



ENGINEER
NEXT

NIDays

The logo features the words "ENGINEER" and "NEXT" in a bold, white, sans-serif font, stacked vertically. A yellow graphic element, resembling a stylized arrow or a folded ribbon, is positioned between the two words. To the left of this text, the word "NIDays" is written in a smaller, white, sans-serif font, enclosed within a white rectangular border. The entire logo is set against a background of diagonal stripes in various shades of blue, green, and orange.

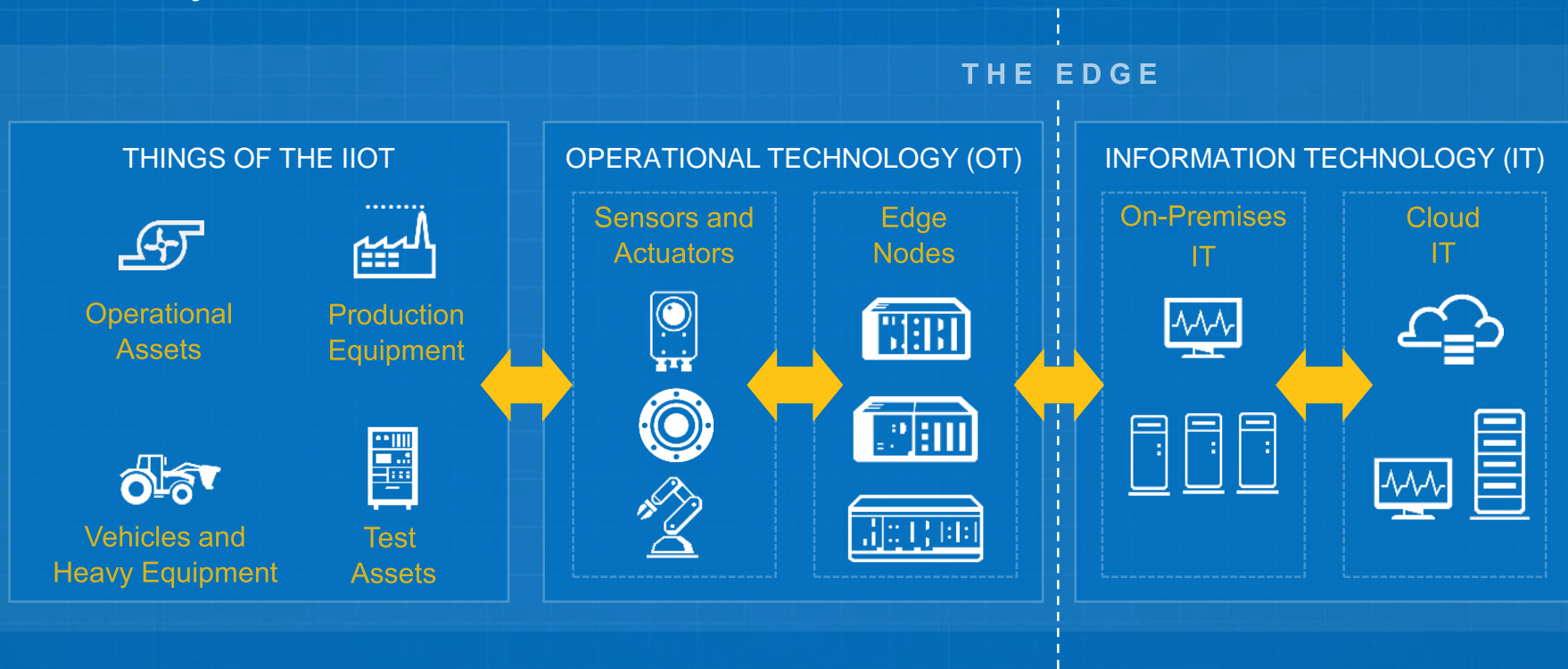
Practical Considerations for Connecting LabVIEW to the Industrial IoT

