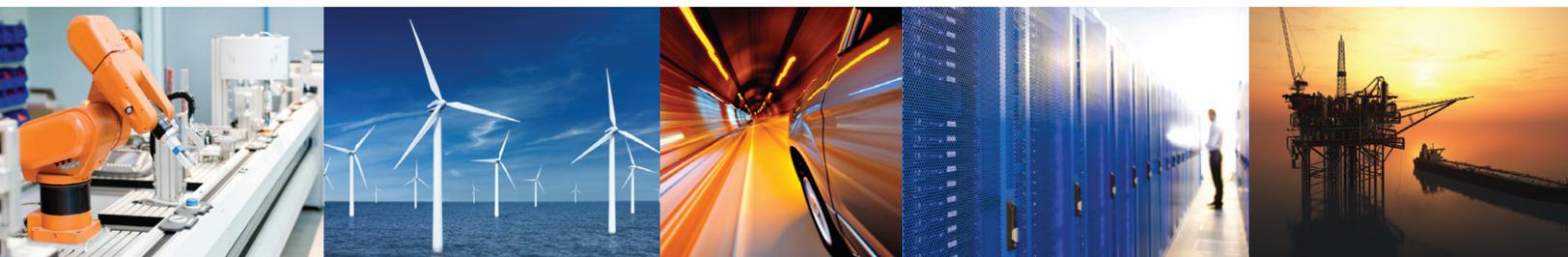


RTI Connex DDS Professional

Connectivity Software for Developing and Integrating IIoT Systems



RTI Connex[®] DDS Professional is the first connectivity software designed to meet the demanding requirements of the Industrial Internet of Things (IIoT). It delivers the low-latency, high reliability, scalability and security essential for mission-critical systems. The Connex DDS Databus significantly reduces development, integration and maintenance costs.

Highlights:

DDS network protocol and API compliance

Gateway Toolkit and adapters for integrating non-DDS components

Interoperability across programming languages, operating systems and CPU families

Shared memory, LAN, WAN and Internet transports

Latency under 50 microseconds over Gigabit Ethernet

Throughput over millions of messages/second

Scalability to millions of tracked data values

Decentralized peer-to-peer communication with no message brokers or servers

Non-stop availability with live upgrades and no single point of failure

Reliable multicast for efficient data distribution

Automatic discovery for self-forming and self-healing systems

RTI Connex DDS Professional comprises a connectivity framework and supporting tools for the IIoT. It distributes real-time data and messages across a system, from devices at the edge, to control applications in the fog, to analytics in the cloud. It provides facilities to accelerate the development of new, interoperable software components as well as the integration of existing and third-party assets.

Connex DDS Professional complies with the Object Management Group (OMG) Data Distribution Service (DDS). DDS is the only connectivity standard designed to support the demanding Quality of Service (QoS) requirements of autonomous cyber-physical systems.

DDS provides a highly scalable integration paradigm. It specifies a software databus – a data-centric framework for distributing and managing real-time data. DDS applications communicate by simply publishing the data they produce and subscribing to the data they consume. Applications need no knowledge of each other; the databus automatically discovers and routes data between matching publishers and subscribers.

Connex DDS Professional includes:

- DDS libraries proven in more than 1,000 systems with the world's most demanding reliability, scalability and performance requirements
- A Gateway Toolkit and adapters to ease integration of application and devices that do not natively support DDS
- Powerful tools that accelerate integration, testing and debugging

Connex DDS Professional is also backed by RTI's unparalleled expertise in architecting, developing and deploying IIoT systems.

Most Robust and Productive Development Environment for DDS Systems

Connex DDS Libraries provide a native, DDS compliant interface to the Connex DDS databus for embedding directly into applications and devices.

Security Plugins, included in Connex DDS Secure, support authentication, encryption, access control and logging based on the DDS Security standard. They provide fine-grain control over security policies and support any Connex DDS transport, including multicast.

Gateway Toolkit enables easy integration of non-DDS applications systems. It includes the source code to several sample adapters that can be customized to support a wide variety of standard and proprietary interfaces.

Routing Service supports systems-of-systems composition. It bridges data across transport protocols, physical networks and security domains. It monitors subscriptions and only forwards currently subscribed data for efficient bandwidth utilization. It can also transform data between applications that use incompatible data types schema.

Web Integration Service provides a RESTful HTTP interface to the databus for easy integration with web applications and scripting languages.

Database Integration Service provides bi-directional integration between the Connex DDS databus and a relational database. It stores published data in the database and can publish database updates to subscriber applications.

Administration Console monitors, controls and debugs a DDS-based system from a centralized tool. It provides non-intrusive visibility into a running system — including nodes, participants, topics, types, QoS and configuration mismatches. It also allows you to visualize data being distributed, administer run-time services and view system-wide logging messages.

