rti Your systems. Working as one.

influxdata Act in Time

How to Remotely Monitor Systems with Time Series and DDS

Brett Murphy, Senior Director Market Development, Industrial IoT, RTI

Kyoungho An, Senior Research Engineer, RTI

About the Viewer Panel

Technical problems?

- Click on the "Question Mark Symbol" on the upper right hand corner of your screen, where you will be directed to a list of system checks
- Send a question from the "Ask a Question" window. Individual technical questions will be answered in the "Answered Questions" on the left hand side of your screen

Slides:

- Click the four pronged arrow button at the top right corner of the slides to view an expanded window
  - Slides should change automatically
- Click on "Download Webcast Slides" under "Event Resources" for a PDF of all slides
  - Warning: The PDF will be a large file

Archive:

- Within 7 days, an archive with Q&A will be posted
- We will send an email to registered attendees with hyperlink
- Can also access from www.controleng.com home page

Speakers

Presenter: Brett Murphy, Senior Director of Market Development, IIoT, RTI

Presenter: Kyoungho An, Senior Research Engineer, RTI

Moderator: Mark Hoske, Content Manager, Control Engineering and CFE Media & Technology

Industrial IoT Systems run on RTI

Autonomous Vehicles/Transportation

Healthcare

Energy

Aerospace & Defense

Software connectivity framework that delivers system **resiliency**, **security**, **performance**, **scale** and **interoperability**.

Foundational to over 1,200 systems.

Digital Transformation Maturity Matrix

Connext DDS Enables Advanced IIoT Systems

Business Impact

	Monitoring, reporting	Control	Autonomy
Major business transformation	Ride Hailing Platforms (e.g. Uber, LYFT)	Connected Supply Chain Building Information Management (BIM)	Autonomous Vehicle Fleet Systems
New revenue streams, customer experience	Servitization (e.g. R-R) Predictive Maintenance Drone Inspections	Facilities Management (FM) Connected Vehicle Drone delivery	Smart Traffic Management Distribution Grid Management
Efficiency, cost savings	Preventive Maintenance Energy Monitoring Performance Monitoring Asset Management Operations Analytics	Energy Management Asset Performance Management Remote Servicing/Operations SCADA/HMI MES/PES	'Lights-out' Production Remote Service and Repair HVAC Control

Technological Capability

Connext 6: Platform for Distributed System Connectivity

Connext DDS Professional
Connectivity software for developing and integrating IIoT systems.

