

Data Distribution Service



GW Tech Talks

Outline



- What is DDS
- DDS Architecture
- Features and Capabilities of DDS
- Use Cases and Applications of DDS
- Performance
- Conclusion

What is DDS?



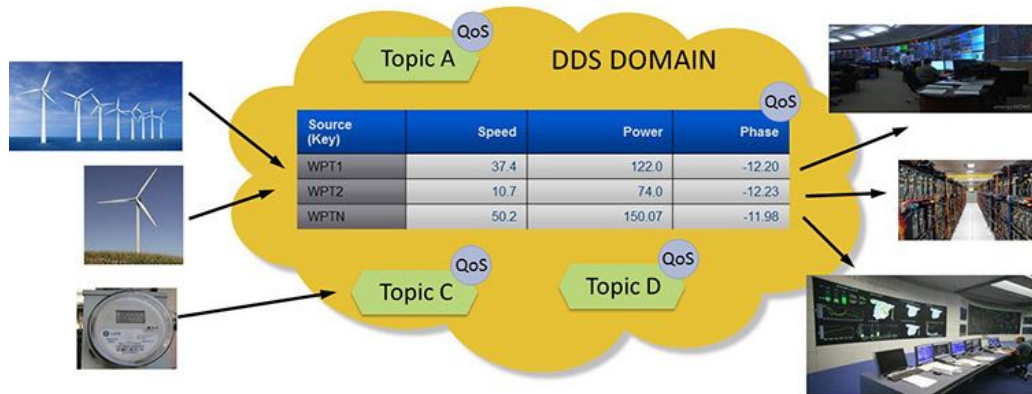
DDS (**Data Distribution Service**) is a middleware protocol and API standard that enables efficient and scalable data communication in distributed systems by abstracting the complexity of network communication.

- Supports **real-time, reliable, and interoperable data exchange**
- Developed by the Object Management Group(OMG)
- Proposed as a data connectivity standard for real-time Industrial Internet of Things (IoT)

Key Concepts of DDS

Data-Centricity

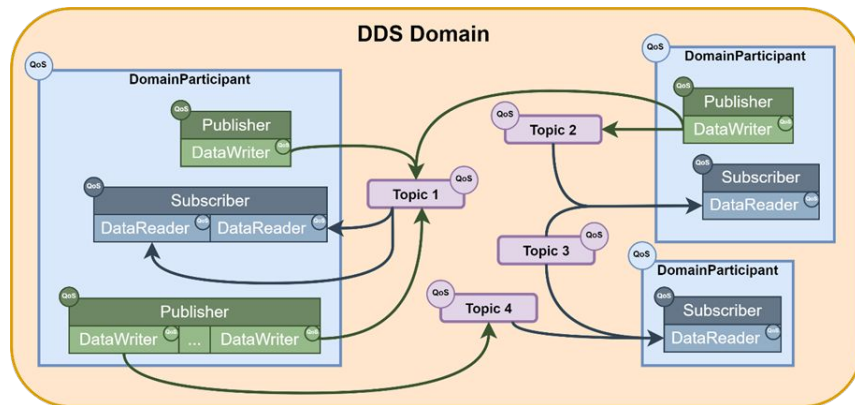
- Data is the primary concern and all systems are designed around it.
- DDS is designed around the concept of data-centricity, and the data is the primary focus.
- Data is described using a data model (e.g., using IDL or XML) and shared among applications transparently.



Publish-Subscribe Pattern

A messaging pattern used in distributed systems.

- Publishers are not aware of subscribers and vice versa.
- Publishers publish data to specific topics, and subscribers express interest in specific topics to receive data.



