Introduction to DDS

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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
  - 4 commercial
  - 3 open source
  - Several more in-house
- Interoperability wire protocol
  - Adopted in July 2006

RTI

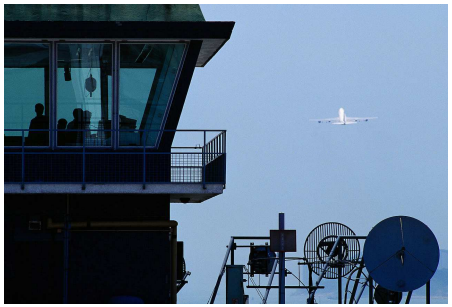
DDS mandated for data-distribution

- 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

Train Communications

Tokyo Japan Traffic Control

Boeing Army Future Combat System

Boeing AWACS program

B1-B Tactical Systems Upgrade

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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THALES

BAE SYSTEMS

RTI

Top reasons to use DDS

- Flexibility of the data-centric model
  - Breaks system dependencies
  - Ease to develop scalable fault-tolerant systems
  - Support data-flow, data replication, and messaging
- Ease of integration
  - Support for heterogeneous and constrained environments (memory, CPU, communication bandwidth)
  - Built-in support for common use cases: Persistence, Failover, Content and time-based filters
  - Multi-language support: C, C++, Java, C#, ADA
  - Multi-platform support: Windows, Linux, Unix, Embedded/Real-Time (VxWorks, LynxOS, Integrity)
- Performance
  - As good as the transport can provide
  - Built-in reliable multicast support
  - Support for Real-Time Messaging
  - Support for QoS and QoS contracts

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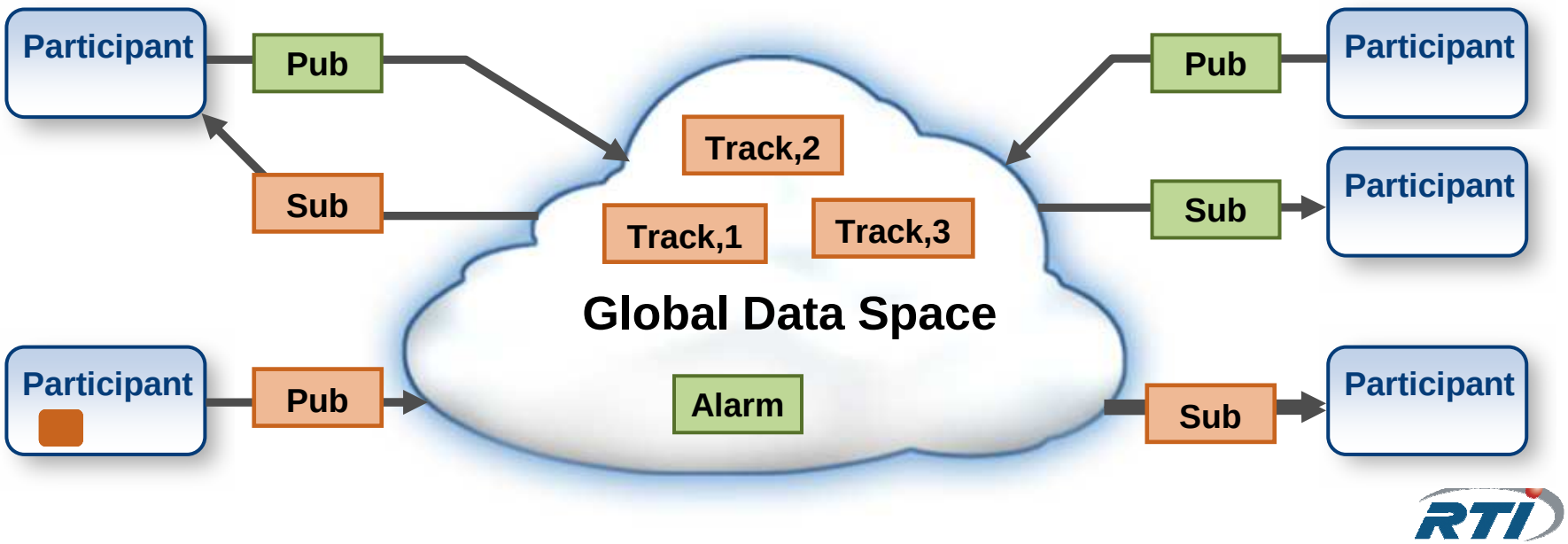
What is DDS? DDS/DCPS

Provides a virtual "**Global Data Space**" that is accessible to all interested applications.