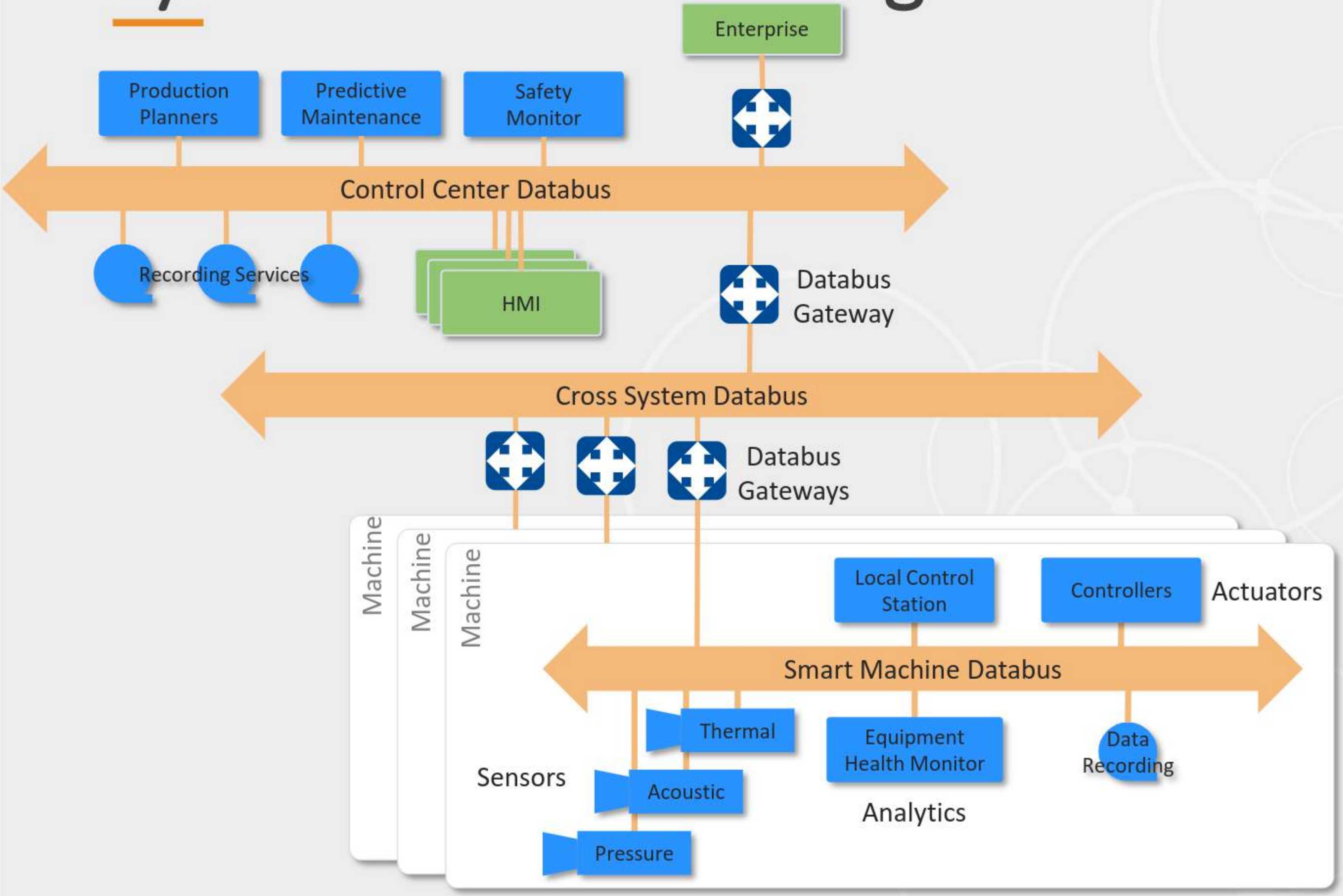
Connext DDS Secure
Designed for systems requiring robust, fine-grained security.

- Code Generation
- Data Routing
- Data Persistence
- Data Queuing
- Recording & Replay
- System Administration
- System Introspection
- System Monitoring
- Database Integration
- Web Integration
- Spreadsheet Integration
- 3rd Party Integrations

Connext DDS Micro
Designed for resource-constrained systems.

Connext DDS Cert
Designed for safety-certifiable systems.

Layered Databus for Edge to Cloud



- Widely used across advanced Industrial IoT systems
- Resilient, secure, fast, scalable

Connext DDS Resilience

- DDS controls the 6.8 GW Grand Coulee Dam
  - Largest power plant in North America
  - Fastest-responding major power source on the Western Grid
  - Requires 24x7 operation

- Connext DDS met the challenges
  - Extreme availability
  - Wide area communications
  - Multi-level routing
  - High security

U.S. Army Corps of Engineers®

Fault tolerance protecting against even minimal downtime

Connext DDS Security: A Demanding Test

- USS Secure cybersecurity testbed
  - Collaboration between the NSA, DoD, Navy, Naval Research, John Hopkins Univ APL, RTI
- Objectives
  - Immunize against cyberattack and to rapidly recover when impacted
  - Determine the best cyber-defense technologies without impacting real-time performance
- Results
  - Thumbs Up for RTI Connext DDS Security

Data secured end-to-end and access managed per user and application

Connext DDS Security: Unique Capabilities

- Beyond endpoint and network security, Connext uses DDS Security to secure the data streams individually
  - Better protects against malicious insider attacks and segregates data by user and application
- Connext provides seamless end-to-end data communication security
  - Works over any network and even between apps on one compute node
- Connext allows you to balance performance and security in the system

Connext DDS Performance

- The NASA Kennedy launch control is the world's largest single-system SCADA
- It combines 400k data points, at 500k msgs/sec

