



ENGINEER
NEXT

NIDays

The logo features the text "ENGINEER" in a white sans-serif font above the word "NEXT" in a larger, bold white sans-serif font. A yellow graphic element, consisting of three parallel lines forming a stylized 'N' or a series of chevrons, is positioned between the two words. To the left of "NEXT" is a white rectangular box containing the word "NIDays" in a white sans-serif font. The entire logo is set against a blue gradient background with diagonal stripes in various shades of blue, orange, and green.

Practical Considerations for Connecting LabVIEW to the Industrial IoT

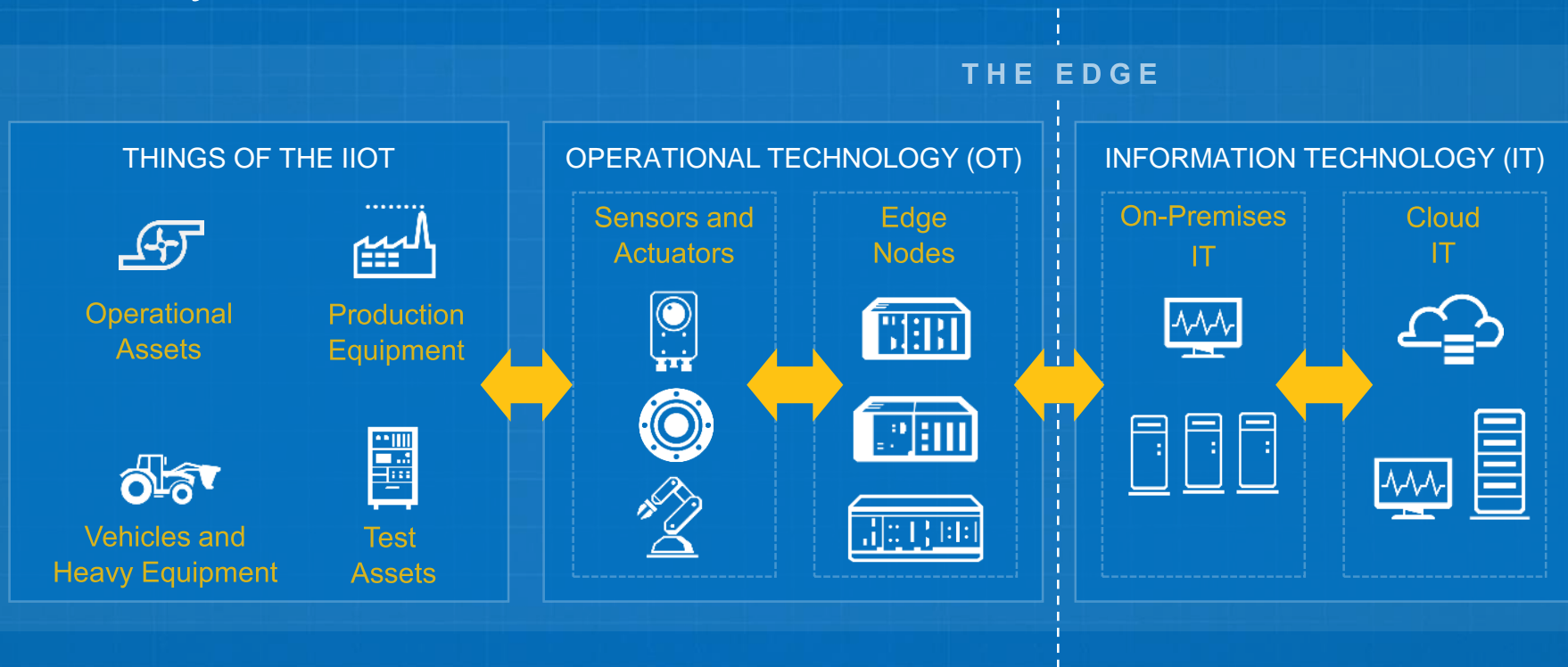
Angel Sendín

National Instruments
Staff Systems Engineer

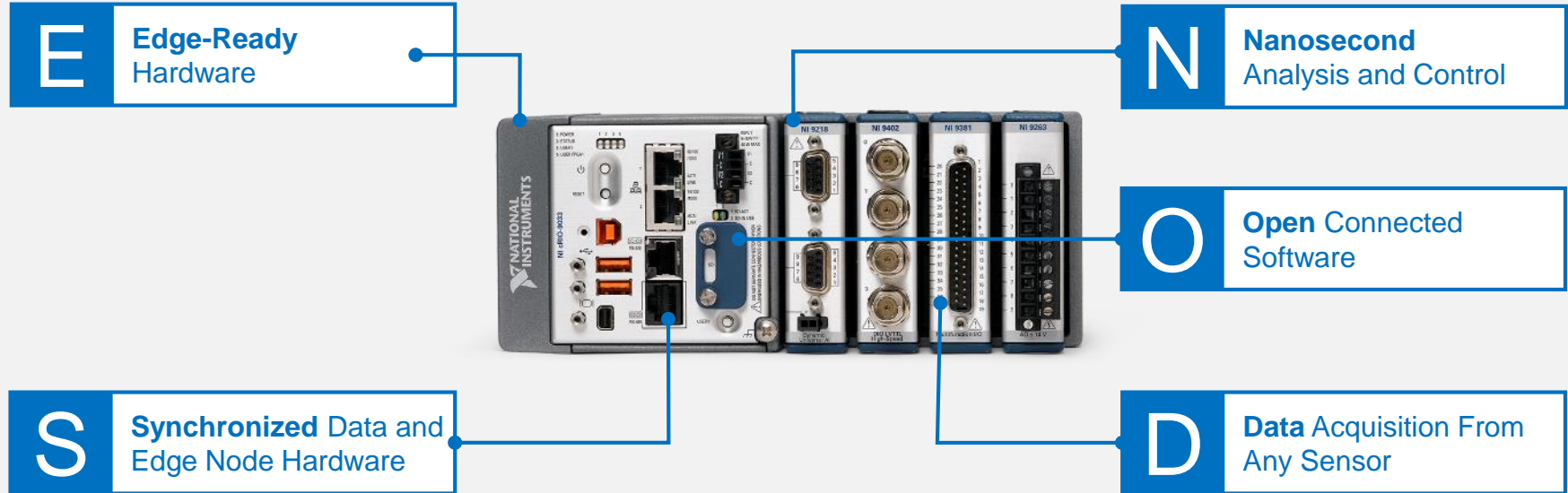
Today's Agenda

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

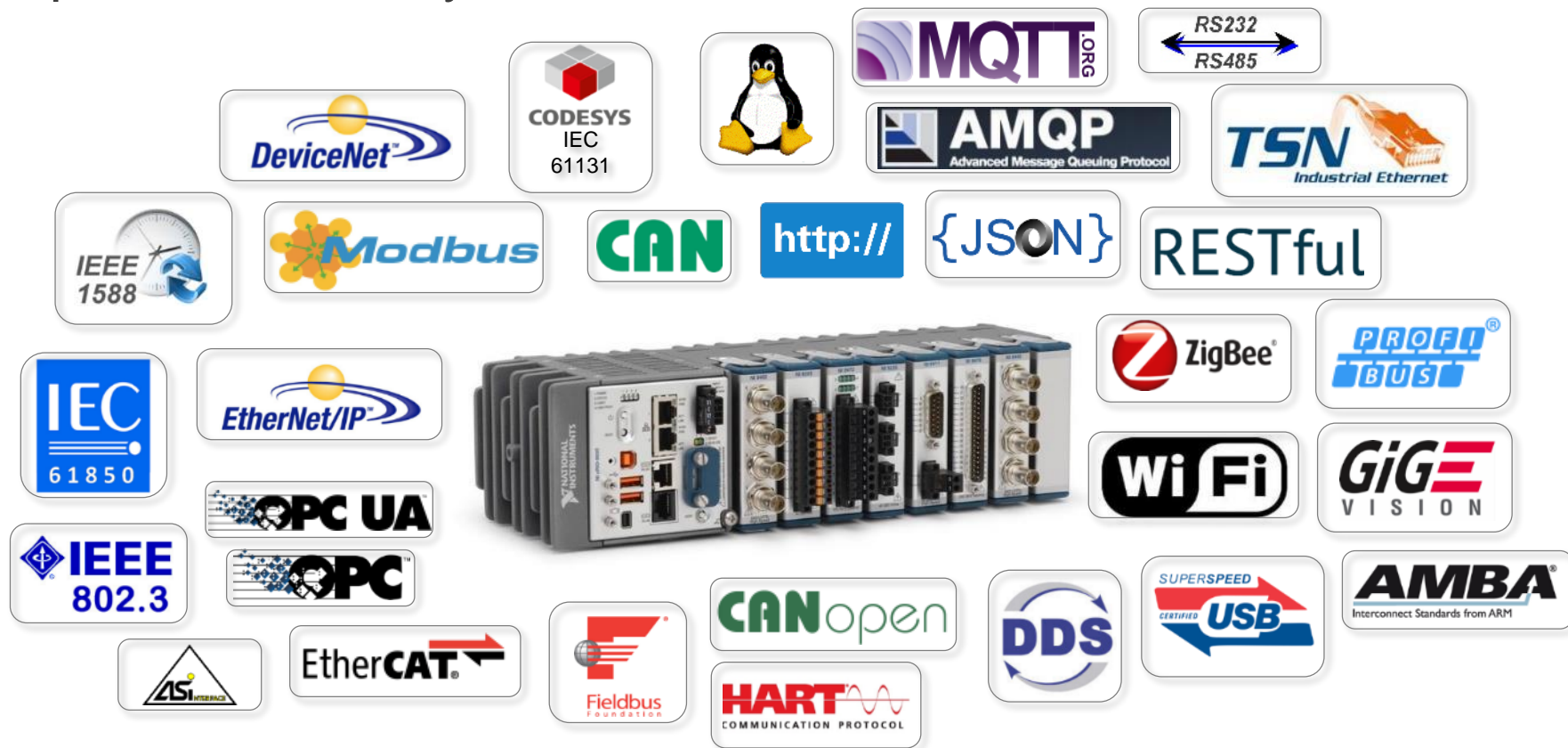
IIoT System Architecture



The NI Edge Node Advantage