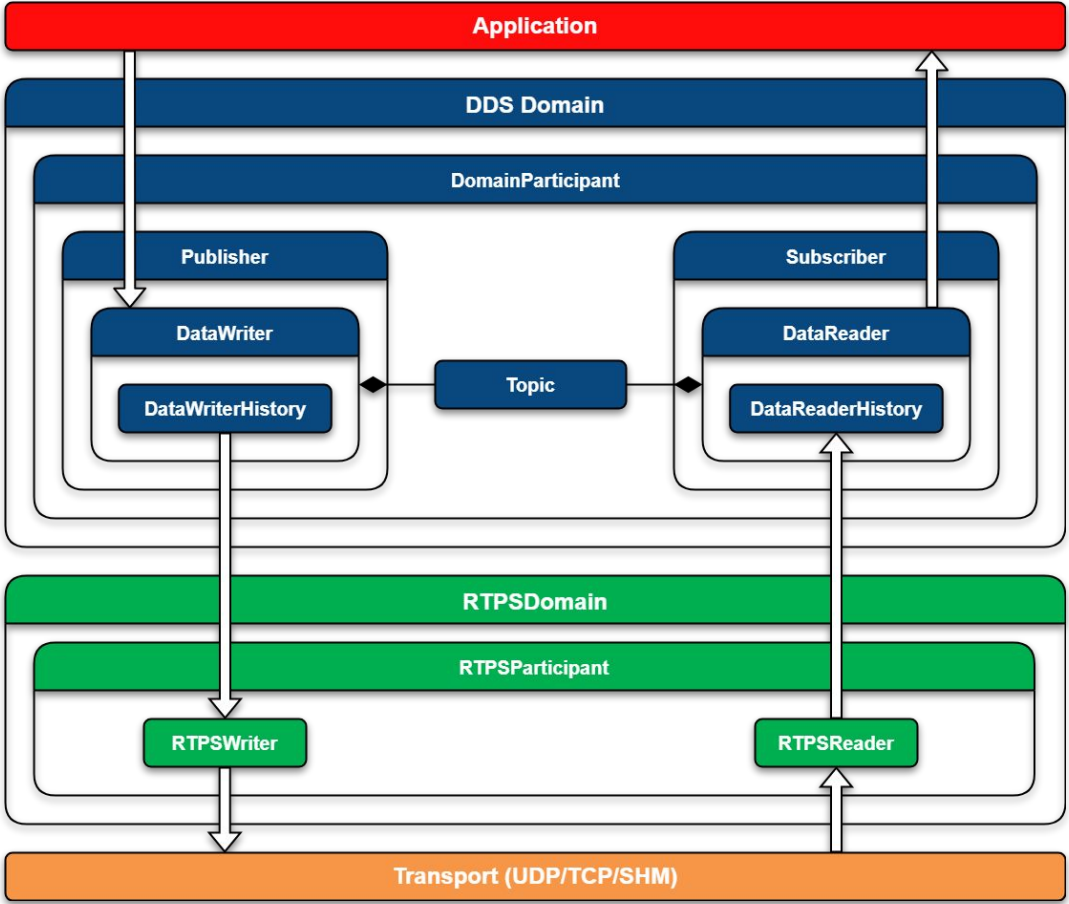
Quality of Service (QoS)



QoS refers to a mechanisms used to ensure that data traffic transmitted over a network maintains a certain level of quality. QoS is critical for applications requiring high quality and low latency communication.

- The main objectives of QoS are bandwidth management, latency reduction, jitter reduction, packet loss management.
- QoS archives these objectives through traffic shaping, prioritization, resource reservation, policing.

DDS Architecture



Features and Capabilities of DDS



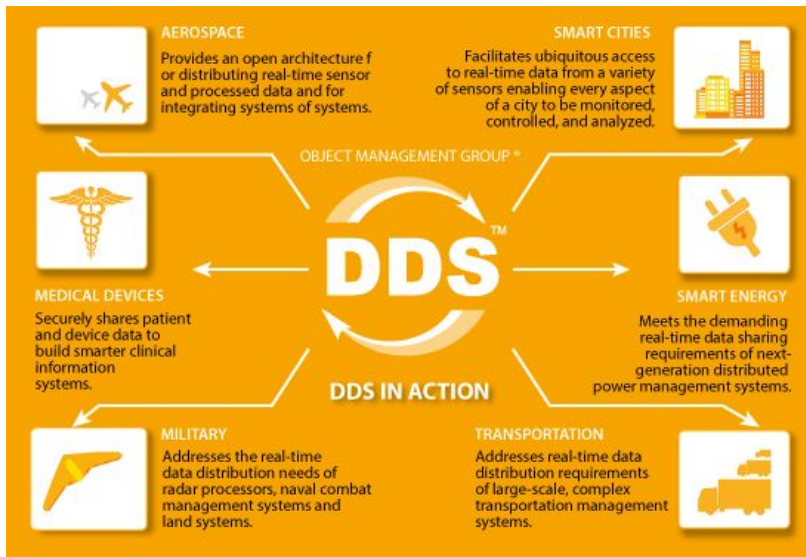
- Type Syntax and Language Mappings (IDL)
- DDSI-RTPS (DDS Interoperability Real-Time Publish-Subscribe)
- DDS provides fine-grained control over communication parameters through QoS policies.
 - QoS configuration can be done at each entity level individually.
- Dynamic Discovery and Configuration
- Security
 - Authentication
 - Access Control
 - Cryptographic
- Support for Large-scale and Complex Systems