Low-latency, high throughput data comms

Connext DDS Scale

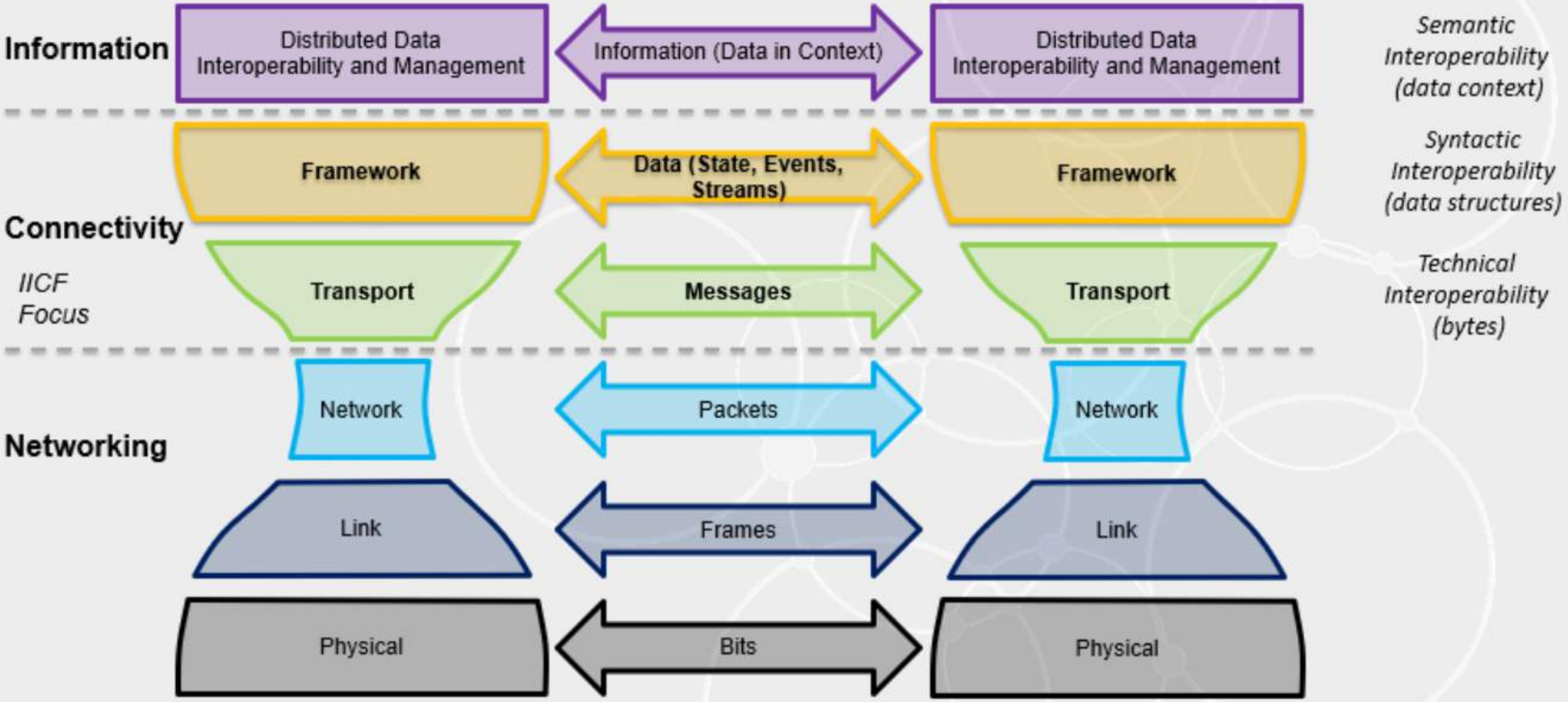
- Raytheon uses RTI middleware to control the new Zumwalt DDG 1000 destroyer
- The system connects hundreds of computers, 1,500 teams building thousands of applications, and more than 10m publish-subscribe pairs

Widely shared data and many applications integrated

Connext DDS Interoperability

- Open DDS Connectivity Standard
- Supports Data Models
- Provides Data Centric Modularity