Dr. Fabian Wehnekamp
Applications Engineer

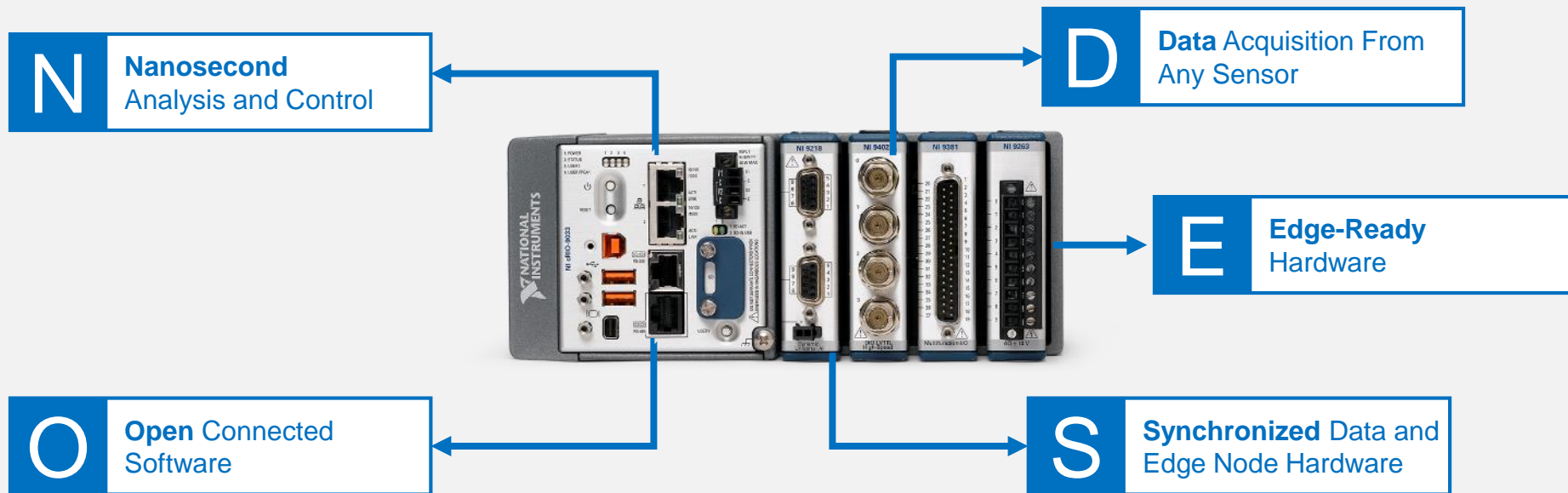
Today's Agenda

- Introduction to the Industrial IoT and NI Edge Nodes
- Speaking the IIoT “Lingo”
- Connecting to IoT Cloud Platforms From LabVIEW

