OpenSplice DDS

Delivering Performance, Openness, and Freedom

The Open Source Messaging Accelerating Wall Street

Angelo Corsaro, Ph.D.
Product Strategy & Marketing Manager
OMG RTESS and DDS SIG Co-Chair
angelo.corsaro@prismtech.com

PRISMTECH
Powering Netcentricity

Agenda

- **The Big News**
- What is OpenSplice DDS
- DDS vs AMQP
- Why OpenSplice DDS?
- Concluding Remarks

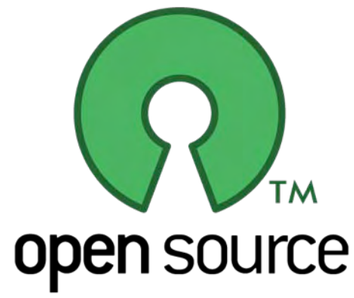
OpenSplice | DDS

Delivering Performance, Openness, and Freedom

April 20th, 2009

OpenSplice | DDS Goes Live!

:: http://www.opensplice.org



Agenda

- The Big News
- What is OpenSplice DDS
- DDS vs AMQP
- Why OpenSplice DDS?
- Concluding Remarks

OpenSplice | DDS

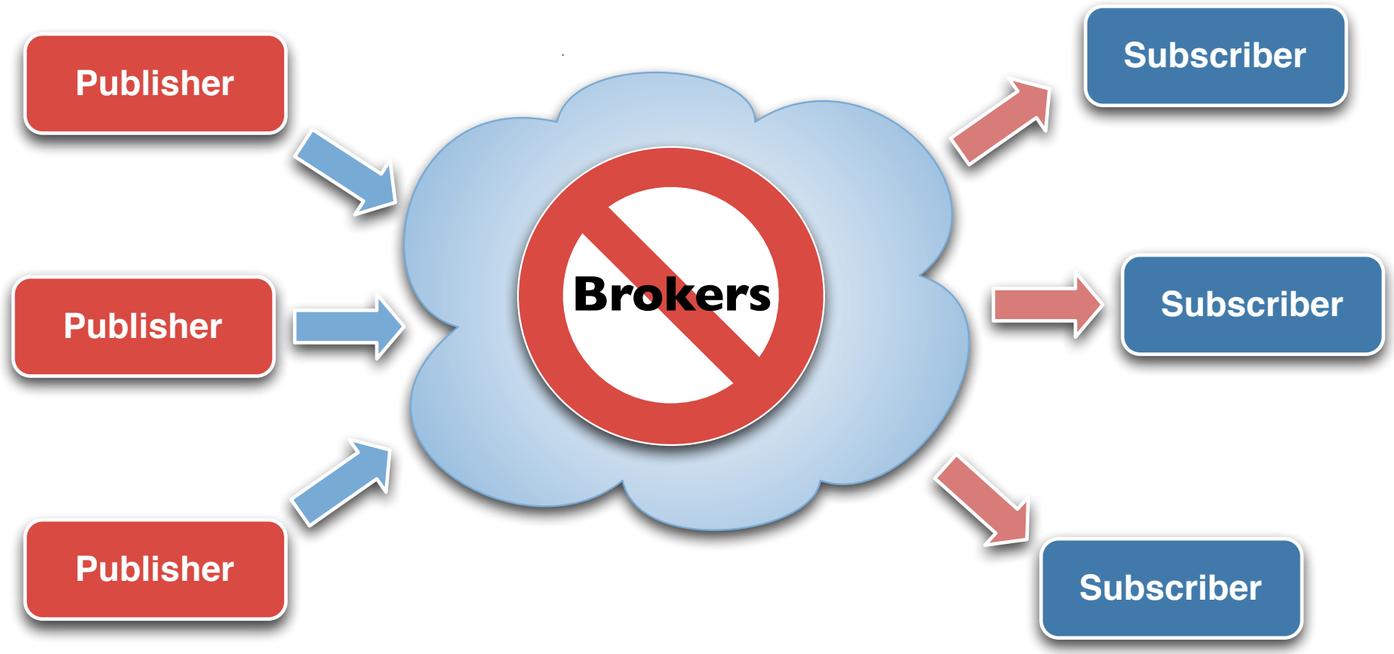
Delivering Performance, Openness, and Freedom

High Performance Pub/Sub

High Performance Pub/Sub

- Fully distributed, Peer-to-Peer Communication
- No Single Point of Failure
- No Single Point of Bottleneck
- Multicast-enabled
- High performance and highly scalable
- High availability
  - hot-swap
  - hot-hot architecture

The right data, at the right place, at the right time – All the Time.



OpenSplice DDS

PRISMTECH

OpenSplice | DDS

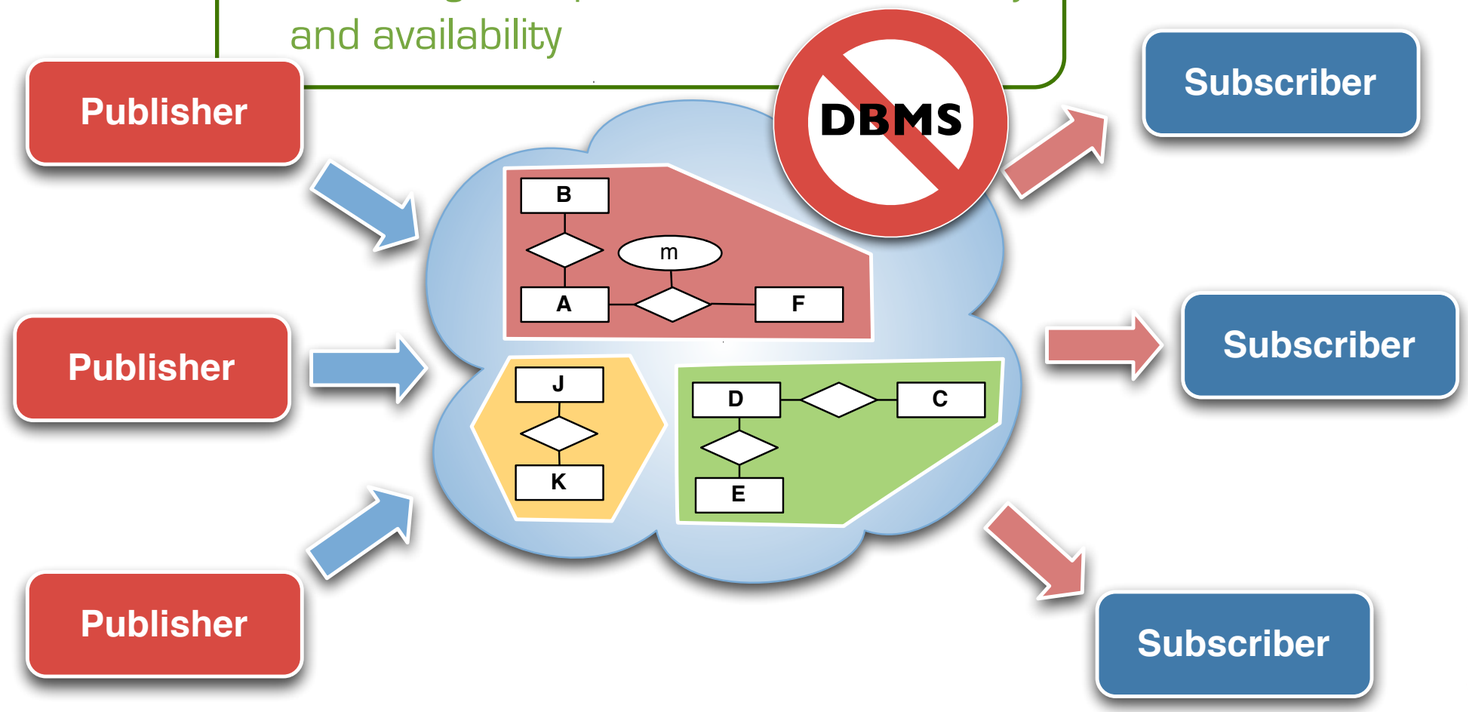
Delivering Performance, Openness, and Freedom

Data-Centric Pub/Sub

Data-Centric Pub/Sub

- Distributed Relational Data Model
- Local Queries
- Continuous Queries / Content Based Subscriptions
- Windows
- Object/Relational Mapping
- Support for a subset of SQL-92

- Data-Centric Features are **built-in** and **don't rely on an external DBMS**
- Providing thus performance, scalability, and availability

