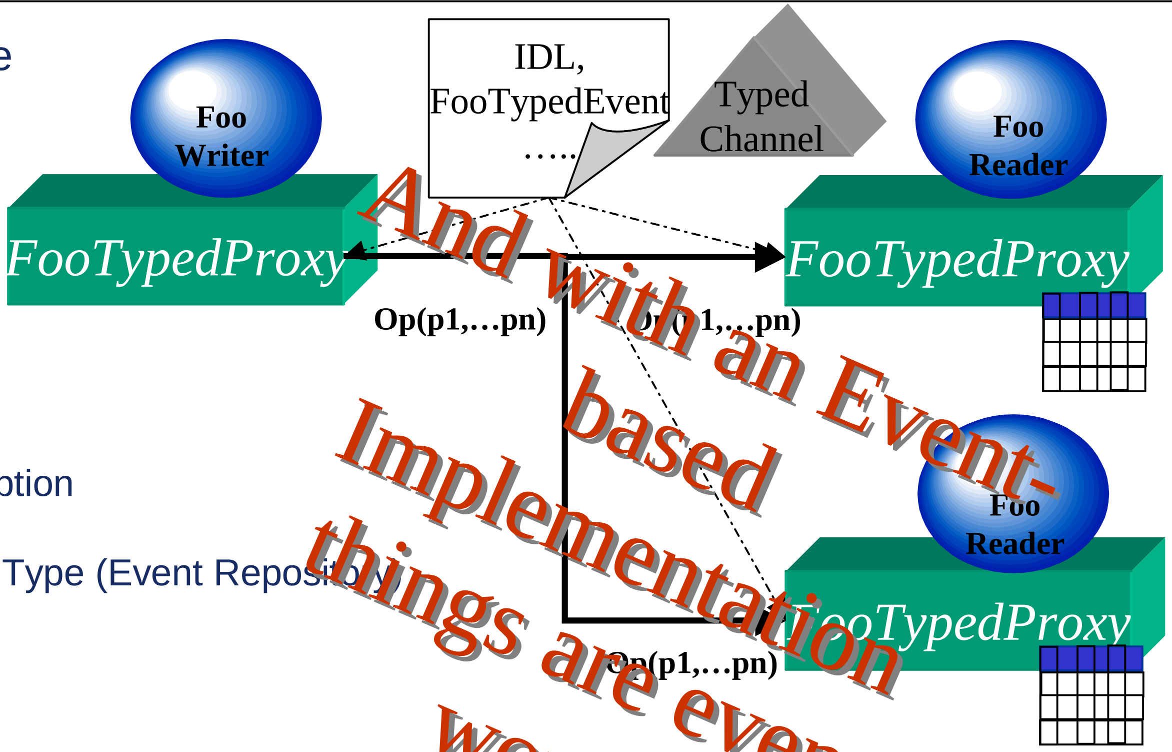
DDS with a CORBA infrastructure ?



Typed Notification Service
A Candidate for a DCPS ?

- Any attempt should at least reuse Notification concepts

- It can use iiop multicast
- What can be done with an NS
  - DDS Typed Data exchange
    - Typed Events
  - DDS Sharing Subscription
    - Notification Sharing Subscription
  - DDS Topic discovery
    - Dynamic Discovery of Event Type (Event Repository)
  - DDS Content subscription
    - Filtering
    - The use of SQL is possible
  - DDS Reliability
    - Event Reliability notification Qos
  - DDS Domain partition
    - Event Domain management QoSs
  - DDS data deadline
    - Event deadline, with no guarantee
  - All the other DDS QoS can not be directly mapped to Notification QoS



And with an Event-based Implementation things are even worst

Beyond QoSs, What can't be Achieved with Notification

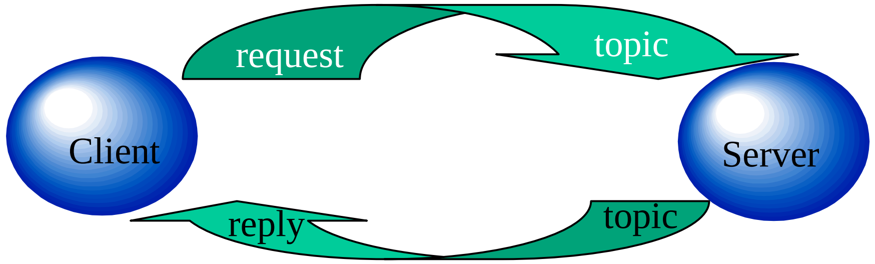
- Rebuilding of dataObject
  - should be handled by Application
- Aggregation of data items
  - Should be handled by the application
- Propagation of Atomic data items
  - Could be done with the help of transaction service,
    - Could impact performance.
- Partial modification of a data object
- Data change state notifications
- Data ownership
- Handling of multiple datatypes
  - Should be handled by the application
- Realtime propagation
- Support of the most current data values
  - Notification does not support the LIFO policy,
- Dynamic discovery of datatype
  - Could be done by using a Trader Service
  - Trader management should be handled by application
- DataHistory
  - Could be done with the integration of Query Service
    - Query management Service should be handled by application