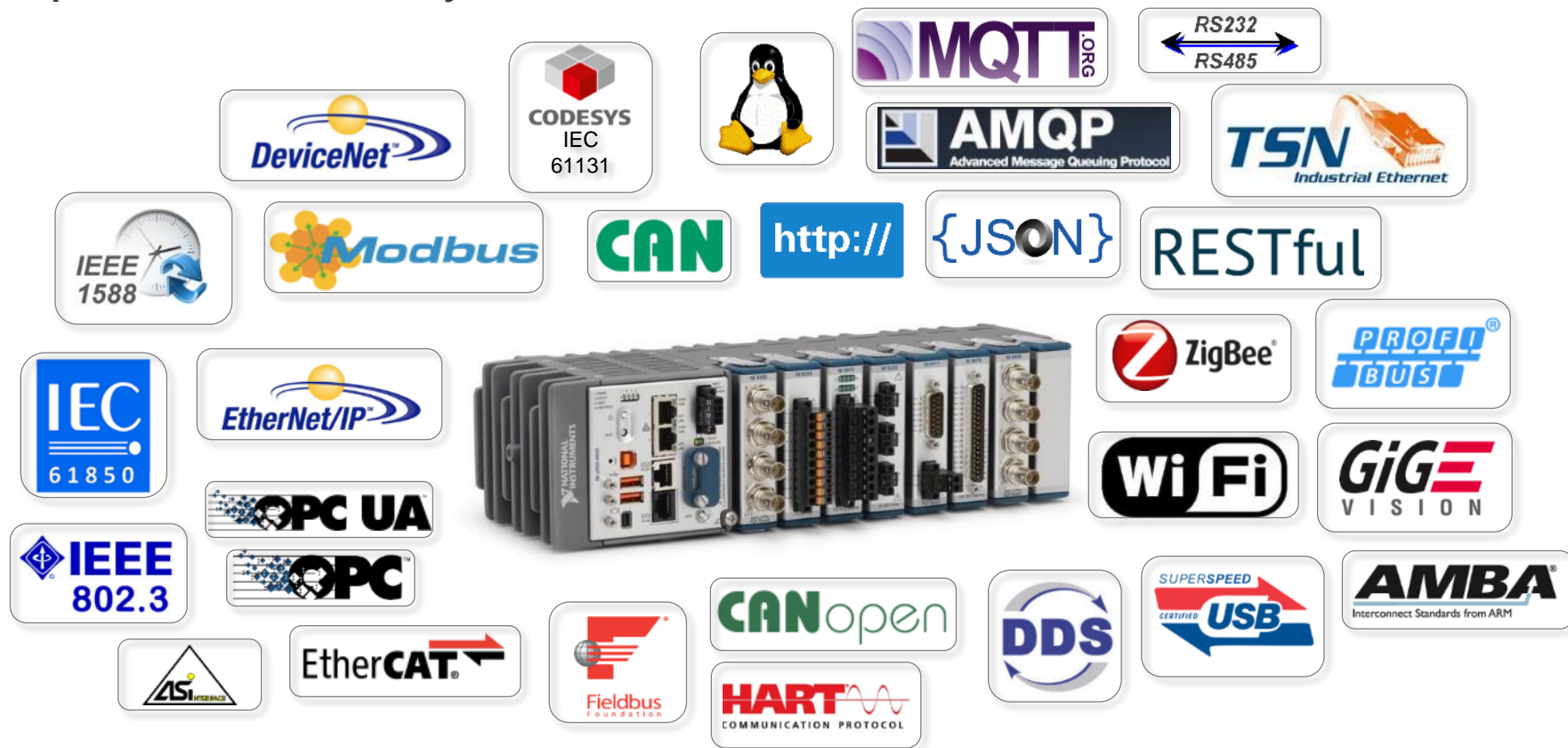
IIoT System Architecture



The NI Edge Node Advantage

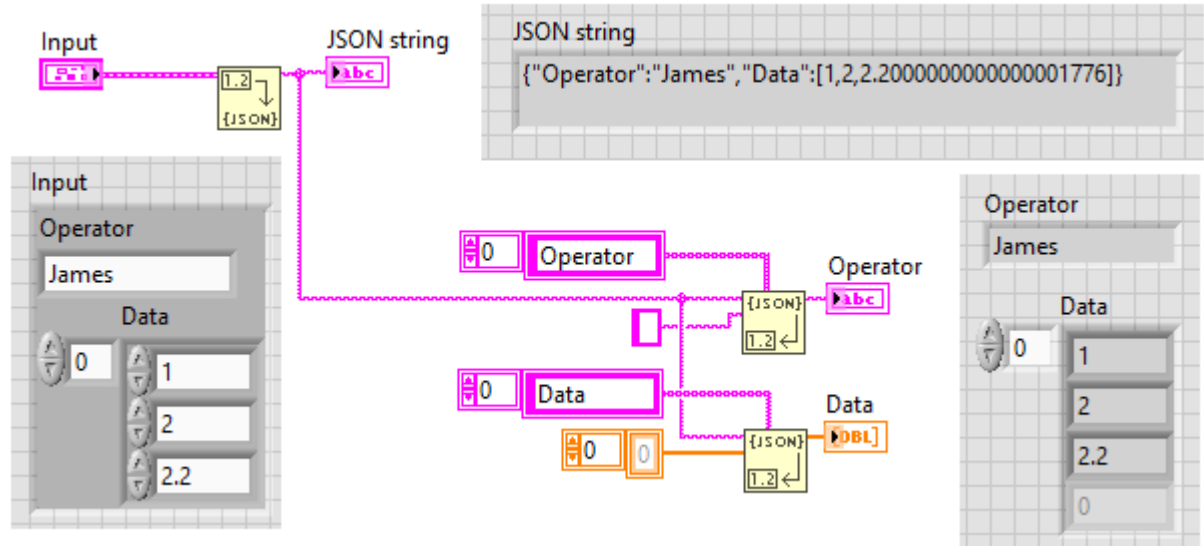


Open Connectivity to OT *and* IT

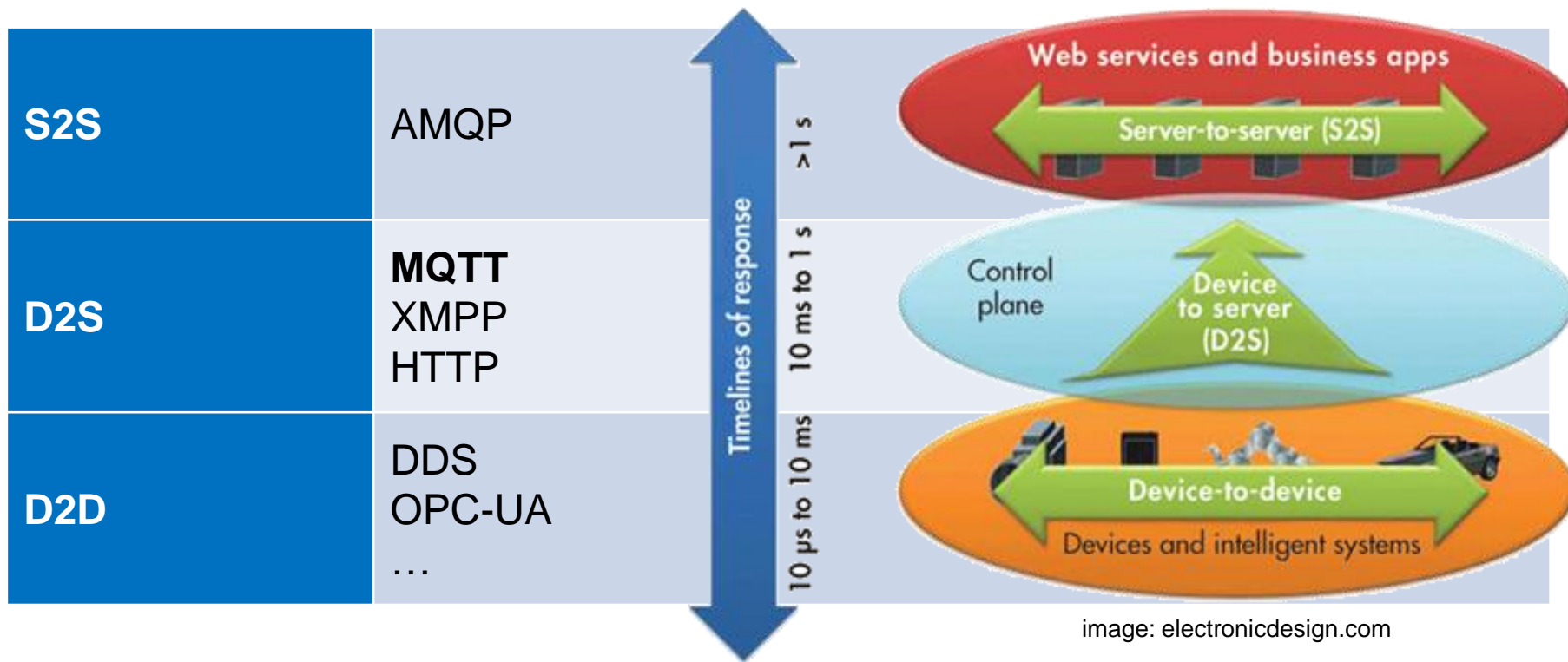


JSON—JavaScript Object Notation

- Standard to store and send data
- Often used between browsers and servers
- Text format
- Self-describing