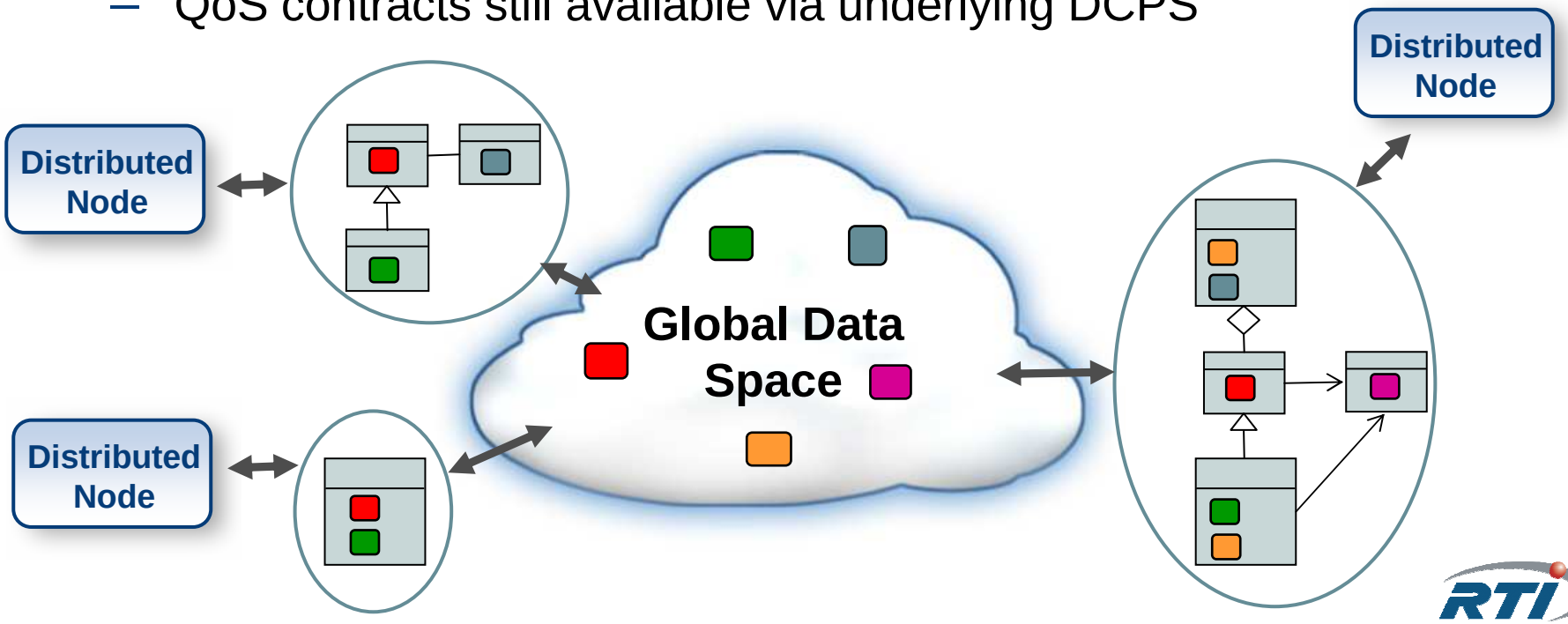
- Data objects addressed by **DomainId, Topic** and **Key**
- Subscriptions are **decoupled** from Publications
- Contracts established by means of **QoS**
- Automatic **discovery** and **configuration**



What is DDS? DDS/DLRL

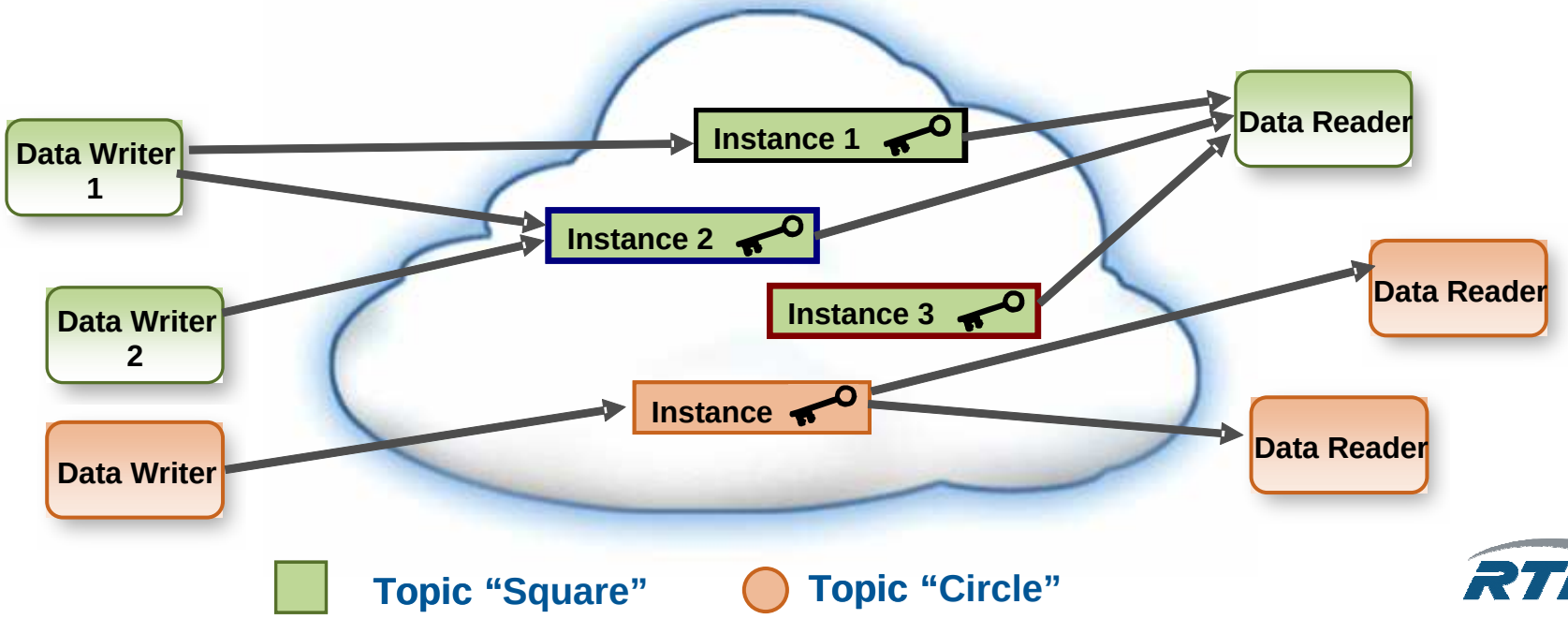
Provides "Local Object Caches" built from the Global Data Space.