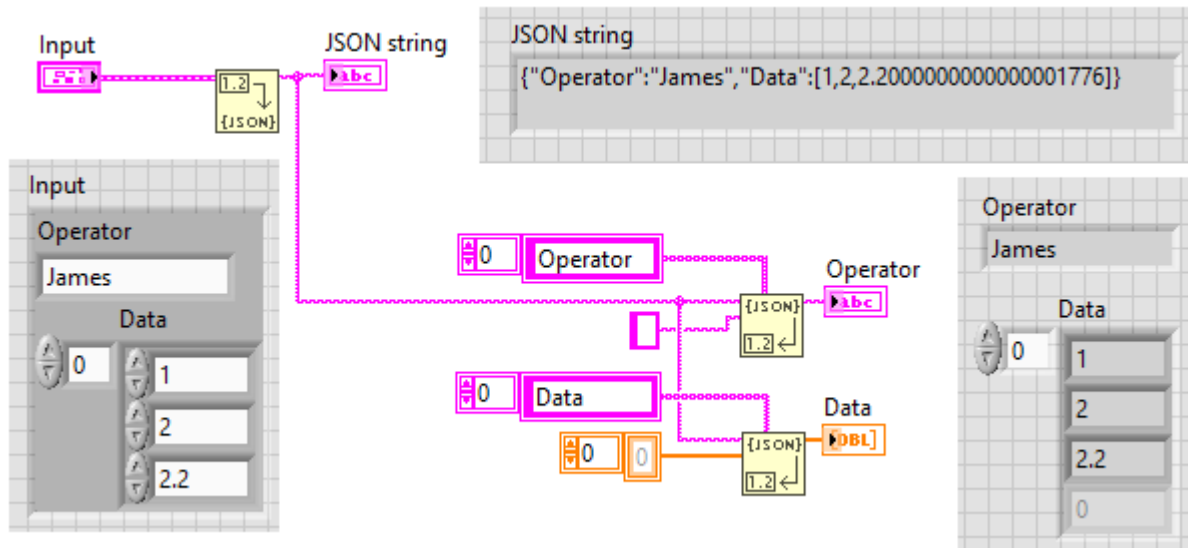


Open Connectivity to OT *and* IT

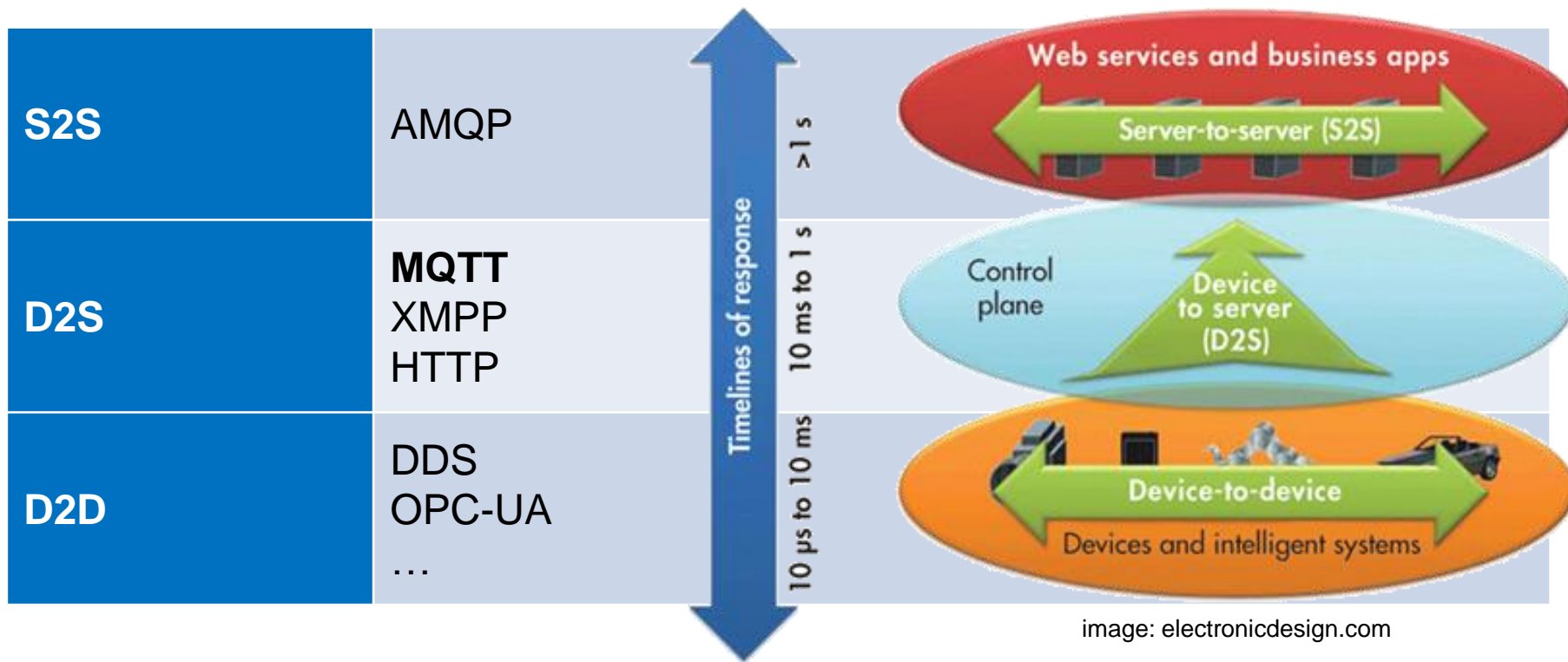


JSON—JavaScript Object Notation

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



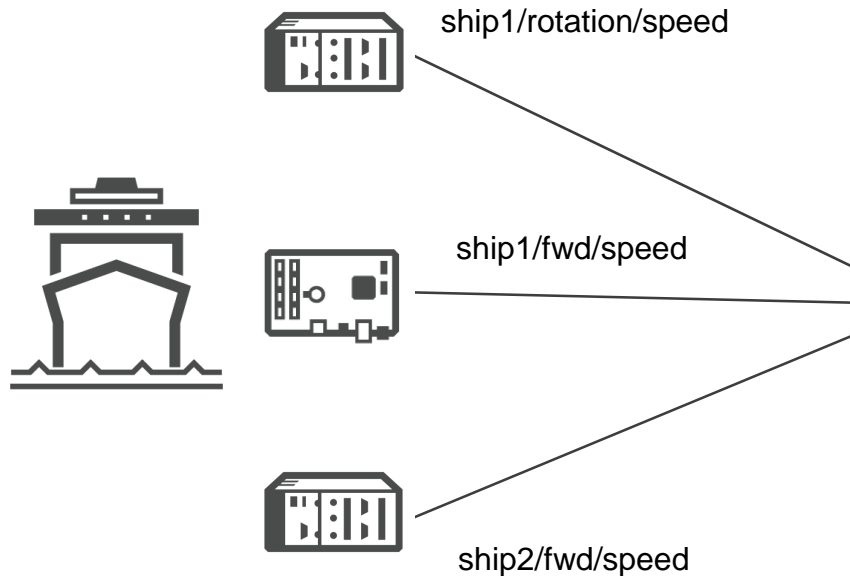
Common IIoT Protocols



MQTT—Message Queue Telemetry Transport



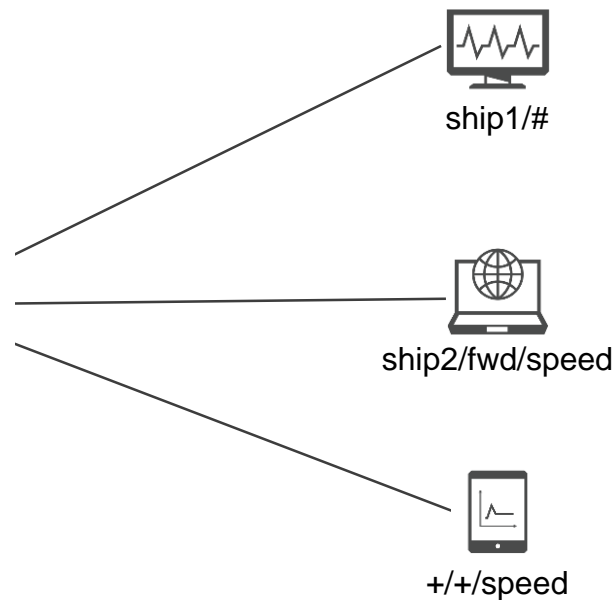
MQTT publishers



MQTT broker



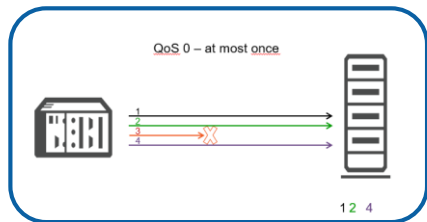
MQTT subscribers



