TWINOAKS COMPUTING INC.

PRACTICAL MIDDLEWARE EXPERTISE

Interoperable DDS Strategies

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Contents:

As **a leading innovator,** you selected DDS to solve a complex communications challenge. Good choice! Now you recognize that your challenge is evolving: you need to consider adding more mobile and embedded devices into the network. The resource requirements of your DDS middleware are becoming a crucial factor. Even if you wanted your vendor to port to the rapidly expanding field of hand-held and mobile embedded devices, you wonder - will your applications still fit and run with needed performance levels within the memory footprint and CPU cycle constraints?

Figure 1: Examples of Supported Hardware

Your management or your client is now requesting you handle some new and interesting hardware and software, mobility solutions while bringing in data from new sources. To do this you might be able to select higher memory versions and/or faster CPU versions of the new devices in order to achieve the performance you need. Or you might be forced to drop features and functionality so that your DDS enabled application fits and provides acceptable performance. Either your costs go up or you leave out features. Do you really want to make that trade off? What options exist now?

Fortunately, one of the great strengths of the DDS standard is that it is open and provides interoperability between DDS versions from other suppliers. That's one of the reasons your choice of DDS was a good one!

Twin Oaks Computing (www.twinoakscomputing.com) has designed its implementation from the ground up especially for resource constrained environments. **CoreDX DDS** is a high-performance implementation of the OMG Data Distribution Service (DDS) standard. The **CoreDX DDS** Publish-Subscribe messaging infrastructure provides high-throughput, low-latency data communications in an extremely small footprint.

CoreDX DDS applications can easily communicate with applications based on DDS from other vendors. This multi-vendor interoperability is enabled by multiple standards managed by the Object Management Group (OMG), including specifications of the application programming interface (API), real-time publish subscribe wire protocol (RTPS), and quality of service (QoS) features. CoreDX DDS includes proven support across all of these interoperability aspects. Twin Oaks has publicly demonstrated CoreDX DDS interoperability with RTI DDS and OpenSplice DDS.

Interoperability is particularly important for systems that are deployed for long periods of time, often measured in the decades, before they can be upgraded or replaced. Maintaining these systems through individual component failures, and ever changing and expanding requirements is hard. Interoperable middleware technologies like DDS make this challenge easier. System

Integrators, faced with the challenge of integrating components from diverse sources, demand interoperability.

The Power of Interoperability

Consider an example DoD system, a typical distributed system originally deployed on commercial desktop hardware with commercial operating systems. The system was architected and implemented with DDS, a design choice that, once all developers were brought up to speed on the technology, eased development and deployment times. Now, nearly 10 years later, the Android market and devices are proliferating at an amazing rate, and the customer would like to make use of this technology by extending the reach of the existing system to individual, mobile, Android devices. The original DDS vendor does not support Android, but because DDS is a **Standards Based Technology** with proven **Interoperability**, this system maintainer can look to other DDS vendors for a possible solution. In this particular example, the contractor maintaining this DoD system contacted Twin Oaks Computing with the hopes of finding a native DDS solution for Android that would meet the customer's requirements - without requiring them to replace their existing DDS solution. Because of DDS Interoperability, they were successful. Now the customer has their enhanced system, connecting their legacy components with new Android devices, and they were able to do it ***without any modifications to the communication components of their legacy system.*** This is the strength of Interoperability, and the strength of the DDS Standards.

Interoperability Aspects

There are multiple aspects to middleware interoperability. These include the application programming interface (API), wire protocol, and quality of service (QoS) coverage. All of these elements play an important role in the interoperability of middleware technologies, and in the interoperability of DDS. In the case of DDS, there are standards specifying the API, the wire protocol, and the QoS coverage that must be adhered to by all participating DDS implementations. Furthermore, the DDS standards are Open Standards, which means they are publically available. Anyone can view and make use of these standards, which not only increases the education of the middleware community, but also increases the likelihood of additional vendor implementations and choices for the consumer. OMG accepts membership from all vendors, consumers, university, and government organizations, allowing all those interested in the technology to influence the standards that drive their development.

Application Programming Interface (API) and Interoperability

The DDS Application Programming Interface (API) is the interface between DDS and the application. It comprises the specific data types and function calls required for the application to interact with the middleware. Because the API is standardized, DDS consumers can replace DDS implementations with a simple recompile and little to no change in application code. A standardized API allows for **portability** of DDS middleware, and **eliminates vendor lock-in**, further reducing the risk of introducing a new technology like DDS. The Data Distribution Service (DDS) standard from the OMG specifies the DDS API.