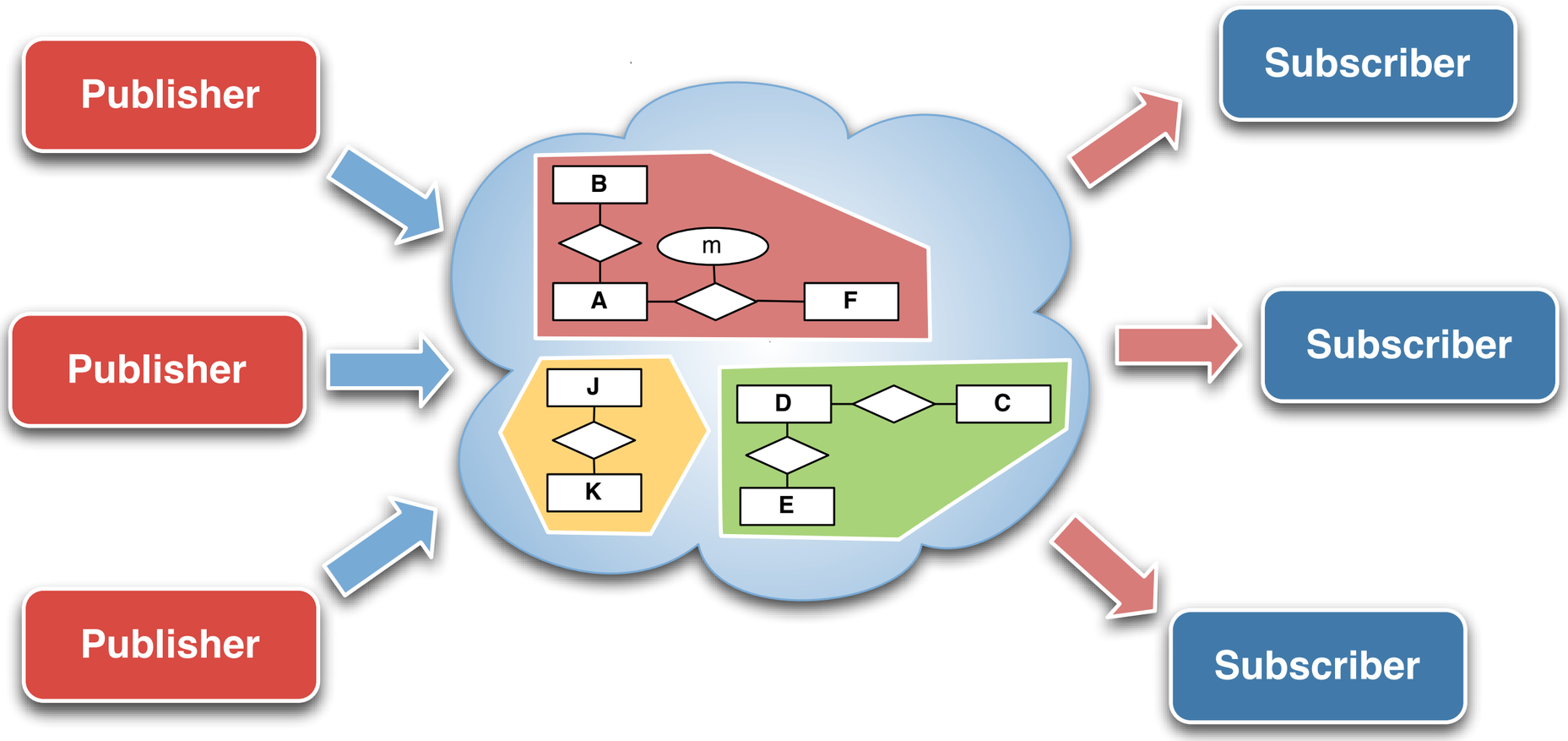


Perfect Blend of Data-Centric and Real-Time Publish/Subscribe Technologies

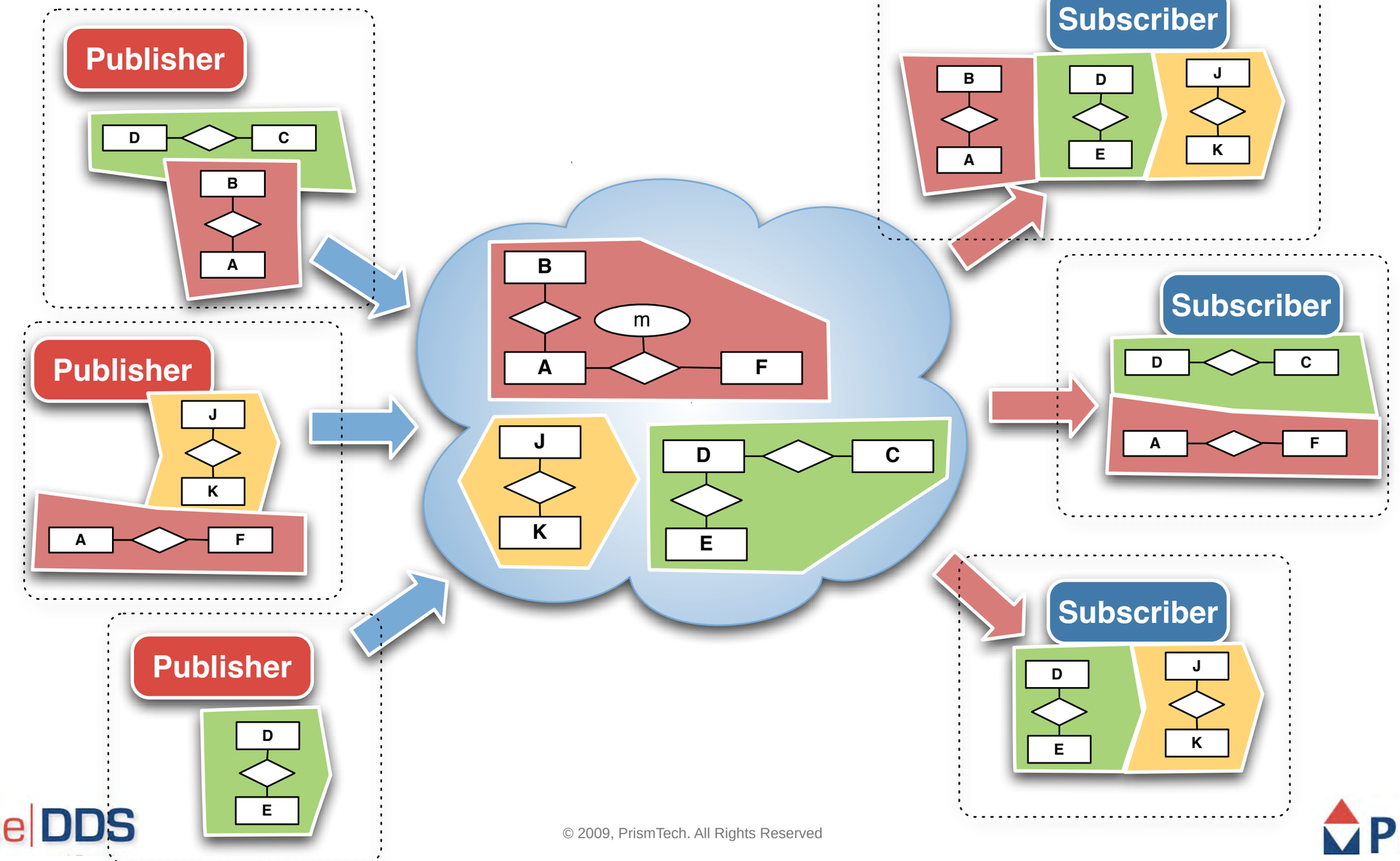
OpenSplice DDS

PRISMTECH

Data-Centric Pub/Sub



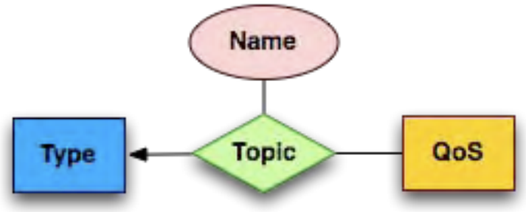
Data-Centric Pub/Sub



Topics and Data-Centric Pub/Sub

- **Topics**. Unit of information exchanged between Publisher and Subscribers.
- **Data Types**. Type associated to a Topic must be a structured type expressed in IDL
- **Topic Instances**. Key values in a datatype uniquely identify a Topic Instance (like rows in table)
- **Content Awareness**. SQL Expressions can be used to do content-aware subscriptions, queries, joins, and correlate topic instances

Topic



Topic Type

```
struct TempSensor {
    int tID;
    float temp;
    float humidity;
};
#pragma keylist TempSensor tID
```

Instances

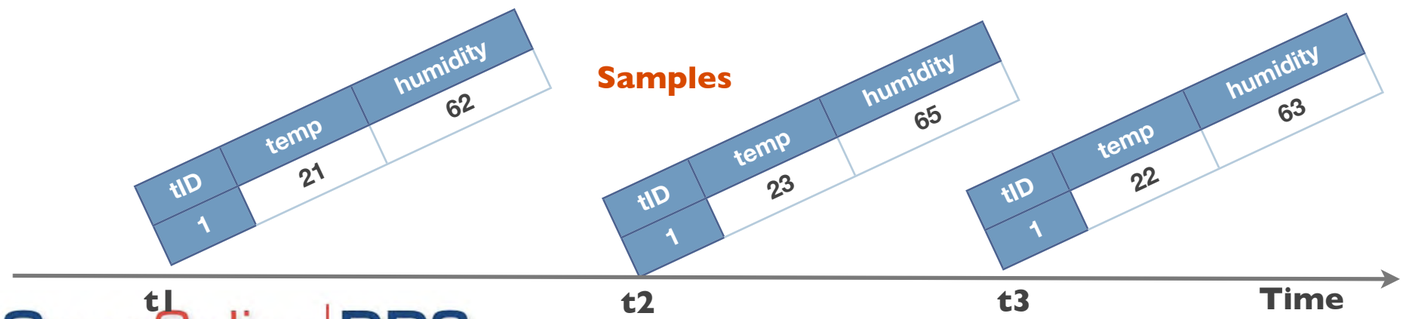
TempSensor

tID	temp	humidity
1	21	62
2	27	78
3	25.5	72.3

SELECT * FROM TempSensor t
WHERE t.temp > 25

tID	temp	humidity
2	27	78
3	25.5	72.3

Samples

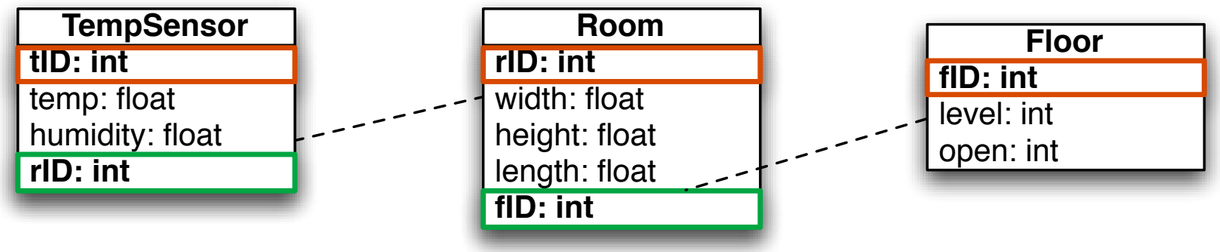


OpenSplice DDS

PRISMTECH

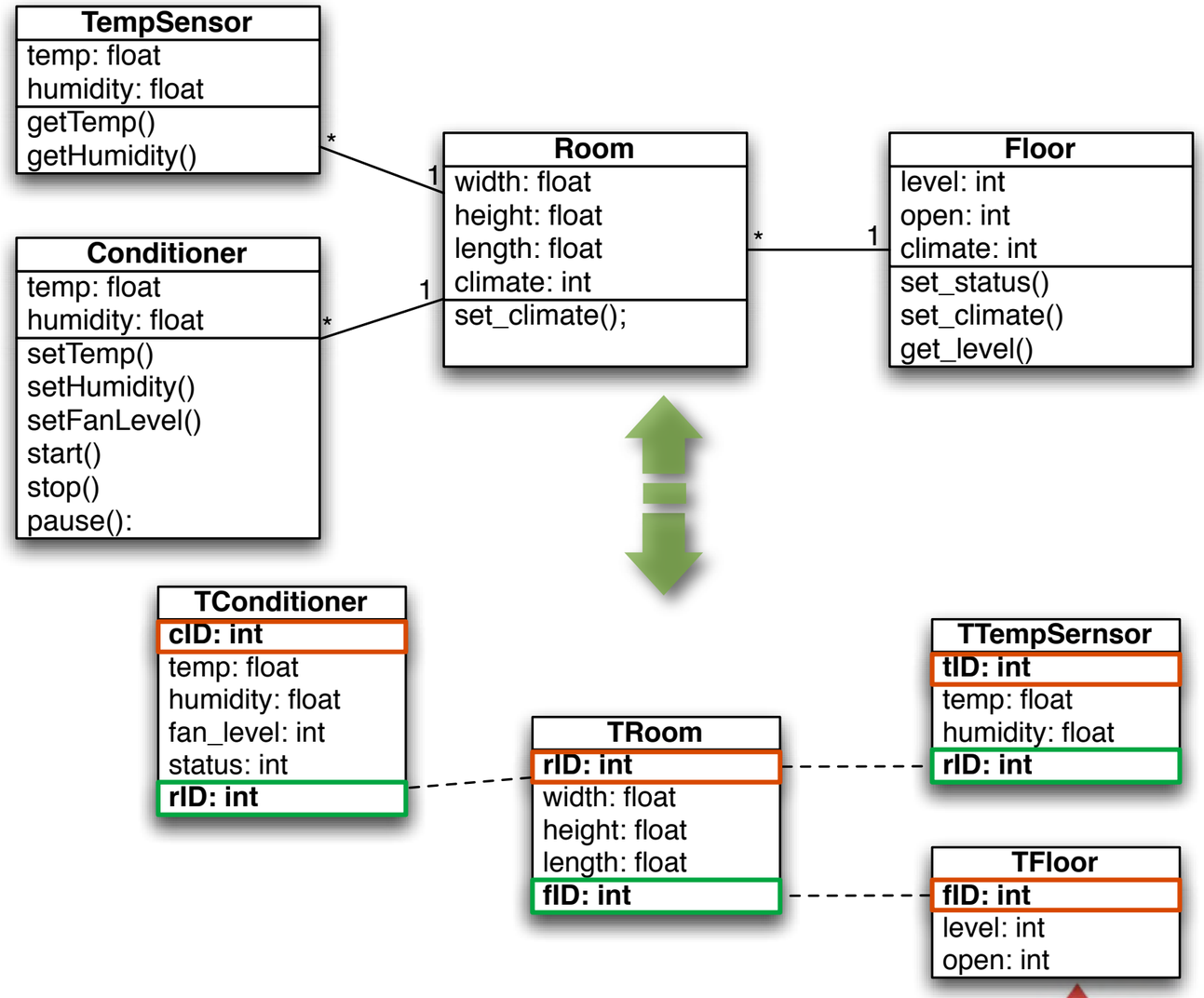
Distributed Relational Information Modeling

- Topic Keys can be used to identify instances as well as relationships
- Relationships can be navigated by relying on a subset of SQL 92
- One-to-many relationships can be captured using foreign keys
- Many-to-many relationships need to be modeled using a topics
- Keys can be represented by an arbitrary number of Topic fields



Object/Relational Mapping

- Arbitrary object reconstructions
- Automatic Relationships Management
- Inheritance
- Local Operations
- Local/Distributed State



Data Centric Publish/Subscribe

Publishers

TempSensor

tID	temp	humidity
1	18	60

TempSensor

tID	temp	humidity
2	22	75

TempSensor

tID	temp	humidity
3	21	71

```
struct TempSensor {
   int tID;
   float temp;
   float humidity;
};
#pragma keylist TempSensor tID
```

Fully Distributed Global Data Space

Subscribers

TempSensor

tID	temp	humidity
1	18	60
2	22	75
3	21	71

TempSensor

tID	temp	humidity
2	22	75
3	21	71

SELECT * FROM TempSensor t
WHERE s.temp > 20

s.tID == 1

TempSensor

tID	temp	humidity
1	18	60

Data Centric Publish/Subscribe

Publishers

TempSensor

tID	temp	humidity
1	21	62

TempSensor

tID	temp	humidity
2	22	75

TempSensor

tID	temp	humidity
3	21	71

```
struct TempSensor {
   int tID;
   float temp;
   float humidity;
};
#pragma keylist TempSensor tID
```

Fully Distributed Global Data Space

Subscribers

TempSensor

tID	temp	humidity
1	21	62
2	22	75
3	21	71

TempSensor

tID	temp	humidity
1	21	62
2	22	75
3	21	71

SELECT * FROM TempSensor t
WHERE s.temp > 20

s.tID == 1

TempSensor

tID	temp	humidity
1	21	62

Processing Content & Structure

Complex Event Processing...

- Local Queries
- Continuous Queries (Content-based Subscriptions)
- Topics Joins & Projections
- Events windows (via History QoS)

OpenSplice DDS some of the most useful features found in Complex Event Processing platforms!

Processing Content & Structure

Complex Event Processing...

- Local Queries
- Continuous Queries (Content-based Subscriptions)
- Topics Joins & Projections
- Events windows (via History QoS)

OpenSplice DDS some of the most useful features found in Complex Event Processing platforms!