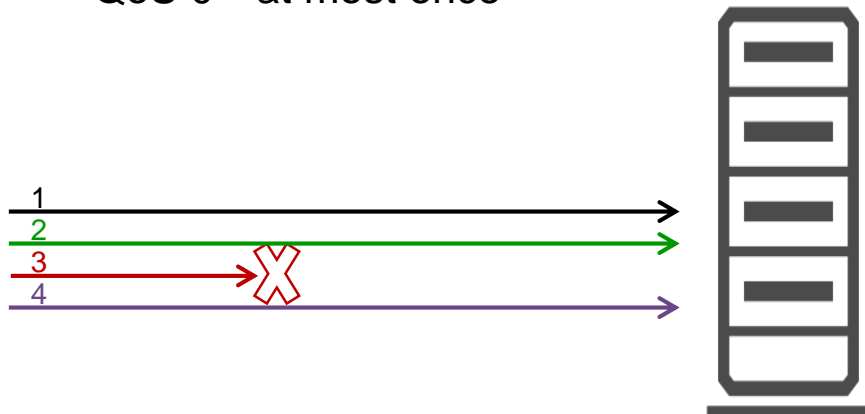
topic = "device/path/topic"



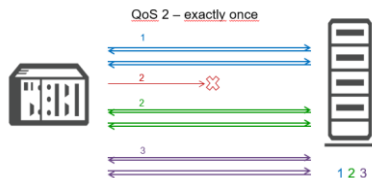
MQTT—Quality of Service (QoS)



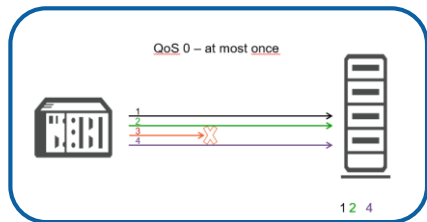
QoS 0—at most once



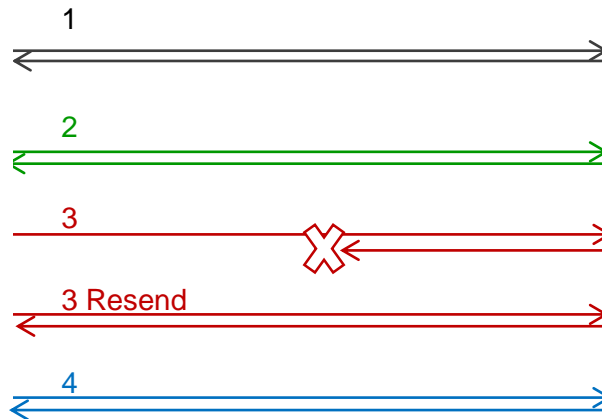
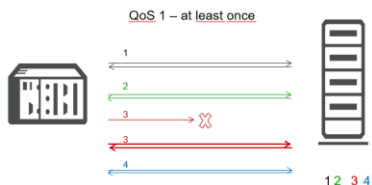
1 2 4



MQTT—Quality of Service (QoS)

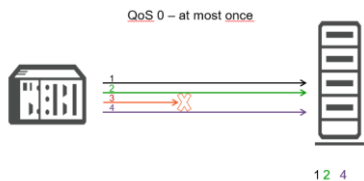


QoS 1—at least once

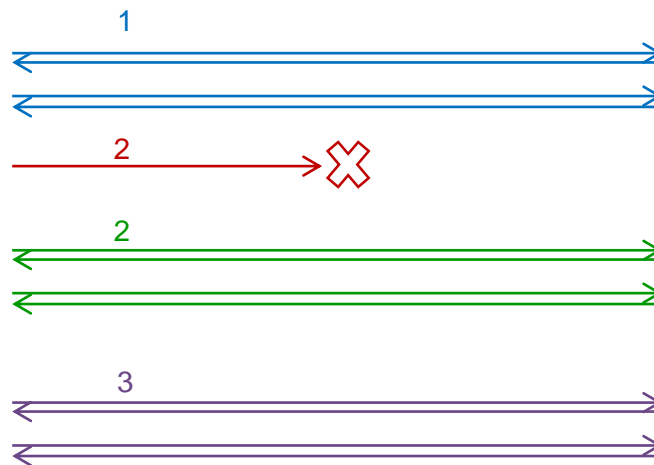


1 2 3 3 4

MQTT—Quality of Service (QoS)



