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ENGINEER NEXT

Practical Considerations for Connecting LabVIEW to the Industrial IoT

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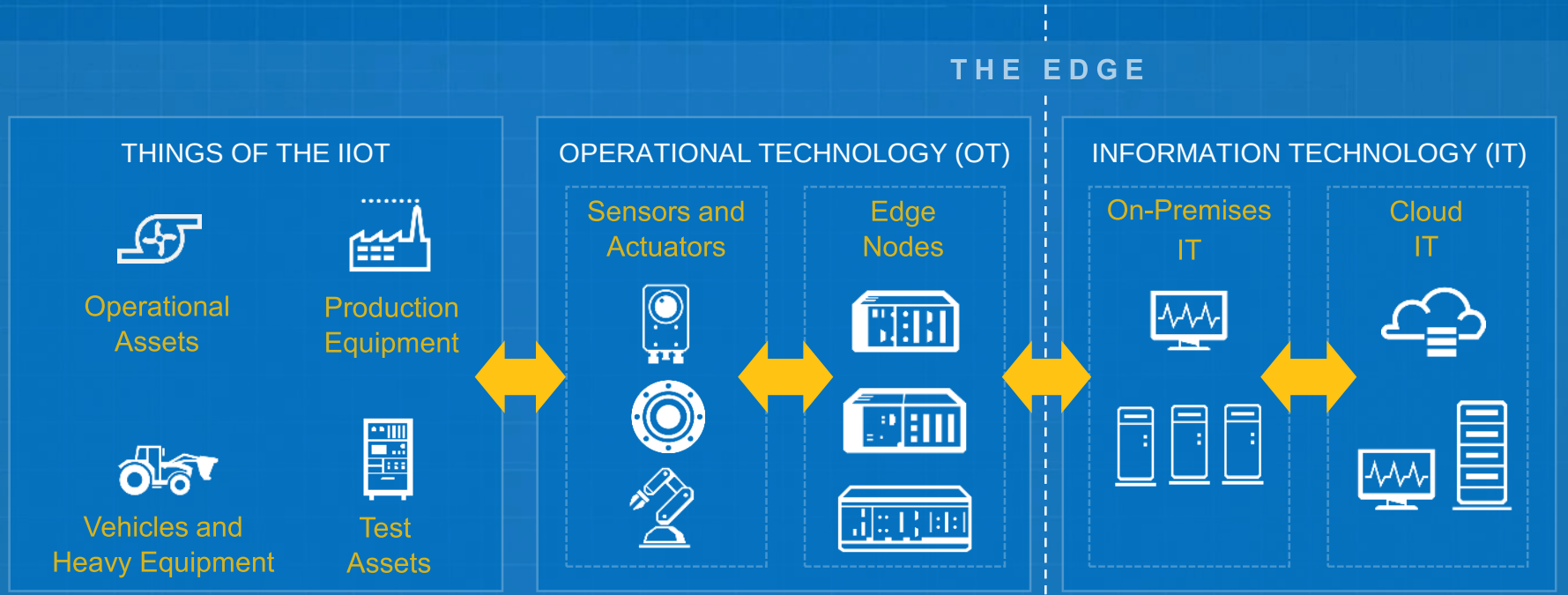
Today's Agenda

