



Deploying DDS on a WAN and the GIG:

The DDS Routing Service

Gerardo Pardo-Castellote, Ph.D.

**The Real-Time
Middleware Experts**

Fernando Crespo Sanchez
Principal Engineer,
Real-Time Innovations
fernando.crespo@rti.com

Alejandro Campos Ruiz
Software Engineer,
Real-Time Innovations
alejandro.campos@rti.com

Gerardo Pardo-Castellote, Ph.D.
Co-chair OMG DDS SIG
CTO, Real-Time Innovations
gerardo.pardo@rti.com

Outline

- Motivation
- The DDS Routing Service
- Demo
- Future Directions

Motivation

- Many systems rely on DDS to distribute the information
- Within a LAN DDS can directly address every participant on the network:
 - Can communicate peer-to-peer for performance
 - Can leverage IP multicast for scalability.
- However, more and more these systems are being integrated in WAN
 - This is a requirement for the GIG
 - Would be desirable to make DDS real-time publish/subscribe data-distribution benefits available in the GIG
- Can DDS be used for the GIG core infrastructure?

- Massive scalability
- Bridging between Global Data Spaces
- Firewall & NAT Traversal
- Lack of multicast support on the WAN

- **Massive scalability:**

- Systems with over 1000 applications/nodes accessing the DDS Global Data Space have already been demonstrated.
- However these systems could exceed 10000 or 100000 nodes which most likely exceed the capabilities of exiting DDS implementations.

- Bridging between Global Data Spaces
- Firewall & NAT Traversal
- Lack of multicast support on the WAN

DDS as core GIG Infrastructure Issues



- Massive scalability:
- **Bridging between Global Data Spaces:**
 - Subsystems may want to maintain certain information contained within.
 - Different services or coalition members may maintain their own private Topics and Global Data Spaces.
 - ... All this points to the need for deploying multiple Global Data Spaces and have means for certain controlled information to flow between them.
- Firewall & NAT Traversal.
- Lack of multicast support on the WAN.

DDS as core GIG Infrastructure: Issues



- Massive scalability
- Bridging between Global Data Spaces
- **Firewall & NAT Traversal:**
 - Subsystems, Services, Coalitions, each may be responsible for deploying their own part of the network infrastructure.
 - Networks may be partitioned and protected by Firewalls and NATs.
 - ...Yet the need to share some information remains necessitating a mechanism that allows controlled data to flow between these network segments.
- Lack of multicast support on the WAN.

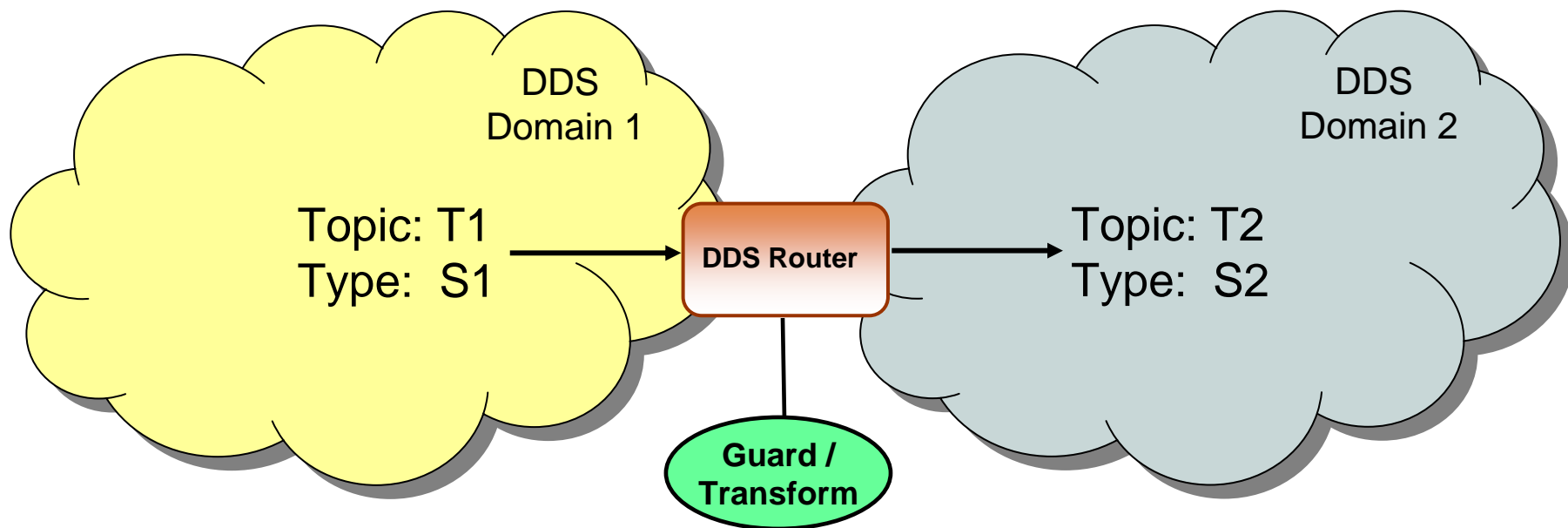
DDS as core GIG Infrastructure: Issues



- Massive scalability
- Bridging between Global Data Spaces
- Firewall & NAT Traversal
- **Lack of multicast support on the WAN**
 - Multicast is relied upon by DDS for discovery and scalability
 - WAN routers typically disable multicast