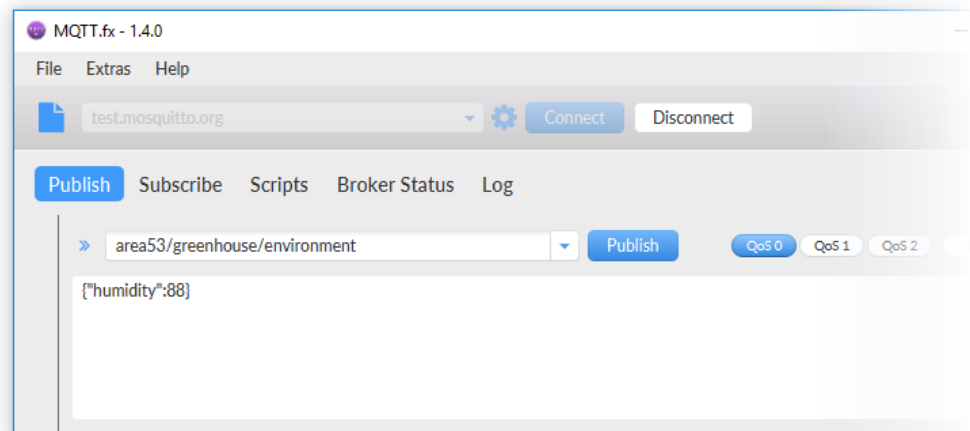
QoS 2—exactly once



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

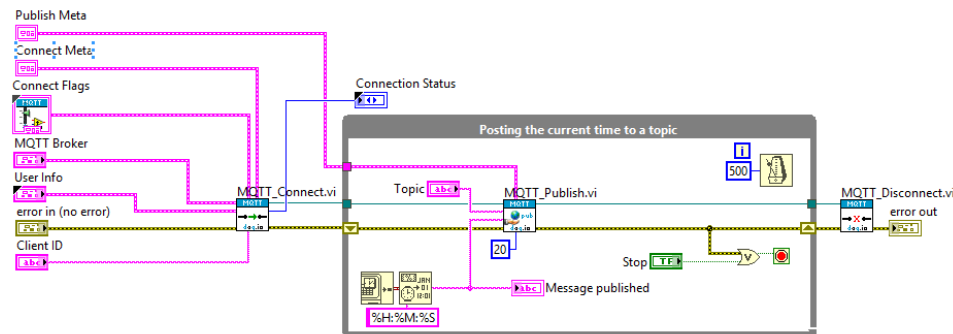


- Several public APIs:

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

- LabVIEW Tools Network:

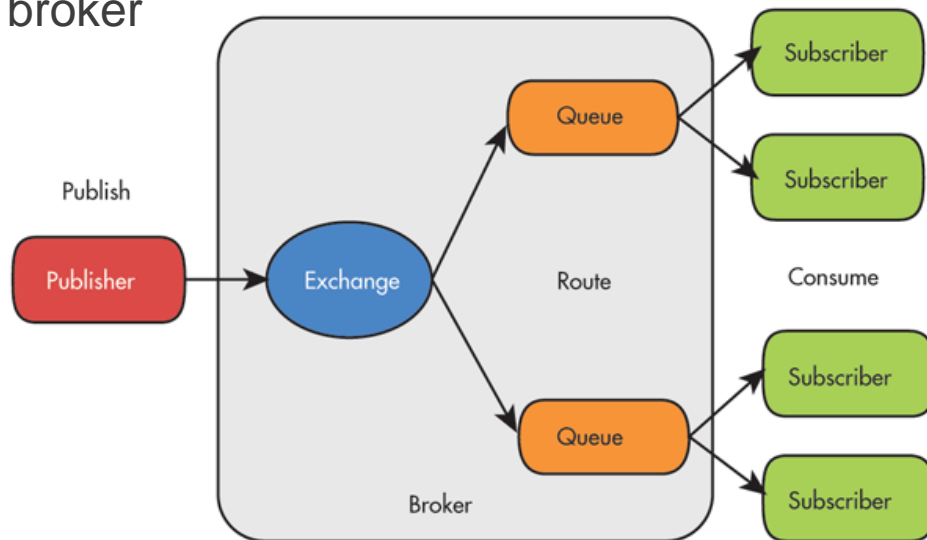
- [IOT Cloud Connector for LabVIEW by Etteplan](#)
 - SSL support on request
 - Focused on use with IBM Watson IoT for Bluemix
- [Wirequeue MQTT by WireFlow](#)
 - Broker runs on WireFlow servers
 - SSL support



AMQP—Advanced Message Queuing Protocol



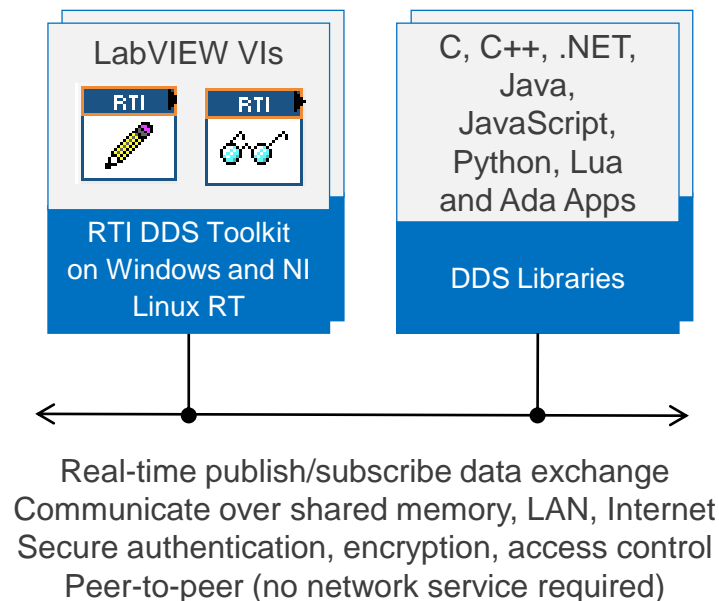
- Sends queues of data between servers
- Endpoints must acknowledge receiving data
- RabbitMQ—open source message broker
- LabVIEW APIs
 - LabbitMQ by Distrio
 - Github AMQP implementation



DDS—Data Distribution Service



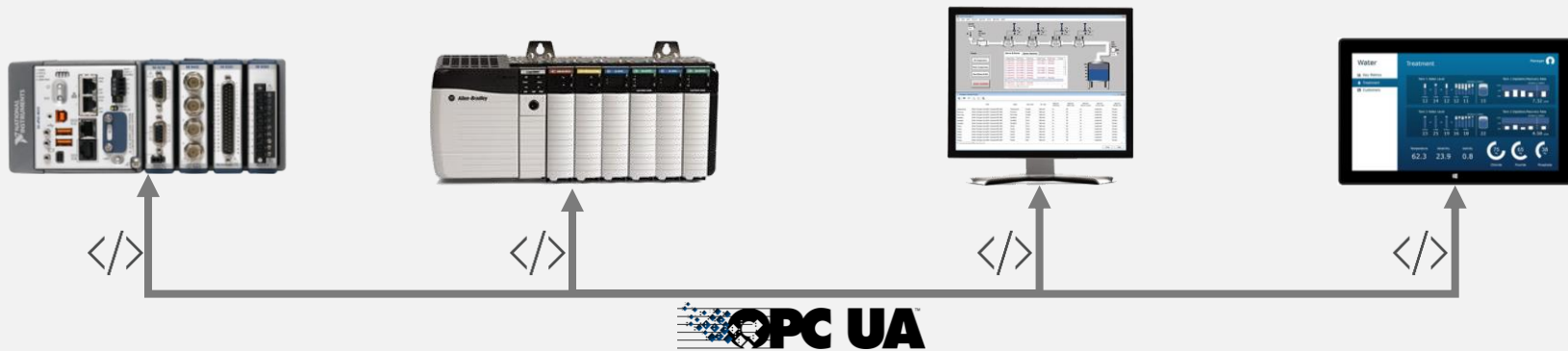
- Publish/subscribe communication model for distributed systems
- Native LabVIEW API that supports Windows and NI Linux Real-Time systems
- DDS compliance—interoperates with C, C++, Java, and C#/.NET applications
- Set quality of service requirements—latency, throughput, and reliability
- Ability to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