Monitor helps diagnose performance problems and tune systems. It displays comprehensive performance, health and resource utilization statistics in a graphical view.

Distributed Logging provides a high-level API for publishing log messages using the Connex DDS databus. Log messages can be visualized from RTI Monitor, Admin Console or subscribed from a custom tool.

Prototyper quickly simulates system components to test applications and assess scalability before development is complete.

Code Generator generates type-specific and type-safe DDS interfaces from IDL or XML data type descriptions. It also generates example publishers and subscribers, makefiles and IDE projects.

Ping and Spy are command-line utilities for checking system connectivity and inspecting packet content.

Persistence Service makes data available to late-joining consumers even if the original publisher is no longer

accessible. It can also offload reliability protocol overhead from CPU-limited producers or those connected over bandwidth-constrained networks.

Performance Test measures network throughput and latency under a given publisher

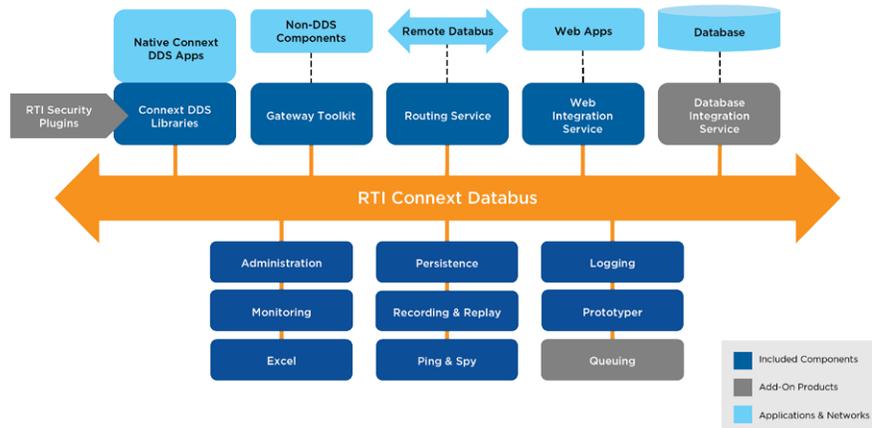
and subscriber configuration and message size. It helps in understanding network capabilities and the impact of different configuration settings.

Spreadsheet Add-in uses Microsoft Excel to display, visualize and write-back RTI Connex DDS data.

Queuing Service delivers each message to only one consumer, enabling efficient load balancing, workload distribution and transaction processing.

Limited Bandwidth Plugins allow DDS applications to run in a bandwidth-constrained network, such as satellite or radio links and does not require use of the Internet Protocol (IP). The Plugins also include a simulator for emulating and testing behavior over low bandwidth networks.

Recording and Replay Service records high-throughput real-time data for future analysis and debugging. Recorded data can be replayed for testing and simulation using the original or modified QoS settings and data rates.





Powerful Data-Centric Paradigm

The Connex DDS Databus simplifies application and integration logic with a powerful data-centric paradigm. Instead of exchanging messages, software components communicate via shared data objects. Applications directly read and write the value of these objects, which are cached in each participant. Connex DDS handles the details of data distribution, synchronization and management, including serialization and lifecycle management. Developers do not have to deal with low-level messaging or networking interfaces.

The databus provides for data in motion what a database provides for data at rest:

- **Decoupling.** Data producers are agnostic to the number of consumers, their network location and the type of processing they do. This allows components to be added and changed without affecting those that are already deployed.
- **Easy integration.** The interfaces in a system—as defined by the data model—are explicit and discoverable. Integration requires no knowledge of a component’s implementation; there is no need to reverse engineer protocols and messages.
- **Robustness.** Connex DDS maintains a system’s shared state, providing a single source of truth. Late and re-joining applications automatically synchronize with the current state. This ensures applications have a consistent world view even in dynamic and large-scale environments.

Unlike a traditional database, subscribers can receive asynchronous notifications when data objects are updated.

Decentralized architecture

While Connex DDS provides many of the benefits of a database, its architecture is completely decentralized and optimized for real-time Quality of Service. Publishers send data updates directly to subscribers’ caches, peer-to-peer. Data is not routed through any intermediate database or message broker.

There are several benefits to this peer-to-peer architecture:

- Minimum latency with no intermediate brokers or extra network hops
- Maximum throughput and scalability with no broker acting as a choke point
- Non-stop availability with no single point of failure
- Easy embedding with no centralized services to deploy and administer
- Inherent security with no single point of vulnerability

Connex DDS also efficiently handles scenarios in which peer-to-peer communication is undesirable, for example when integrating a system of systems or implementing a layered databus architecture. In these cases, it is necessary to regulate the data flowing between networks to avoid overwhelming bandwidth.