- 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

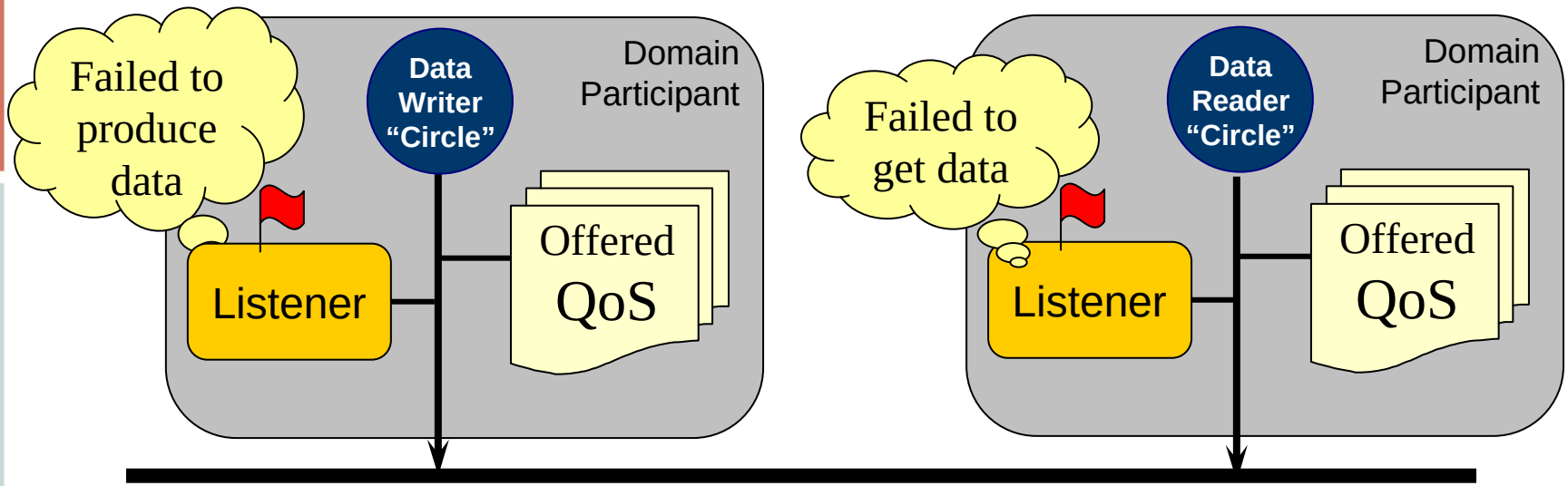


DDS Global Data

- 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

QoS Policy	QoS Policy
DURABILITY	USER DATA
HISTORY	TOPIC DATA
READER DATA LIFECYCLE	GROUP DATA
WRITER DATA LIFECYCLE	PARTITION
LIFESPAN	PRESENTATION
ENTITY FACTORY	DESTINATION ORDER
RESOURCE LIMITS	OWNERSHIP
RELIABILITY	OWNERSHIP STRENGTH
TIME BASED FILTER	LIVELINESS
DEADLINE	LATENCY BUDGET
CONTENT FILTERS	TRANSPORT PRIORITY