IIoT Connectivity Stack Model

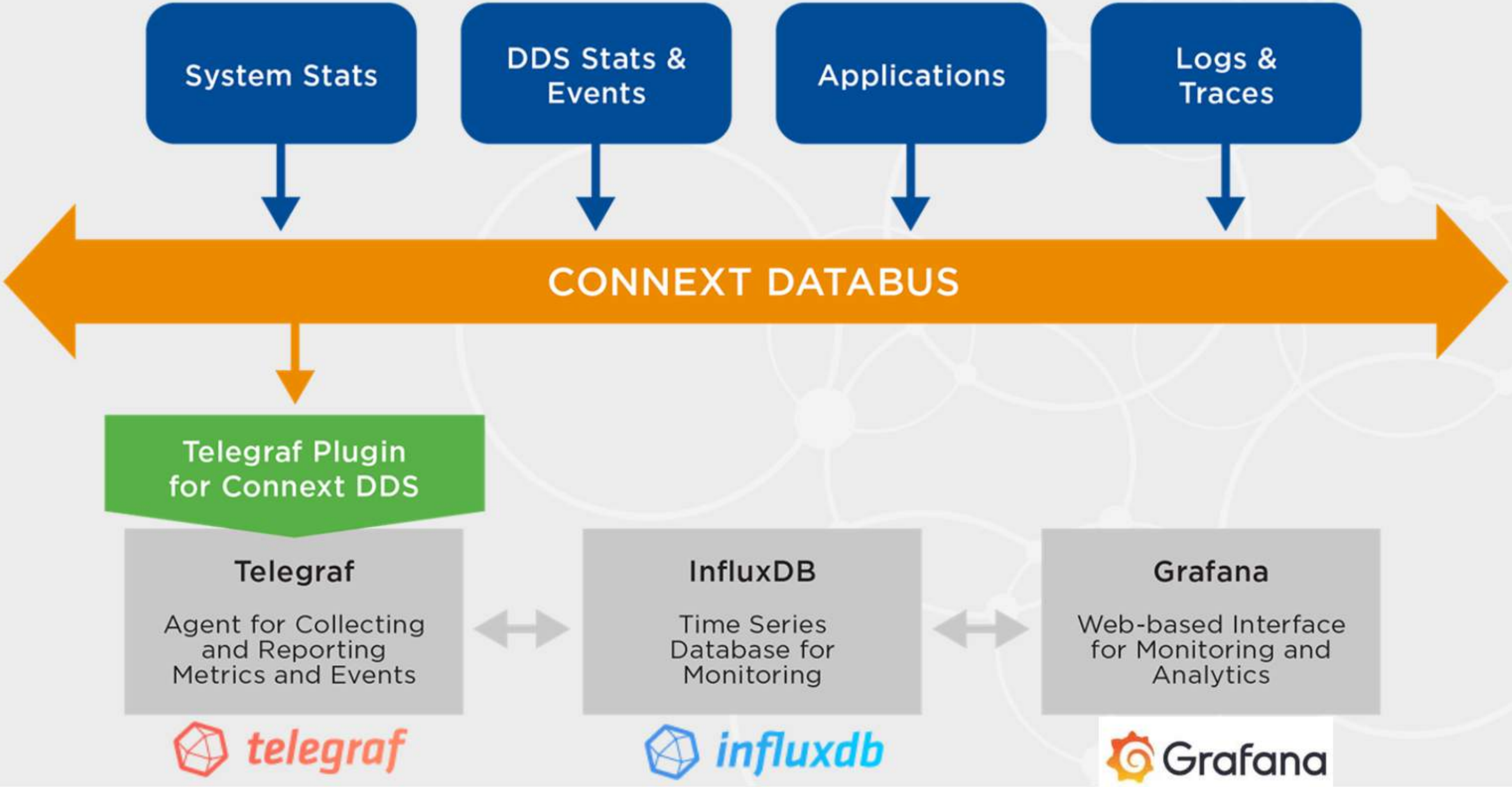


Information
Distributed Data Interoperability and Management
Information (Data in Context)
Distributed Data Interoperability and Management
Semantic Interoperability (data context)
Framework
Data (State, Events, Streams)
Framework
Syntactic Interoperability (data structures)
Connectivity
IICF Focus
Transport
Messages
Transport
Technical Interoperability (bytes)
Networking
Network
Packets
Network
Link
Frames
Link
Physical
Bits
Physical