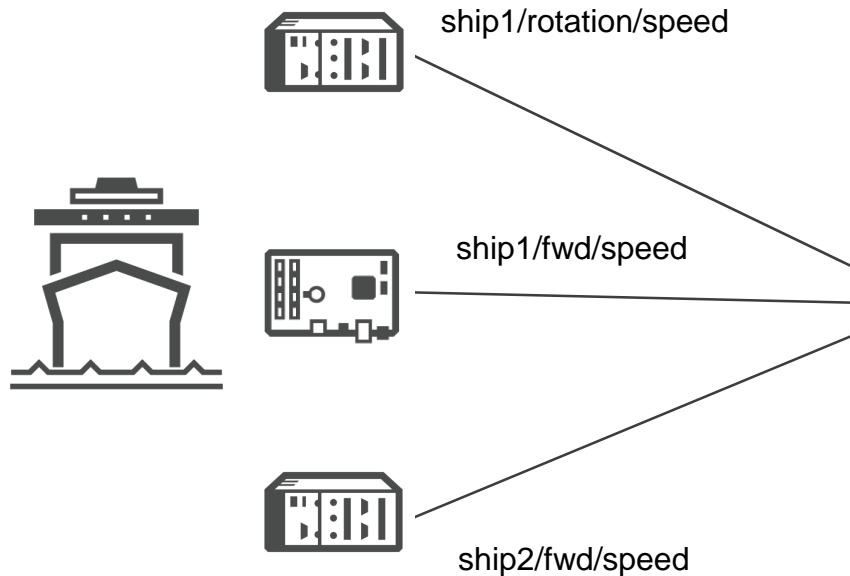
Common IIoT Protocols



MQTT—Message Queue Telemetry Transport



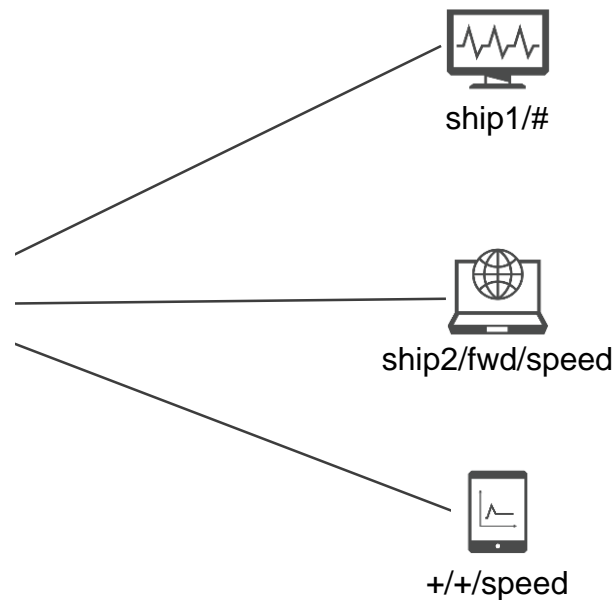
MQTT publishers



MQTT broker



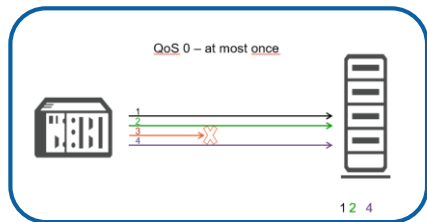
MQTT subscribers



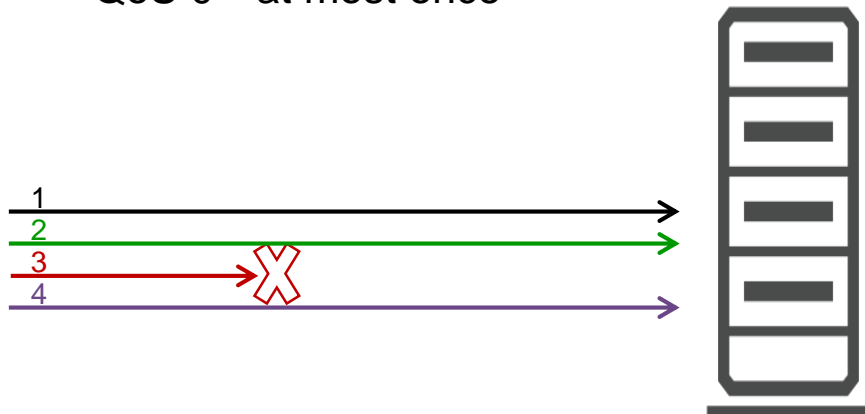
topic = "device/path/topic"



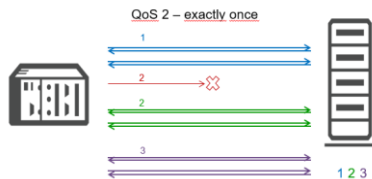
MQTT—Quality of Service (QoS)



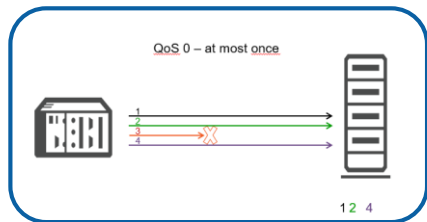
QoS 0—at most once



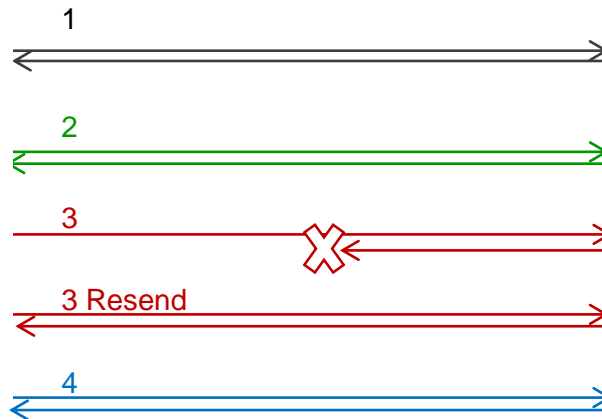
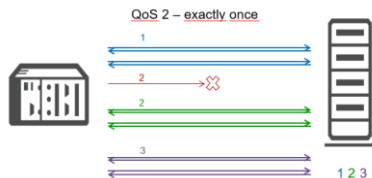
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MQTT—Quality of Service (QoS)