Volatility

Infrastructure

Delivery

User QoS

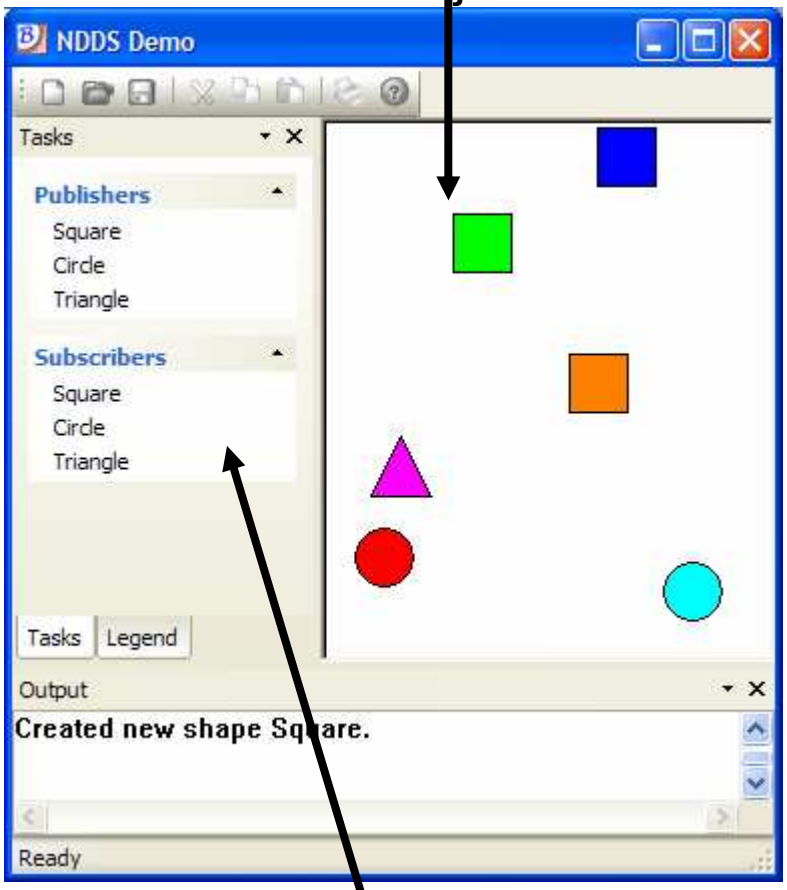
Presentation

Redundancy

Transport

Concept Demo

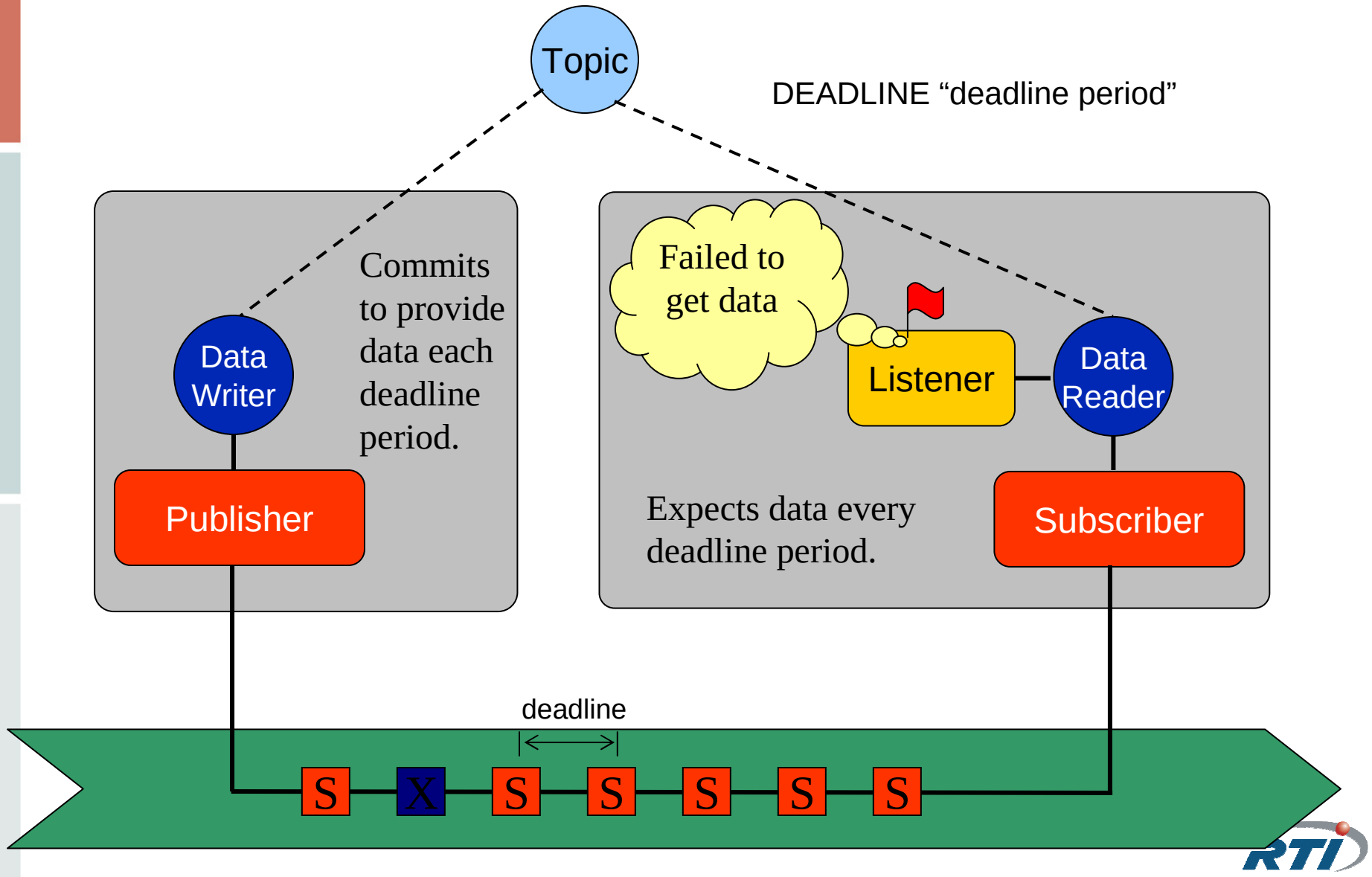
Display Area:
Shows state of objects



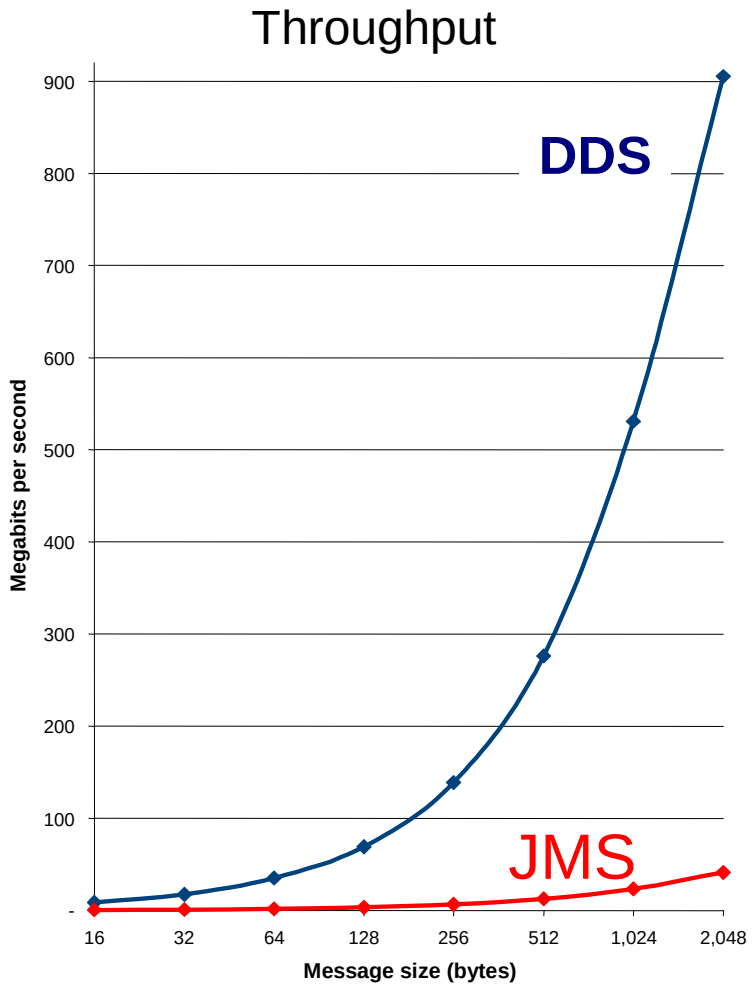
Control Area:
Allows selection of objects and QoS