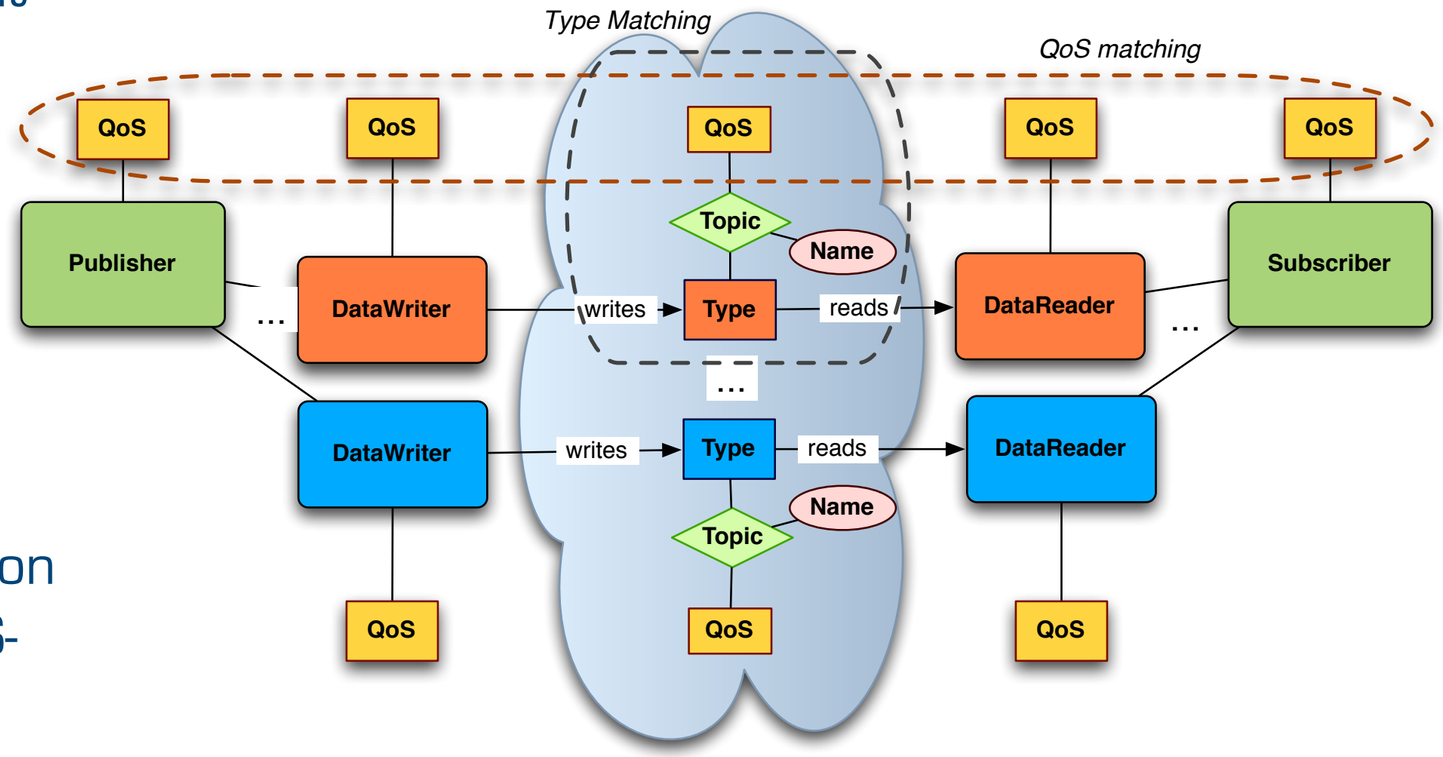
OpenSplice | DDS

Delivering Performance, Openness, and Freedom

QoS-Enabled Pub/Sub

QoS Model

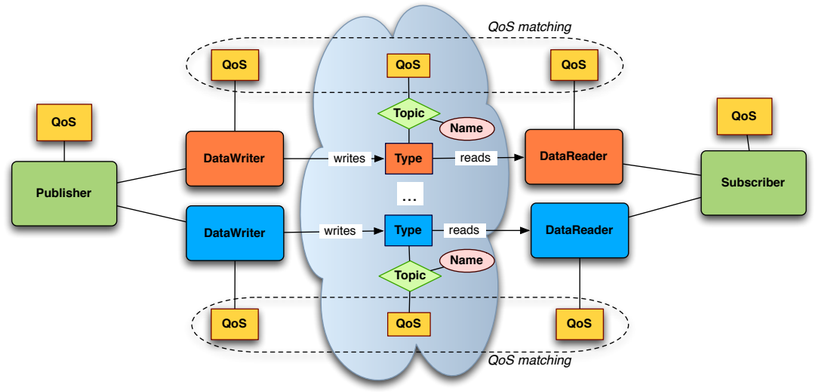
- QoS-Policies are used to control relevant properties of OpenSplice DDS entities, such as:
  - Temporal Properties
  - Priority
  - Durability
  - Availability
  - ...
- Some QoS-Policies are matched based on a **Request vs. Offered Model** thus QoS-enforcement



- Publications and Subscriptions match only if the declared vs. requested QoS are compatible
  - e.g., it is not possible to match a publisher which delivers data unreliably with a subscriber which requires reliability

Sample QoS Policies

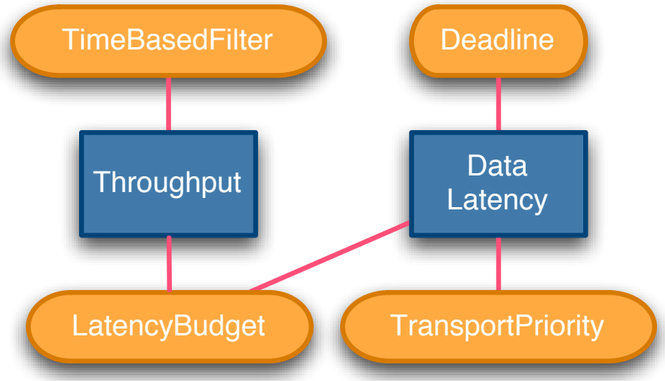
QoS Policy	Applicability	RxO	Modifiable	
DURABILITY	T, DR, DW	Y	N	**Data Availability**
DURABILITY SERVICE	T, DW	N	N	
LIFESPAN	T, DW	-	Y	
HISTORY	T, DR, DW	N	N	
PRESENTATION	P, S	Y	N	**Data Delivery**
RELIABILITY	T, DR, DW	Y	N	
PARTITION	P, S	N	Y	
DESTINATION ORDER	T, DR, DW	Y	N	
OWNERSHIP	T, DR, DW	Y	N	
OWNERSHIP STRENGTH	DW	-	Y	
DEADLINE	T, DR, DW	Y	Y	**Data Timeliness**
LATENCY BUDGET	T, DR, DW	Y	Y	
TRANSPORT PRIORITY	T, DW	-	Y	
TIME BASED FILTER	DR	-	Y	**Resources**
RESOURCE LIMITS	T, DR, DW	N	N	
USER_DATA	DP, DR, DW	N	Y	**Configuration**
TOPIC_DATA	T	N	Y	
GROUP_DATA	P, S	N	Y	



- Rich set of QoS allow to configure several different aspects of data availability, delivery and timeliness
- QoS can be used to control and optimize network as well as computing resource

Mapping QoS

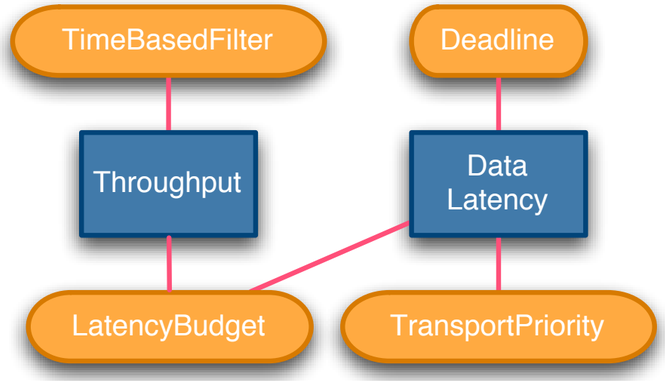
Which properties does QoS controls?



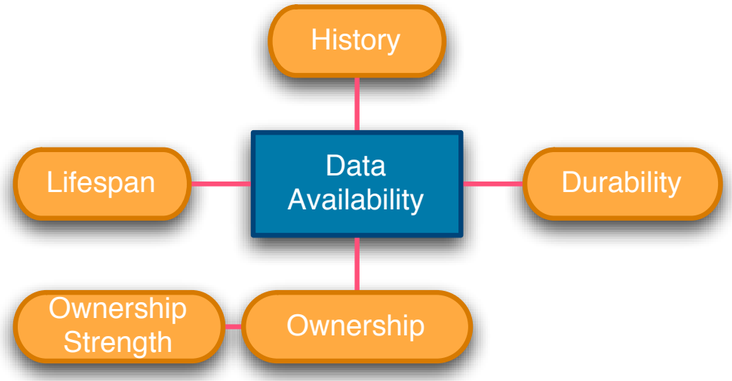
- ☑ **Control over Latency/Throughput tradeoff**
- ☑ **Control over data latency**
- ☑ **Control over data priority**

Mapping QoS

Which properties does QoS controls?



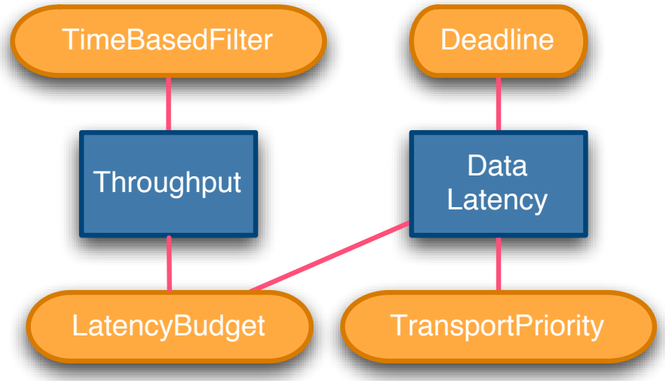
- ☑ Control over Latency/Throughput tradeoff
- ☑ Control over data latency
- ☑ Control over data priority



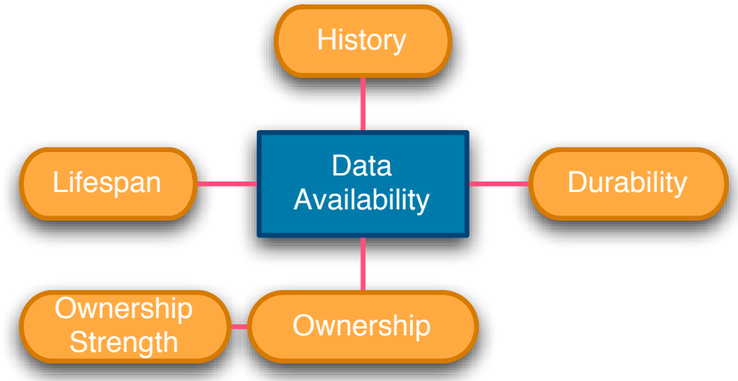
- ☑ Control over data queueing
- ☑ Control over data persistency
- ☑ Control over data sources hot-swap

Mapping QoS

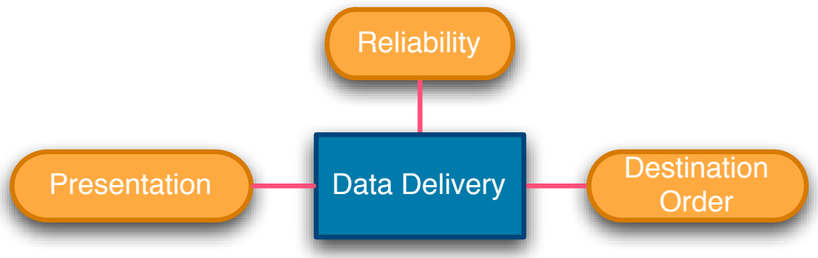
Which properties does QoS controls?



- Control over Latency/Throughput tradeoff
- Control over data latency
- Control over data priority



- Control over data queueing
- Control over data persistency
- Control over data sources hot-swap



- Control over data distribution reliability
- Control over data ordering
- Control over presentation

OpenSplice DDS provides programmatic QoS-driven support for configuring the most important properties of data distribution!

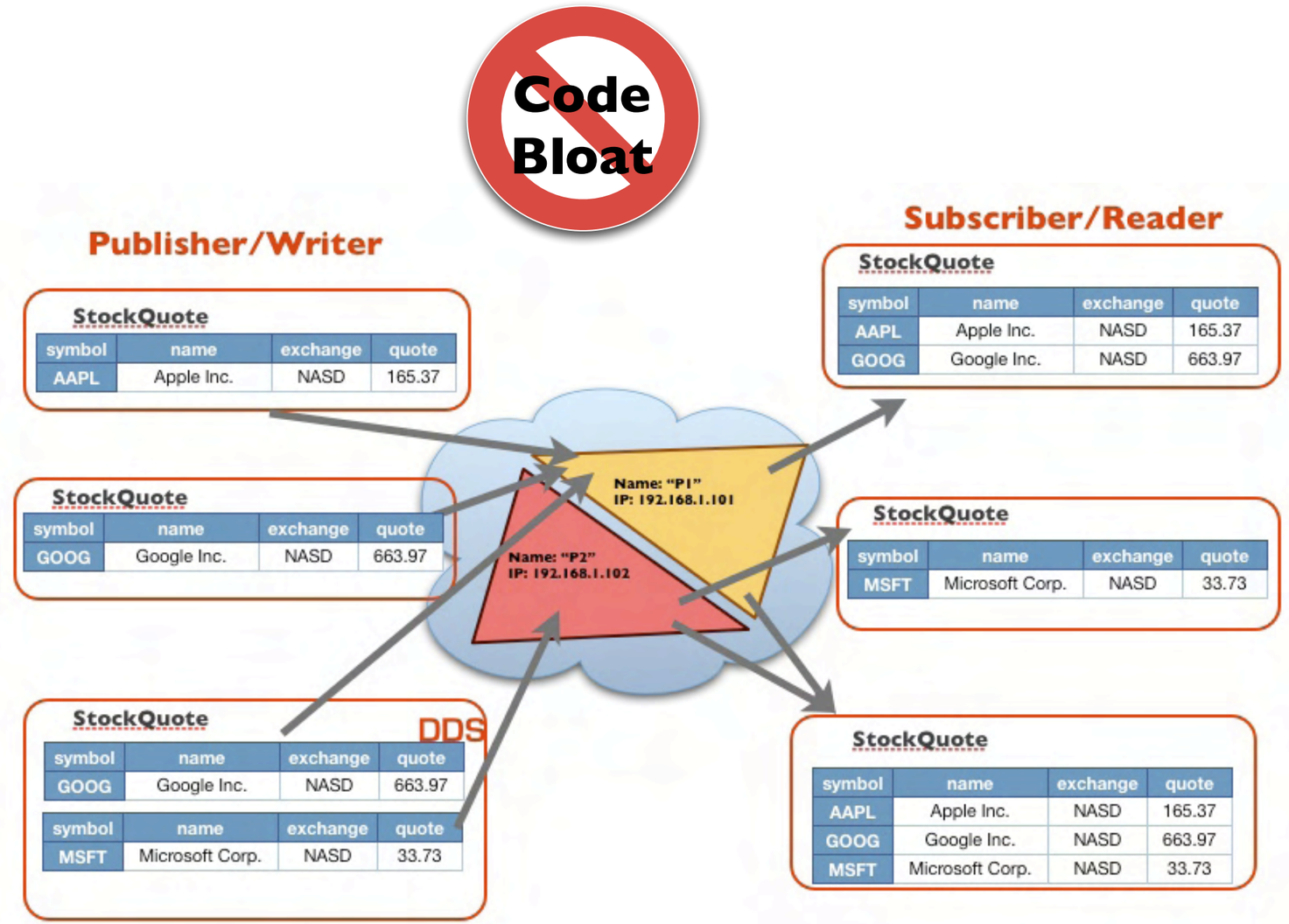
OpenSplice | DDS

Delivering Performance, Openness, and Freedom

Zero-Conf Pub/Sub

Zero-Conf Pub/Sub

- **Dynamic Discovery.** Publisher, Subscriber, and Topics are dynamically discovered
- **Separation of Concerns.** Applications are agnostic from networking details. Thus you can re-deploy the same business logic with different network, partitioning, configurations
- **Tool Based.** All configuration is tool assisted and happens outside of your application