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

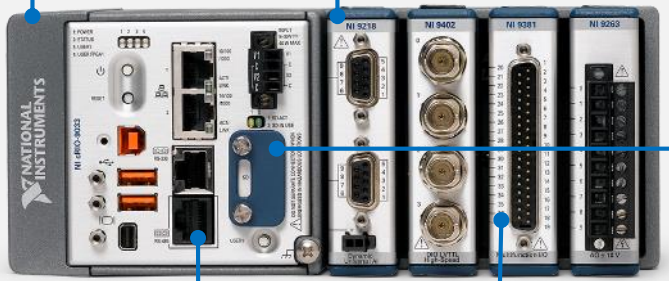
IIoT System Architecture



The NI Edge Node Advantage

E **Edge-Ready** Hardware

N **Nanosecond** Analysis and Control



O **Open** Connected Software

S **Synchronized** Data and Edge Node Hardware

D **Data** Acquisition From Any Sensor

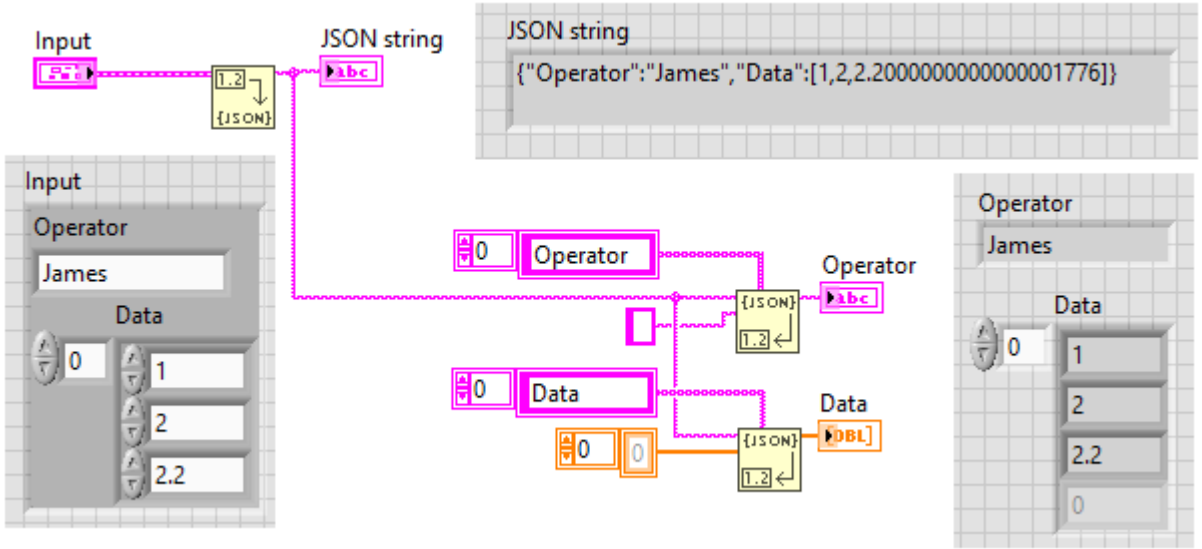
Open Connectivity to OT *and* IT

DeviceNet
CODESYS IEC 61131
MQTT.ORG
RS232 RS485
AMQP Advanced Message Queuing Protocol
TSN Industrial Ethernet
IEEE 1588
Modbus
CAN
http://
{JSON}
RESTful
ZigBee
PROFIBUS
IEC 61850
EtherNet/IP
Wi Fi
GiGE VISION
OPC UA
OPC
IEEE 802.3
CANopen
DDS
SUPERSPEED USB
AMBA Interconnect Standards from ARM
EtherCAT
Fieldbus Foundation
HART COMMUNICATION PROTOCOL

Learning the IoT Language

JSON - **J**ava**S**cript **O**bject **N**otation

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



Common IIoT Protocols

S2S	AMQP	>1 s
D2S	**MQTT** XMPP HTTP	10 ms to 1 s
D2D	DDS OPC-UA …	10 µs to 10 ms

Timelines of response

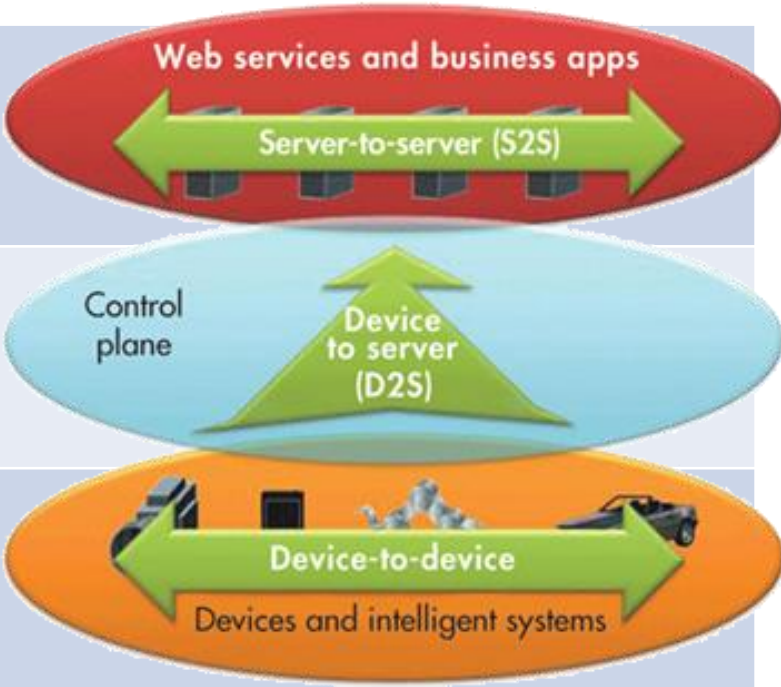
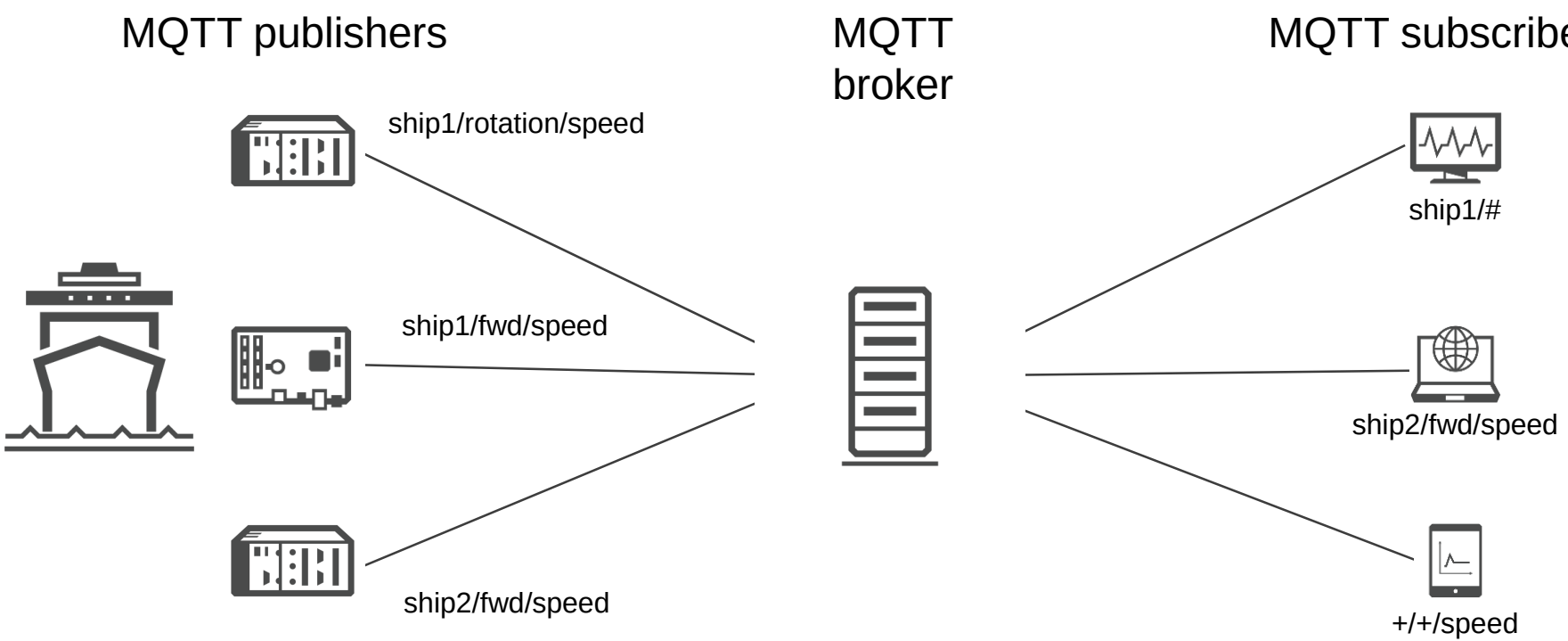