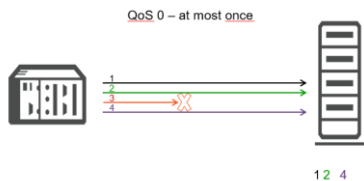


QoS 1—at least once

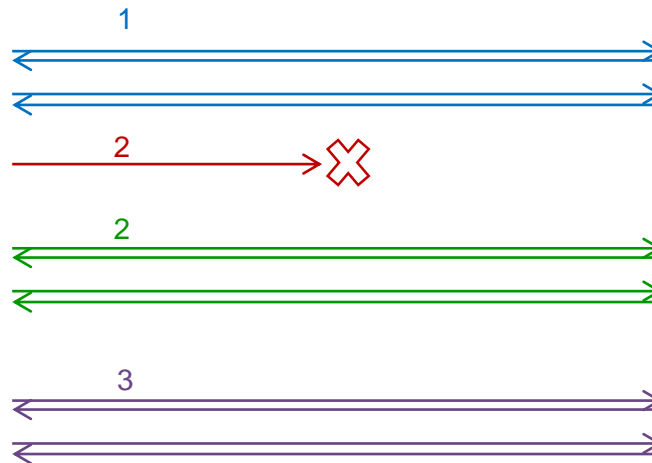


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MQTT—Quality of Service (QoS)



QoS 2—exactly once

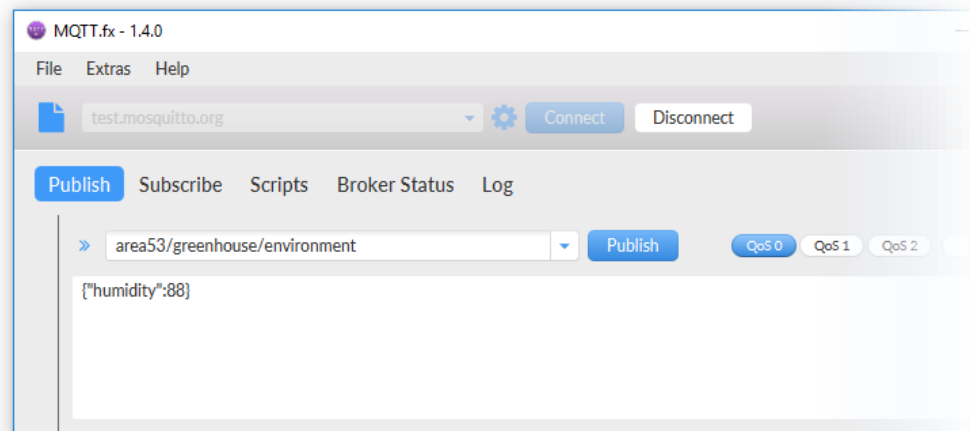


1 2 3

MQTT—Tips



- MQTT client
 - MQTT.fx
 - Linux, Mac, and Windows
 - <http://www.mqttfx.org/>
- MQTT broker
 - test.mosquitto.org
 - Linux, Mac, and Windows
 - Install your own MQTT broker
 - <https://mosquitto.org/download/>
- Use port 1883 for open and 8883 for encrypted data transfer (TLS 1.2/SSL)



LabVIEW MQTT APIs

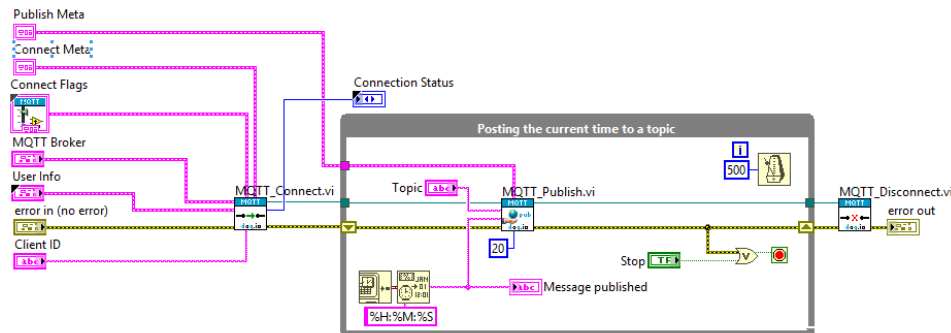


- Several public APIs:

- <https://github.com/DAQIO/LVMQTT>
- <https://github.com/Indie-Energy/AWS-IoT-RESTful>
- more

- LabVIEW Tools Network:

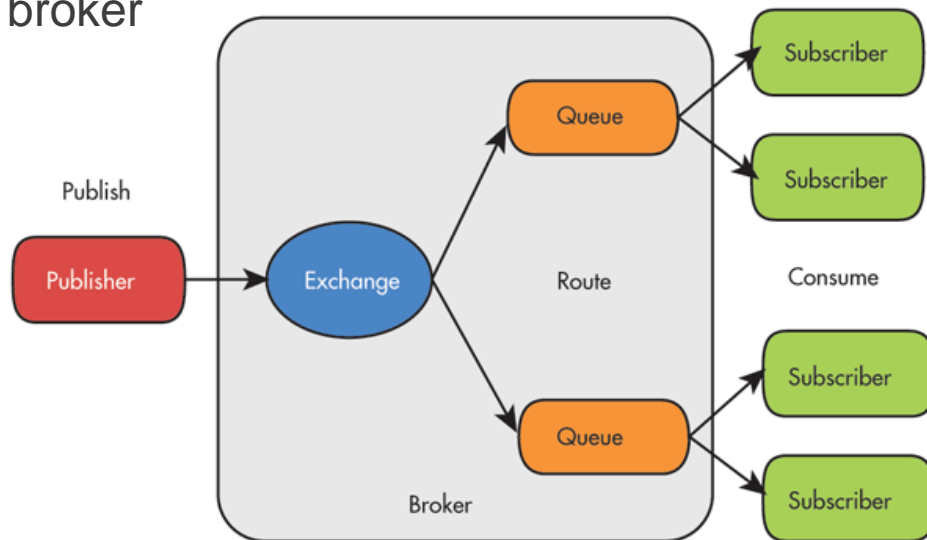
- [IOT Cloud Connector for LabVIEW by Etteplan](#)
 - SSL support on request
 - Focused on use with IBM Watson IoT for Bluemix
- [Wirequeue MQTT by WireFlow](#)
 - Broker runs on WireFlow servers
 - SSL support



AMQP—Advanced Message Queuing Protocol



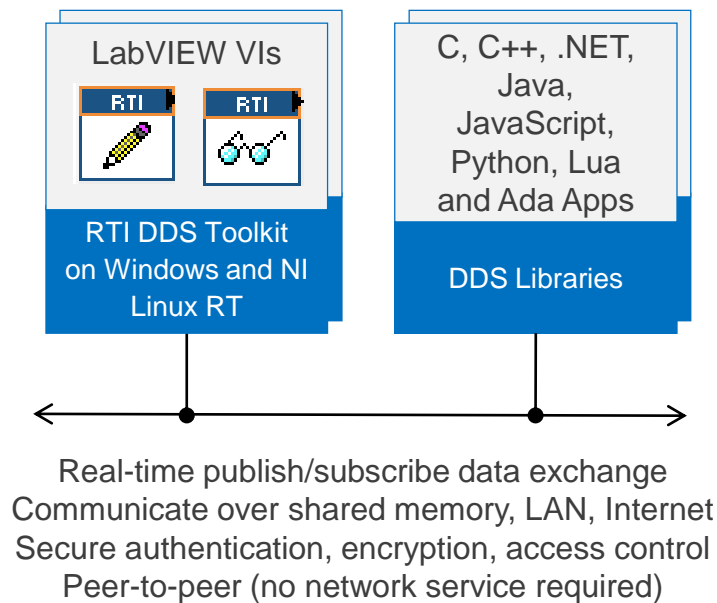
- Sends queues of data between servers
- Endpoints must acknowledge receiving data
- RabbitMQ—open source message broker
- LabVIEW APIs
 - LabbitMQ by Distrio
 - Github AMQP implementation



DDS—Data Distribution Service



- Publish/subscribe communication model for distributed systems
- Native LabVIEW API that supports Windows and NI Linux Real-Time systems
- DDS compliance—interoperates with C, C++, Java, and C#/.NET applications
- Set quality of service requirements—latency, throughput, and reliability
- Ability to scale to thousands of nodes and millions of data points
- **DDS Security** enables per-topic read/write access control



Popular IIoT Platforms

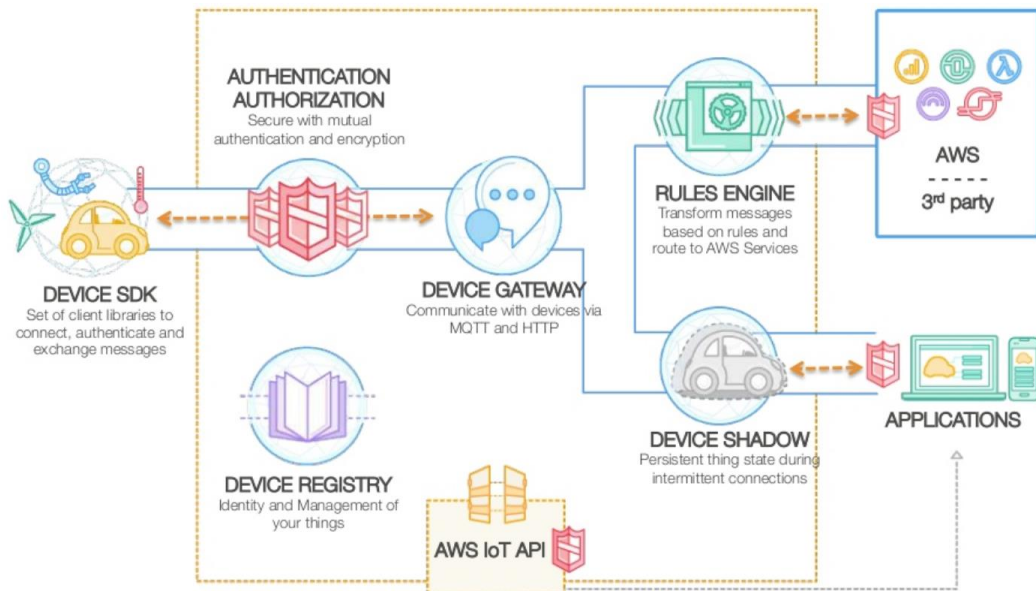
- Many platforms available
- Preference depends on
 - Service model (IaaS, PaaS, SaaS)
 - Company IT preferences
 - Experience
 - Capabilities and requirements
 - Cost model
 - And more



