

OpenSpliceDDS MATLAB-Simulink

Version 1.0 - September 7th, 2026



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Innovation shapes the vision.

Hard work brings it to life.

Determination turns it into success."

— ZettaScale Technology

About ZettaScale

ZettaScale's mission is to bring to every connected human and machine the unconstrained freedom to communicate, compute and store — anywhere, at any scale, efficiently and securely. We strive for excellence as engineers and humans -- we firmly believe that we can't separate "the engineer" from "the human". As such we embrace and promote the Seven Knightly Virtues of Courage, Justice, Mercy, Generosity, Faith, Nobility and Hope.



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OpenSpliceDDS is part of the ZettaScale DDS offering - it is a fully featured DDS implementation targeted for enterprise platforms and devices. It is fully interoperable with Cyclone DDS, Vortex Link and Vortex Insight products. The OpenSpliceDDS product offering is made of the Core offering and a set of commercially available add-ons and extra features. The OpenSpliceDDS Core is a full implementation of the Object Management Group (OMG) Data Distribution Service for Real-time Systems (henceforth DDS) rev1.4 standard (DCPS profiles) and the DDSI-RTPS v2.4 interoperable wire-protocol.

1. Data Distribution Service and MATLAB Synergy

The Data Distribution Service (DDS™) technology is a middleware platform made of a set of standard APIs and Interoperable protocols to build data-centric systems. This open technology is under the governance of the international standards consortium (OMG®), Object Management Group®.

With DDS, Data and their associated Quality of Services are the only contracts that bound and integrate distributed applications together. Data can represent system States, Commands or Replies, Video and Audio streams, Documents and messages.

From that perspective, DDS helps building decoupled and flexible distributed architectures where Applications do not have to expose their location, their APIs, their internal behavior nor need to be active and alive at the same time. With DDS, the decoupling is bidimensional, it happens both in Space and Time.

This disruptive innovation provides, Secure, Low-latency and Ultra-high-throughput data exchange rates.

Furthermore, it provides extreme Reliability, automatic Discovery and Ultra-scalability features that business and mission-critical Internet of Things (IoT) applications need.

DDS shares the Right data at the Right place at the Right time, Every time, in a completely decoupled way.



Conceptually, DDS builds a distributed Global Data Space where applications that produce and consume data can share it in Real-time and Fault-tolerant ways. DDS guarantees exceptional deterministic behaviours, while providing unparalleled level of reliability, security and performance.

Over the last decade, it has been proven that DDS is the only technology that covers a wide range of application spectrums. It spans across the board, from embedded systems with extreme hard Real-time constraints to System of System, IIoT (Industrial Internet of Things) or at the intercontinental scales, including Air Traffic Control,

Combat Management, Scada Command and Control Systems, and many others. This technology is also deployed in Smart Cities, Smart Factories, Smart Grids, Software Defined Networks, Robotics, Healthcare and Medical devices, Transportation and Automotive markets.

OpenSpliceDDS is the market leader of DDS technology. OpenSpliceDDS offers both the middleware platform for intelligent data sharing as well as the required productivity tooling to Develop, Test, Tune, Deploy and Monitor the DDS based applications, everywhere and in every circumstance. Over Local Area, Wide Area, Low bandwidth, Adhoc, Mobile Networks or over the scale of Internet.

On the other hand, **MATLAB®** is ubiquitously used in numerical, scientific and industrial computing. The matrix based MATLAB language expresses easily computational mathematic concepts. Its Built-in graphics make it easy to visualize and gain insights from data. A vast library of prebuilt toolboxes allows you to build complex algorithms in your specific domain. You can run your analysis on **larger data sets** and scale up to clusters and clouds. MATLAB code can be integrated with other languages and technologies including **OpenSpliceDDS**, enabling you to feed your applications and algorithms **with Real-time data** from your production systems and deploy them on the **Edge** or in the **Cloud**.

Similarly, **Simulink®** is a modeling tool with block diagram environment for multi-domain simulation and ModelBased Design. It supports system dynamics simulation, system-level design, automatic code generation, and continuous test and verification of embedded systems. Simulink provides a graphical editor, customizable block libraries. It is integrated with MATLAB® as well as OpenSpliceDDS, enabling you to represent and model the Key DDS computational entities and incorporate MATLAB algorithms into one model. Subsequently, you can generate the code and export simulation results to MATLAB for further analysis or spread them through OpenSpliceDDS in the DDS Global Data Space.