Open standards: software and device modularity, interchange and portability

Integration of RTI Connext DDS and InfluxDB

Telegraf Plugin for Connext DDS enables monitoring architecture with DDS and InfluxDB

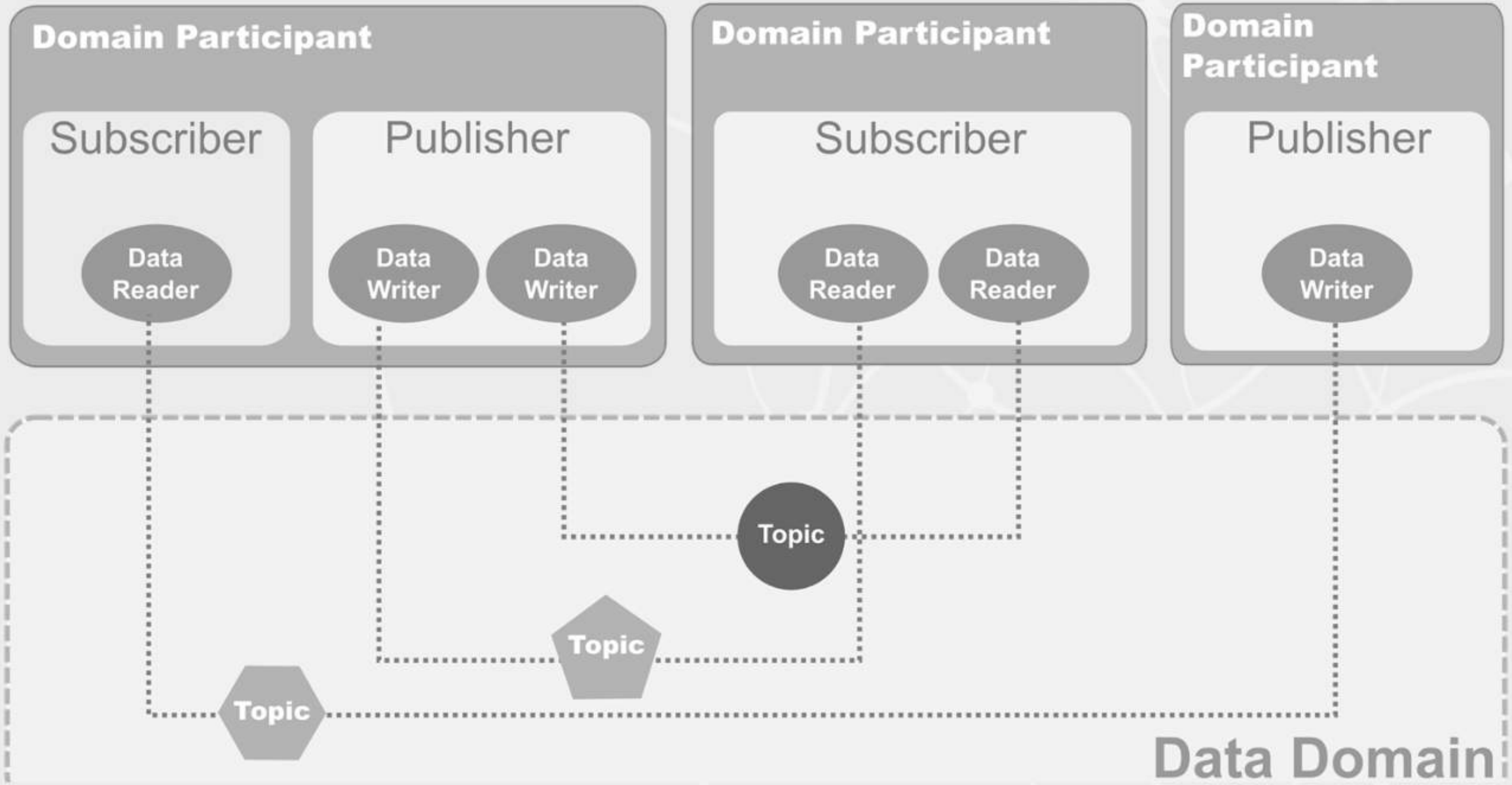

System Stats
DDS Stats & Events
Applications
Logs & Traces
CONNEXT DATABUS
Telegraf Plugin for Connext DDS
Telegraf
Agent for Collecting and Reporting Metrics and Events
InfluxDB
Time Series Database for Monitoring