LabVIEW 2017 OPC UA Toolkit

Semantic Interoperability with Third-Party Industrial Automation Devices

- Develop secure, reliable communications with OPC UA
- Supported on both Windows and NI Linux Real Time targets
- Supported Facets:
 - Data Access (DA)—Data communication and information models
 - Historical Access (HA)—Management of archived data and annotations
 - Alarms and Conditions (AC)—Management of state-driven notifications



Popular IIoT Platforms

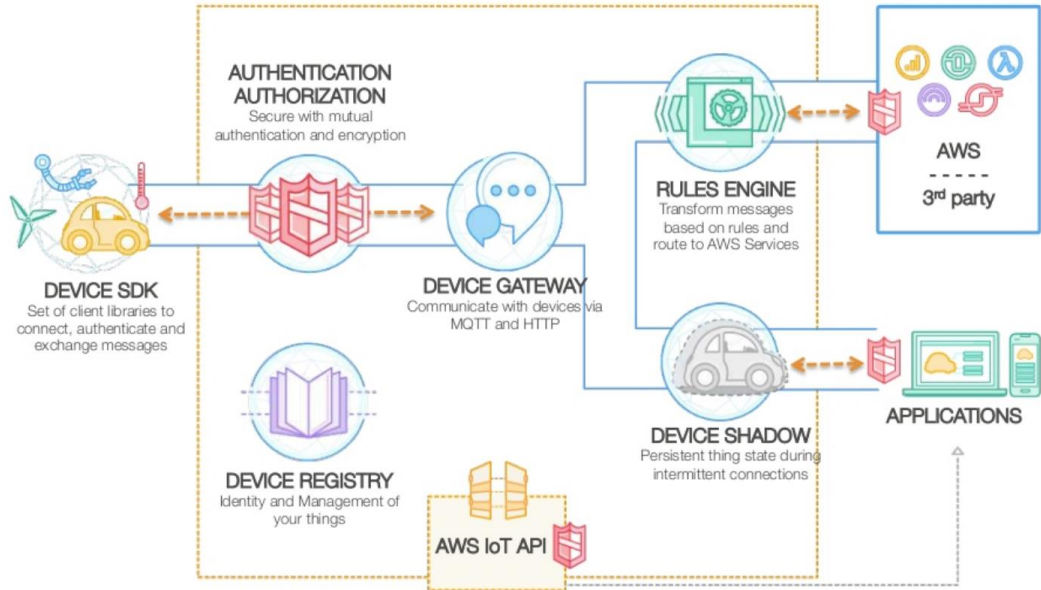
- Many platforms available
- Preference depends on
 - Service model (IaaS, PaaS, SaaS)
 - Company IT preferences
 - Experience
 - Capabilities and requirements
 - Cost model
 - And more



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/>

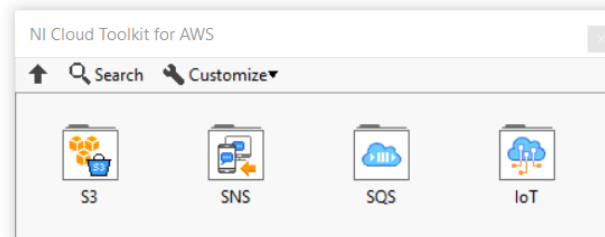
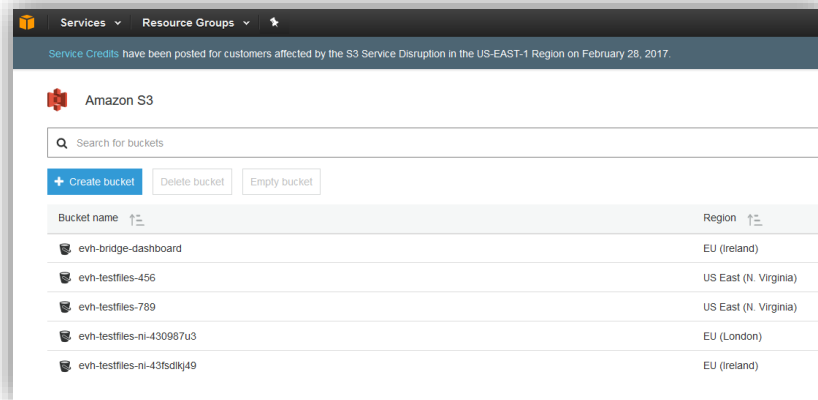