Solution: The DDS Routing Service

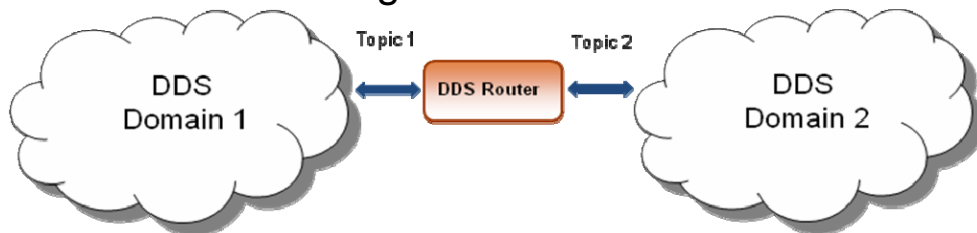
- Runs as a service (daemon)
- Straddles two DDS Domains
- Forwards data from one domain to the other
 - Can be configured to forward only certain Topics
 - Can Change the DDS Topic name and transform the data
 - Can Use different Transports and QoS on each domain
 - Can persist data as well (operate as persistence service)
 - Can operate full duplex



Solution: The DDS Routing Service

- Application or Library used to:

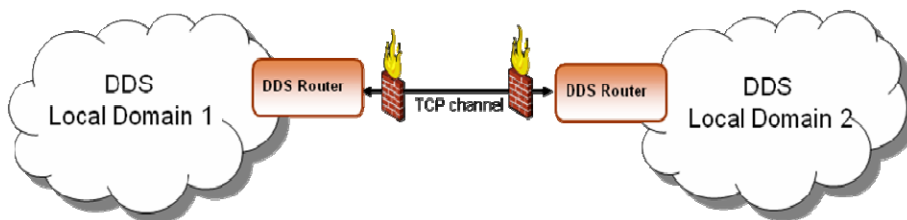
- Secure and Bridge data across DDS domains and topics



Topic 1 and Topic2 can have:

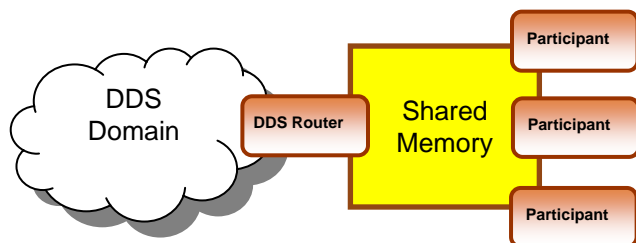
- Different topic names
- Different registered type names
- Different types schemas
- Forwarding Topics can be allowed/denied
- Programmable Guards can modify/filter/guard data as it goes

- Enable Secure WAN traversal in combination with TCP transport



TCP transport can be used in asymmetric mode where connection are always initiated from one side of the firewall
 Connection can be secured using PKI and TLS/SSL

- Provide Scalability

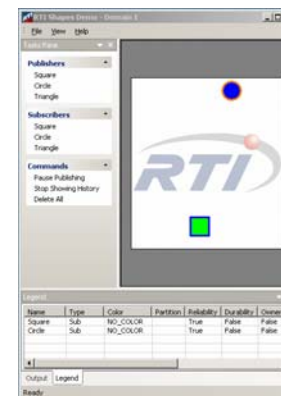
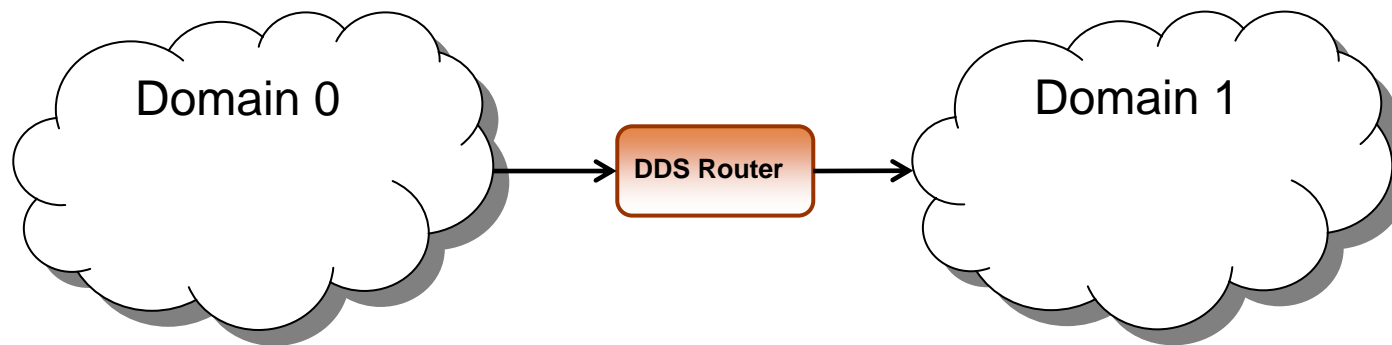


Router can be used as a daemon server in each machine:
 -Reduce network traffic
 -Zero copy over shared memory