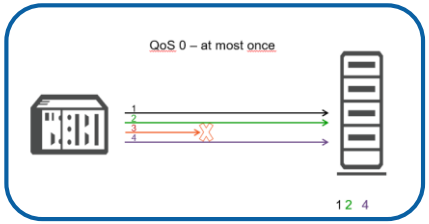
image: electronicdesign.com

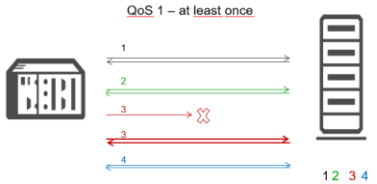
MQTT—Message Queue Telemetry Transport



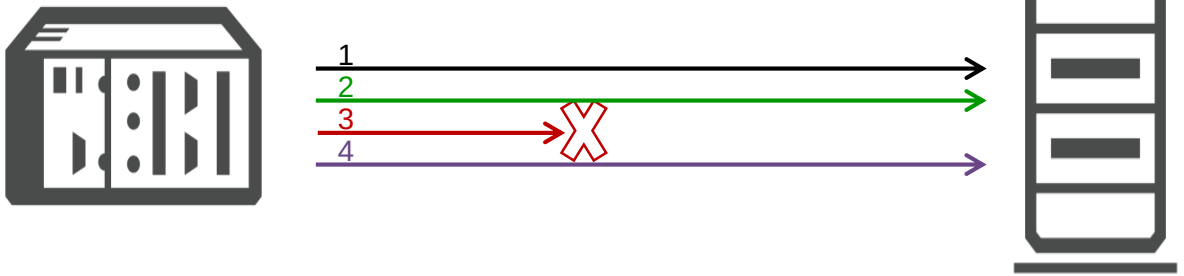
topic = “device/path/topic"

MQTT—Quality of Service (QoS)





QoS 0—at most once



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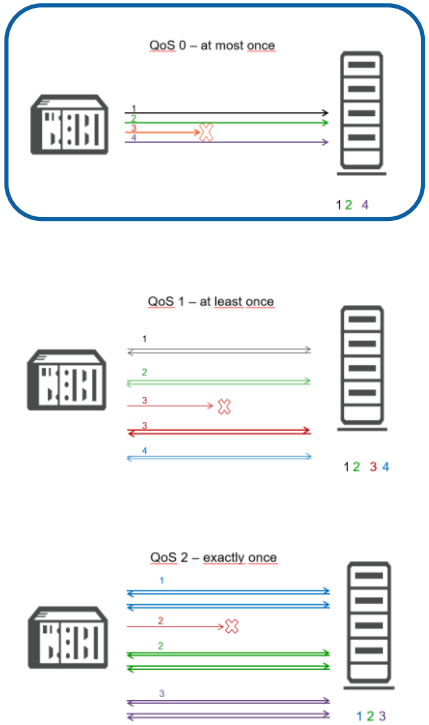
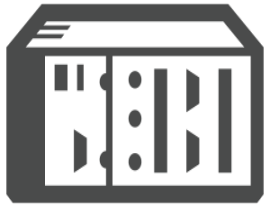
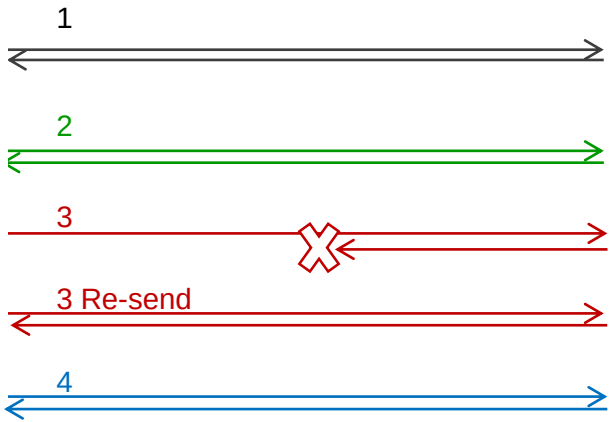
MQTT—Quality of Service (QoS)