OpenSplice DDS

PRISMTECH

OpenSplice | DDS

Delivering Performance, Openness, and Freedom

Standard-Based Pub/Sub

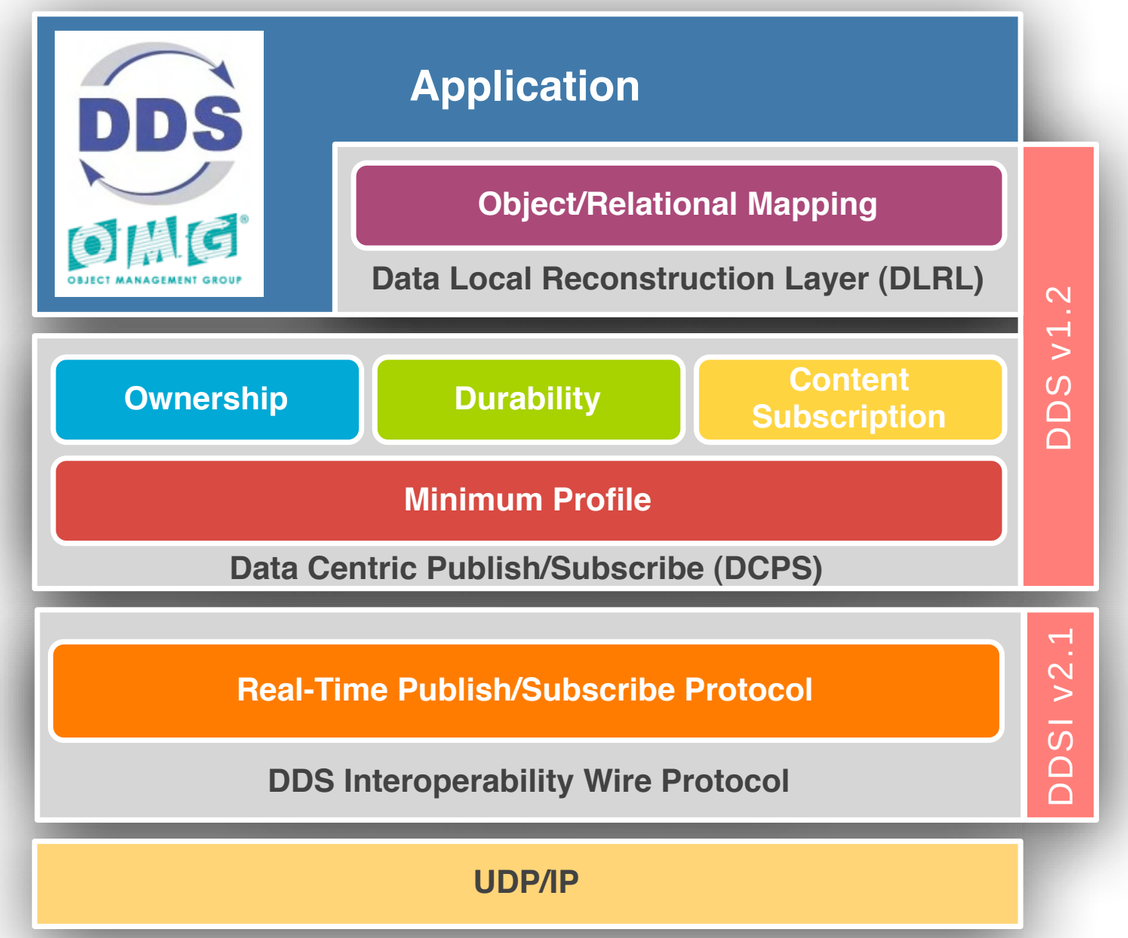
The OMG Data Distribution Service

Data Distribution Service for Real-Time Systems

- Leap forward in Topic-based Publish/Subscribe Middleware state of the art
- Carefully specified to allow very high performance, scalable, predictable and high-availability implementations
- Language Independent, OS and HW architecture independent

Fully Standardized Solution

- Data Distribution Service (DDS) for Real-Time Systems v1.2
- RTPS, DDS Interoperability Wire Protocol



The OMG Data Distribution Service satisfies the most challenging information dissemination requirements across a wide set of application domains, ranging from multi-board systems to system-of-systems

OpenSplice DDS

PRISMTECH

DDS Recommendations

Increasingly Mandated/Recommended by Administrations

- **US Navy**: Open Architecture
- **DISR/DISA**: Net-centric Systems
- **EuroControl**: Air Traffic Control Center Operational Interoperability
- **QinetiQ**: Recommending DDS for VSI

OpenSplice DDS

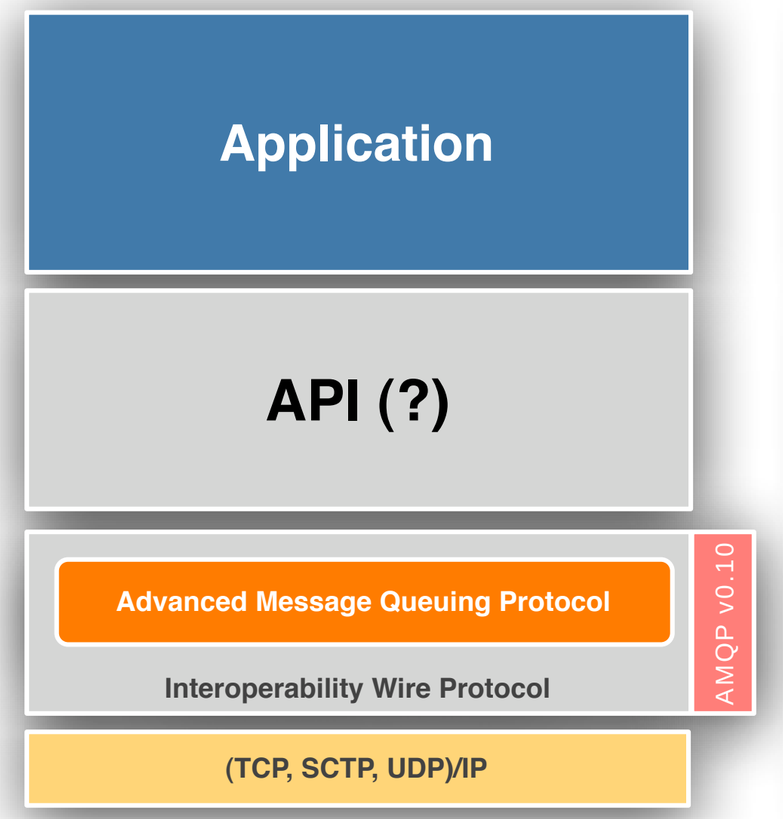
PRISMTECH

Agenda

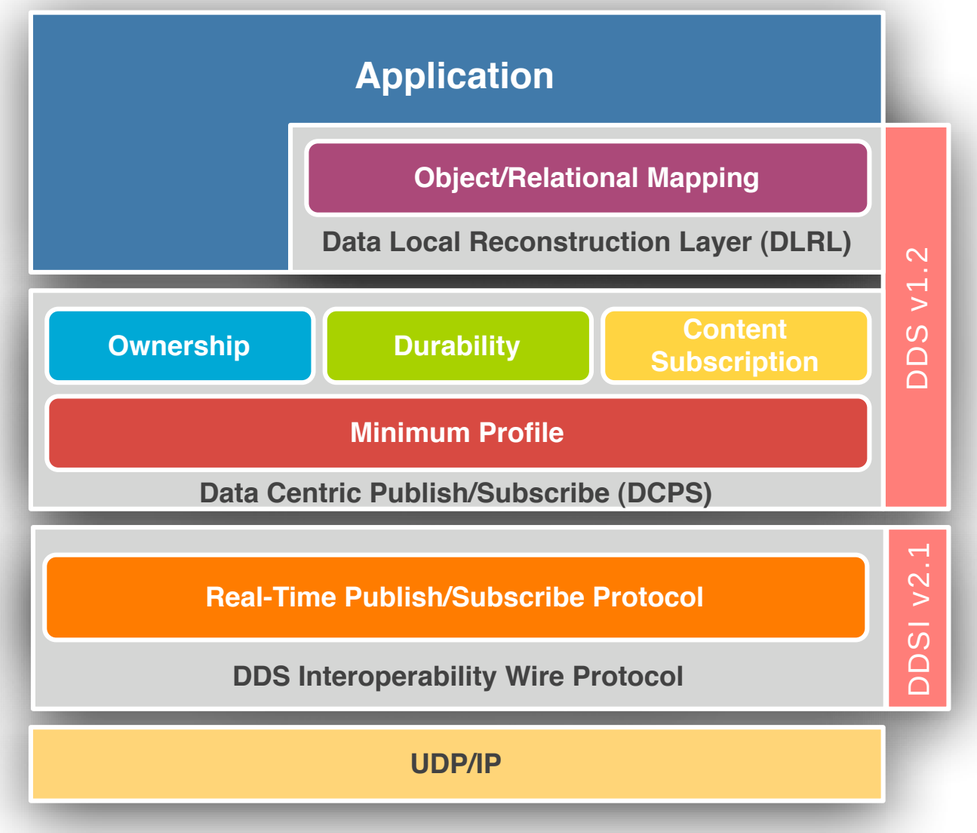
- The Big News
- What is OpenSplice DDS
- **DDS vs AMQP**
- Why OpenSplice DDS?
- Concluding Remarks