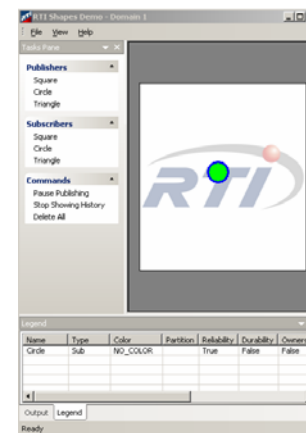
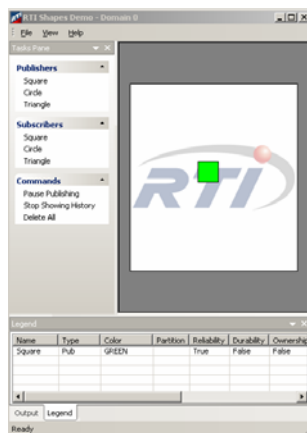
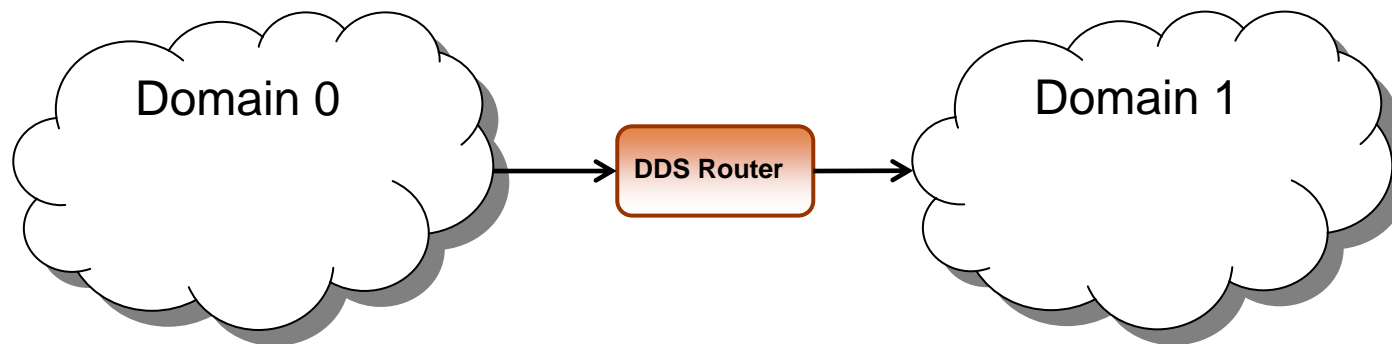
DDS Routing Service Use Cases

- Domain Bridging
- Topic Bridging
- Topic Bridging With Data Transformation
- Topic Bridging With Custom Data Transformation
- Domain Bridging Over WAN

