Data Distribution Service
A foundation of Real-Time Data Centricity

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Agenda

- History
- What is Data-Centricity?
- The Future
  - Enabling Unified Global Data
  - A Real-Time “Service” Bus
History: DDS the Standard

- Data Distribution Service for Real-Time Systems
  - Adopted in June 2003
  - Finalized in June 2004
  - Revised June 2005, June 2006
  - Joint submission (RTI, THALES, OIS)
  - Specification of API for Data-Centric Publish-Subscribe in real-time distributed systems.

- Multiple Implementations
  - 3 commercial
  - 3 open source
  - Several more in-house

- Interoperability in progress at OMG
  - Recommended for adoption in July 2006
DDS mandated for data-distribution

- DISR (formerly JTA)
  - DoD Information Technology Standards Registry

- US Navy Open Architecture

- FCS SOSCOE
  - Future Combat System – System of System Common Operating Environment

- In Progress
  - RETF
    - Railroad Electronics Task Force
  - UK MOD
    - Advocating Open Systems
US Navy Programs

- DDG 1000 – previously DD(X)
- LCS – Littoral Combat Ship
- SSDS – Ship Self Defense System
- SPY OA – Aegis System
- LPD 17
- Sea Slice
- E2-C Hawkeye
- ...
DDS Adoption

EU Air Traffic Management

Boeing Army Future Combat System

Train Communications

Boeing AWACS program

Tokyo Japan Traffic Control

US Navy, DD(X) LCS, LPD-17 SeaSlicer and 13 other Navies
DDS Adoption

- **Aerospace & Defense**
  - BAE (Joint Strike Fighter avionics)
  - USA, CAE, NADS, Boeing (Simulators)
  - TCG, Lincoln Labs, General Dynamics (C4ISR)
  - Boeing, Lockheed, Northrop (Navy OA)
  - SAIC (Ground vehicle control)

- **Industrial Automation**
  - Schneider (Factory automation)
  - Applied Materials, Nikon (Semiconductor equipment)
  - Ferag (Post printing assembling and binding)
  - Schilling (Robotics)
  - Max Planck (Power research)

- **Telecomm/Datacomm**
  - Accom (Digital video control)
  - Tekelec (Network test equipment)
  - IPC (Telecomm equipment)
  - Infinera (Optical switch control)
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What is DDS? DDS/DCPS

Provides a “Global Data Space” that is accessible to all interested applications.

- Data objects addressed by **DomainId, Topic** and **Key**
- Subscriptions are **decoupled** from Publications
- Contracts established by means of **QoS**
- Automatic **discovery** and **configuration**
What is DDS?

DDS/DLRL

Provides “Local Object Caches” built from the Global Data Space.

- Objects manipulated with a “natural” language binding
  - Inheritance, Object Graphs, supported as language objects
- Actions on local objects cause updates to DCPS Global Data
- No need for a “global” object model
- QoS contracts still available via underlying DCPS

Distributed Node

Distributed Node

Global Data Space

Distributed Node
dds global data

- address in global data space = (domainid, topic, key)
  - each topic corresponds to a multiple data instances
  - each datawriter can write to multiple instances of a single topic
  - multiple datawriters may write to the same instance
  - each datareader can receive updates from multiple instances of a single topic
  - multiple datareaders may read from the same instances
DDS communications model

- Publisher declares information it has and specifies the Topic
  - and the offered QoS contract
  - and an associated listener to be alerted of any significant status changes

- Subscriber declares information it wants and specifies the Topic
  - and the requested QoS contract
  - and an associated listener to be alerted of any significant status changes

- DDS automatically discovers publishers and subscribers
  - DDS ensures QoS matching and alerts of inconsistencies
# QoS: Quality of Service

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## User QoS Policies

- Presentation
- Redundancy
- Transport

## Infrastructure

- Delivery
- Volatility
QoS: Deadline

DEADLINE “deadline period”

- **Deadline**: Commits to provide data each deadline period. Expects data every deadline period.

- **Publisher**: Data Writer
- **Subscriber**: Data Reader
- **Listener**: Failed to get data

Deadline: S X S S S S S S
What makes DDS different?

- **Data-centricity**
  - High level of data abstraction: Topic, Key
  - Proven scalable model for RT systems
  - “Smart” services such as:
    - Ownership, ContentFilteredTopics, KeepLast History
  - Automatic discovery
  - Directly supports state propagation/caching

- **Configurability by QoS**
  - Wide range of applicability: Enterprise to real-time
  - P2P infrastructure:
    - High-performance and scalability
    - Fault-tolerance
    - Scalability
  - Subsumes message-oriented and data-centric

- **Object model built as local cache**
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Data-Distribution and Real-Time

- Java/RMI
- Java/JMS
- CORBA
- RT CORBA
- RTSJ (soft RT)
- RTSJ (hard RT)
- Web Services
- MPI
- Data Distribution Service / DDS

Adapted from NSWC-DD OA Documentation
Until now: Different Data Solutions

- **Database Management Systems**
  - Good for: Complex queries, dynamic sorting, standard SQL I/F, enterprise solution
  - But... No RT performance, centralized, non-distributed

- **Data Distribution Services**
  - Good for: High performance, dynamic architectures, real-time solution
  - But... what do you do with the data once you get it there?
A new model is possible: Standards-Based Global Data Space

- Data accessible to all interested applications:
  - Data distribution (publishers and subscribers): **DDS**
  - Data management (storage, retrieval, queries): **SQL**
  - Rich QoS, automatic discovery and configuration
  - Real-time and/or high-performance access to data
Global Data & End-to-End Integration

Isolates real-time data performance from interference from non-real-time systems

- Data access from the Web Services or Enterprise networks does not hinder the real-time performance Network
- Additional portals to other systems can be added dynamically
DDS Opportunities

Net-centric interface to tactical systems

Simulation Systems

Surveillance Systems

Financial Systems
OMG Opportunity

- Open, Standard Platform Enabling Integration
  - from the Enterprise Service Bus (ESB)
  - to the Real-Time Service Bus (RTSB)
Thank you

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