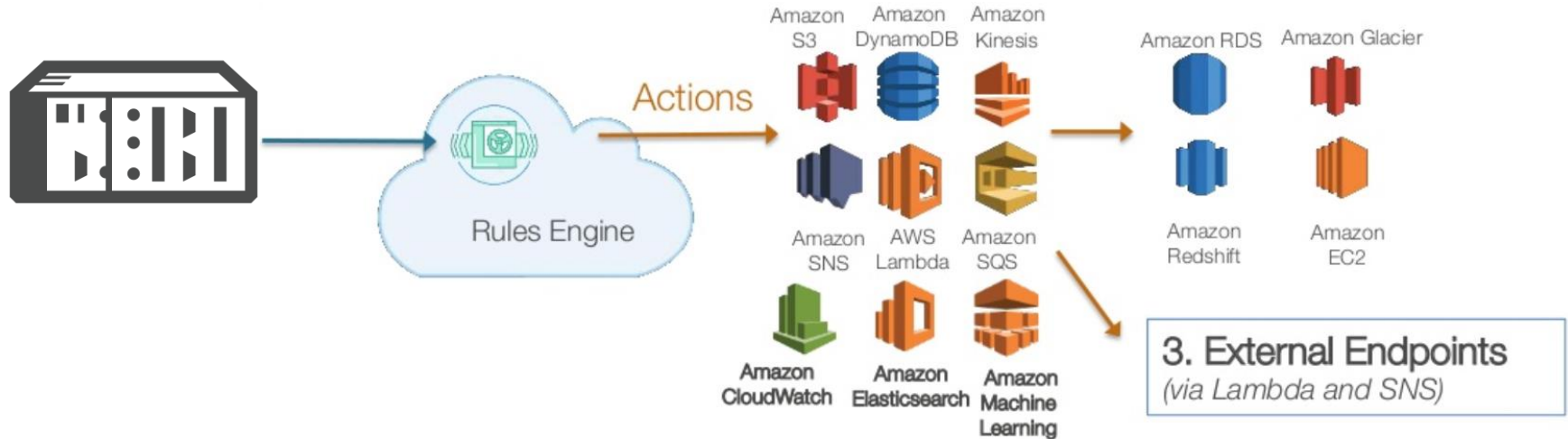
Connecting to Amazon Web Services IoT

Amazon Web Services (AWS)—IoT service

- Connect over MQTT
- Manage things
- Route messages to other services
- Debug
- <https://aws.amazon.com/iot/>

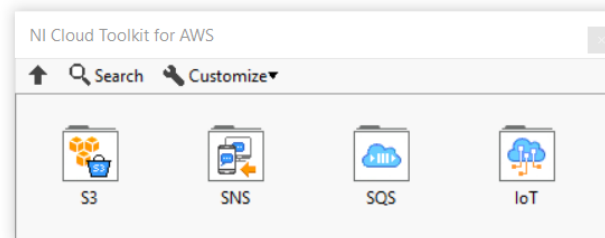
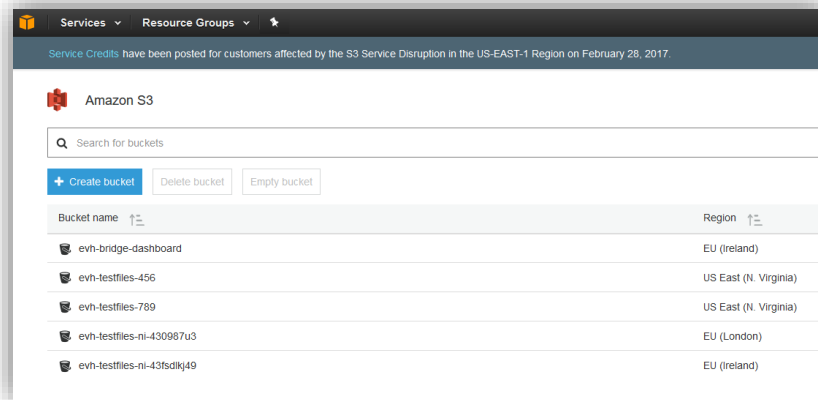


AWS IoT Rules and Services



Amazon S3 Storage

- Simple Storage Service (S3)
 - Store and retrieve from anywhere
 - Store large files up to 5TB
 - S3 buckets (folders) and objects (files)
 - Regions
 - <https://aws.amazon.com/s3/>
-
- LabVIEW Cloud Toolkit for Amazon Web Services
 - HTTP and HTTPS
 - Large data uploads
 - Low-level VIs include source code
 - Run on desktop and real-time OS