Grafana
Web-based Interface for Monitoring and Analytics
telegraf
influxdb
Grafana

Why did RTI decide to use the InfluxDB stack?

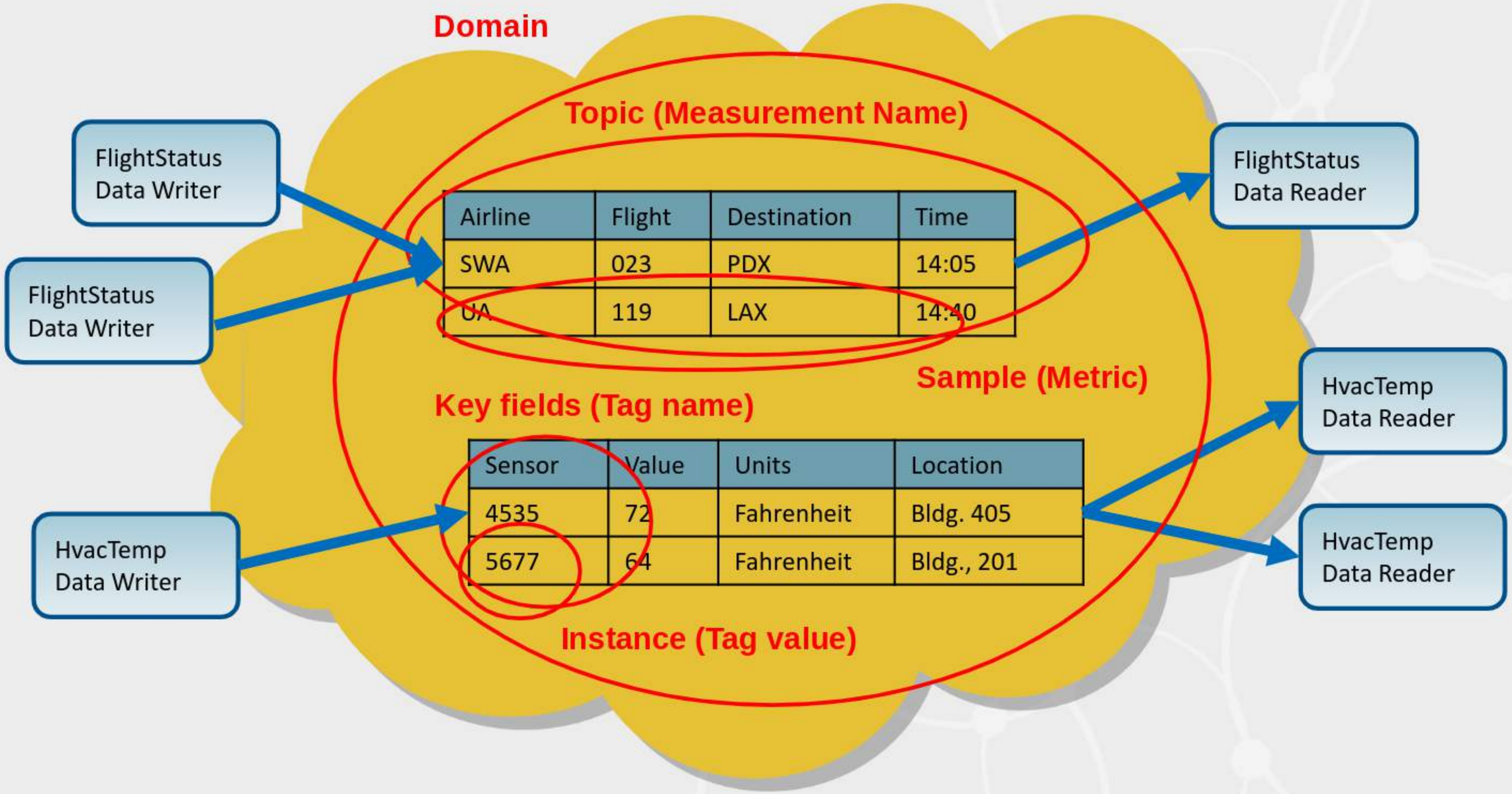
- Telegraf uses **push-based** metric collection, which is a better fit for DDS (event-based based pub/sub model)
- Many **out-of-the-box plugins** for system monitoring
- **Mature** and widely adopted **open source** technology with **commercial** offering/support