QoS 1—at least once



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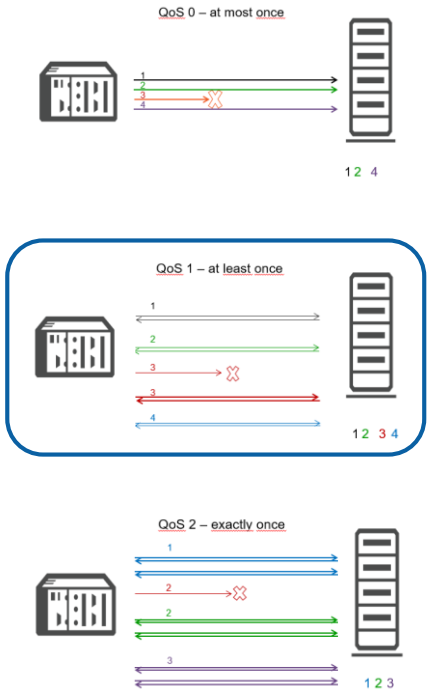
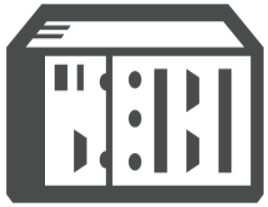
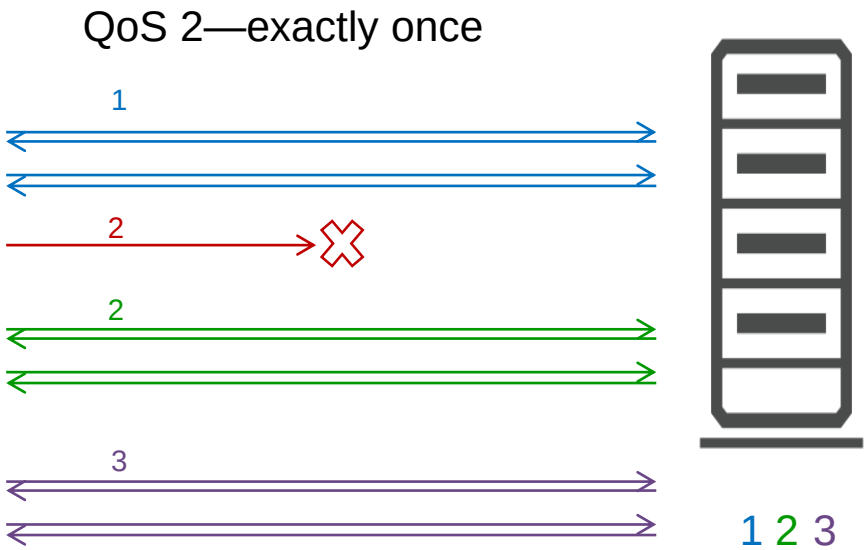
MQTT—Quality of Service (QoS)



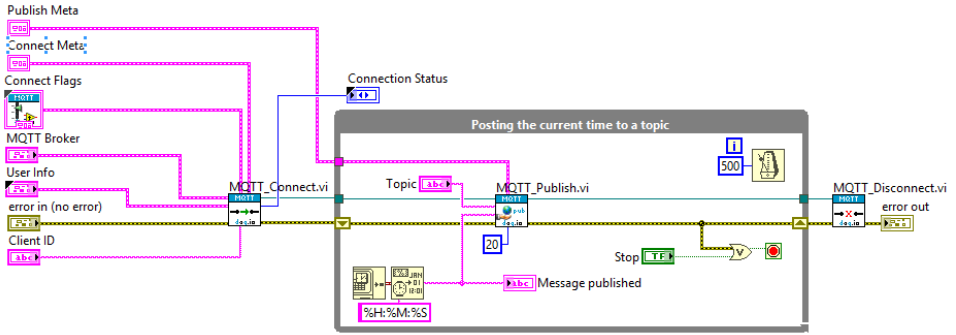




LabVIEW MQTT APIs

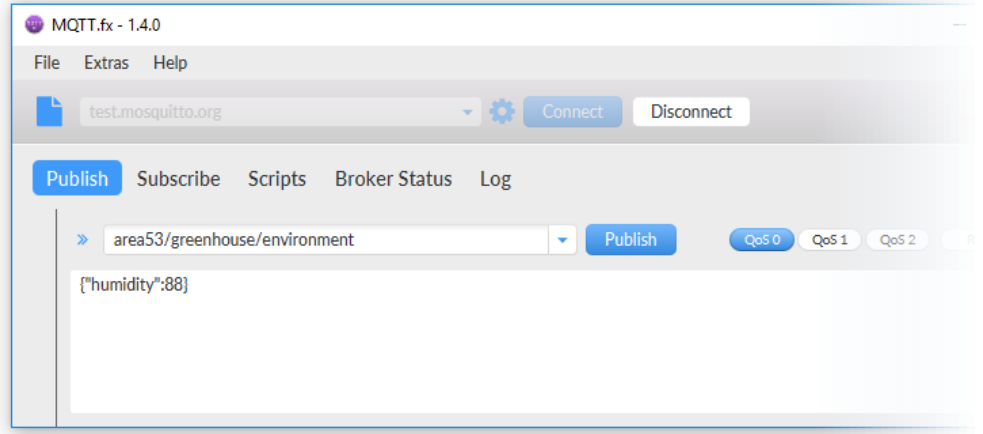
- Several public APIs:
  - https://github.com/DAQIO/LVMQTT
  - https://github.com/Indie-Energy/AWS-IoT-RESTful
  - more