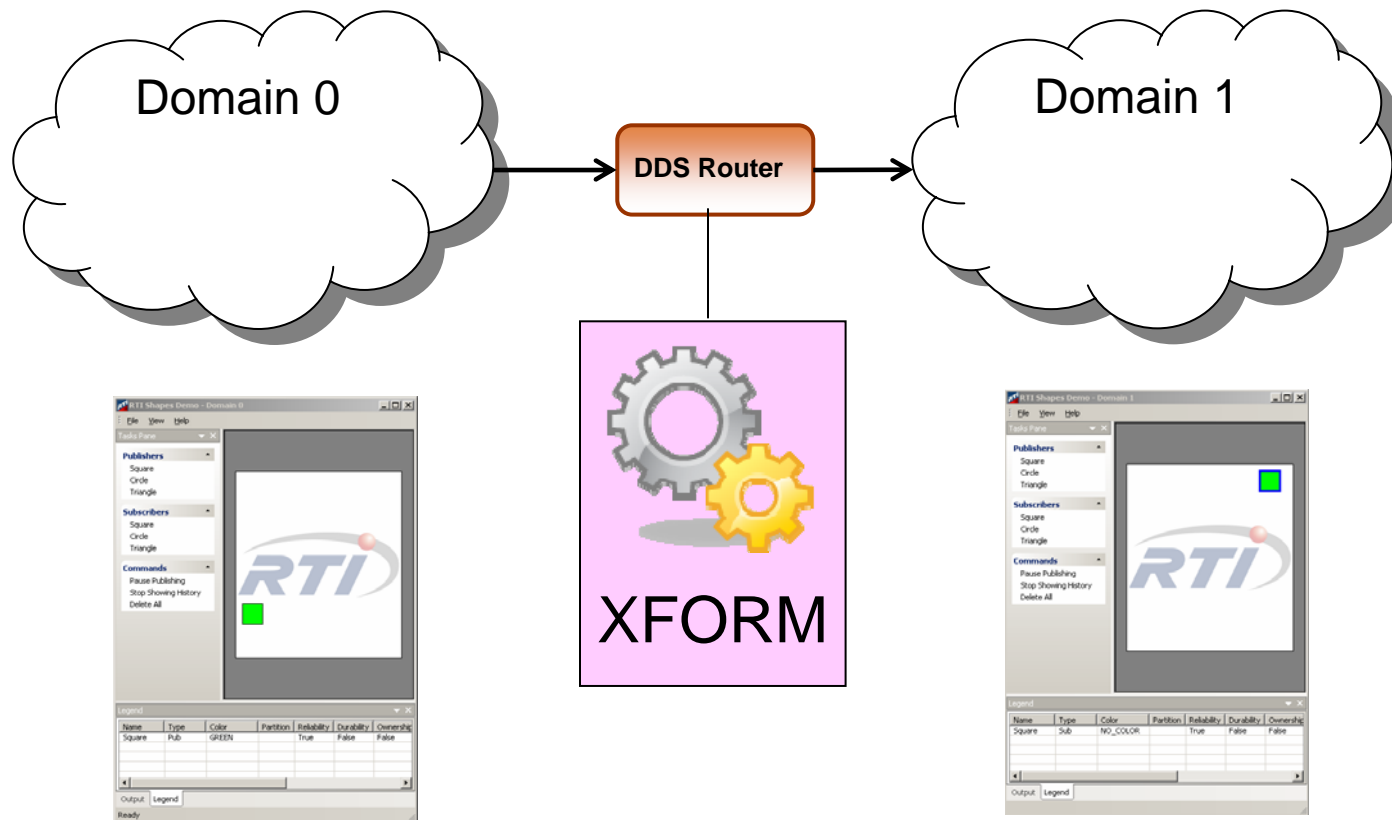
Domain Bridging: Demo



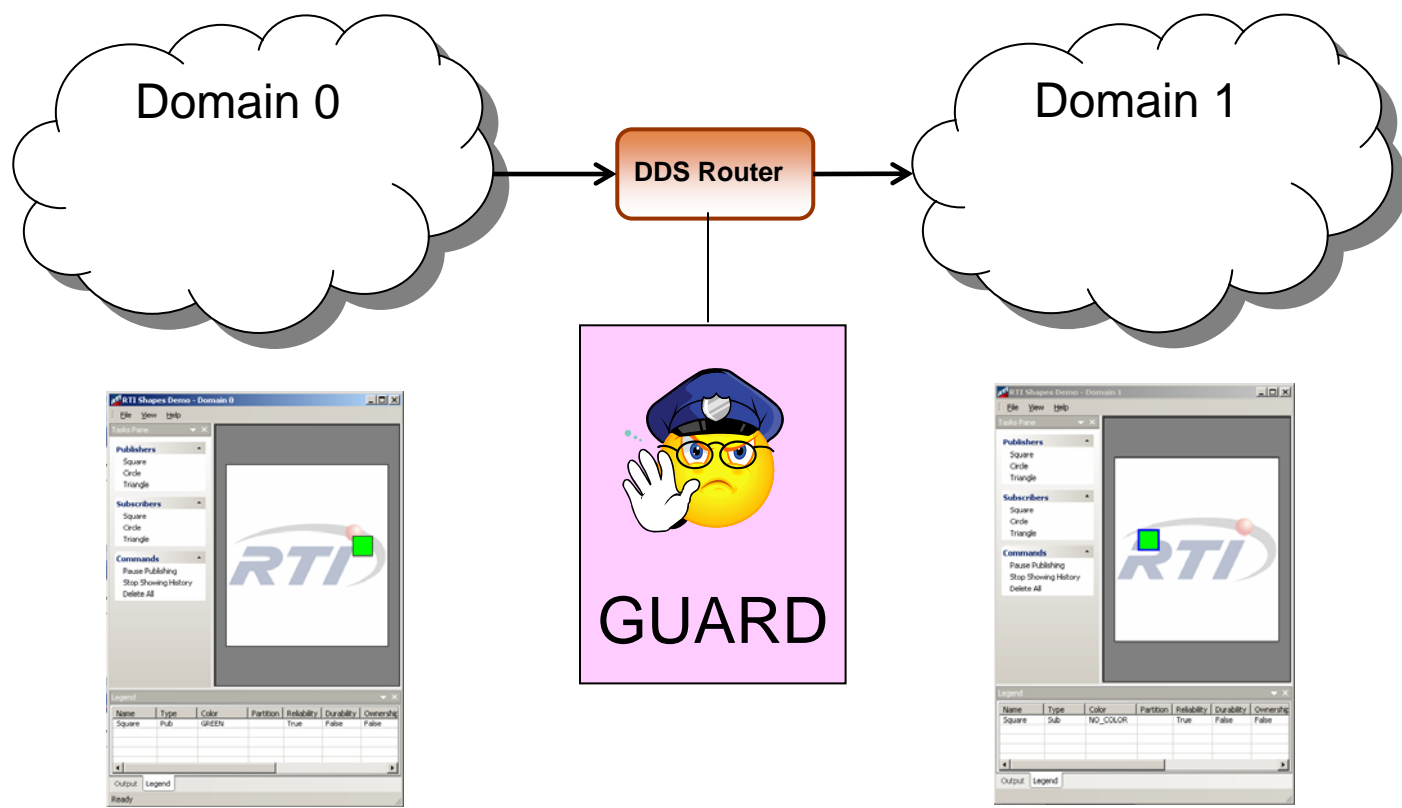
Topic Bridging: Demo



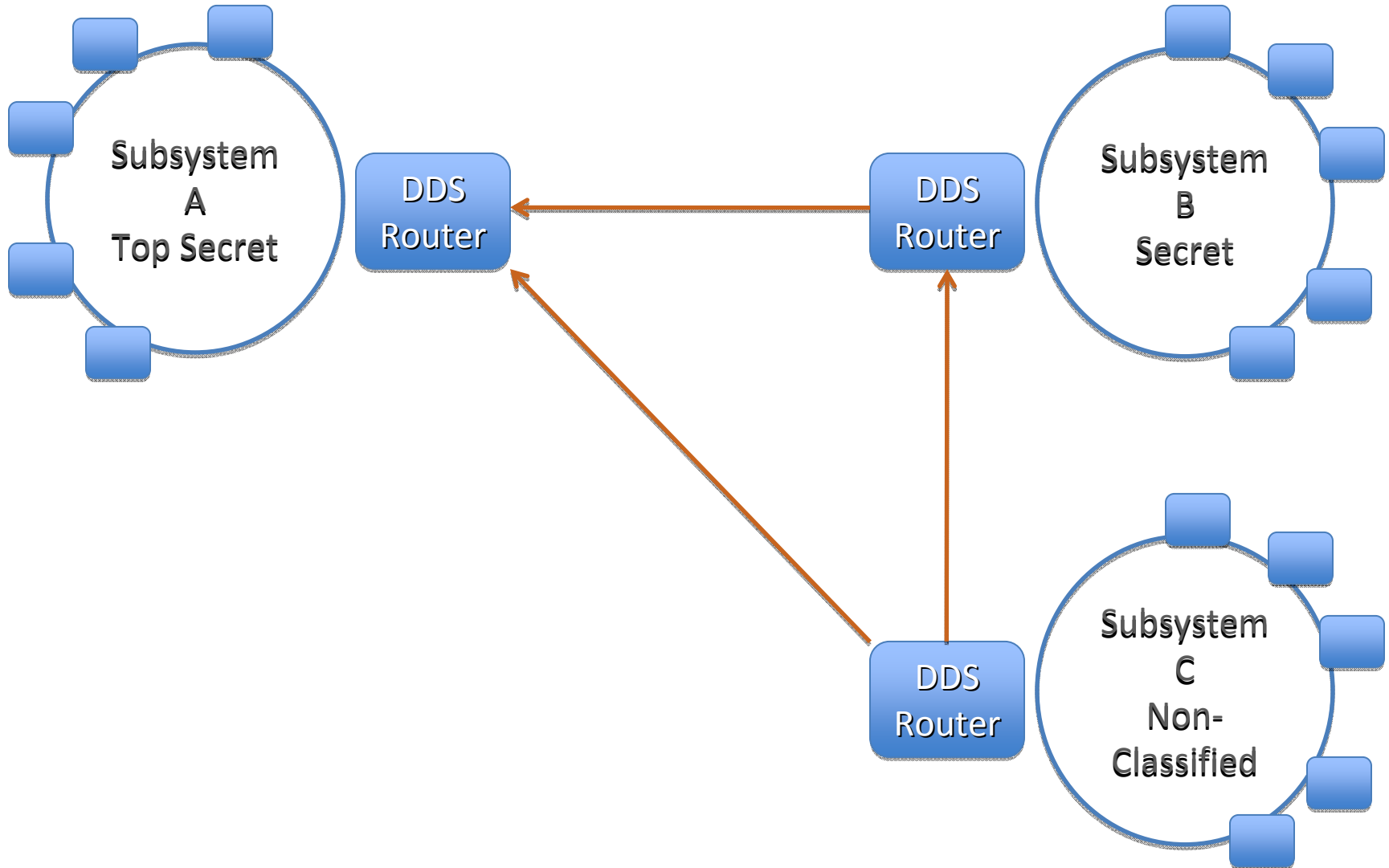
Topic Bridging With Transformation



Topic Bridging With Custom Transformation or Guard: Demo



DDS Routing Svc: Multi-Level Security Gateway

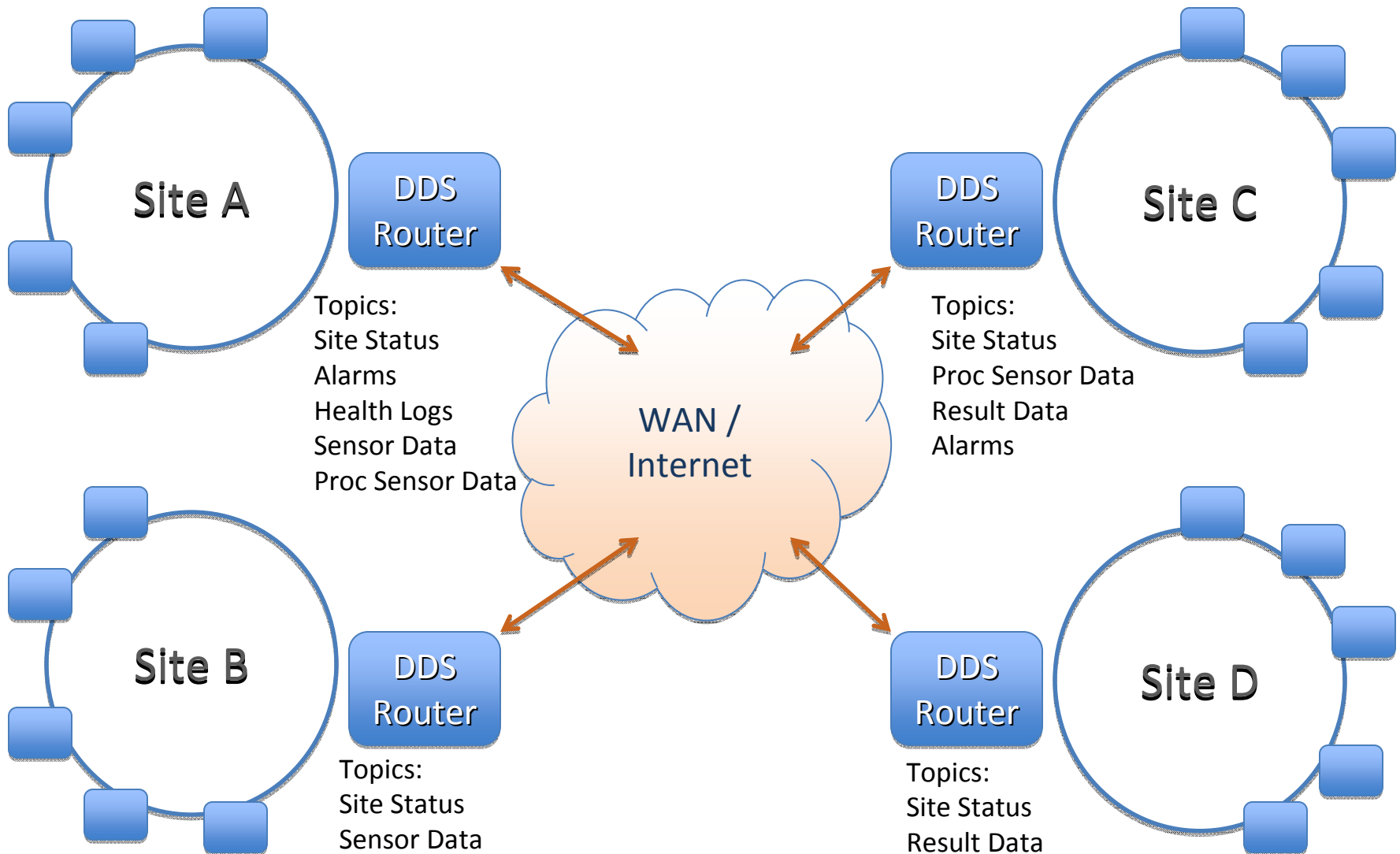