OpenSpliceDDS, MATLAB® and Simulink® are now fully integrated enabling you to design and develop a wide range of advanced products, including automotive systems, defense, aerospace flight control and avionics, telecommunications, industrial machinery, medical devices, and other electronics equipment. They are your fundamental tools and platforms for your research and development.



2. Simulink Integration with OpenSpliceDDS

The OpenSpliceDDS product comes with a free of charge **DDS-Simulink Integration Module**. The DDS-Simulink

Integration Module provides a dedicated building block library to model how the DDS interacts in a Simulink Model. As shown in Figure 1, each DDS entity, such as Publishers/Subscribers, Readers/Writers and Topics is represented by a dedicated block in the Simulink model.

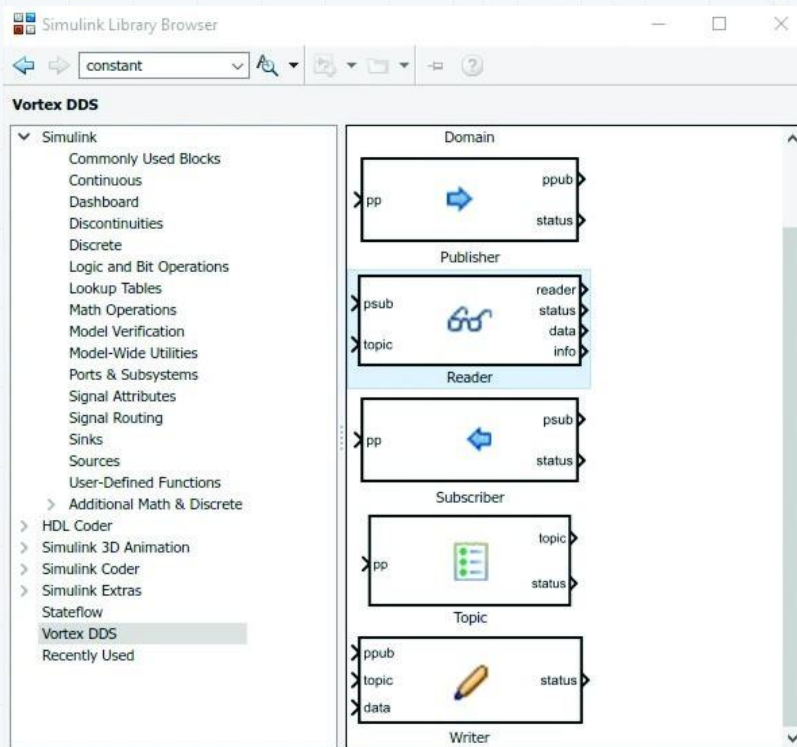


Figure 1 OpenSpliceDDS Integration with Simulink

Furthermore, each DDS block has an associated QoS profile that can be tuned and refined to control the behavior of the underlying DDS entity.

Simulink data is represented in buses whose types need to map with DDS datatypes. Therefore, sending Simulink data to DDS requires a conversion from Simulink types to DDS types. Simulink buses will be mapped to DDS topic types and vice versa. The user can generate or create the Simulink bus definitions by either generating them from an IDL file, or by using the Simulink bus editor.