Use Cases and Applications of DDS



Used for Real Time system that require reliable and timely data distribution.

- Defense and Aerospace Applications
- Industrial Automation and Control Systems
- Internet of Things (IoT)
- Healthcare and Medical Systems



Use Cases and Applications of DDS

NASA Launch Control System

NASA's Launch Control System at KSC is one of the world's largest SCADA systems, with over 400,000 control points. The DDS based system was first used during the successful first launch of the Orion spacecraft.

DDS intelligently distributes updates from thousands of sensors. It also stores all data for later analysis and allows all information to be viewed (after downsampling) on HMI stations in the control room.



THALES

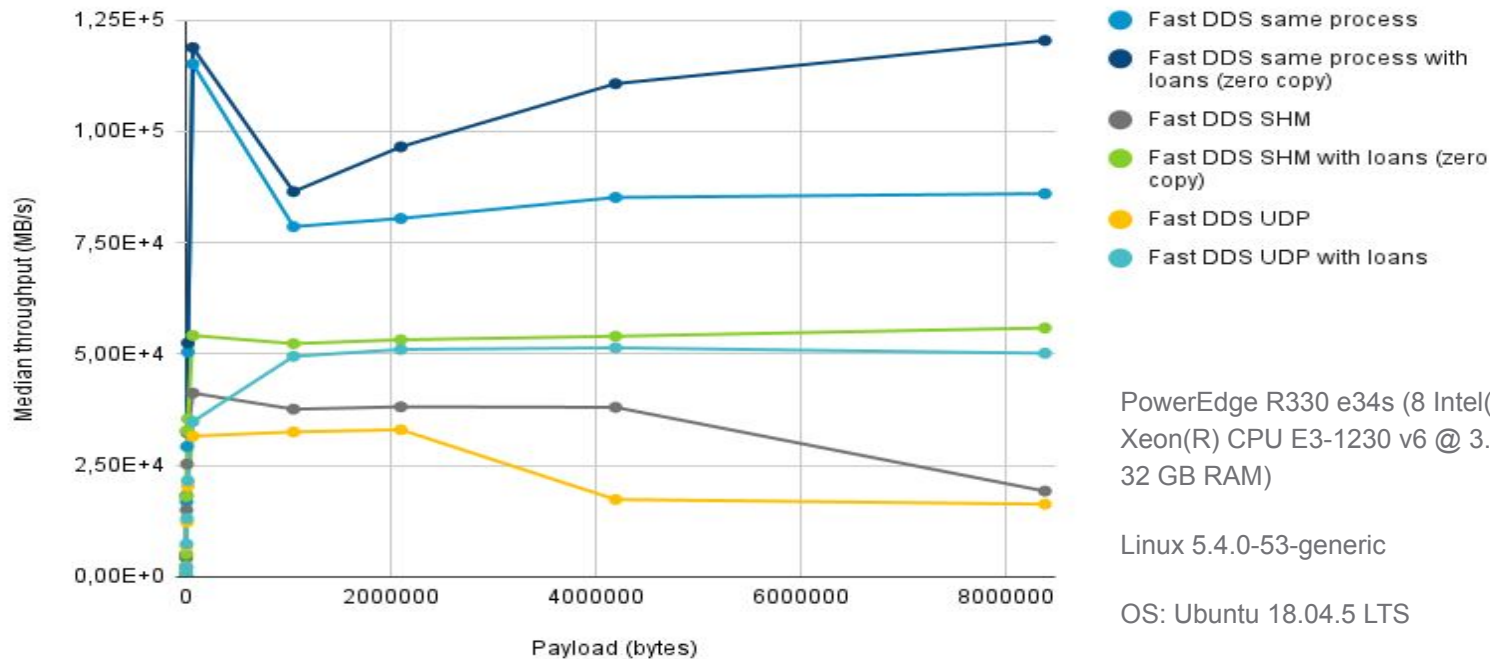
Naval Combat Management Systems

DDS is underpinning Thales Combat Management systems and naval applications including its flagship TACTICOS Net Centric Solution