DDS Routing Svc: Multi-Level Security Gateway



- Implement One-way routes that only let lower classified data in
- Prevent higher classified data from leaving high-class network
- Enables all non-classified data to be seen on all networks, and prevents non-classified network from seeing any classified data.

DDS Routing Svc: Multi-site Distributed Application

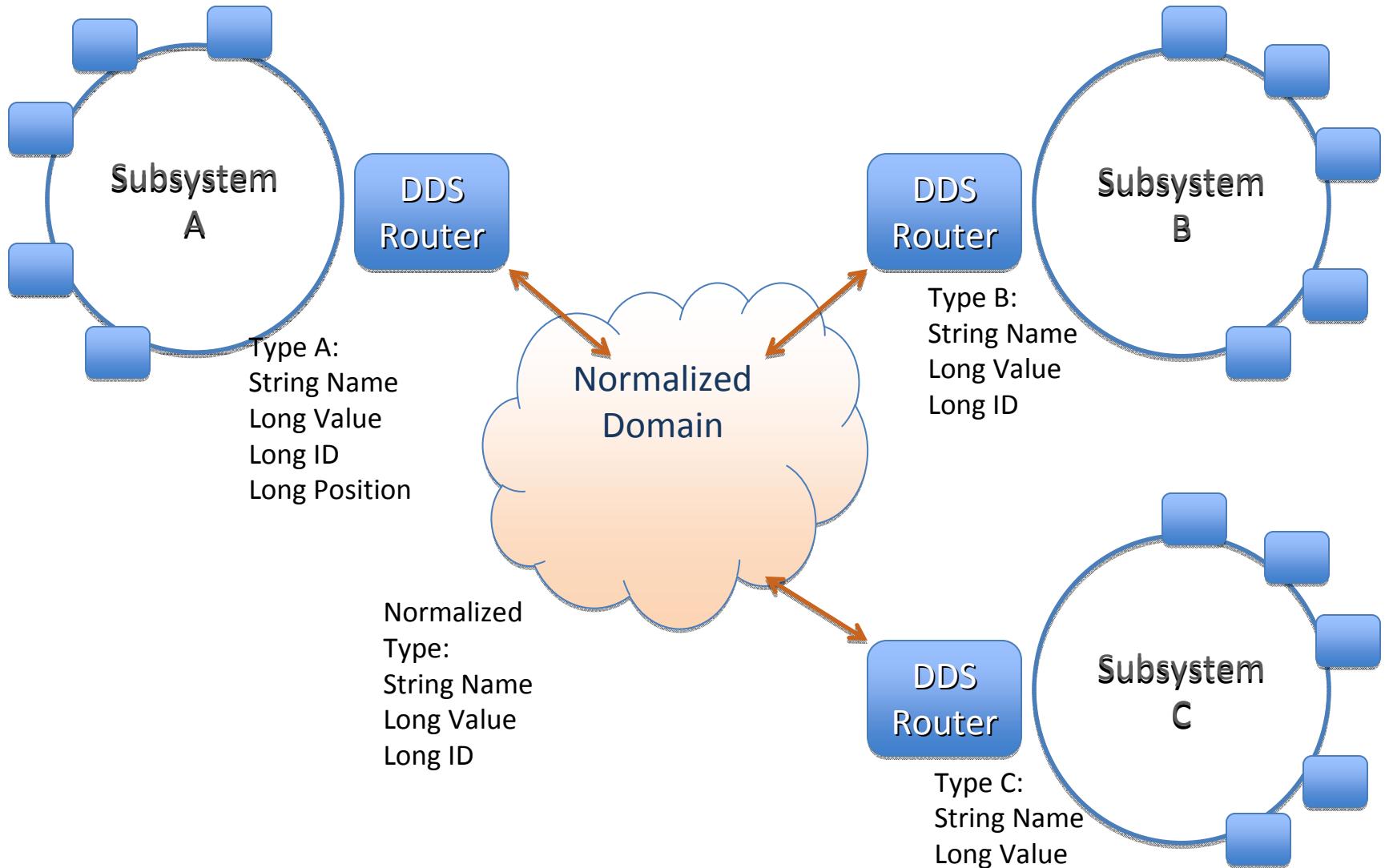


DDS Routing Svc: Multi-site Distributed Application



- Each Site can specify what topics it wants to send and receive
- Each Site can determine the level of filtering to occur before sending data out to other sites
- Integrates with a TCP Transport and can facilitate Firewall port setup