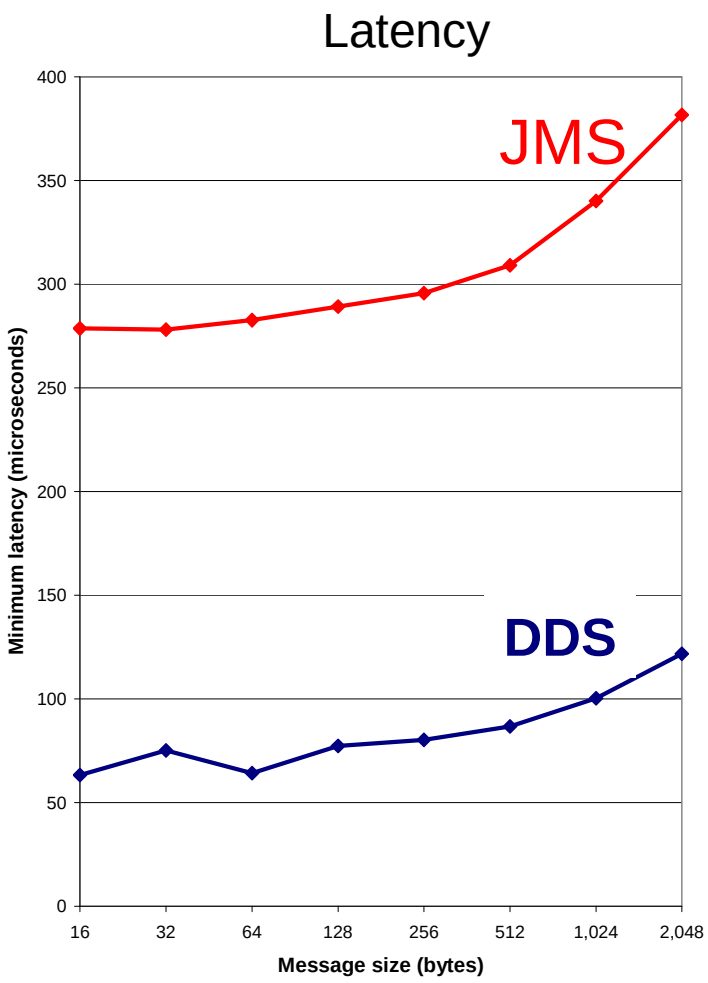
- Topics
  - Square, Circle, Triangle
  - Attributes
- Data types (schemas)
  - Shape (color, x, y, size)
    - Color is instance Key
  - Attributes
    - Shape & color used for key
- QoS
  - Deadline, Liveliness
  - Reliability, Durability
  - History, Partition
  - Ownership