- 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



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/

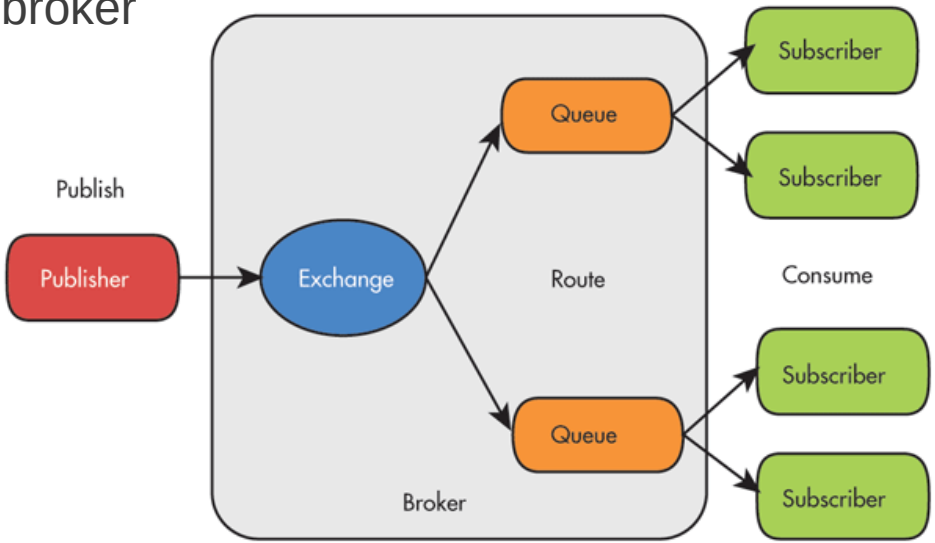


- Use port 1883 for open and 8883 for encripted data transfer (TLS 1.2/SSL).

AMQP—Advanced Message Queuing Protocol

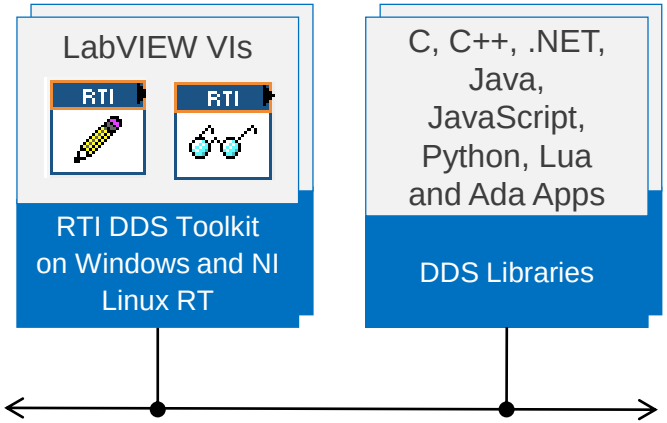
- Sends queues of data between servers
- Endpoints must acknowledge receiving data
- RabbitMQ—open source message broker

- 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



Real-time publish/subscribe data exchange
Communicate over shared memory, LAN, Internet
Secure authentication, encryption, access control
Peer-to-peer (no network service required)

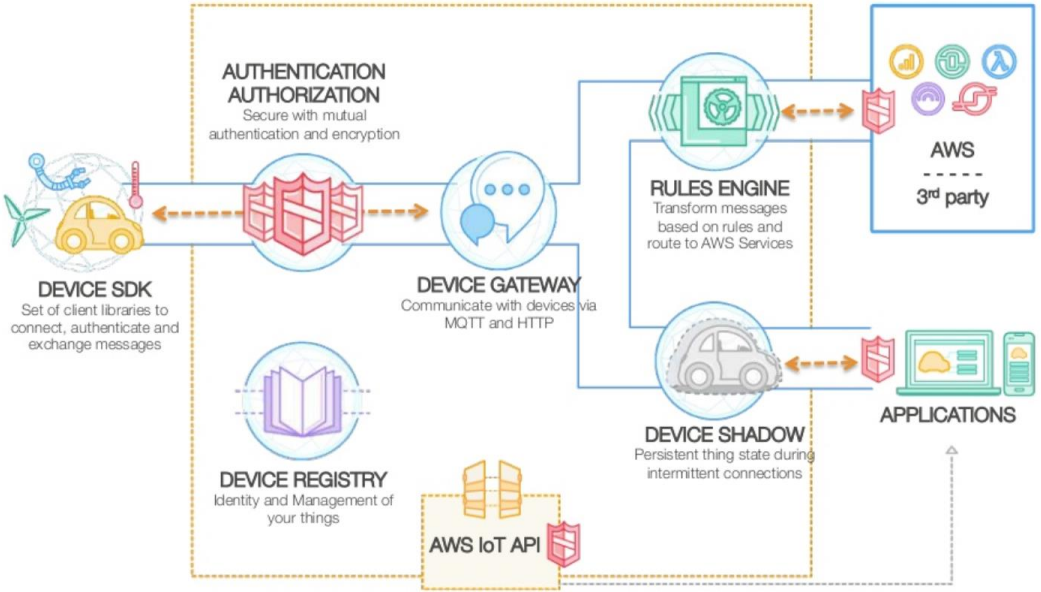
Popular IIoT Platforms

- Many platforms available
- Preference depends on
  - Service model (IaaS, PaaS, SaaS)
  - Company IT preferences
  - Experience
  - Capabilities & Requirements
  - Cost model
  - ..