DDS Routing Svc: Data Fusion / Normalization

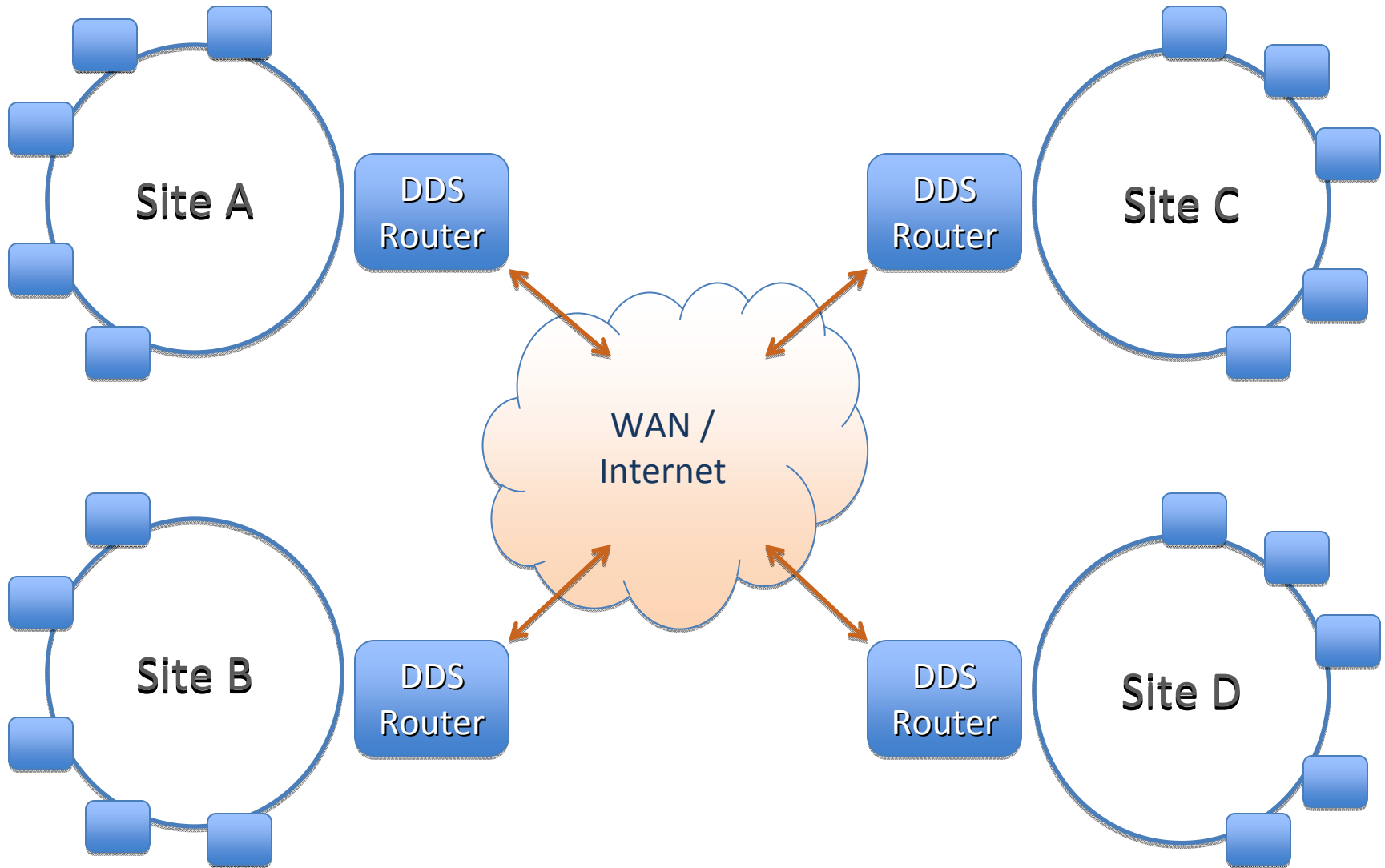


DDS Routing Svc: Data Fusion / Normalization



- DDS Router can transform / normalize any data type to any data type
- DDS Router can remove extraneous data from subsystem types to normalized types
- DDS Router can add constants for data values where no field is available from subsystem type.

DDS Routing Svc: Multi-site Development Integration



DDS Routing Svc: Multi-site Development Integration



- Perform testing and integration tasks without need to be physically co-located
- Run testing patterns across worst-case latency networks (WAN / Internet)
- Shorten Integration time by saving on Travel time and cost.

