Network middleware provides the communication infrastructure that make complex, distributed systems possible. Traditional client-server solutions offer standard protocols, but often don’t fit real-time systems well. Publish-subscribe networking is an elegant, powerful addition. It allows many distributed systems to efficiently share data in a network. With the recent addition of OMG’s Data-Distribution Service (DDS) standard, publish-subscribe networking is now ready for the most demanding applications.

RTI created the first commercial publish-subscribe middleware for real-time systems—Network Data Distribution Service (NDDS®). It works on multiple architectures, operating systems, compilers, and physical networking transports. NDDS was designed from the ground up for high-performance and embedded applications.

NDDS is field proven and successfully used in many mission-critical applications around the world, including optical transport interconnect messaging, Navy shipboard communications, air-traffic control systems, and distributed industrial control.

“NDDS provides a scaleable real-time COTS middleware that is easy to integrate and has proven to be very reliable in the field.”

Sea SLICE Lead Software Engineer
Introduction to Publish-Subscribe

There are two basic networking paradigms in common use: client-server and publish-subscribe.

**Client-Server**

Client-server networks connect multiple clients through a central server. Most enterprise networking is client-server based, including HTTP, CORBA, and DCOM. Client-server is best for:

- Naturally-centralized information
- No single-point failure or data bottleneck problems
- Little data between clients

**Publish-Subscribe**

Publish-subscribe networks push data out, in the same way that magazines and newspapers deliver content. Publish-subscribe has gained rapid growth and acceptance due to its simplicity, versatility, and low overhead. Publish-subscribe is best for:

- Complex networks and data flow
- Fault-tolerant networks
- Time-critical node-to-node transfer
- Dynamic “plug and play” operation

OMG Networking Standards

The Object Management Group (OMG) developed both the CORBA and the DDS standards. CORBA addresses client-server object distribution, DDS addresses publish-subscribe data distribution.

DDS extends the publish-subscribe model for real-time systems. It supports deadlines, publisher arbitration and failover, reliability tuning, and more.

The OMG Middleware and Related Services Platform Task Force (MARS PTF) produced the DDS specification to address the need for a data-centric publish-subscribe standard.

<table>
<thead>
<tr>
<th>Property</th>
<th>CORBA</th>
<th>DDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Model</td>
<td>Client-Server</td>
<td>Publish-Subscribe</td>
</tr>
<tr>
<td>Primary Use Case</td>
<td>Call Remote Methods</td>
<td>Send Data to Many Nodes</td>
</tr>
<tr>
<td>Implementation</td>
<td>Complex, General</td>
<td>Simple, Lightweight</td>
</tr>
<tr>
<td>Target Application</td>
<td>Many</td>
<td>Real-Time Systems ranging from Embedded to Enterprise</td>
</tr>
<tr>
<td>QoS Configurability</td>
<td>Limited Real-Time QoS</td>
<td>Determinism/Reliability Levels, Deadline, Resource Usage, Bandwidth Usage, More</td>
</tr>
<tr>
<td>Underlying Network</td>
<td>Connection-Oriented</td>
<td>Connectionless</td>
</tr>
</tbody>
</table>

“CORBA covers the client-server communication requirements for distributed real-time systems and DDS covers the data-distribution requirements. The DDS specification is a significant addition to OMG’s real-time networking standards.”

Char Wales, Co-chair of the MARS PTF at OMG
NDDS Real-Time Publish-Subscribe Network Middleware

NDDS is network middleware that sits between your application and the operating system. It is a layer of software that sits on top of a network stack. It simplifies the underlying low-level network code with a common, standards-based, application programmer interface (API).

NDDS alleviates the need to manage complicated initialization procedures, network addresses, failover, and a host of other tricky networking chores.

NDDS takes care of these tasks. The programmer simply uses a few NDDS function calls, replacing hundreds of socket calls.

The publish-subscribe model defines:
- Publishers, which simply create a publication and give it a topic name. To send an issue (data), the application just calls a single NDDS function.
- Subscribers, which simply create a subscription to a topic name and tell NDDS what to do when a new issue arrives.

NDDS handles the network I/O, transparently sending each published issue to all interested subscribers.

NDDS Tools

The NDDS tools help debug, fine-tune, and maintain publish-subscribe networks.

**Surf**

Surf visualizes network connections. See all the connections in your system, and easily analyze data flow.

**Snoop**

Snoop analyzes the protocol, showing you every byte on the network. Easily see how your network is used, track down application errors, and ensure sufficient bandwidth margins.

**Scope**

Scope shows you the data inside the NDDS packets on the wire. Capture the data being sent, and plot or save it for analysis.

The publish-subscribe model takes care of channel configuration and data distribution for the application.
Application Examples

Land

**National Automotive Driving Simulator**
The US Army and the University of Iowa use NDDS to tie together VPG simulators to test and evaluate Army vehicles and components.

**Schneider PLC Devices for Factory Automation**
Schneider Automation uses NDDS to provide global data access in its new line of programmable logic controllers.

Air

**CAE SimXXI Flight Simulator**
CAE powers their next generation flight simulators with NDDS for real-time communications between simulator subsystems.

Sea

**US Navy LPD-17**
NDDS forms the backbone for the entire Ship-Wide Area Network (SWAN) on the Navy’s newest ship.

**Schilling Electric Work-Class ROV**
ALSTOM Schilling Robotics built the communications system for the Quest remotely operated undersea vehicle using NDDS.

Space

**NASA Robonaut**
Johnson Space Center uses NDDS for simulation and communications of their EVA robot, Robonaut.

Availability

**Multi-Language:**
- C
- C++
- Java
- [More]

**Extensive training and consulting available**

**Multi-OS:**
- Windows NT, 2000, XP
- Linux
- Solaris
- VxWorks
- Integrity
- LynxOS
- [More]

Additional Information

**See www.rti.com for:**
- Publish-Subscribe Overview
- Performance Paper
- Build Your Own Middleware Guide
- DDS Standard
- Load Calculation Spreadsheet
- Ethernet Can Be Real Time Paper
- RTPS Wire Protocol Specification
- Application Examples

About RTI

Real-Time Innovations, Inc., the expert in real-time information networking, leads the industry with high performance standards-based software solutions for data-critical applications. Its products and consulting services provide the infrastructure for national railways, air traffic control, traffic monitoring, mission-critical combat systems, financial transaction processing, and industrial automation. RTI’s flagship product, NDDS, is middleware based on the Object Management Group’s (OMG) Data Distribution Service (DDS). NDDS provides the essential foundation for real-time communication in a networked system and enables a new class of embedded to enterprise (e2E) applications. Raytheon, Nikon, Omron, Harmonic, Applied Materials, Schneider Automation, Boeing, Lockheed Martin and the US Military rely on RTI technology for their real-time, data-centric, distributed applications. Headquartered in the heart of Silicon Valley since 1991, RTI is a privately held company.