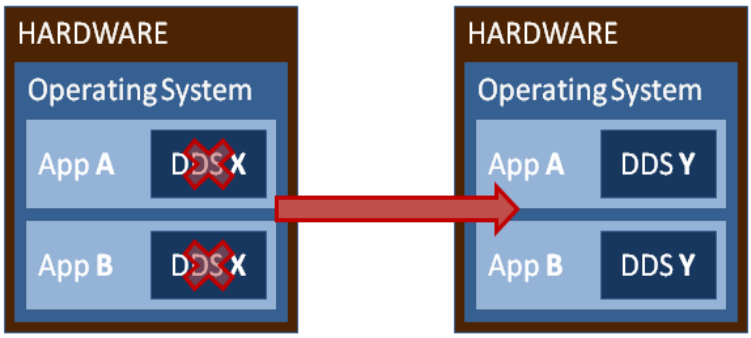

Figure 2: API Interoperability, replace DDS within an existing application

Wire Protocol and Interoperability

The Real Time Publish Subscribe (RTPS) protocol is responsible for DDS interoperability over the wire. The OMG also manages the RTPS standard, and adherence to this standard by multiple DDS vendors allows for wire protocol interoperability. RTPS is used as the underlying data transport protocol for CoreDX DDS communications. It provides support for all of the critical DDS technologies - Dynamic Discovery, Type-safe communications, platform independence, and Quality of Service (QoS) matching. This aspect of interoperability enabled the DDS consumer in the above example to easily extend their distributed system by adding an additional DDS implementation. CoreDX DDS makes strategic use of MULTICAST and UNICAST data communications based on application needs. CoreDX DDS provides a native implementation of RTPS - there are no RTPS gateways, daemons, or helper applications required - for the best performance possible.

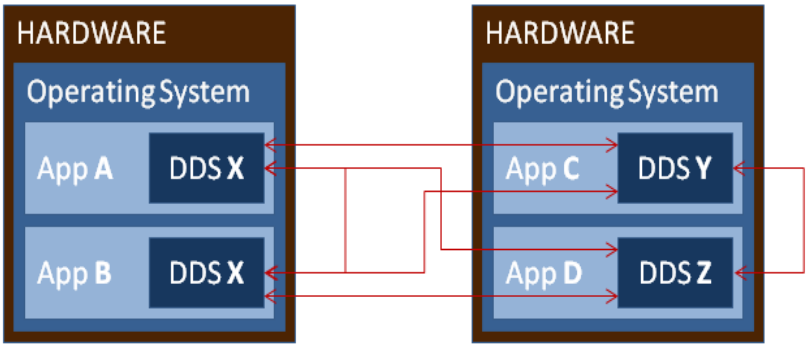

Figure 3: Wire Protocol Interoperability, different DDS implementations communicate

QoS Coverage and Interoperability

Quality of Service (QoS) policies allow the application to tailor the specific behavior of data communications. This tailoring includes many different aspects of data communication. Examples of QoS policies include **Reliability** (what are the reliability requirements for this data?), **Durability** (how long is data saved for possible future publication?), **History** and **Resource Limits** (what are the storage requirements?), **Filtering** and **Presentation** (which data should be presented to the subscriber, and how?), and **Ownership** (are there any failover or redundancy requirements?) These are just a few of the twenty-two distinct QoS policies defined by the DDS standards.

These QoS policies provide a rich set of configuration options, allowing applications to easily take advantage of very complex and powerful communication strategies. QoS features play a role across all aspects of interoperability. Of course, the API for QoS configuration and the wire protocol for QoS interaction must be standardized in order to provide portable and wire-interoperable DDS implementations. However, it is the **coverage** of these QoS policies – the number of these standardized QoS policies implemented by each DDS vendor – that allows for truly interoperable implementations.

The DDS standard, in addition to specifying the DDS API, also categorizes the QoS features into profiles that define different levels of compliance. The *minimum profile* contains most of the twenty-two QoS policies, and defines the minimum set of QoS policies that must be **covered** in order for a DDS implementation to be compliant with the standard (and therefore, interoperable). The additional profiles contain the remaining QoS policies and are well specified in order to clearly define the different levels of compliance (and therefore, interoperability).

All of these interoperability aspects put together allow the greatest flexibility for middleware consumers.

Achieving Interoperability

The DDS and RTPS standards from the OMG are the first ingredient to achieving interoperability. But standards alone are not enough without vendors to create, maintain, and test the ability of their implementations to operate.