QoS: Deadline



DDS is Optimized for Time- and Bandwidth-Critical Applications

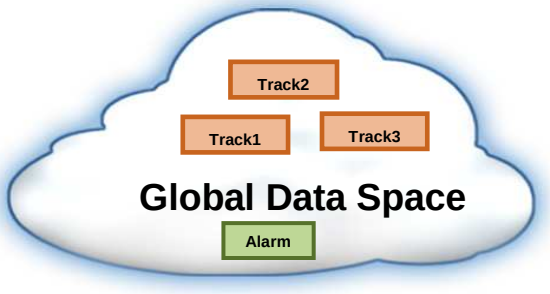




Benchmark performed over Gigabit Ethernet between 2.0 GHz Opteron PCs running Linux. RTI can saturate the network with packet sizes greater than 2,048 bytes.

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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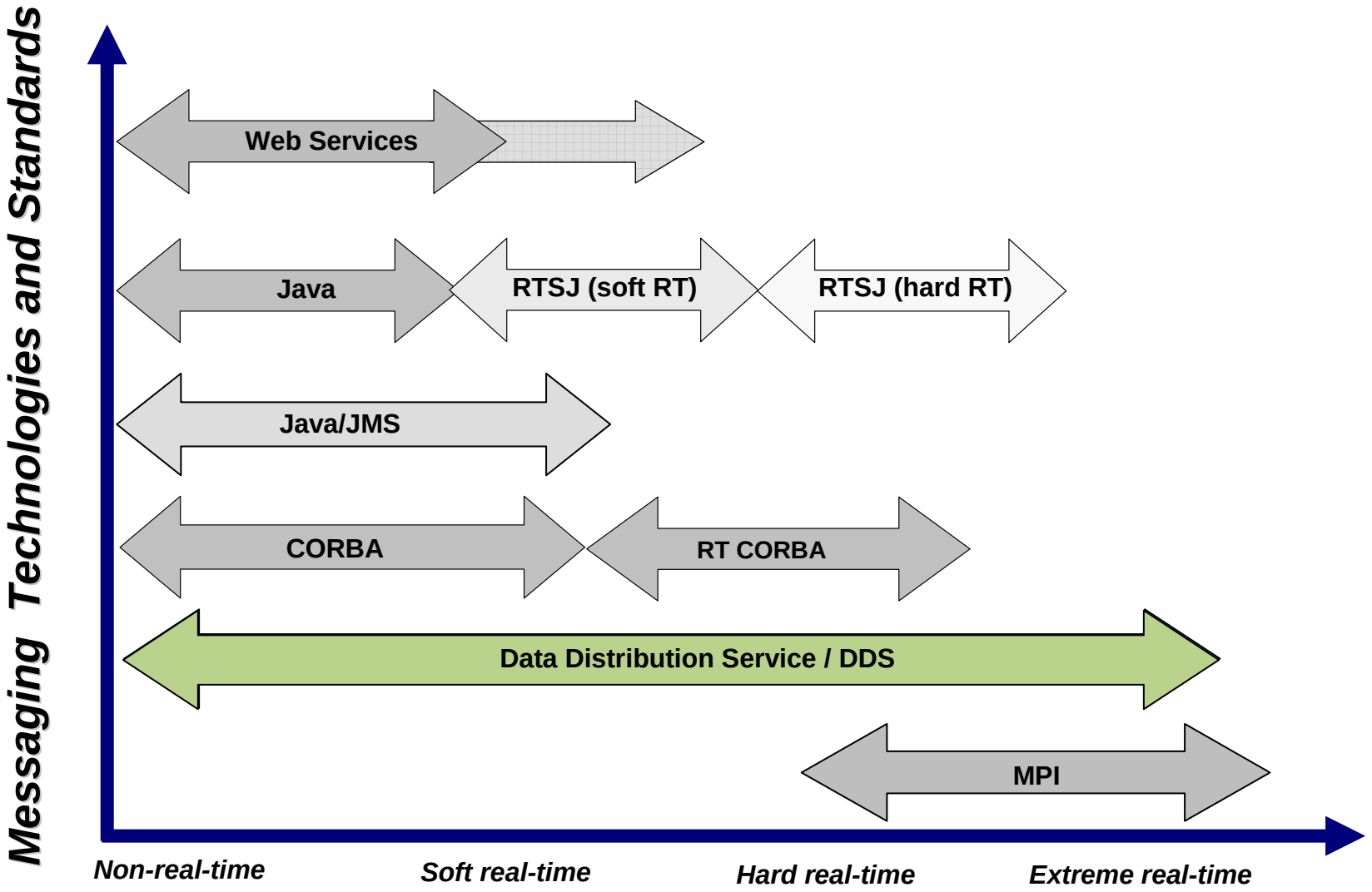
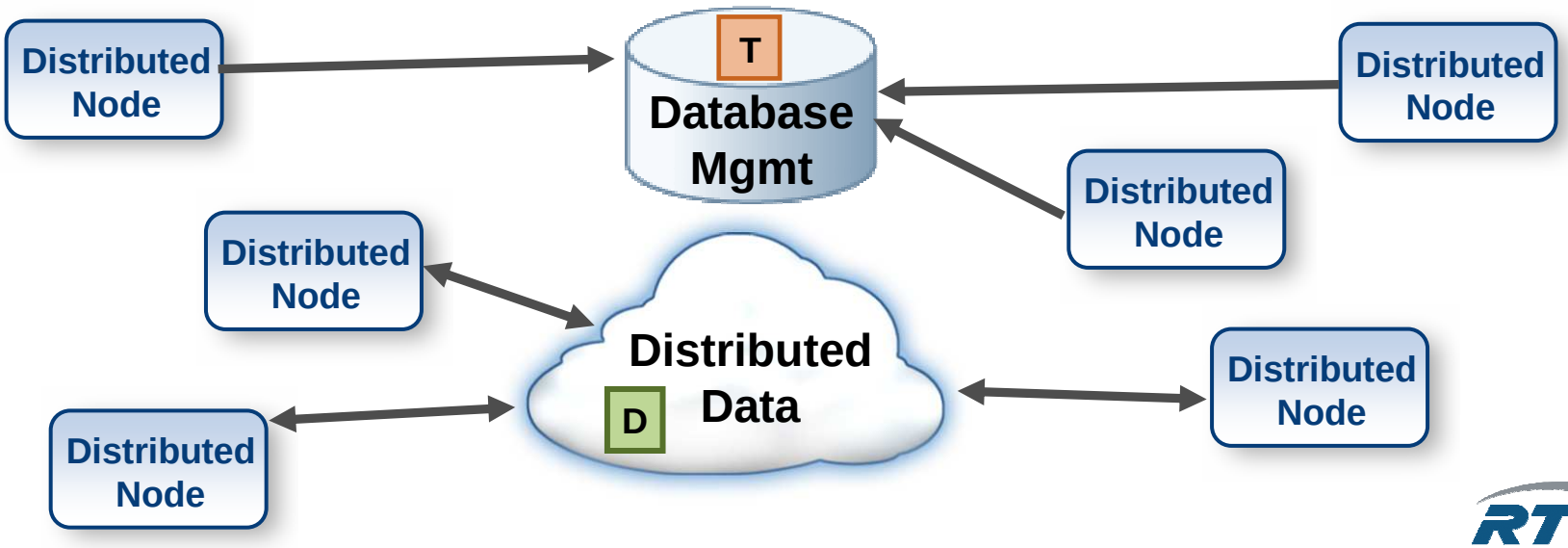
Data-Distribution and Real-Time



