Network Data Distribution Service (NDDS)

Real-Time Publish-Subscribe Network Middleware

"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

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.

Requirement	NDDS Delivers
Direct transfer from node-to-node	Faster than other middleware; performance is there when you need it
Support for many architectures, OSes, and languages	Connects complex systems and expands to cover future needs
Dynamic reconfiguration	Nodes can enter and leave system in any order at any time
Many-to-many communications	Send the data everywhere you want it, now
Scalability	Build large systems with thousands of topics
Multicast support	Distribute data to many nodes efficiently
Configurable QoS	Tune to meet complex delivery requirements
No central server	Prevents single point-of-failure and bottlenecks
Tools	NDDS tools simplify development, testing, and maintenance

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.

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

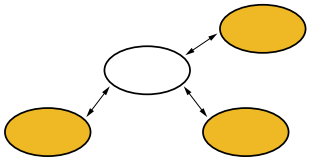
Publish-Subscribe

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.

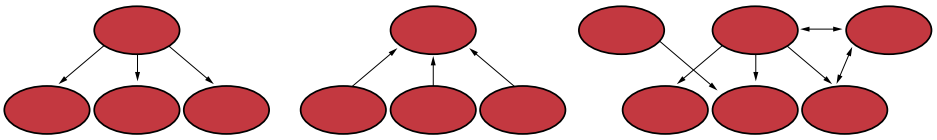
Publish-subscribe is best for:

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

Client-Server



Publish-Subscribe



One-to-Many *Many-to-One* *Many-to-Many*

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.

"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

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

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).

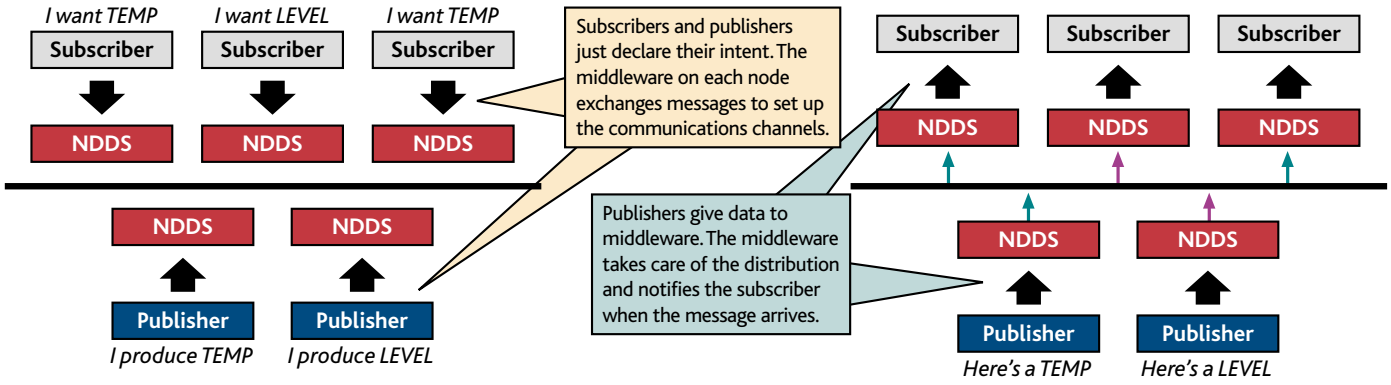
NDDS alleviates the need to manage complicated initialization procedures, network addresses, failover, and a host of other tricky networking chores.

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.



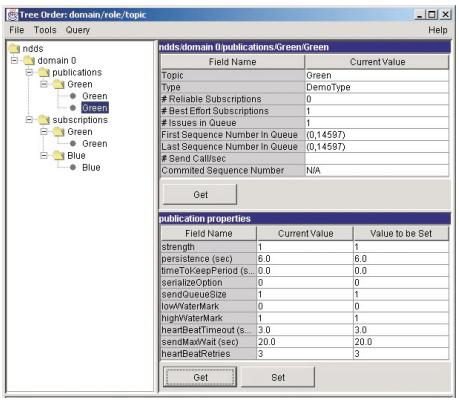
The publish-subscribe model takes care of channel configuration and data distribution for the application.

NDDS Tools

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

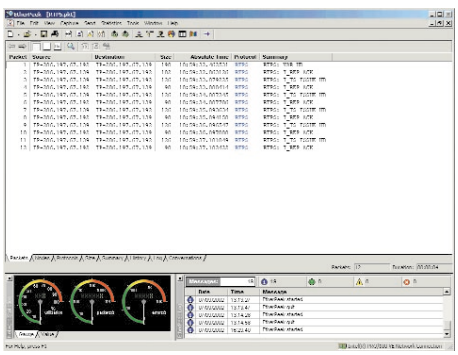
Surf

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



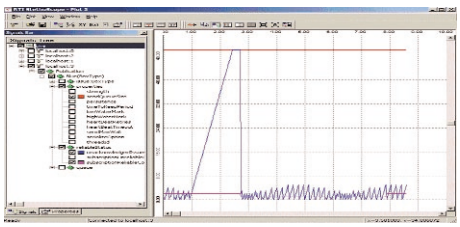
Snoop

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.



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.

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