To support this, RTI Routing Service can be used as a bridge between networks. Routing Service only relays data that is needed on a remote network. Unlike with a message broker, however, data flows on each individual network are still peer-to-peer. In addition, multiple Routing Service instances can be deployed for fault tolerance and load balancing.

Flexible communication patterns

In addition to data-centric publish-subscribe, Connex DDS supports additional interaction patterns to ease development.

Historical Data Query. Applications can retrieve historical data from publishers’ caches on demand, even if the data was not subscribed when originally written. This provides much more efficient and scalable access than speculatively subscribing to data that may not be needed.

Request/Reply. Connex DDS can issue a single request to multiple components and correlate multiple responses to a single request—for example, to track the execution status of a command.

Durable Subscriptions. Connex DDS can retain all updates to a data object—not just the preconfigured history—until they are acknowledged by a specified set of subscribers.

Application-Level Acknowledgement. Updates are not considered delivered until they are processed by the receiving application. This ensures critical data or commands are not lost if the recipient fails between receiving and processing an update.

Message Queuing. With the optional Queuing Service, Connex DDS delivers each message to only one consumer, enabling efficient load balancing.

Optimized for performance, scalability and availability

Automatic discovery eliminates the need for deployment-time configuration. Applications are plug-and-play, self forming and self healing, facilitating use in dynamic and ad hoc systems. Connex DDS automatically discovers and routes data between matching producers and consumers at run-time.

Transport protocol independence allows reliable communication over any network type, from the edge to the cloud, including:

- Shared memory within an intelligent machine
- UDP multicast on a LAN
- TCP or TLS over the Internet
- Non-IP radio or satellite links in the field

Seamless device mobility automatically re-locates and re-authenticates participants without data loss when their IP address changes. This can occur when roaming across networks or when switching between wired, wireless and mobile networks.

Reliable multicast provides scalable one-to-many and many-to-many data distribution. Messages only have to be sent over the network once, regardless of the number of subscribers. Connex DDS includes an optional multicast reliability protocol optimized for real-time behavior.

Smart filtering maximizes efficiency and scalability. Connex DDS can filter by specific content (not just metadata) and desired frequency of delivery, simplifying application logic. Filters are applied on the publisher's side to reduce network and processor overhead. In addition, when bridging networks, Routing Service only forwards currently subscribed data.

Quality of Service control eases integration of applications with disparate performance needs. The frequency, timeliness and reliability of data delivery are configurable per stream and per component. Applications are also notified if timing deadlines are missed so they can take remediating action.

Automatic failover between publishers and networks provides uninterrupted availability in the event of hardware and software failures.

Type extensibility allows data types to change over time without breaking interoperability with applications that use older or different versions of a type. This is essential for evolving IIoT systems with long lifecycles and for which it is infeasible to update already deployed applications. Types can be extended through the addition of new fields or modification of existing fields.

Programming Interfaces

- DDS: C, C++, C#/.NET, Java, Ada
- Lua[^], JavaScript (node.js)[^], Python[^]
- LabVIEW*, MATLAB*, Simulink*

Transports

- Shared memory
- UDPv4, v6 unicast and multicast
- TCP
- TLS, DTLS
- Low bandwidth

Operating Systems

- Linux, Windows, OS X
- VxWorks, QNX, INTEGRITY, LynxOS, AIX, Solaris
- Android, iOS

Processor Families

- x86, x64
- ARM
- PowerPC / Cell
- SPARC

DDS Compliance

- DDS API 1.4
 - Minimum, Persistence and Ownership profiles
 - ContentFilteredTopic & QueryCondition
- DDS Wire Protocol (RTPS) 2.2
- DDS Security 1.0
- C++ Language DDS PSM 1.0
- XTypes: Extensible and Dynamic Topic Types 1.1 (partial)
- Remote Procedure Calls over DDS 1.0 (partial)
- Web-enabled DDS 1.0
- DDS XML Syntax 1.0
- IDL 4.1

[^] Experimental product

* Third-party product

About RTI

Real-Time Innovations (RTI) is the Industrial Internet of Things (IIoT) connectivity company. The RTI Connex[®] databus is a software framework that shares information in real time, making applications work together as one, integrated system. It connects across field, fog and cloud. Its reliability, security, performance and scalability are proven in the most demanding industrial systems. Deployed systems include medical devices and imaging; wind, hydro and solar power; autonomous planes, trains and cars; traffic control; Oil and Gas; robotics, ships and defense.

RTI lives at the intersection of functional artificial intelligence and pervasive networkingSM.

RTI is the largest vendor of products based on the Object Management Group (OMG) Data Distribution Service[™] (DDS) standard. RTI is privately held and headquartered in Sunnyvale, Calif.



Your systems. Working as one.

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