Adapted from NSWC-DD OA Documentation

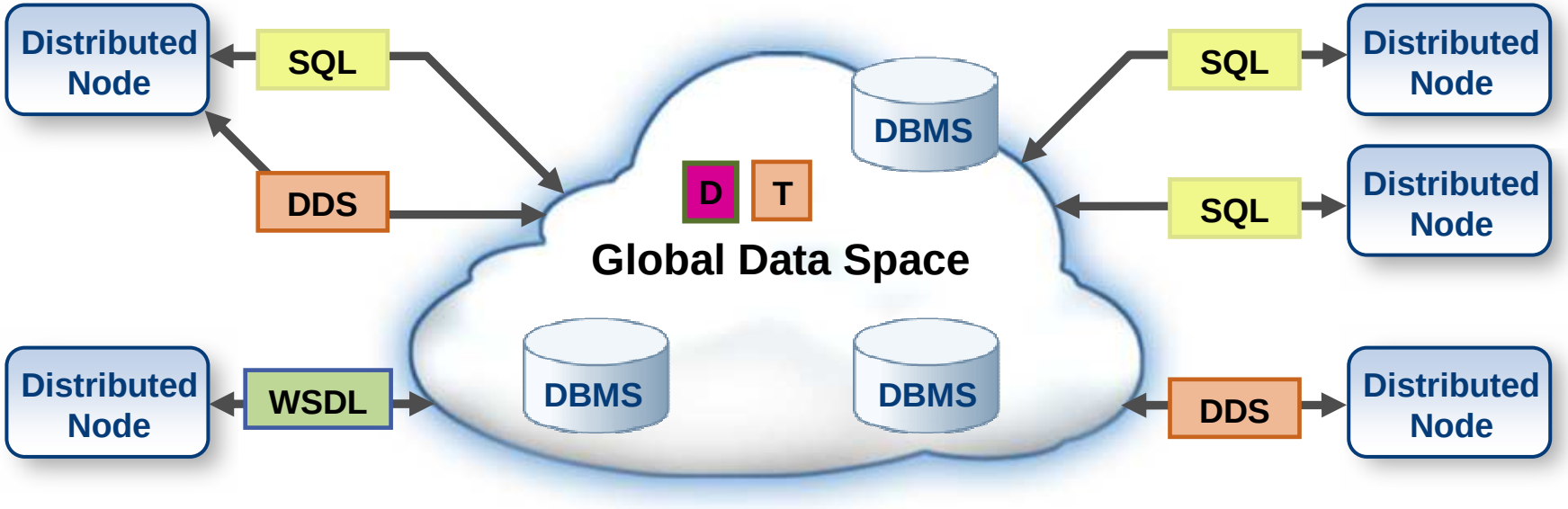
Until now: Different Data Solutions

- Database Management Systems
  - Good for: Complex queries, Storage, Data-Mining, Persistence
  - But... No RT performance, centralized, non-distributed
- Data Distribution Services
  - Good for: High performance, dynamic architectures, real-time
  - But... what do you do with the data once you get it there?