DEMO

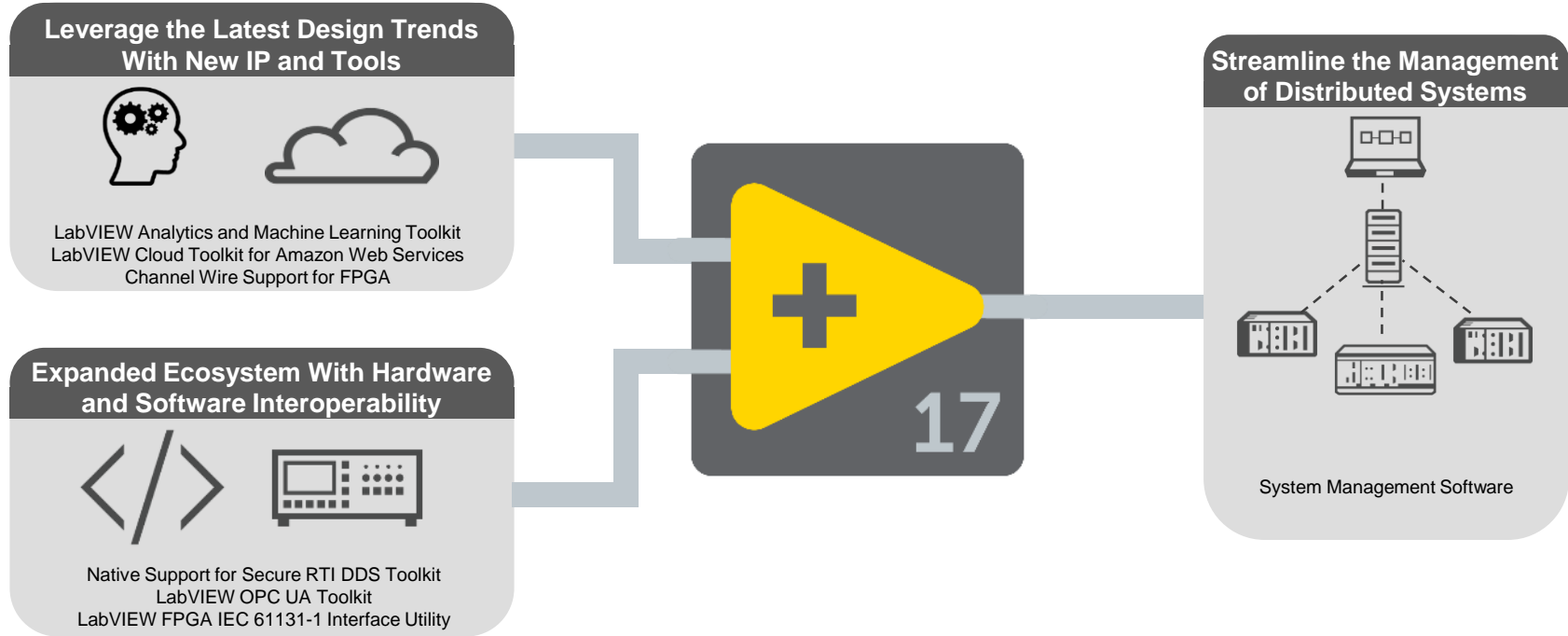


IoT Connections, Rules, and Monitoring

- Features
 - Amazon Web Services— S3, SNS, SMS
 - CompactRIO
- Requirements
 - Network connection
 - AWS account (free tier)
 - LabVIEW Cloud Toolkit for AWS

LabVIEW 2017

Complex applications. Distributed systems. Streamlined development.



SystemLink™—Product Overview

Manage distributed systems with software that provides mass coordination of device management, software deployment, and data transfer.

Web Application







Browser-Based: PC, Mac, Tablet

Systems Manager

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Dashboard

Managed Systems

Groups	History	Software	Restart	More		
	Name ↑	IP Address	Model Name	Operating System	Serial Number	Connection
Monitoring Systems (4)						
<input type="checkbox"/>	 Ni-cRIO-9068-190C87B	10.2.74.64	cRIO-9068	NI Linux RT 4.1	190C87B	Connected
<input type="checkbox"/>	 Ni-cRIO-9068-190D5D5	10.2.74.67	cRIO-9068	NI Linux RT 4.1	190D5D5	Connected
<input type="checkbox"/>	 Ni-cRIO-9068-190D673	10.2.74.65	cRIO-9068	NI Linux RT 4.1	190D673	Connected
<input type="checkbox"/>	 Ni-cRIO-9068-190FDF5	10.2.74.66	cRIO-9068	NI Linux RT 4.1	190FDF5	Connected
Test Systems (2)						
<input type="checkbox"/>	 PXIe-8840Quad-1	10.2.74.79	NI PXIe-8840 Quad-Core	Windows 7	030E1626	Connected
<input type="checkbox"/>	 PXIe-8840Quad-2	10.2.74.80	NI PXIe-8840 Quad-Core	Windows 7	030D0B85	Connected



Server

Windows PC or Server

Managed Systems

Windows and NI Linux® Real-Time



System and Data Security
User Authentication
Data Processing



CompactRIO



CompactRIO



PXI



PXI

PRODUCT FEATURES

SOFTWARE DEPLOYMENT

- Mass deploy software to multiple remote hardware nodes
- Create and manage deployment packages for LabVIEW apps and non-NI software

DEVICE MANAGEMENT

- View and configure device settings; perform diagnostics such as restart and self-test
- Classify systems according to operational context

DATA TRANSFER SERVICES

- Automate data transfer using LabVIEW and Web APIs
- Use data viewers to administer data transferred from targets

Summary

- MQTT
 - Most common IIoT communication protocol for device to server
 - Feature extraction
 - MQTT through GitHub or native HTTP calls
- LabVIEW 2017
 - Cloud Toolkit for Amazon Web Services
 - RTI DDS Toolkit
 - Data storage to cloud
- NI's continual investment in IIoT technologies
- Resources:
 - White paper [A Practical Guide for Connecting LabVIEW to the Industrial IoT](#)
 - Examples in cloud toolkit

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