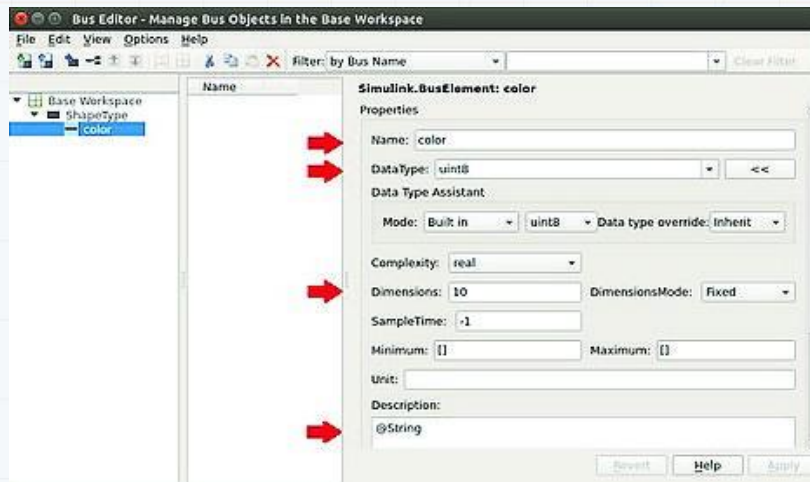


Figure 2: Mapping Data Types Using Simulink Bus Editor

If required, you can filter or query the data using the DDS SQL query language as shown in the Figure 3.

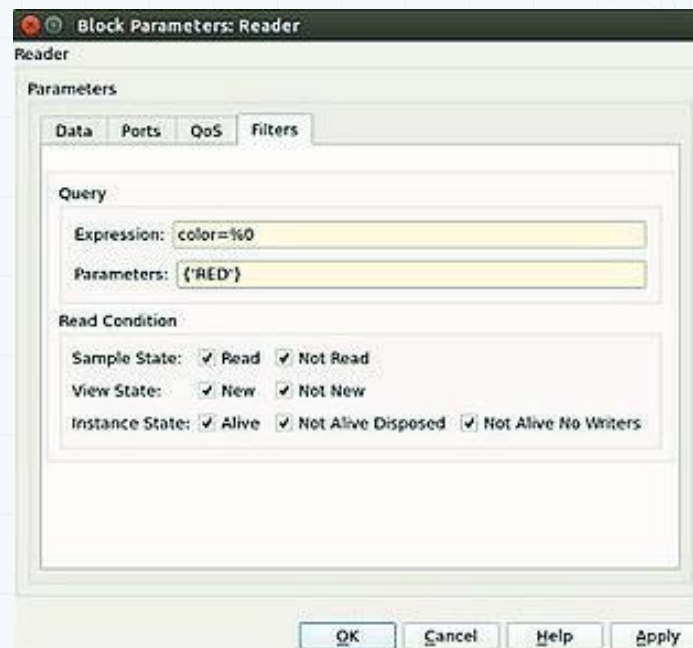


Figure 3: Query definition using OpenSpliceDDS Simulink Integration Module

Once the key DDS building blocks and datatypes are defined and associated to DDS topics, the user can wire and interconnect the DDS building blocks together including Simulink native modeling blocks such as Math function, Time function or Simulink Display blocks to build complete simulation module. The user can then run the simulation as depicted in the figure below.