DDS with CORBA - Conclusions

- Building full DDS-like architecture with <u>existing</u> CORBA infrastructure and services is very difficult
  - Several basic CoSs (COTS) are not available on market anymore (Query, Persistence, Lifecylce …)
  - Application level have to endorse the integration of the CoSs (Notification, Query, LifeCycle, Persistence) to build data-items, coordinate their state and build additional features
  - No Realtime Typed Notification Service implementation available.
- *Performance, Fault-tolerance, and high-availability, continues to present a concern*
  - *No major FT-CORBA COTS available*
  - *FT-CORBA impact Performance*
  - *... ROMiop and Miop are not the clear favorites in the race for the definition of a DDS interoperable wire protocol …*

Where CORBA Can Complement DDS?

- Request/Reply transportation
  - Application will should handle request processing
    - Use topic keys like RequestID/ReplyID
    - Correlate Requests with replies
    - ….
  - Don’t offer an object oriented view of the Server interfaces …
  - Synchronous remote invocations are not possible



- CORBA and DDS are complementary and compatible

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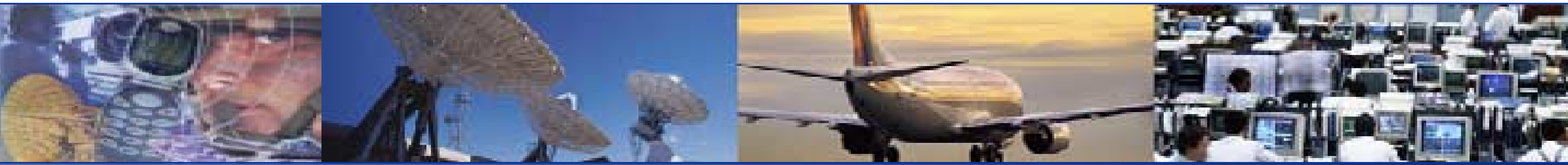
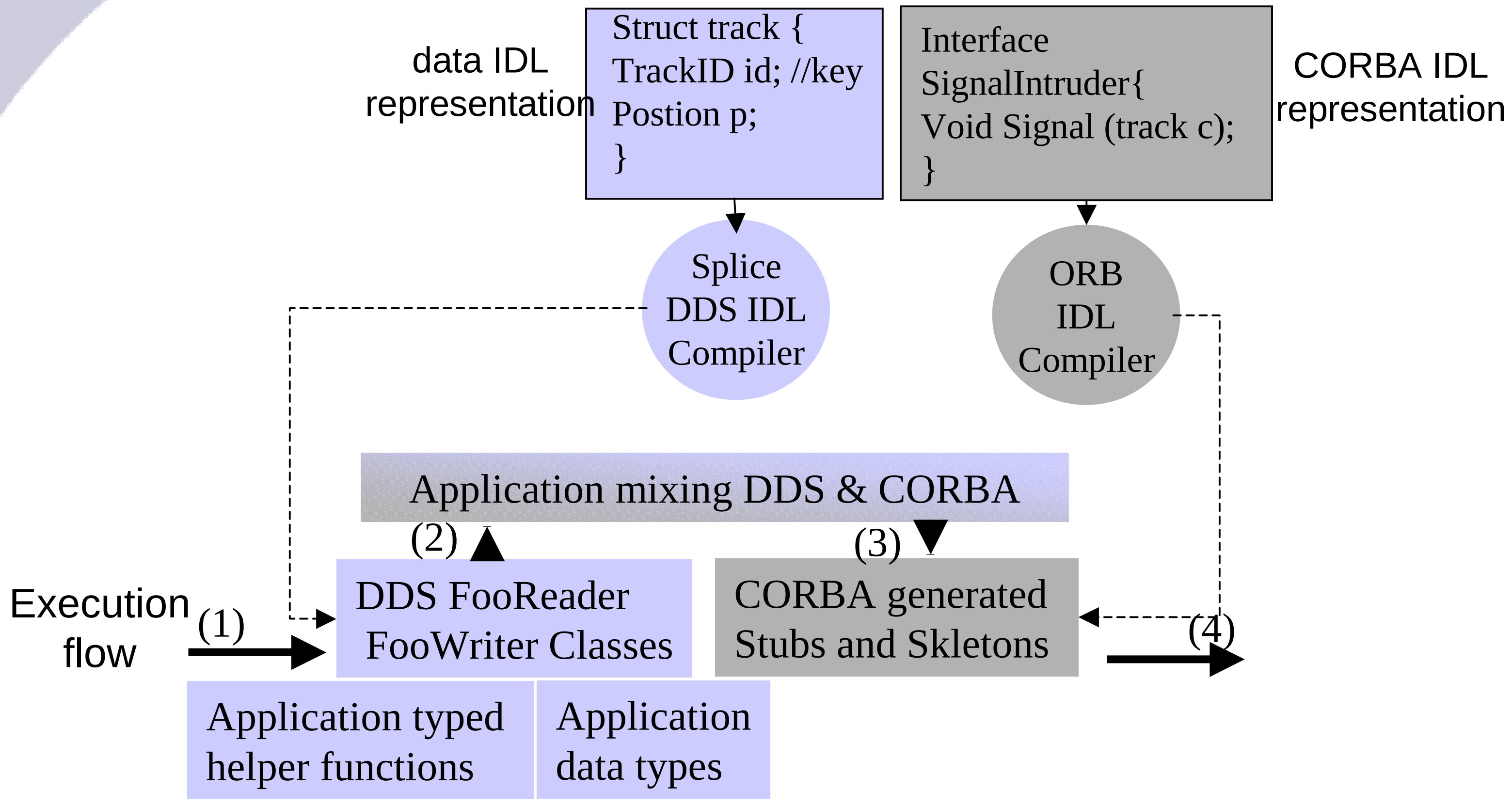
DDS CORBA Interworking