Connecting to Amazon Web Services IoT

Amazon Web Services (AWS) – IoT service

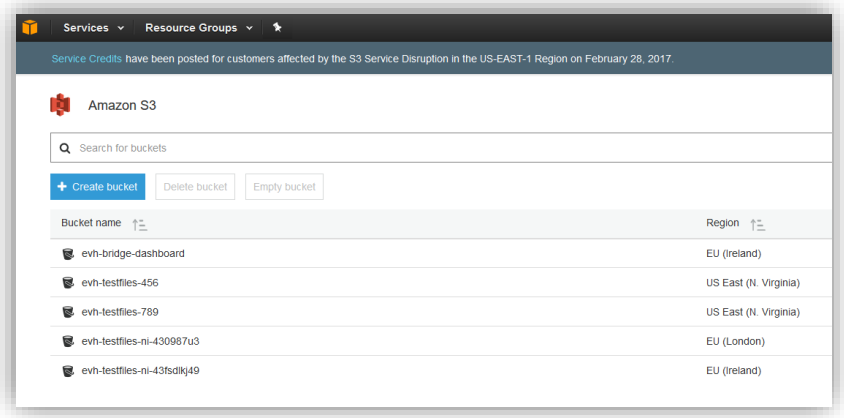
- Connect over MQTT
- Manage things
- Route messages to other services
- Debug
- https://aws.amazon.com/iot/



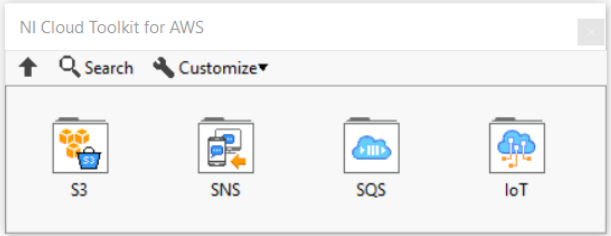
AWS IoT Rules and Services

Amazon S3 Storage

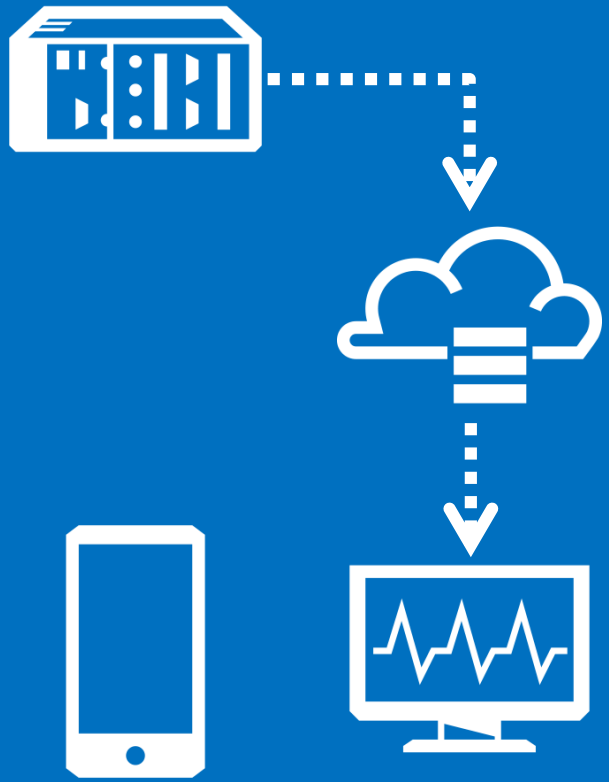
- Simple Storage Service (S3)
- Store and retrieve from anywhere
- Store large files up to 5TB
- S3 Buckets (folders) and objects (files)
- Regions
- https://aws.amazon.com/s3/



- 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—IoT, DynamoDB, S3
  - MQTT
  - CompactRIO
- Requirements
  - Network connection
  - AWS account (free tier)
  - LabVIEW NI Cloud Toolkit for AWS
  - LabVIEW MQTT API