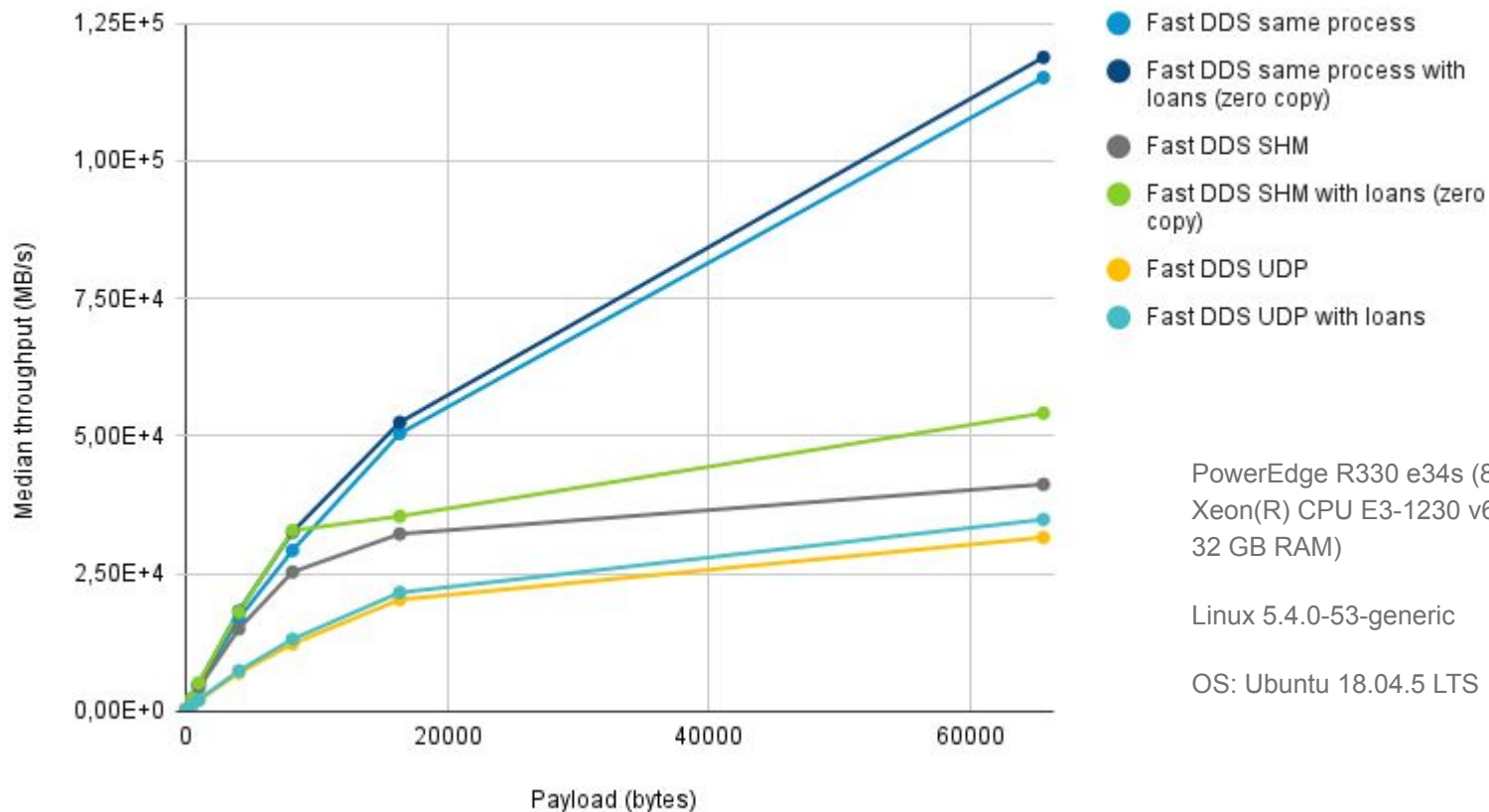


Fast DDS Performance

Fast DDS v2.8.0 Throughput

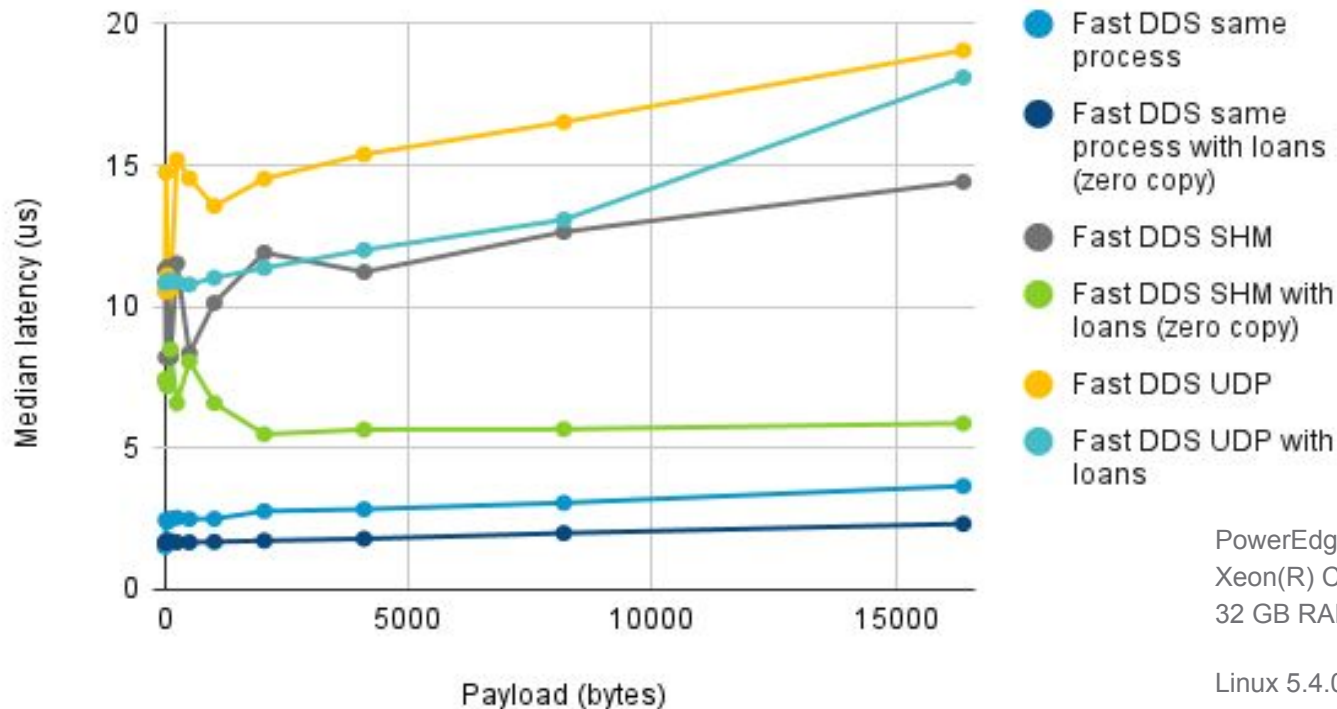


Fast DDS v2.8.0 Throughput up to 65 kB



DDS Latency

Fast DDS v2.8.0 Latency

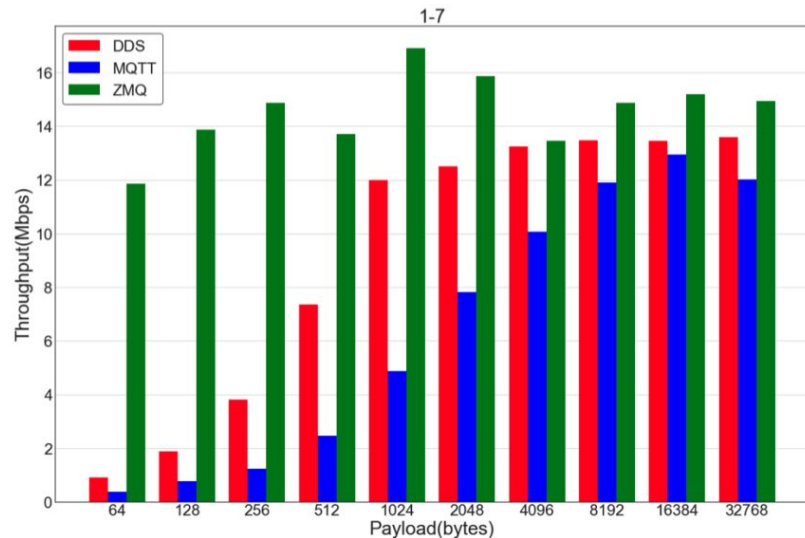
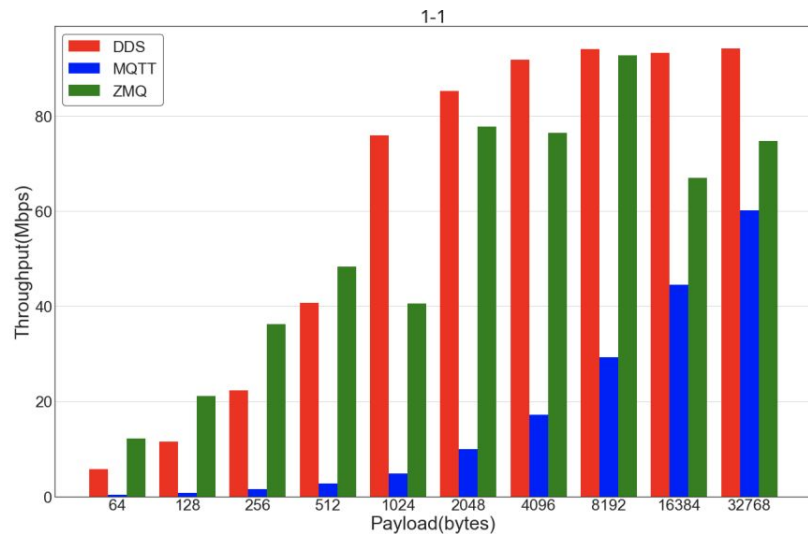


PowerEdge R330 e34s (8 Intel(R)
Xeon(R) CPU E3-1230 v6 @ 3.50GHz,
32 GB RAM)

Linux 5.4.0-53-generic

OS: Ubuntu 18.04.5 LTS

Throughput Comparison



**High-frequency Data-flow Tests: 1pub-1sub & 1pub-7sub, PubRate: unlimited. Figure shows mean throughput over five runs. QoS settings: Unicast, Reliable, No Batching*

Latency Comparison



Target	Latency (us)
Kafka	73
MQTT	27
Cyclone DDS	8
Zenoh-brokered	21
Zenoh-p2p	10
Zenoh-pico	5
ping	1

Single-machine

Target	Latency (us)
Kafka	84
MQTT	45
Cyclone DDS	38
Zenoh-brokered	41
Zenoh-p2p	16
Zenoh-pico	13
ping	7

Multiple-Machine

WHY



- OMG Standard (Widely use)
- Open Source
- Interoperability
- Real-time support
- Dynamic Discovery
- Security (Auth - Authorize) - ***WAN
- Cost effective

Conclusion



DDS is a powerful middleware protocol for distributed systems.

The key concepts of DDS

- publish-subscribe communication,
- data-centricity, and
- QoS policies.

The benefits of DDS

- reliability,
- real-time communication,
- scalability, and
- flexibility.

Ongoing research and development efforts to enhance DDS in terms of performance, security, and interoperability

References

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