AWS IoT Rules and Services



Amazon S3 Storage

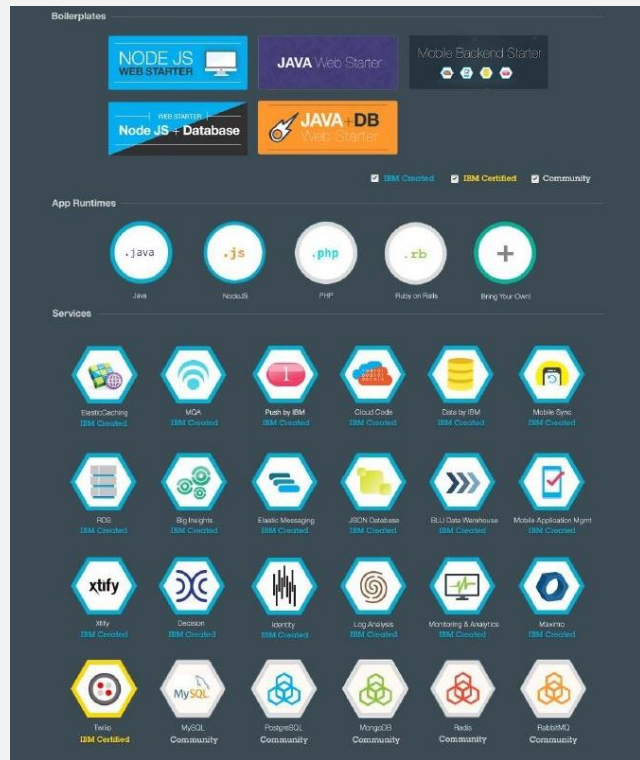
- Simple Storage Service (S3)
 - Store and retrieve from anywhere
 - Store large files up to 5TB
 - S3 buckets (folders) and objects (files)
 - Regions
 - <https://aws.amazon.com/s3/>
-
- LabVIEW Cloud Toolkit for Amazon Web Services
 - HTTP and HTTPS
 - Large data uploads
 - Low-level VIs include source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



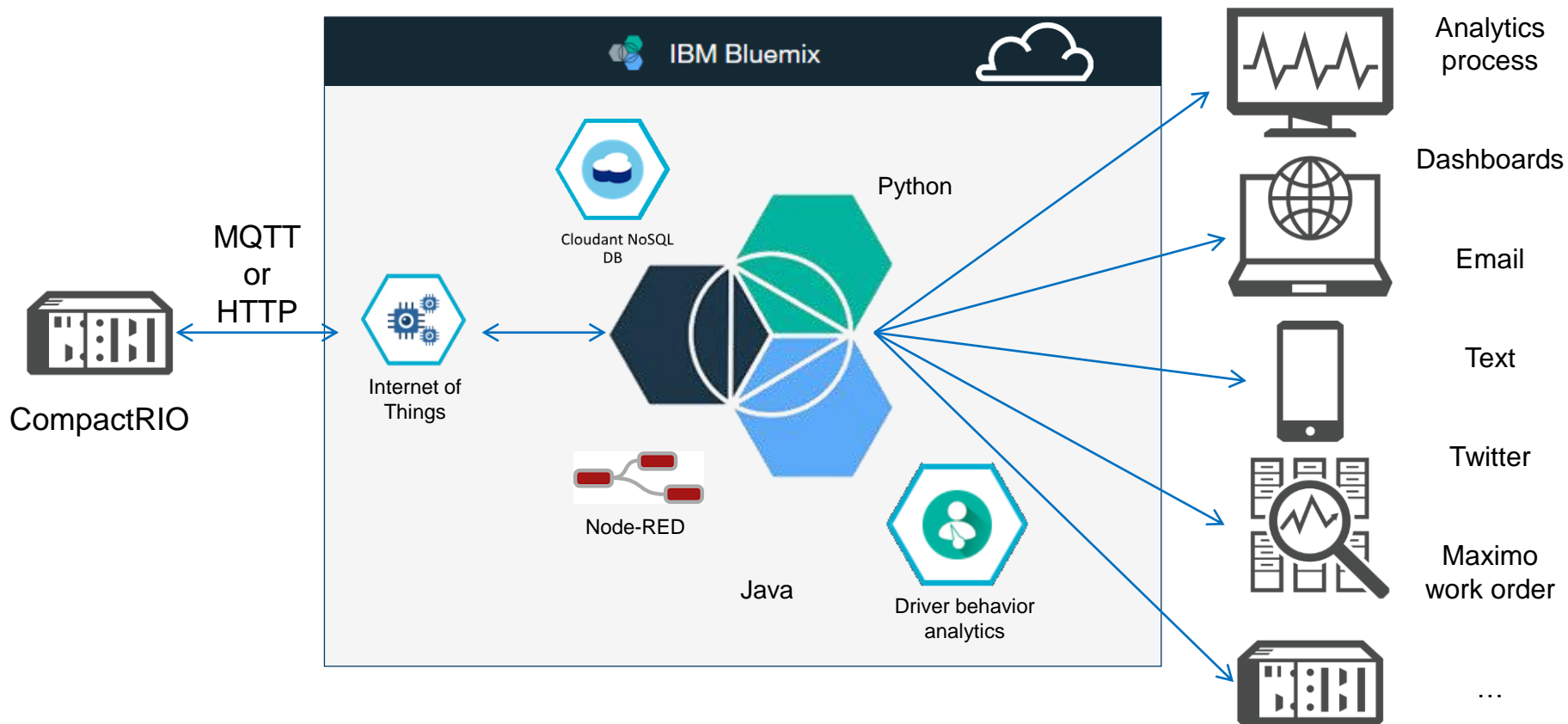
Connecting to IBM Watson IoT for Bluemix

IBM Watson IoT for Bluemix

- Build, run, deploy, and manage applications in the cloud
- Support for several programming languages
 - Java, Node.js, Python, PHP, Go, and so on
- Broad catalog of services
 - Data analytics, Watson, IoT, network, storage, and so on
- Communicate with devices via Watson IoT for Bluemix
- MQTT support
- <https://bluemix.net>



IBM Bluemix Concept



Connecting to PTC ThingWorx

PTC ThingWorx IoT Platform

- CAD industry
- Model-Based Design approach
- Things modeled in detail
- Connectivity:
 - REST API
 - Edge microserver
 - Device SDK
 - Kepware
 - AWS IoT
- LabVIEW Rest API available