Scope of Standardization

AMQP

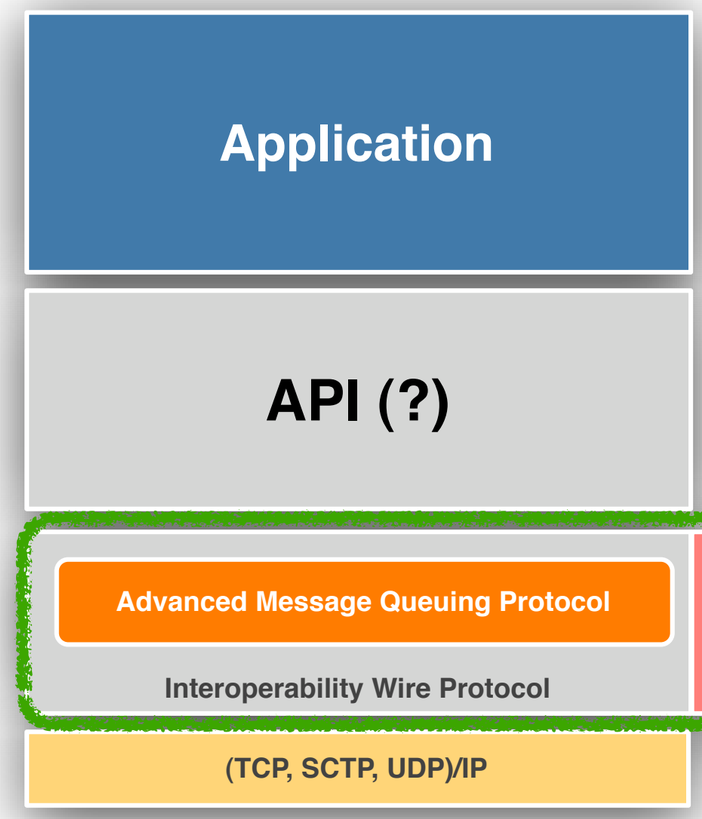


OMG DDS

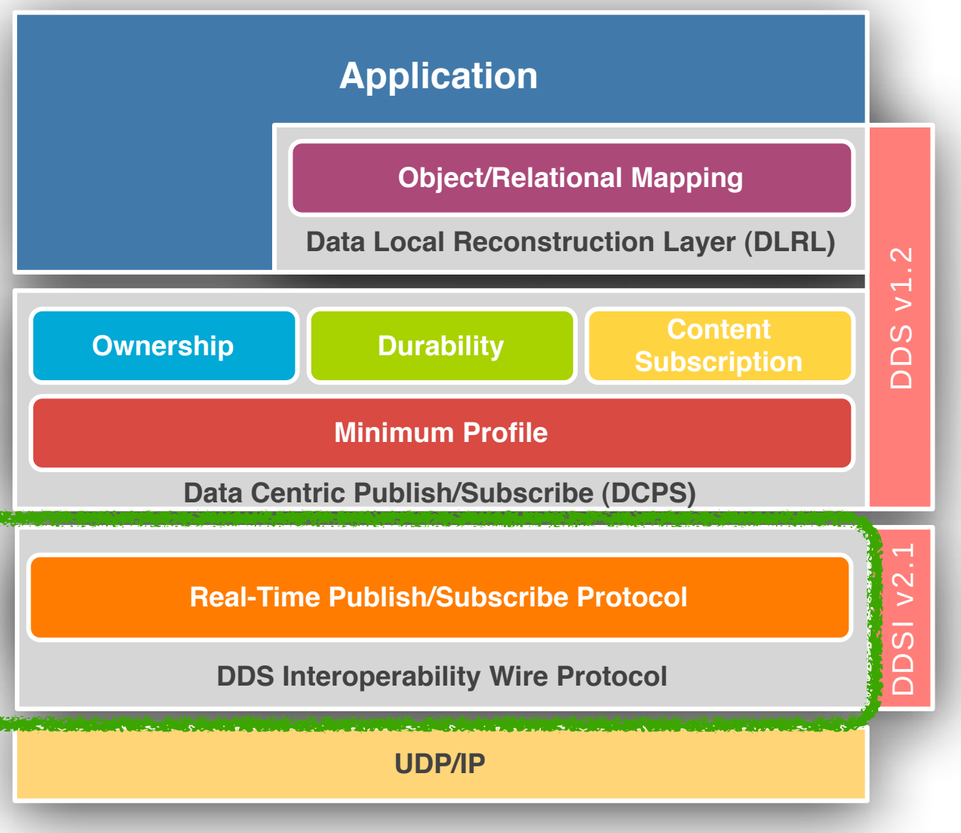


Scope of Standardization

AMQP



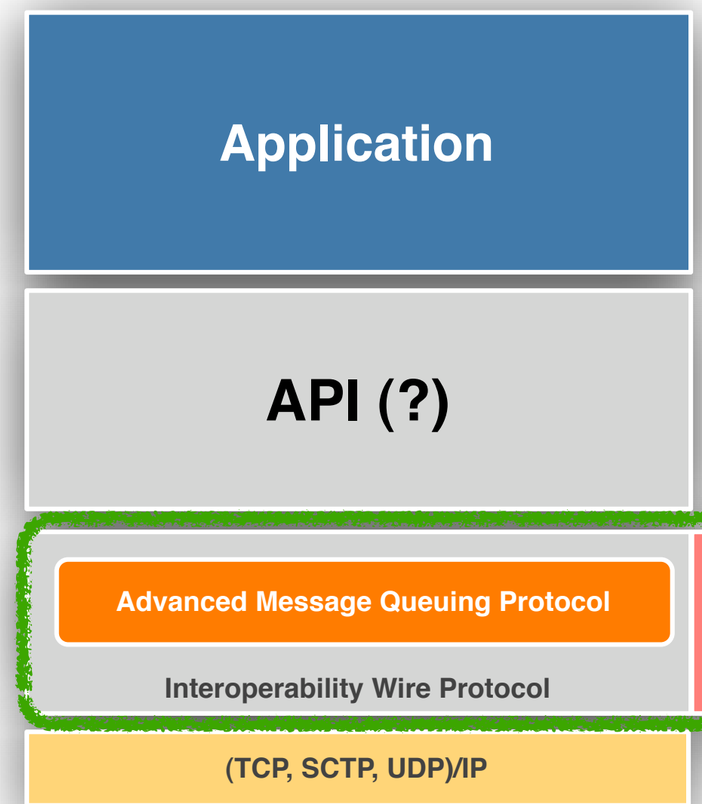
OMG DDS



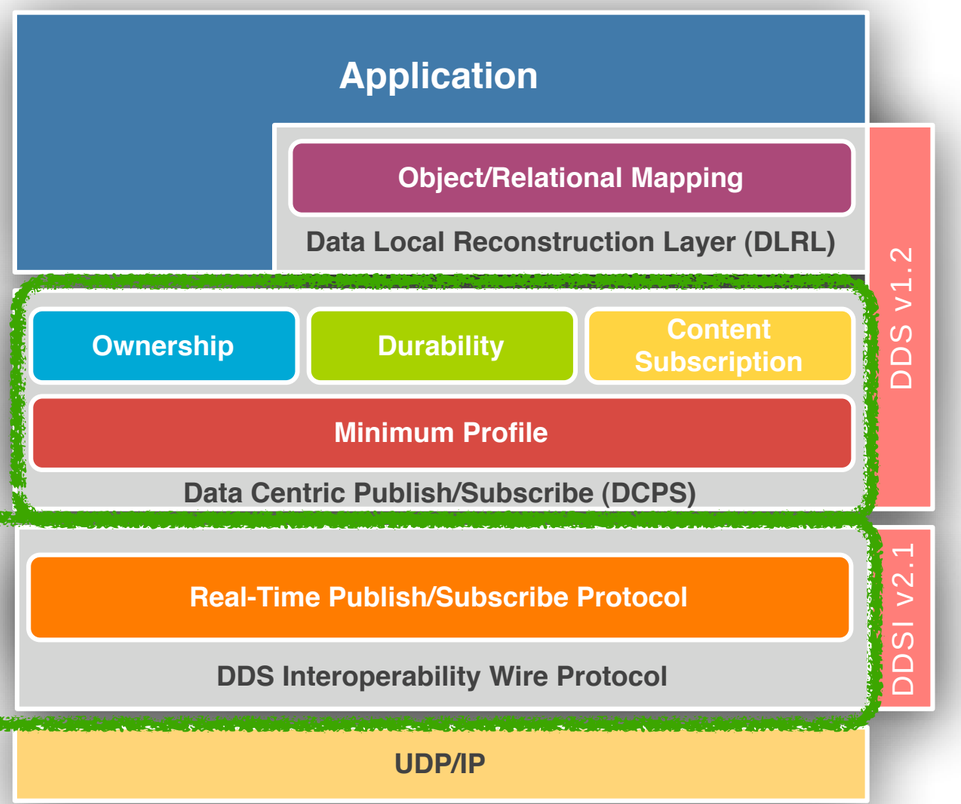
Wire Protocol Standard

Scope of Standardization

AMQP



OMG DDS

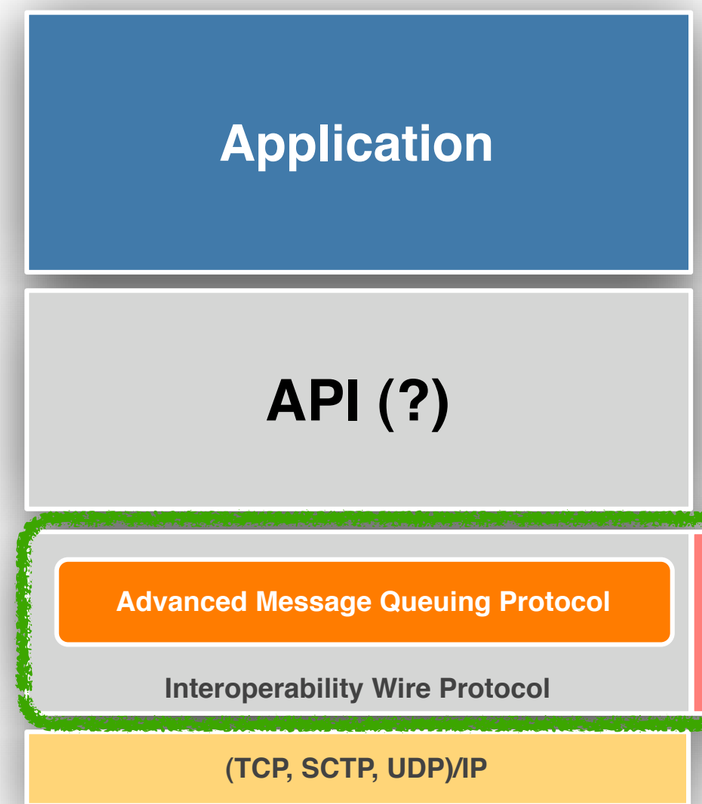


Pub/Sub Standard API

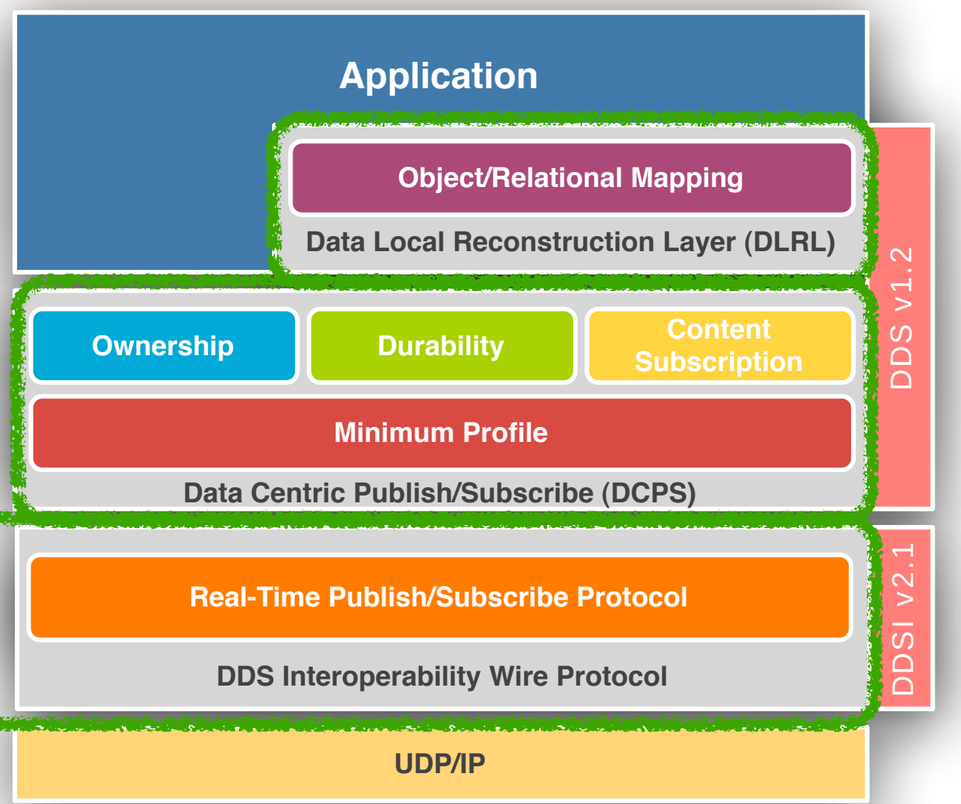
Wire Protocol Standard

Scope of Standardization

AMQP



OMG DDS

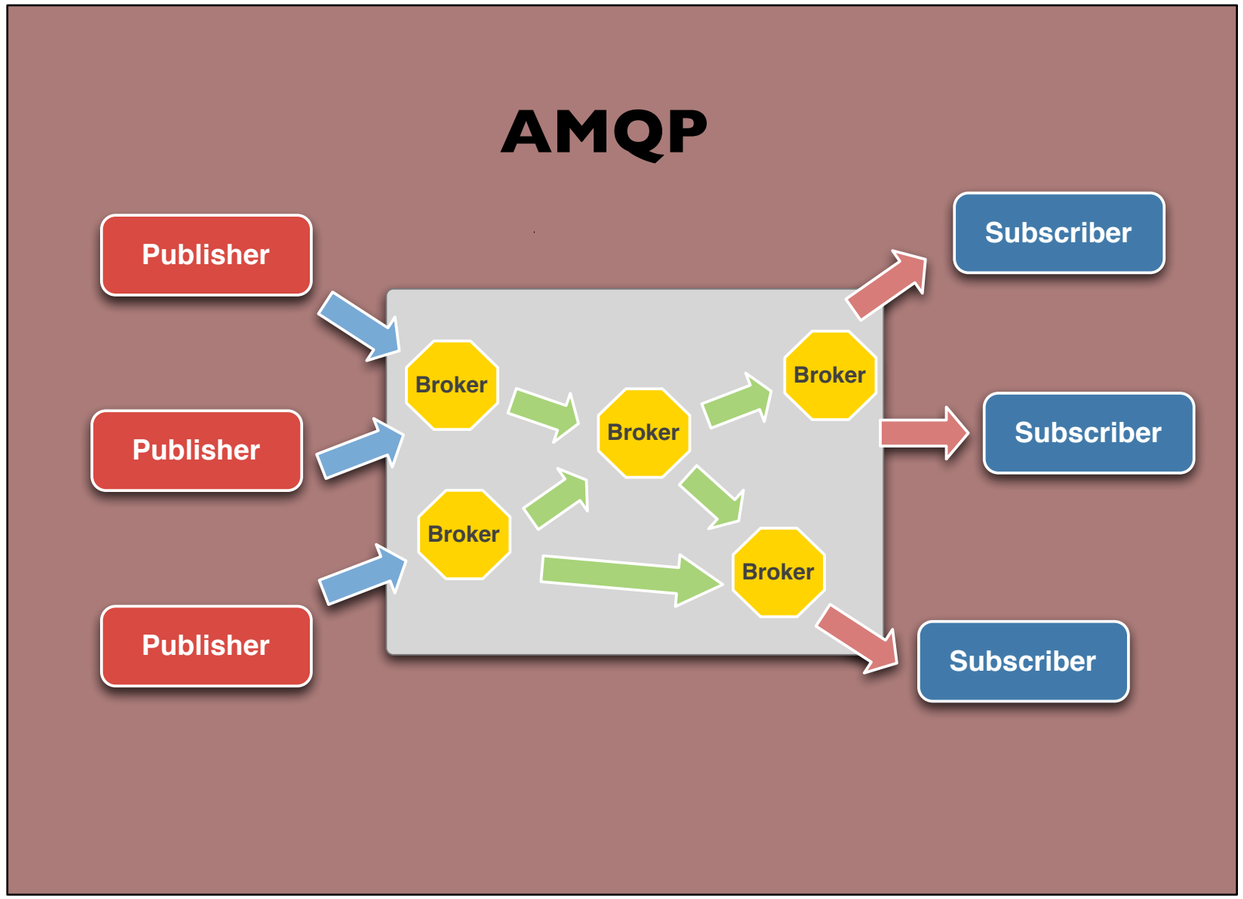


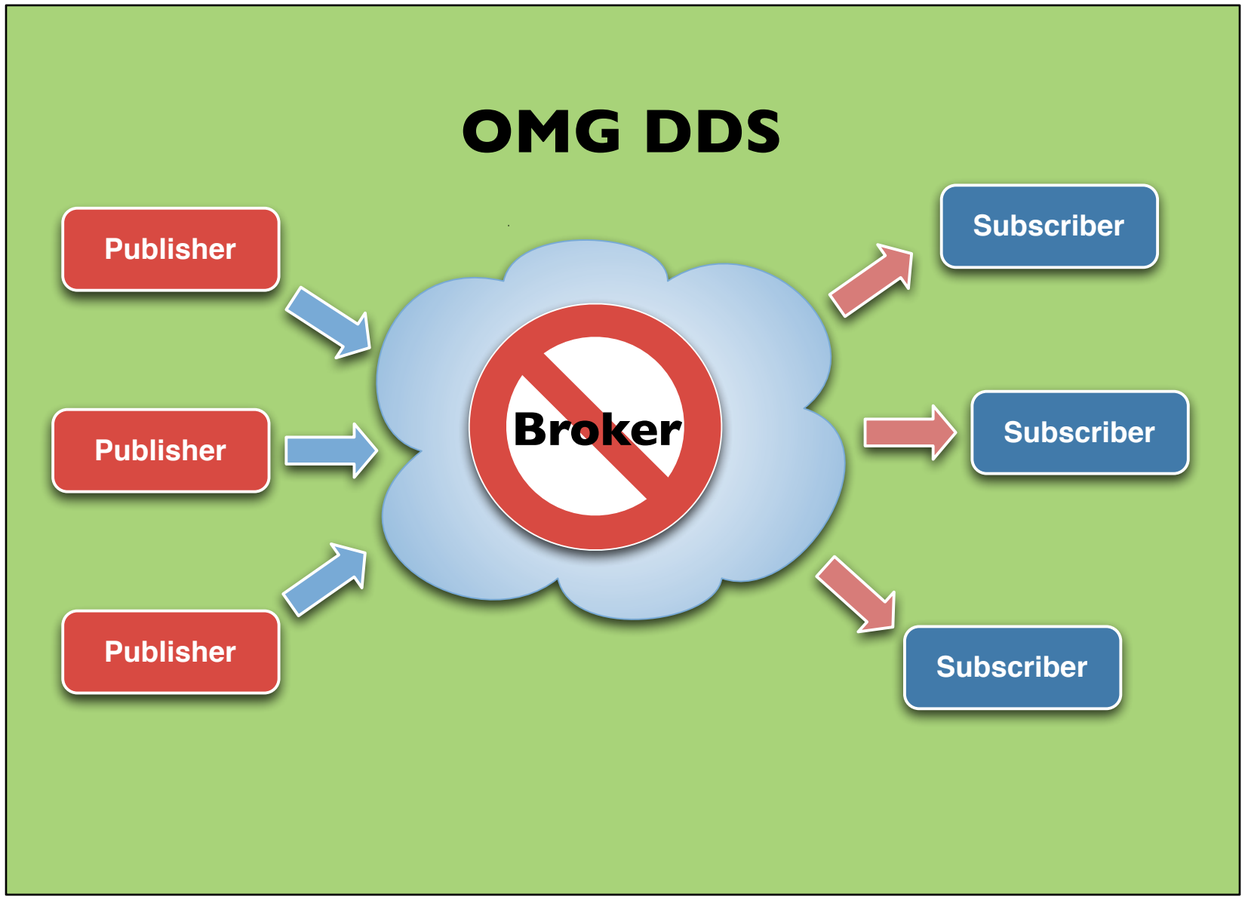
Object Relational Mapping Standard API

Pub/Sub Standard API

Wire Protocol Standard

Architectural Style





Key Differences in Summary

AMQP	DDS
Brokered Communication Architecture	Peer-to-Peer Communication Architecture
Wire Protocol Standard - Interoperability across AMQP implementations	Wire Protocol + API Standard - Interoperability across DDS implementations - Application Portability across DDS Implementation