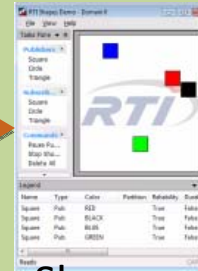
DDS Routing Service: Data Versioning Support



Shapes

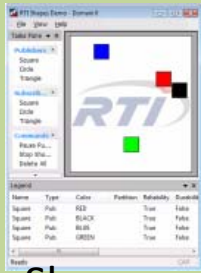
DDS Router

Forward Topic Versioning



Shapes +

Route previous version topics to new updated version applications



Shapes +

DDS Router

Backward Topic Versioning



Shapes

Route new updated version topics to previous version applications

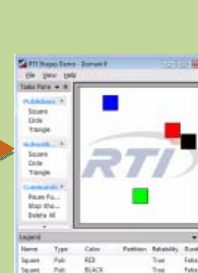


Shapes

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DDS Router

Forward Topic Versioning w/ Augmentation



Shapes +

Merge previous version topic with additional topic to provide new updated topic interface for new applications

- Transform previous topic definitions to new topic definitions
- Transform new topic definitions to previous baseline architectures
- Augment previous topic definitions with new field data sources to provide interface with new applications.

DDS Routing Service: Legacy Data Bridging

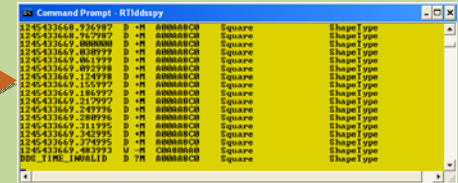


Serial Digital Compass

RS232

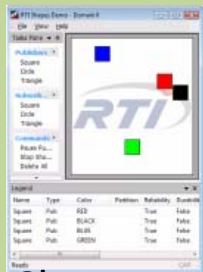


DDS



RTI DDS Spy output

Serial Data to DDS Transformation



Shapes

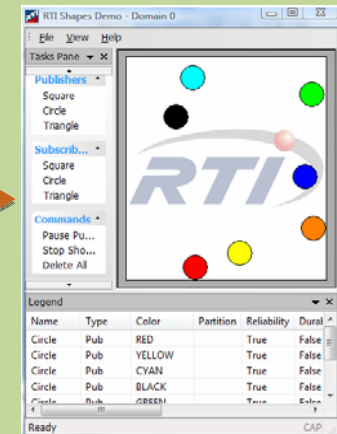


Serial Digital Compass

RS232



DDS

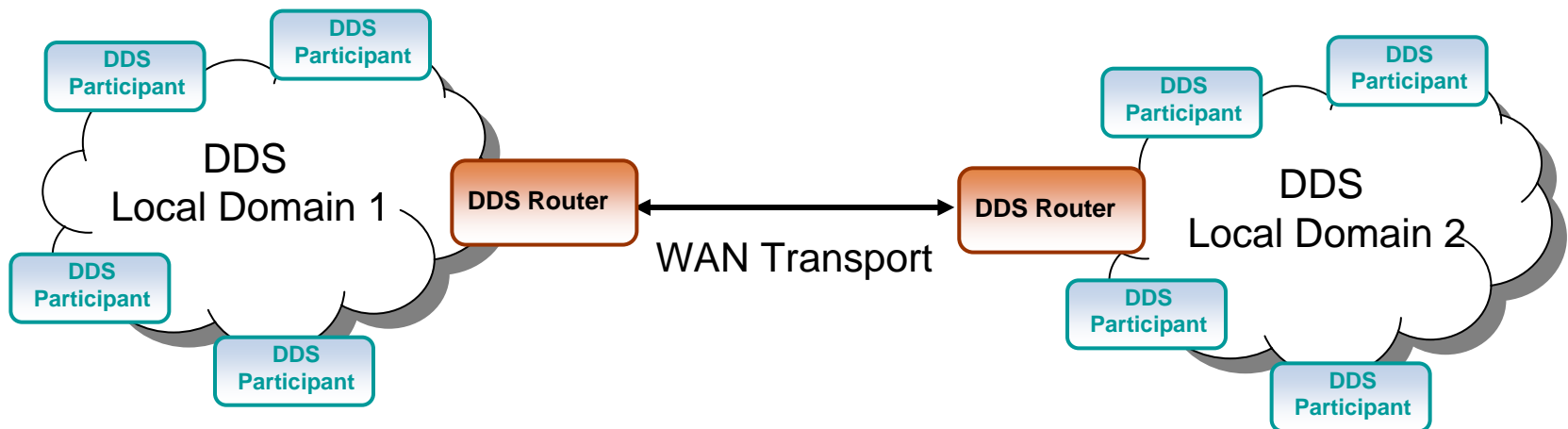


Shapes +

Combined previous data version augmented with converted RS232 serial data as extra field information

DDS Routing Service for WAN

- Common deployment will be for WAN bridging
 - Local Domains can be connected via WAN transport
 - Router acts as a gateway providing “static” addresses and ports
 - WAN Transport can use TCP and TLS (SSL) security:
 - Authentication
 - Encryption
 - Tamper prevention



Conclusions

- DDS Routing Service can be implemented just relying on
 - DDS Spec.
 - DDS Interoperability Protocol
 - (*)DDS Extensible Topics (for transformations)
 - (**)WAN Transport (For WAN/Firewall traversal)
- This service can satisfy many of the DDS deployment scenarios in the GIG
 - Scalability
 - Isolation
 - Security
 - Data version support
 - Legacy Integration