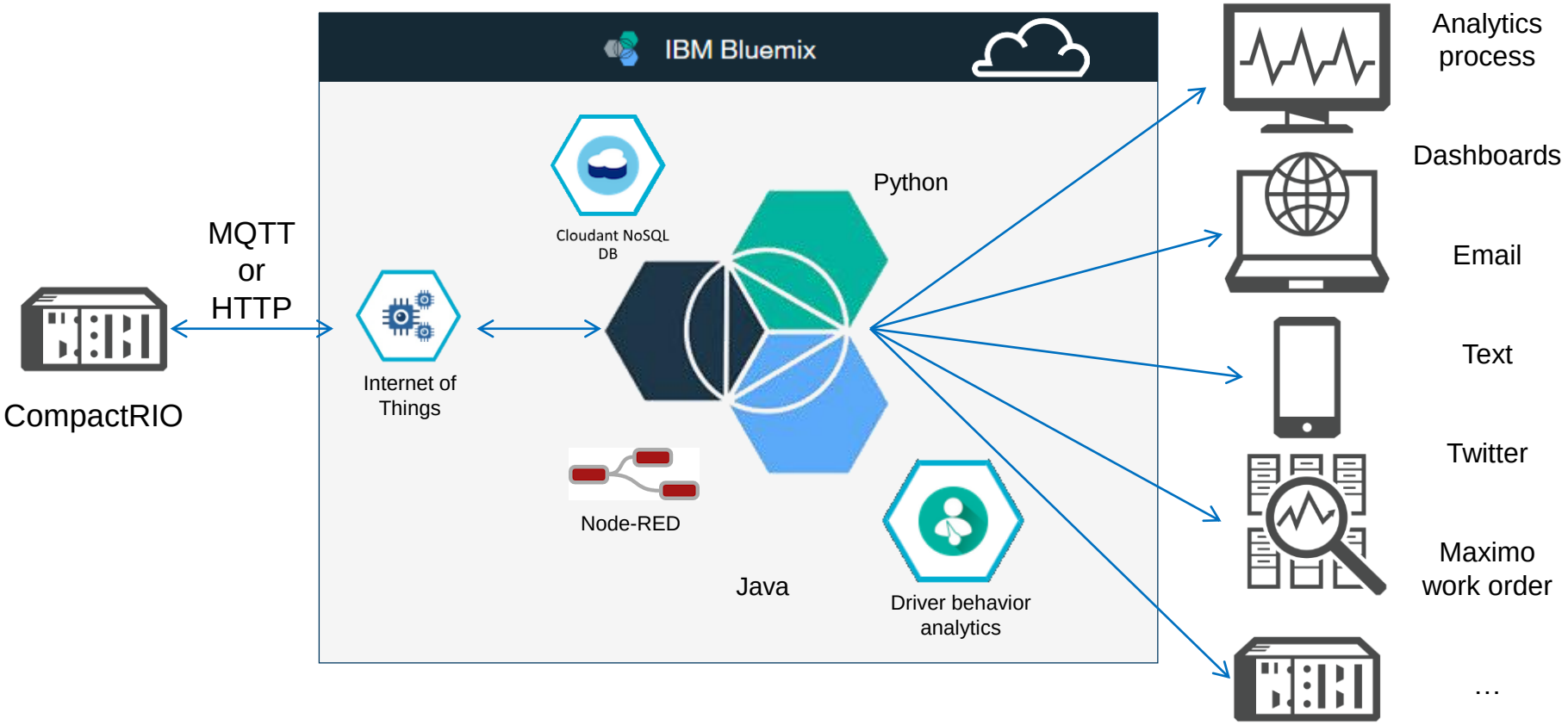
Connecting to IBM Watson IoT for Bluemix