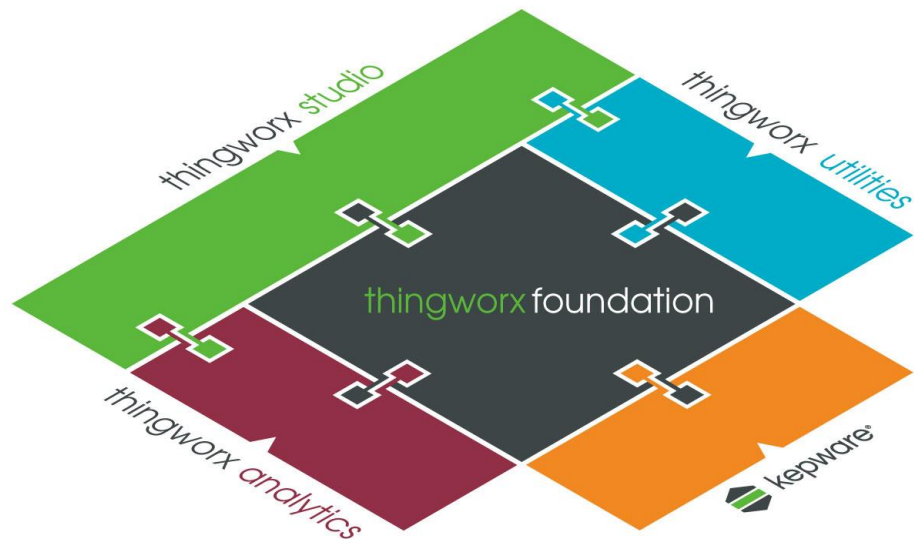
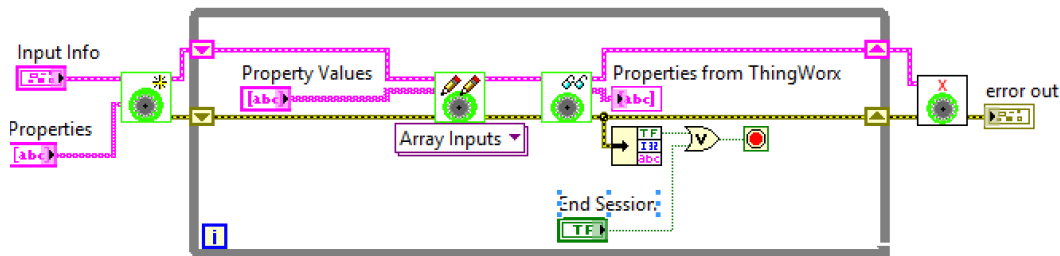
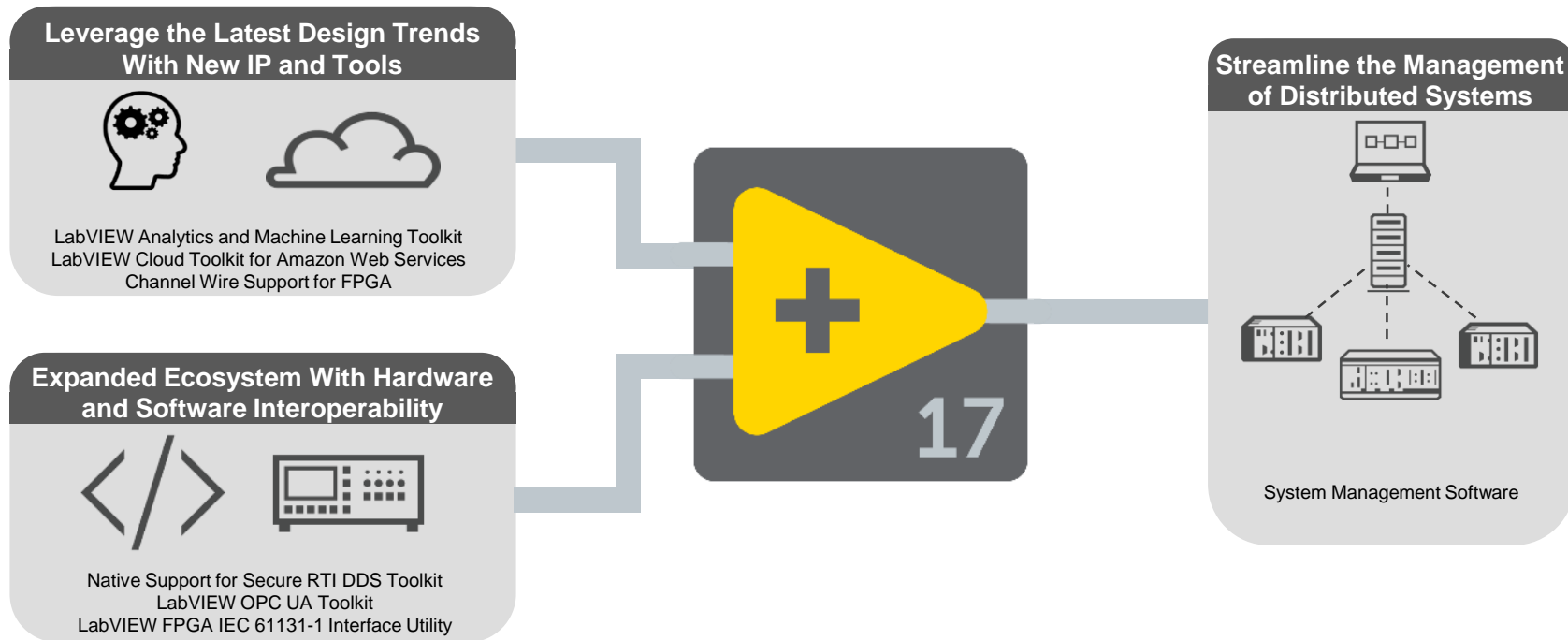


Image source: PTC



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

NATIONAL INSTRUMENTS

Dashboard

Managed Systems

Groups

History

Software

Restart

More

Name

IP Address

Model Name

Operating System

Serial Number

Connection

Monitoring Systems (4)

Ni-cRIO-9068-190C87B

10.2.74.64

cRIO-9068

NILinuxRT 4.1

190C87B

Connected

Ni-cRIO-9068-190D5D5

10.2.74.67

cRIO-9068

NILinuxRT 4.1

190D5D5

Connected

Ni-cRIO-9068-190D673

10.2.74.65

cRIO-9068

NILinuxRT 4.1

190D673

Connected

Ni-cRIO-9068-190FDF5

10.2.74.66

cRIO-9068

NILinuxRT 4.1

190FDF5

Connected

Test Systems (2)

PXIe-8840Quad-1

10.2.74.79

NI PXIe-8840 Quad-Core

Windows 7

030E1626

Connected

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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