Header Based Routing	Content-Based Filtering/Quering
Not geared for High-Performance	Designed bottom-up for maximum performance and determinism

Agenda

- The Big News
- What is OpenSplice DDS
- DDS vs AMQP
- **Why OpenSplice DDS?**
- Concluding Remarks

OpenSplice | DDS

Delivering Performance, Openness, and Freedom

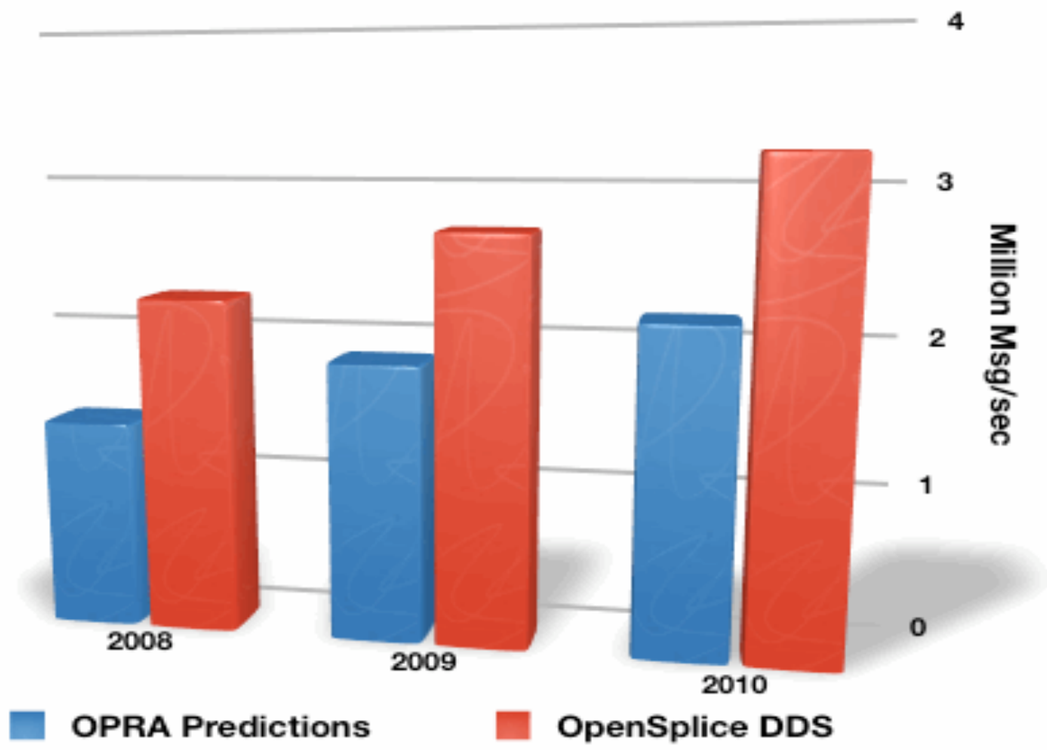
Best Performance

Fast and Furious

The Fastest Open Source Ultra-Low Latency Messaging Middleware

- Millions of Market Data Updates per Second
- < 60 micro-seconds latency on 1GBps Ethernet
- Negligible inter-core latency

Stay Ahead of Market Data Rates



OpenSplice DDS

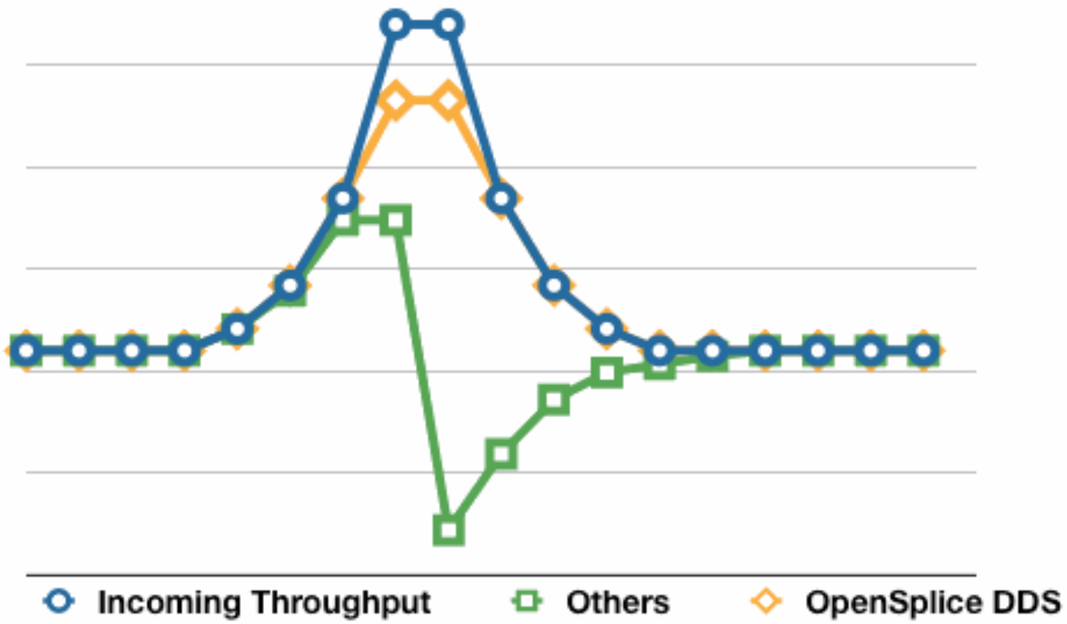
PRISMTECH

Stable and Reliable

Stability, Reliability, and Predictability, Under all Conditions

- Stable under the most extreme traffic spikes
- Three configurable level of Spike Absorption
- Guaranteed Reliability