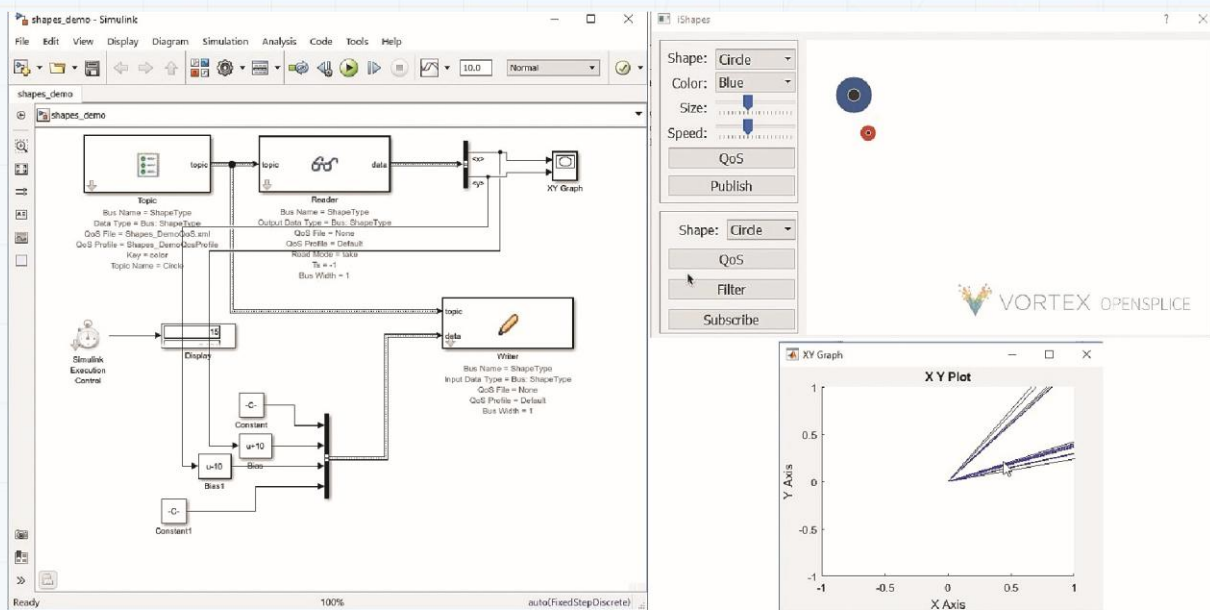


Figure 4: OpenSpliceDDS Publisher and Subscriber Models Integration with Simulink

Once your model has been validated via simulation mode, you are ready to generate and compile (or cross compile) the associated code of your models. The OpenSpliceDDS Simulink Integration Module interacts with Simulink Code to generate the corresponding C code from the DDS building blocks. Once compiled your simulation can run on your selected target in a distributed way via DDS.

Similarly, instances of MATLAB OpenSpliceDDS classes can be created in MATLAB and interact with DDS entities as shown in the next section.

3. MATLAB Integration with OpenSpliceDDS

The DDS MATLAB Integration provides users with DDS MATLAB classes to model DDS communication using MATLAB language.

Typically, during the development phase users need to:

1. Define a **DDS Data Model** using the standard OMG IDL data definition language.
2. Translate the DDS Data Model into **MATLAB DDS Entity Classes** (e.g Topic classes).
3. Code your MATLAB program using the **MATLAB API for OpenSpliceDDS**.

These steps are summarized in code snapshot below:



Figure 5: MATLAB based Pub Sub Applications

The MATLAB API for OpenSpliceDDS supports all the DDS capabilities in terms of QoS, data filtering and querying.

4. Conclusion

With OpenSpliceDDS you can achieve System Integration including MATLAB and Simulink based applications and simulations and build a Widely Distributed Global Data Space. The Global Data Space will handle and manage in real-time and no single point of failure all your valuable data taking into account its semantic, type, content and format. You can therefore build a situation awareness layer on top of your Global Data Space to control and monitor your system and build added value services to your end users at minimum cost.

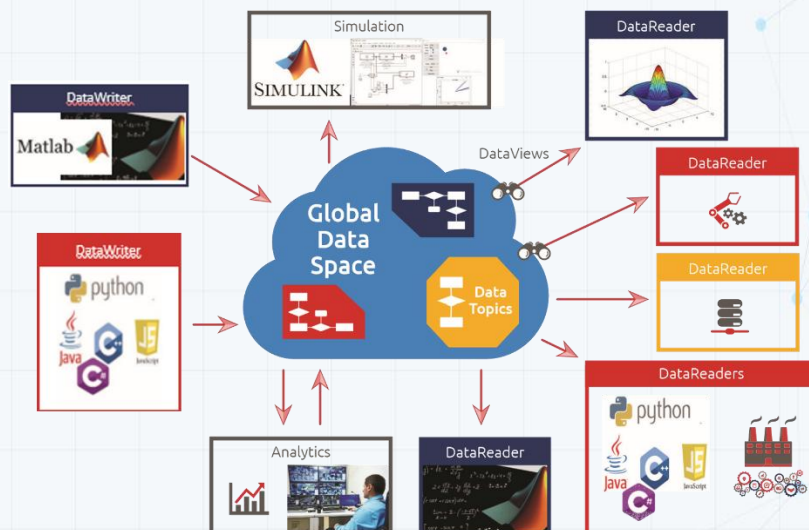


Figure 6: Global Data Space integrating and streaming MATLAB and Simulink data

References and For More Information

For further information regarding OpenSpliceDDS, please e-mail: contact@zettascale.tech or visit: www.zettascale.tech



OpenSpliceDDS

DATA-CENTRIC MIDDLEWARE FOR MISSION-CRITICAL SYSTEMS



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