In order to have meaningful interoperability, there must be more than 1 implementation (from more than one vendor). It is therefore important to enable and even encourage additional implementations and additional participation by new and existing vendors. The DDS technology is well documented in Open Standards, and at least one vendor has developed a viable and extremely competitive DDS implementation based strictly on the DDS Open Standards. This is rare proof of the validity of the DDS standards offered by the OMG.

Figure 4: DDS vendors, OMG-hosted Public Interoperability Demonstration, March 2011

The next element in achieving interoperability is the regular testing by participating vendors of the interoperable technology. This is not necessarily easy to accomplish, as it requires the independent cooperation of competing companies, including not only the donation of their time and money to support testing, but also the to sharing of (sometimes highly competitive) details of their implementations. This close level of cooperation is required in order to successfully test and maintain each of the aspects of interoperability. The currently participating DDS vendors, including Twin Oaks Computing, go a step further in their cooperation to support periodic public demonstrations of interoperability. This inter-competitor cooperation required for true interoperability is extremely rare, and cannot be over-emphasized in its importance the success of DDS interoperability and its benefits for users of DDS technology.

The final piece of the interoperability puzzle is the regular and continuing maintenance of the standards, the vendor implementations, and testing of interoperability. Without regular maintenance, interoperability cannot be maintained. Since the most valuable benefits from interoperability come from long-lived systems and programs, this commitment to maintenance is critical to the long term success of the DDS technology.

Future of Interoperability

Twin Oaks Computing is committed to interoperability. We were involved in the very first interoperability test and demonstration on March, 24, 2009 in Washington, DC, and have been actively involved in keeping our CoreDX DDS compliant with the evolving standards and with ongoing testing with the other interoperable vendors.

Most DDS consumers recognize the benefits of interoperability, especially where it provides them the flexibility to adapt and extend their systems with very little cost. Here are a few examples of the types of new devices are our clients using or planning to use to extend their projects with CoreDX DDS:

- Android based phones, tablets and embedded devices
- QNX based mobile devices
- Set-top boxes
- Gateways
- Gumstix tiny Linux computers
- Micrium µC OS
- FPGA's
- Safety Critical Applications

CoreDX DDS Source Code

The CoreDX DDS source code is clean, easy to read, easy to build, easy to port, and easy to modify. Further, with the availability of CoreDX DDS Source Code Training and shared, online problem tracking tools, the CoreDX DDS source code is the answer to your expanding requirements.

Further, the small line of code count of CoreDX DDS helps certification costs. CoreDX DDS was written using a robust disciplined process that is fully documented. It is completely native source code, 100% designed and developed by Twin Oaks Computing. CoreDX DDS does not include (and is not built on top of) any 3rd party commercial or open source products.

Conclusion and Summary

The DDS technology increases software development productivity, reduces risk, and eases deployment and maintenance challenges in dynamic systems. DDS Interoperability allows consumers to replace or augment one DDS implementation with another better suited to their requirements and extend already deployed systems with new applications using different DDS implementations. This flexibility further reduces risk and further enables management of changing systems.

You made a good choice before. Make a good choice again – this time with the Interoperable CoreDX DDS from Twin Oaks Computing. Download a free evaluation copy at www.twinoakscomputing.com/coredx/download.

About Twin Oaks Computing

Twin Oaks Computing, Inc. is a company dedicated to developing and delivering quality software solutions. Our staff has extensive experience developing and supporting robust communication architectures. We leverage this world-class technical experience to provide innovative and useful communication software systems. We build the software that collects, manages, and distributes information in a wide range of industries. Our software is in use around the world supporting critical missions.

Equally important, our clients are amazed and totally satisfied with our super responsive customer service. One of our early customers in China states,

> *"Twin Oaks Computing [provided] great porting work during very short period of time (each porting for about 2-3 weeks). This made me really appreciate the portability framework of CoreDX DDS."*
>
> - Mr. Huang

More recently, we received this comment,

> *"There is nothing I don't like about working with Twin Oaks Computing. In particular, working with Nina is a singular pleasure in today's world of technical support - she is very responsive and helpful."*
>
> - Mr. Michael Mezzino

Super-small and blazingly fast, our flagship product, CoreDX DDS is the leading Publish-Subscribe middleware available for small-footprint and embedded systems.

For more information please visit www.twinoakscomputing.com.

About Twin Oaks Computing

With corporate headquarters located in Castle Rock, Colorado, USA, Twin Oaks Computing is a company dedicated to developing and delivering quality software solutions. We leverage our technical experience and abilities to provide innovative and useful services in the domain of data communications. Founded in 2005, Twin Oaks Computing, Inc delivered the first version of CoreDX DDS in 2008. The next two years saw deliveries to over 100 customers around the world. We continue to provide world class support to these customers while ever expanding.

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