Advanced Traffic Spikes-Absorption Technology



OpenSplice DDS

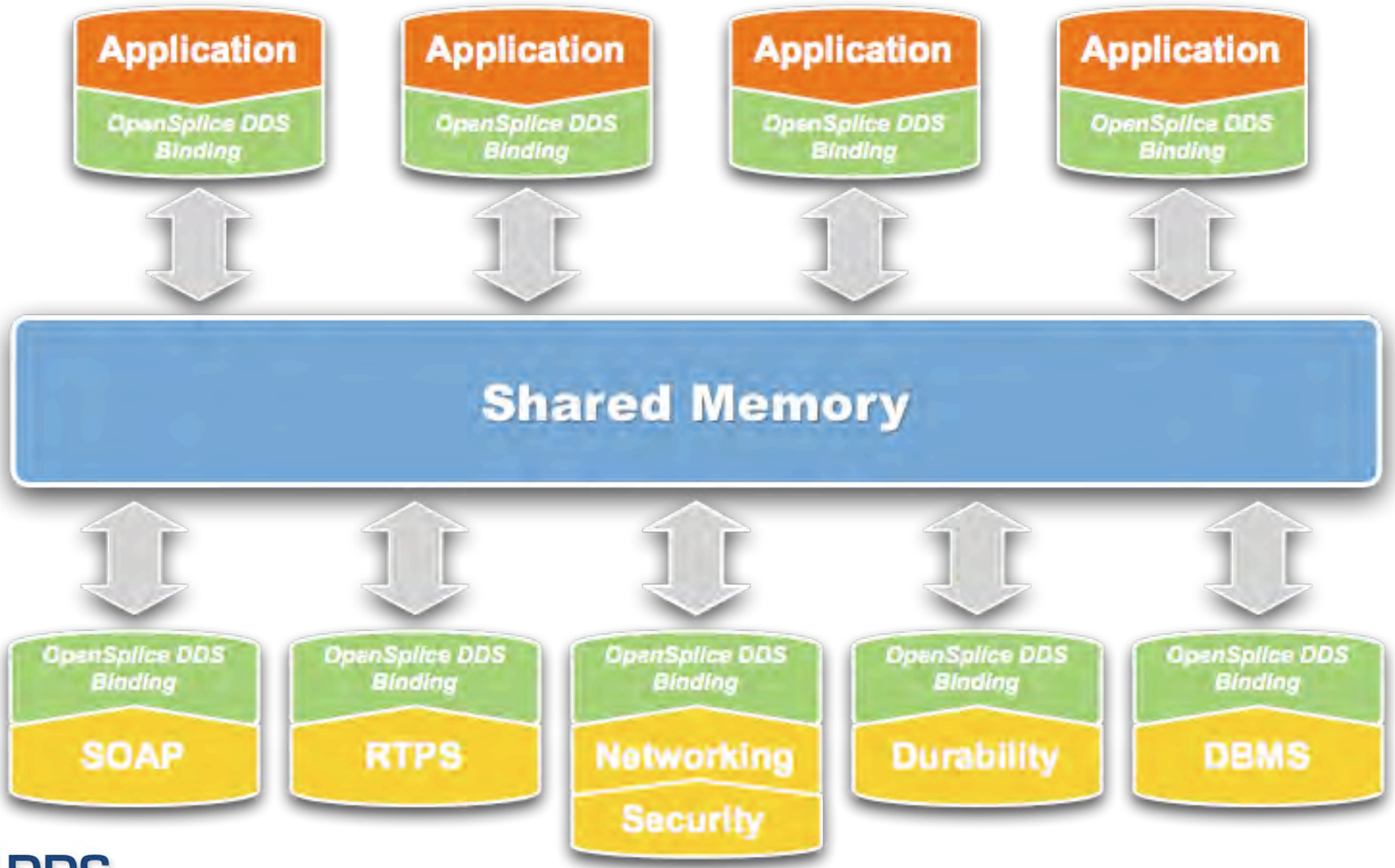
PRISMTECH

OpenSplice | DDS

Delivering Performance, Openness, and Freedom

Best Architecture

Multi-Core Ready Architecture



Networking Architecture

Architecture

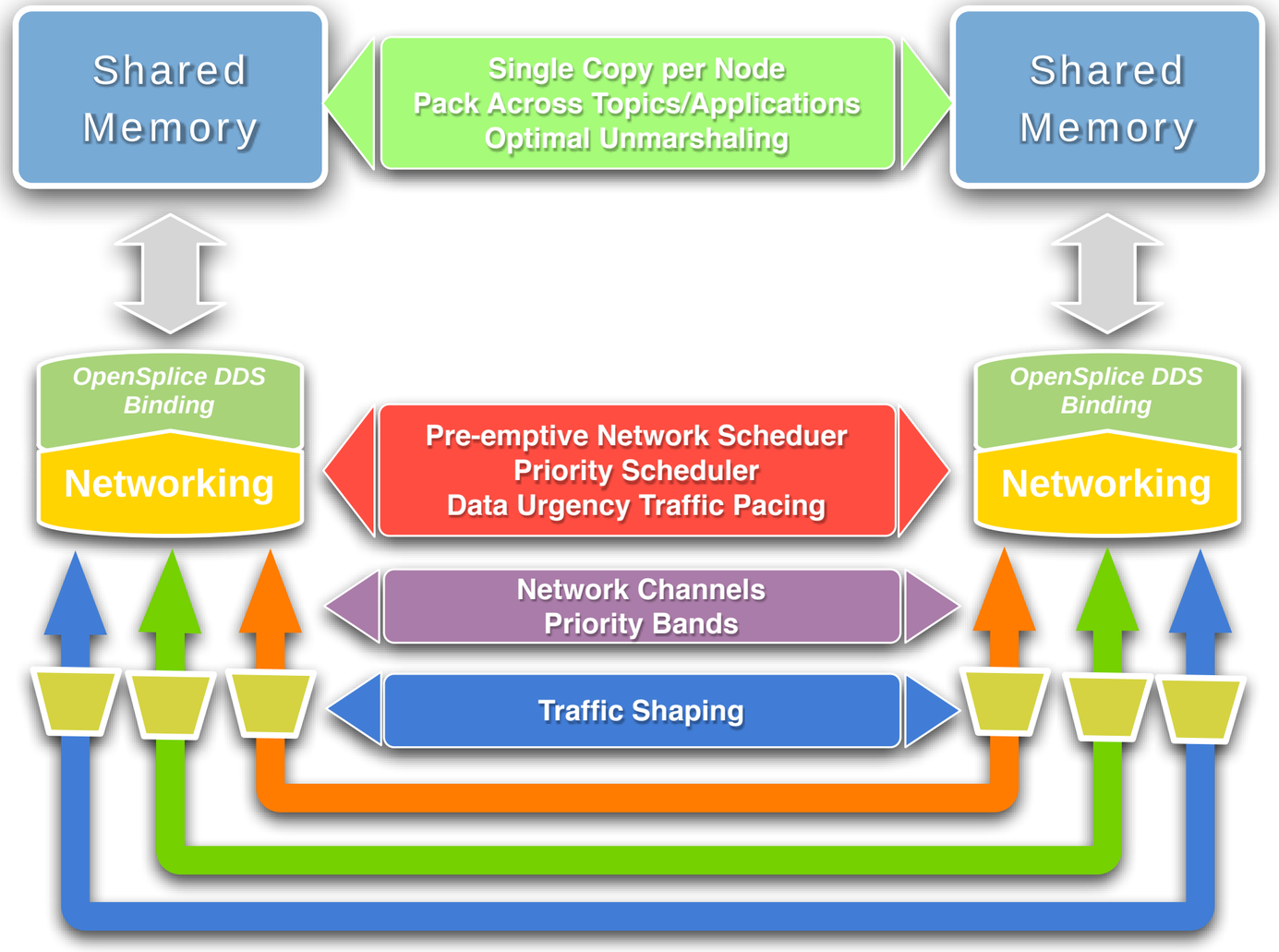
- **Network-channels**
  - Priority bands
- **Network-partitions**
  - Multicast Groups
- **Traffic-shaping**
  - Burst/Throughput

Scalability and Efficiency

- Single shared library for applications & services
- Ring-fenced shared memory segment
- Data urgency driven network-packing

Determinism & Safety

- Preemptive network-scheduler
- Data importance based network-channel selection
- Partition based multicast-group selection
- Managed critical network-resource



OpenSplice DDS

PRISMTECH

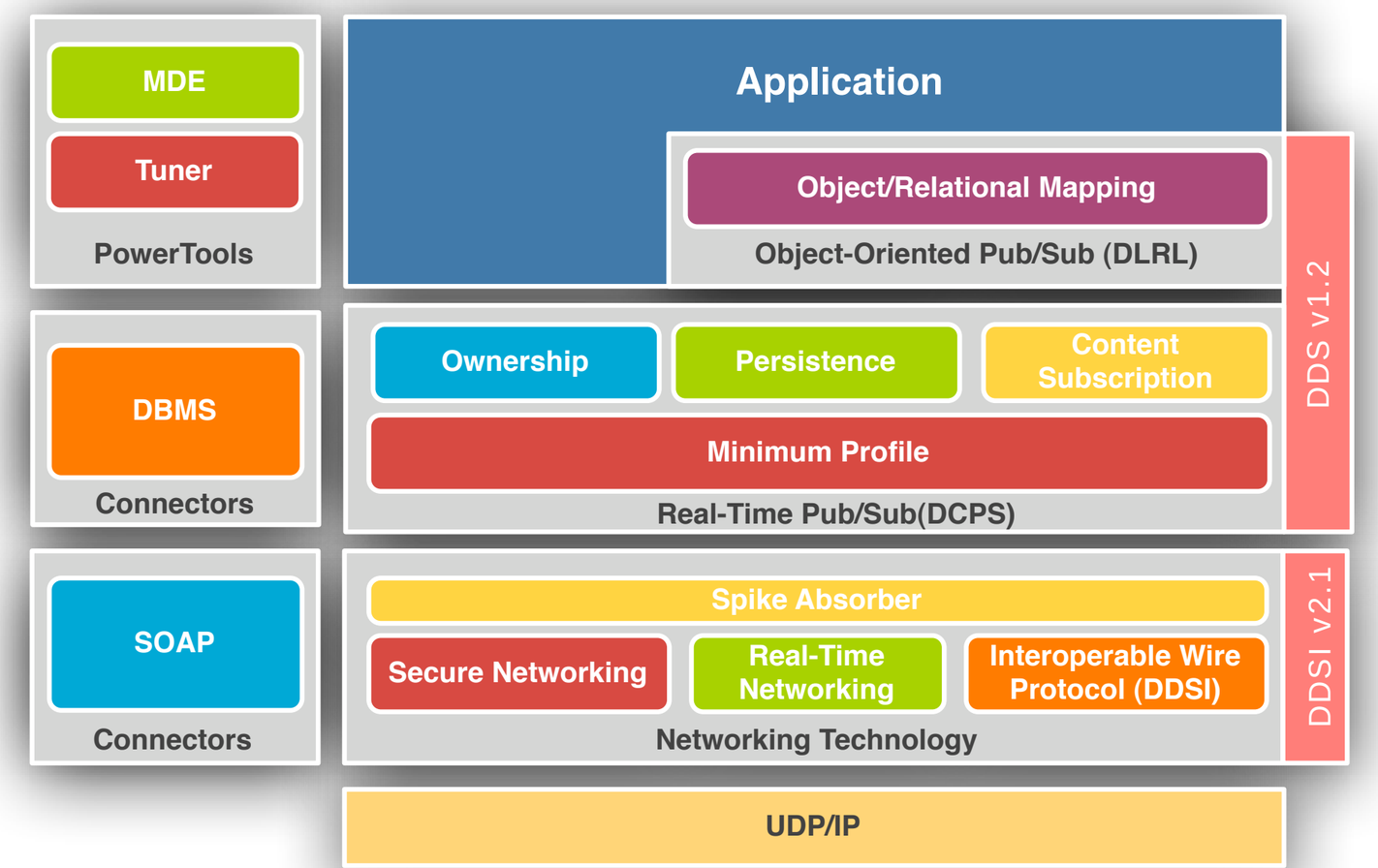
OpenSplice | DDS

Delivering Performance, Openness, and Freedom

Best Technology Ecosystem

Advanced Features

- Relational Data Modeling
- Object/Relational Mapping
- Event Processing
  - Queries
  - Continuous Queries
  - Join/Projections
- High Performance Caching
- Persistency
- Security
- Development Tools

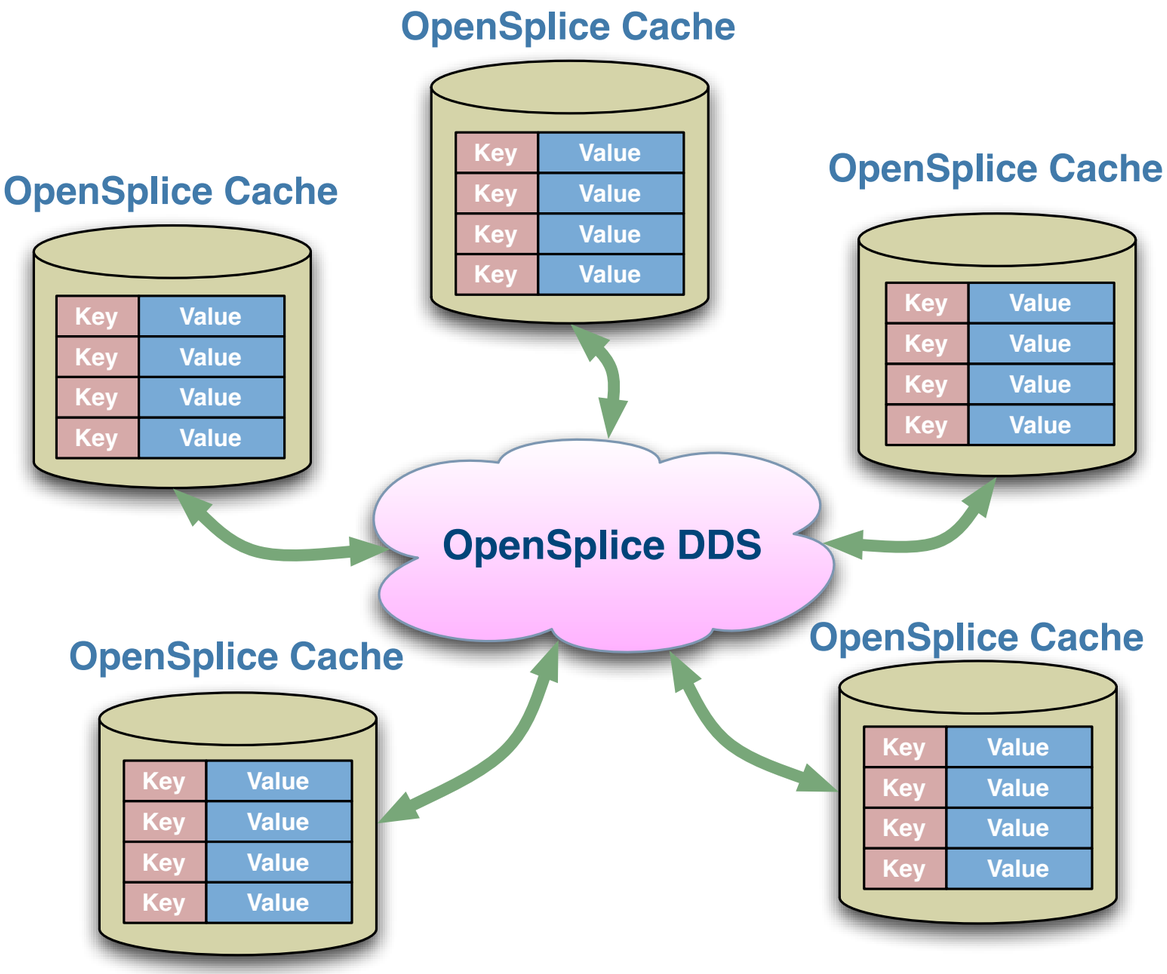


OpenSplice DDS

PRISMTECH

High Performance Caching

- **Fully Distributed** Caching Technology
- Supports **SQL Queries** on local Cache
- Support for **Continuous SQL Queries** on the whole distributed Cache
- **High-Performance, ultra-low-latency** communication engine based on OpenSplice DDS
- Fully exploits **Data Locality** and **Prefetching**