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

NATIONAL INSTRUMENTS

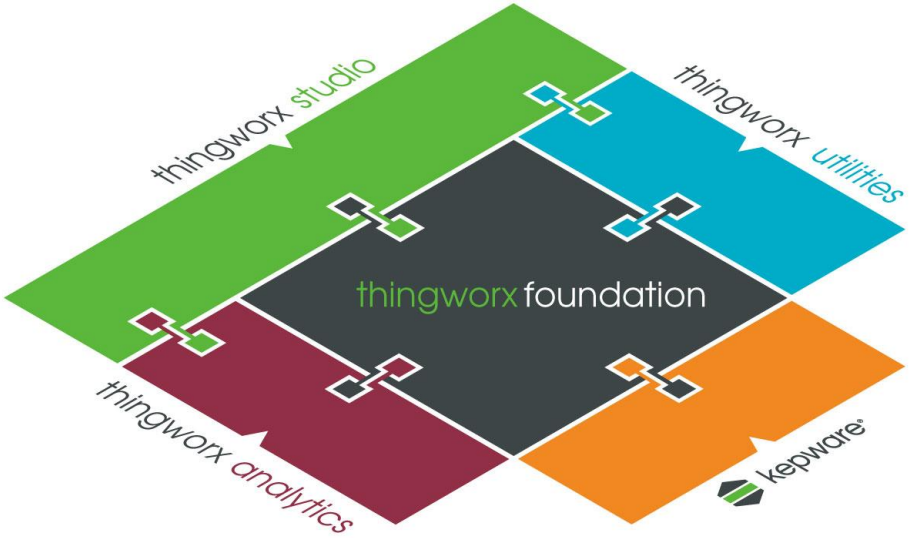
IBM Bluemix Concept



Connecting to PTC ThingWorx

PTC ThingWorx IoT platform

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



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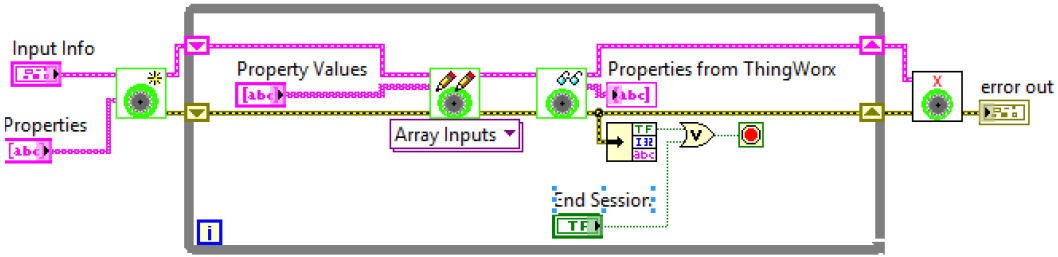
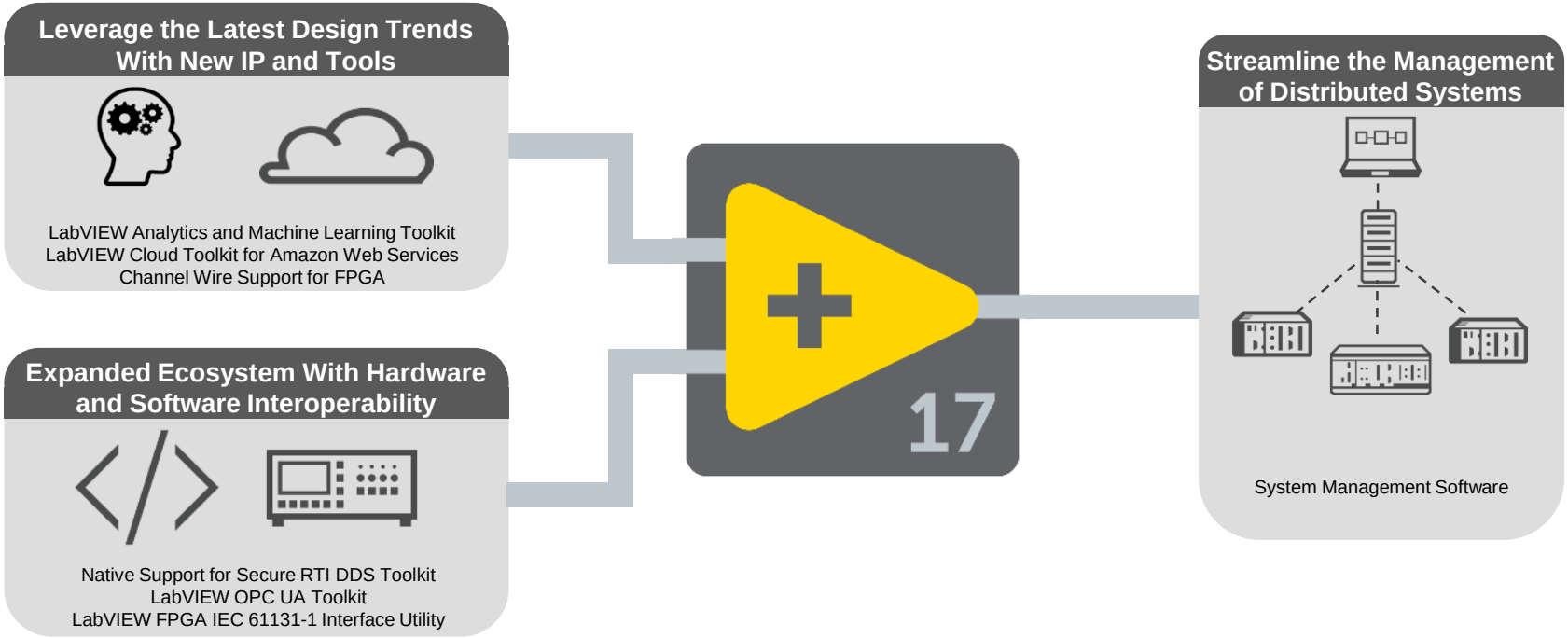


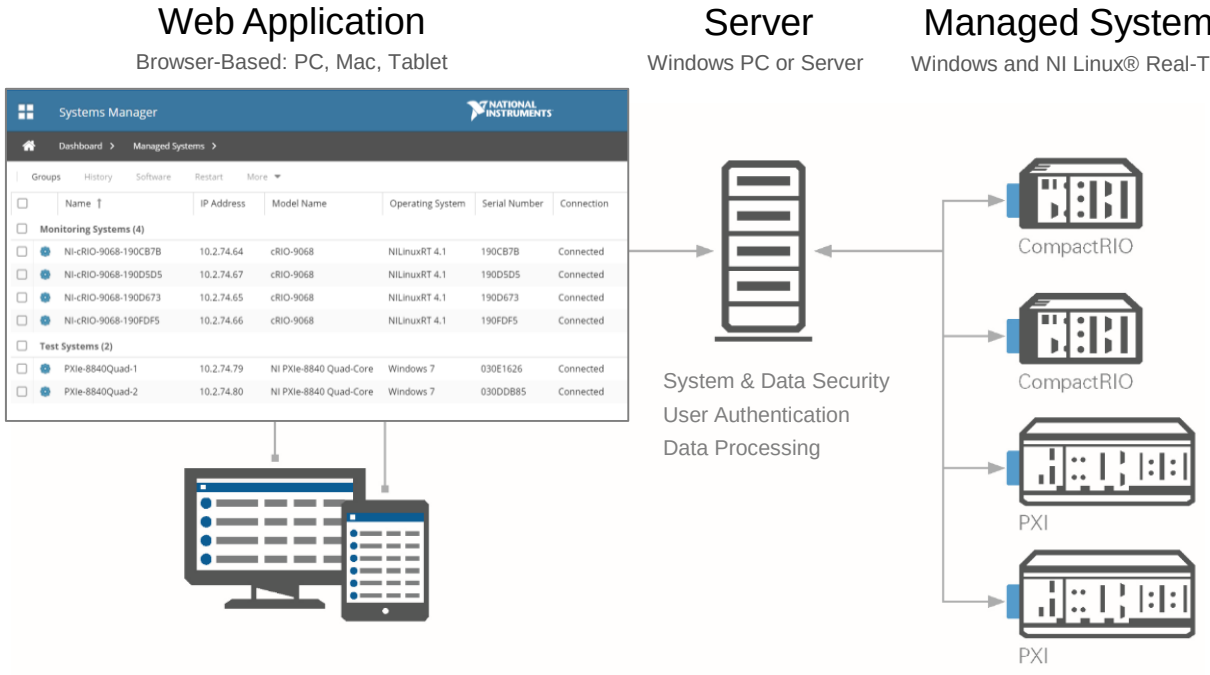
LabVIEW 2017

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.



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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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