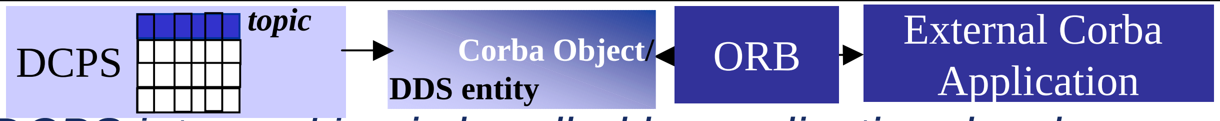


The Problem to solve



- Carry DDS dataItems to the CORBA world
- Carry CORBA invocations to the DDS world

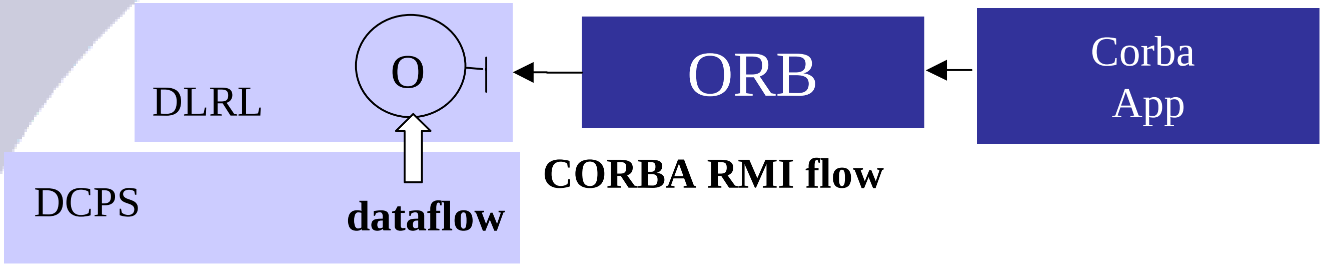
DCPS CORBA Interworking: Some Work to be Done



If the CORBA - DCPS interworking is handled by application developers:

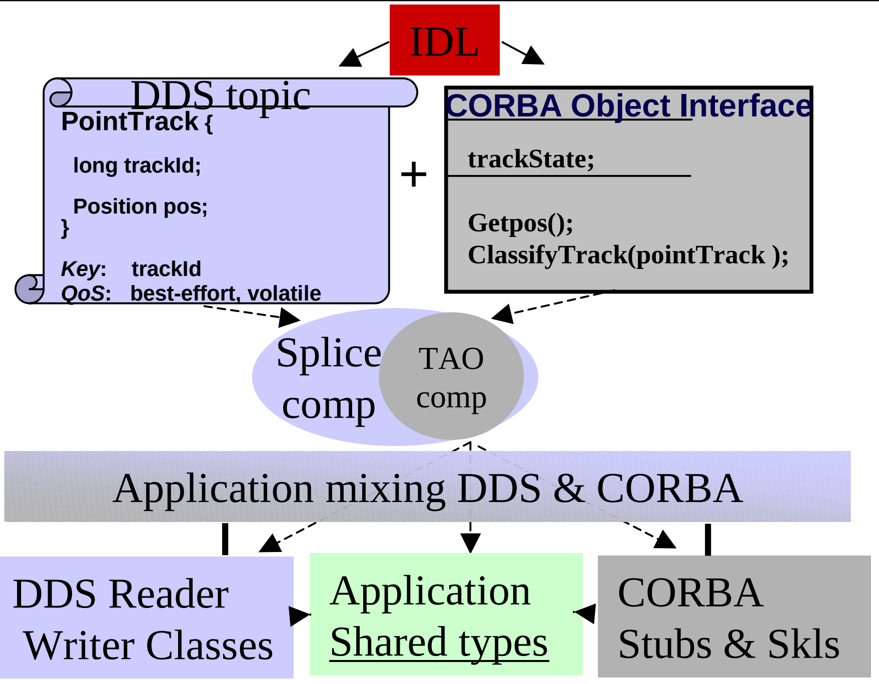
- From CORBA to DDS
  - Each CORBA Call need to be converted to a topic
    - CORBA, op(x1,x2) -> To DDS topic(x1,x2)
      - *Restrictions: Xi could not be OBV nor a Struct*
      - *ValueTypes can not be defined at the DCPS level*
- From DDS to CORBA
  - Data instances are , either mapped to RMI parameters or used to build an Object request (DII)
  - DDS Typed Interfaces makes the design of Generic bridging technology difficult,
- First Solution
  - Half of the Corba-DDS brigde could be made generic easily
  - Complicates the Application Programming Model and limits the application portability
  - Error-prone
- Second Solution
  - Bridge Code Generation
    - Using IDL topic description and Corba Object IDL interfaces
- Third Solution
  - Interoperability handled at the transport level
  - Encapsulation of the DDS Message in GIOP
  - Encapsulation of the GIOP Message in DDS
    - Main issue: DDS does not provide any common transport protocol, yet .. !!

DLRL: Toward Smooth Integration Between DDS and CORBA



- DLRL Objects maps to ValueTypes
- DLRL does not directly distribute these valuetypes over the network
- CORBA can distribute valuetypes
  - DLRL Objects can be passed as arguments to Remote Method Invocation, or
  - DLRL Object can be wrapped into a CORBA object to make it reachable remotely
  - A CORBA-DDS container could be defined or generated to wrap the DLRL objects

SPLICE-DDS: an Example of a SMART DDS-CORBA Interworking



- **IDL, a Common definition language:**
  - For CORBA-interfaces & DDS topics,
    - same IDL, name-space, same IDL to native language mapping
  - Code generation : Typed data generation as well as (typed-)interfaces
- **Seamless Runtime Cooperation**
  - Shared types allow direct passing-on of RPC-obtained information into DDS-topics
  - Fully autonomous runtime-systems (no dependency, no real-time influence)

Conclusion

- **Building full DDS-like architecture with existing CORBA infrastructure is not viable**
  - **Require intensive development and Finalization of Other technologies …**
    - **Realtime notification service, …**
- **Building a full CORBA-like architecture with DDS infrastructure is not viable either**
- **DDS-CORBA Interworking is well suited for growing demand of data centric and service centric mixed architectures**
  - Network Centric Warfare, etc …

- **DDS is suitable for Tier-2 type of application**

  Fast Information Access Essential
  - Command Execution in CMS
    - Distribution of Track updates and navigation data to OA components
  - ATM, Inter-site connection
- **CORBA is more suitable for Tier-3**

  Service Centric Architecture Essential
    - Command Control & Support
    - ATM, Site-2-Site connection

- **SPLICE-DDS can make DDS-CORBA interworking easier**
  - **Use same name space and IDL for both DCPS-topics and CORBA Object Interfaces**
  - **Future development of SPLICE-DLRL would make the integration more natural**

Questions and Additional Information

- We are very interested by your feedback on CORBA-DDS interworking
  - Your requirements,
  - Your suggestions,

  …
- Downloads and More information on SPLICE-DDS available at www.prismtech.com
- Off-line questions can be sent to ramzi.karoui@prismtech.com and Hans van 't Hag at hans.vanthag@nl.thalesgroup.com
- Much more information to come on SPLICE-DDS with Hans’s next presentation