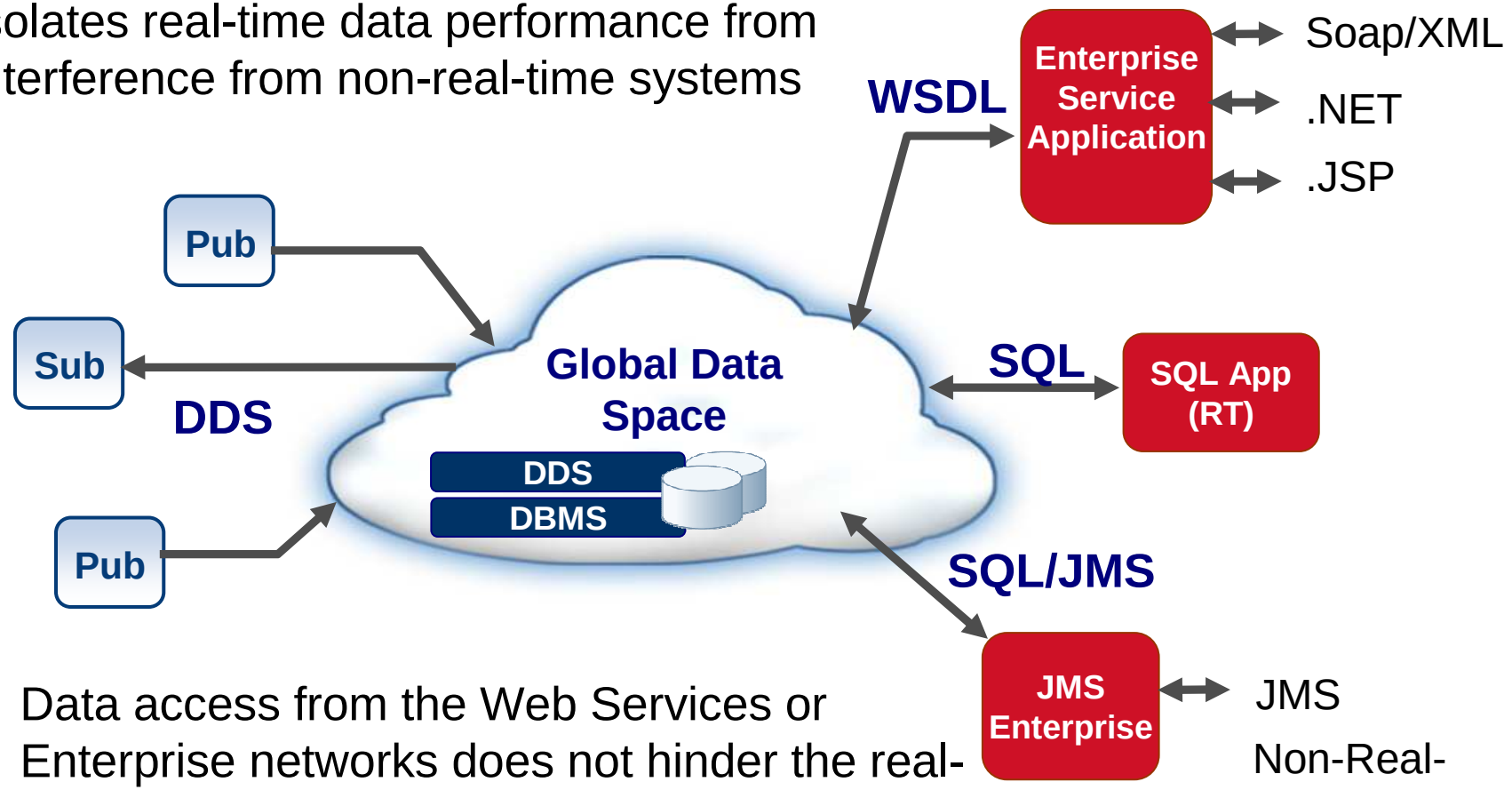
A new model is possible:
Standards-Based Global Data Space

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



Global Data & End-to-End Integration

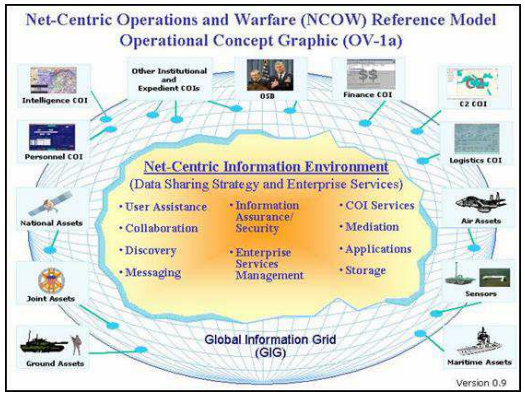
Isolates real-time data performance from interference from non-real-time systems



- 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



Surveillance Systems

Simulation Systems

Financial Systems

RTI

Thank you

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