OpenSplice DDS

PRISMTECH

OpenSplice | DDS

Delivering Performance, Openness, and Freedom

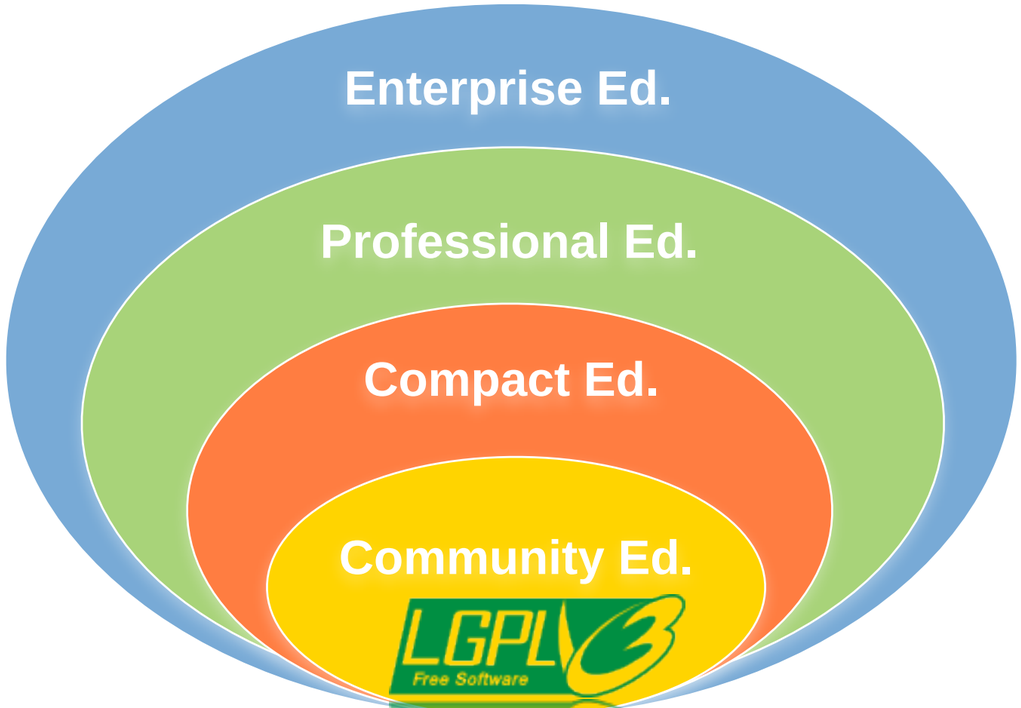
Best of Open Source

OpenSplice DDS is Open Source

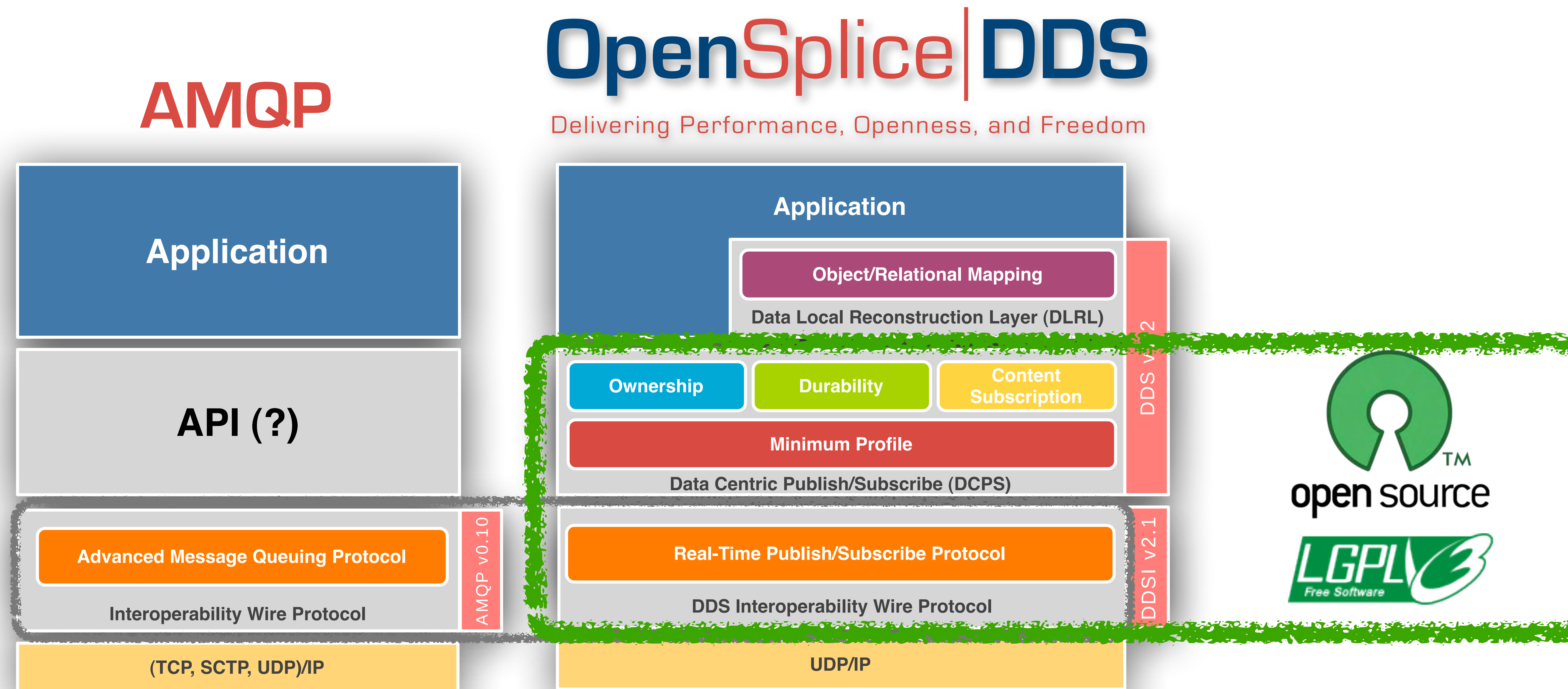
- Product reorganized into Editions
  - Community Edition
  - Compact Edition
  - Professional Edition
  - Enterprise Edition
- Product Editions provide a a growing set of functionality to address the needs of increasingly more sophisticated users
- The Community Edition is Open Source
- Compact, Enterprise and Professional Edition are available only through Commercial Subscriptions

OpenSplice DDS

Delivering Performance, Openness, and Freedom



A Feature Rich Community Edition



OpenSplice DDS
Delivering Performance, Openness, and Freedom
AMQP
Application
API (?)
Advanced Message Queuing Protocol
Interoperability Wire Protocol
AMQP v0.10
(TCP, SCTP, UDP)/IP
Application
Object/Relational Mapping
Data Local Reconstruction Layer (DLRL)
Ownership
Durability
Content Subscription
Minimum Profile
Data Centric Publish/Subscribe (DCPS)
DDS v1.2
Real-Time Publish/Subscribe Protocol
DDS Interoperability Wire Protocol
DDSI v2.1
UDP/IP
open source
LGPL v3
Free Software

Best Way of Spending Your Money

Financial Advantages

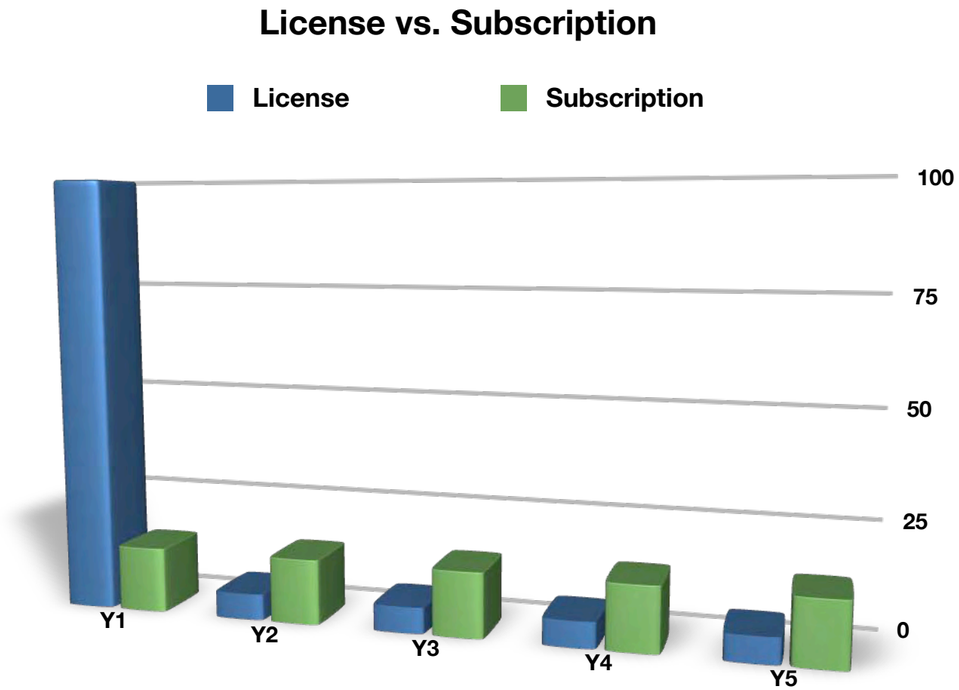
OpenSplice DDS subscriptions provides key advantages:

Community Edition

- Free like free speech, and
- Free like free beer!

Commercial Editions

- Cash/Flow Friendly
- Lower Total Cost of Ownership (TCO)
- Flexible model to tune needs vs. subscription



OpenSplice DDS

PRISMTECH

OpenSplice | DDS

Delivering Performance, Openness, and Freedom

Hottest Technology

DDS Adoption

Defense

- Combat Management Systems
- Tactical Systems
- Communication Systems
- Radar Processing
- Submarine Systems
- Future Combat Systems

SCADA/Utilities

- Industrial Automation
- Power Grids (Smart Grids)
- Complex Telemetry (e.g. NASA Rocket Launch System)

OpenSplice DDS

PRISMTECH

DDS Adoption

Transportation

- Air Traffic Management/Control
- Metropolitan Traffic Management
- Underground Metropolitan Transportation

Financial Services

- Automated Trading
- Market Data Platforms
- Compliance Systems
- Risk Management

OpenSplice DDS

PRISMTECH

Agenda

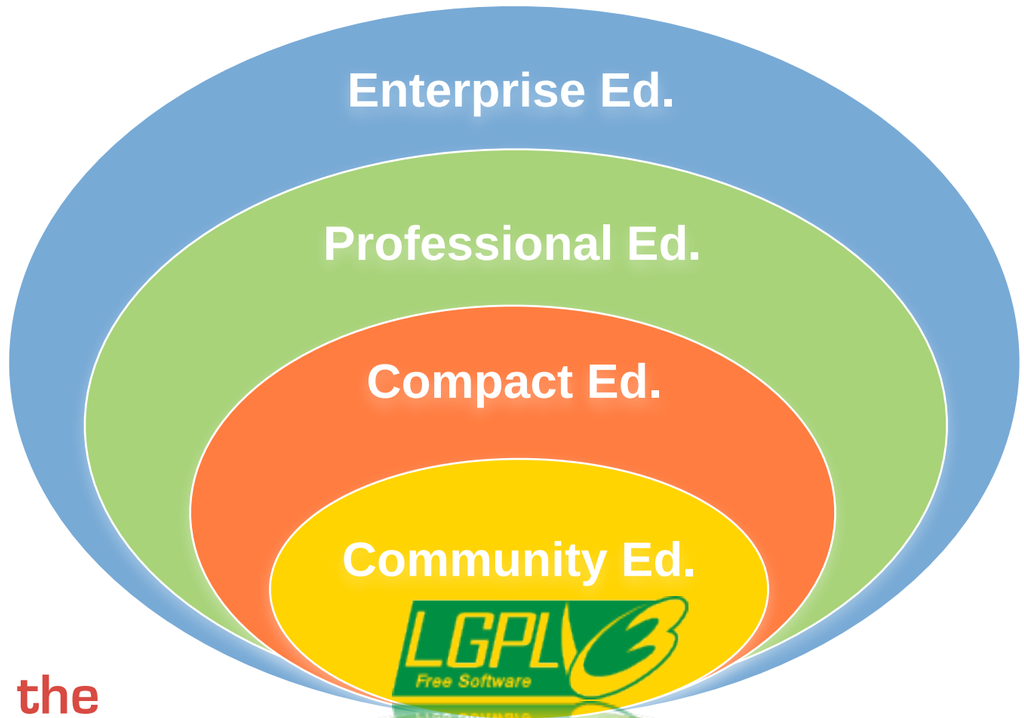
- The Big News
- What is OpenSplice DDS
- DDS vs AMQP
- Why OpenSplice DDS?
- Concluding Remarks

Concluding Remarks

- OpenSplice DDS is the ideal fit for addressing several of the data distribution and management challenges faced by financial firms, such as:
  - Market Data Distribution
  - High Performance Caching
  - Real-Time Business Intelligence
- OpenSplice DDS has great performance on standard COTS HW and its architecture is designed for exploiting at best high-end multi-cores such as the Intel XEON 5500
- OpenSplice DDS is Commercially Supported Open Source Software

OpenSplice|DDS

Delivering Performance, Openness, and Freedom



Embrace Performance, Openness and Freedom. Join the OpenSplice DDS Community at www.opensplice.org

OpenSplice|DDS

PRISMTECH

Online Resources

OpenSplice DDS

Delivering Performance, Openness, and Freedom

- http://www.opensplice.com/
- emailto:opensplicedds@prismtech.com

twitter

- http://twitter.com/acorsaro/

webex™

- http://bit.ly/1Sreg

Blogger

- http://opensplice.blogspot.com

YouTube

- http://www.youtube.com/OpenSpliceTube

OMG OBJECT MANAGEMENT GROUP DDS

- http://www.dds-forum.org
- http://portals.omg.org/dds