DDS and InfluxDB

DDS Terminology



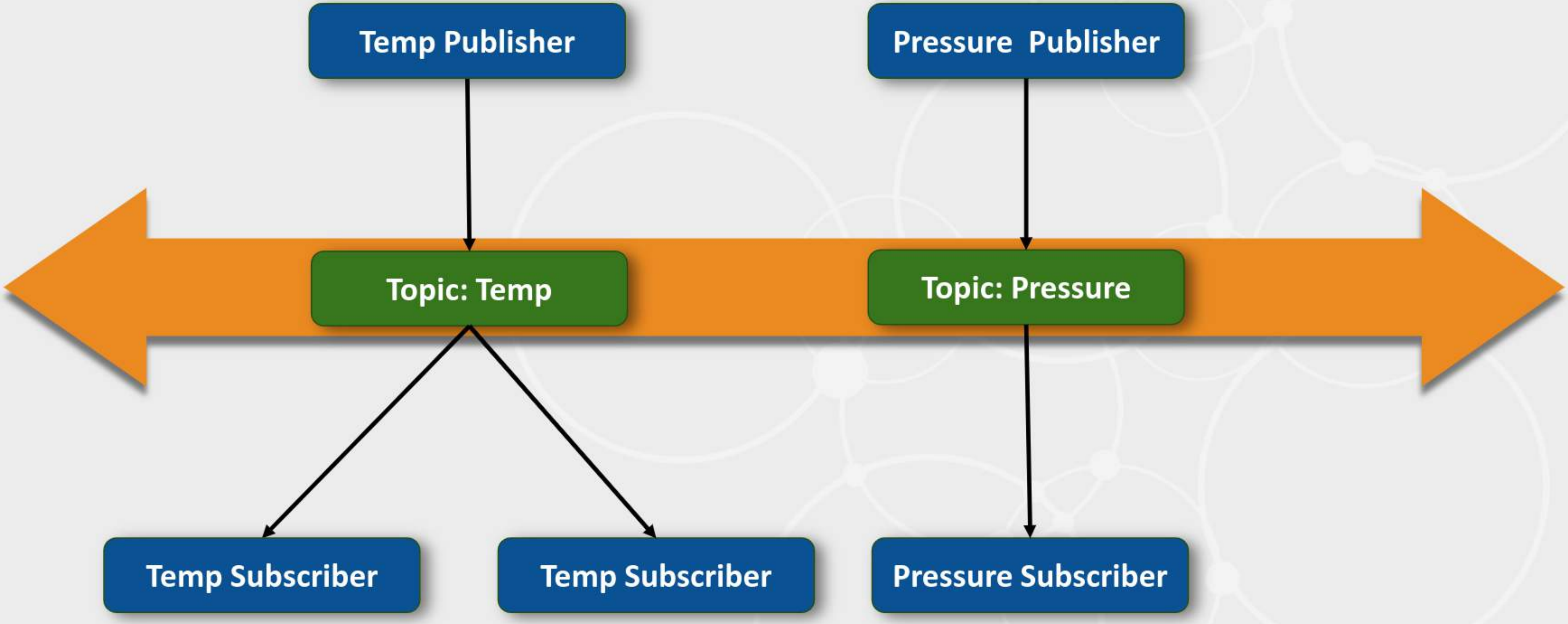
Mapping of DDS and InfluxDB concepts



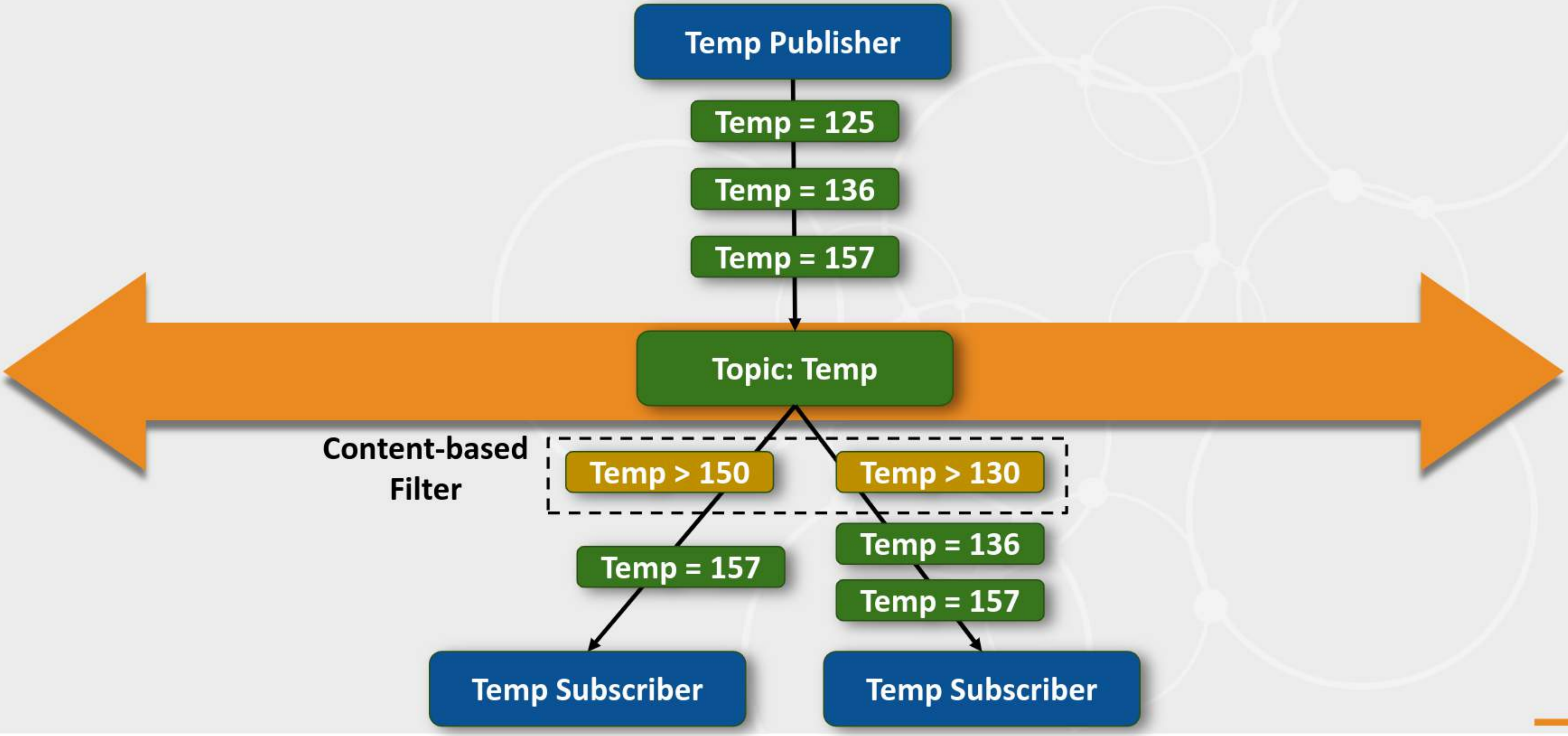
Airline	Flight	Destination	Time
SWA	023	PDX	14:05
UA	119	LAX	14:40

Sensor	Value	Units	Location
4535	72	Fahrenheit	Bldg. 405
5677	64	Fahrenheit	Bldg., 201

DDS is fully distributed and supports decoupled publish/subscribe communications



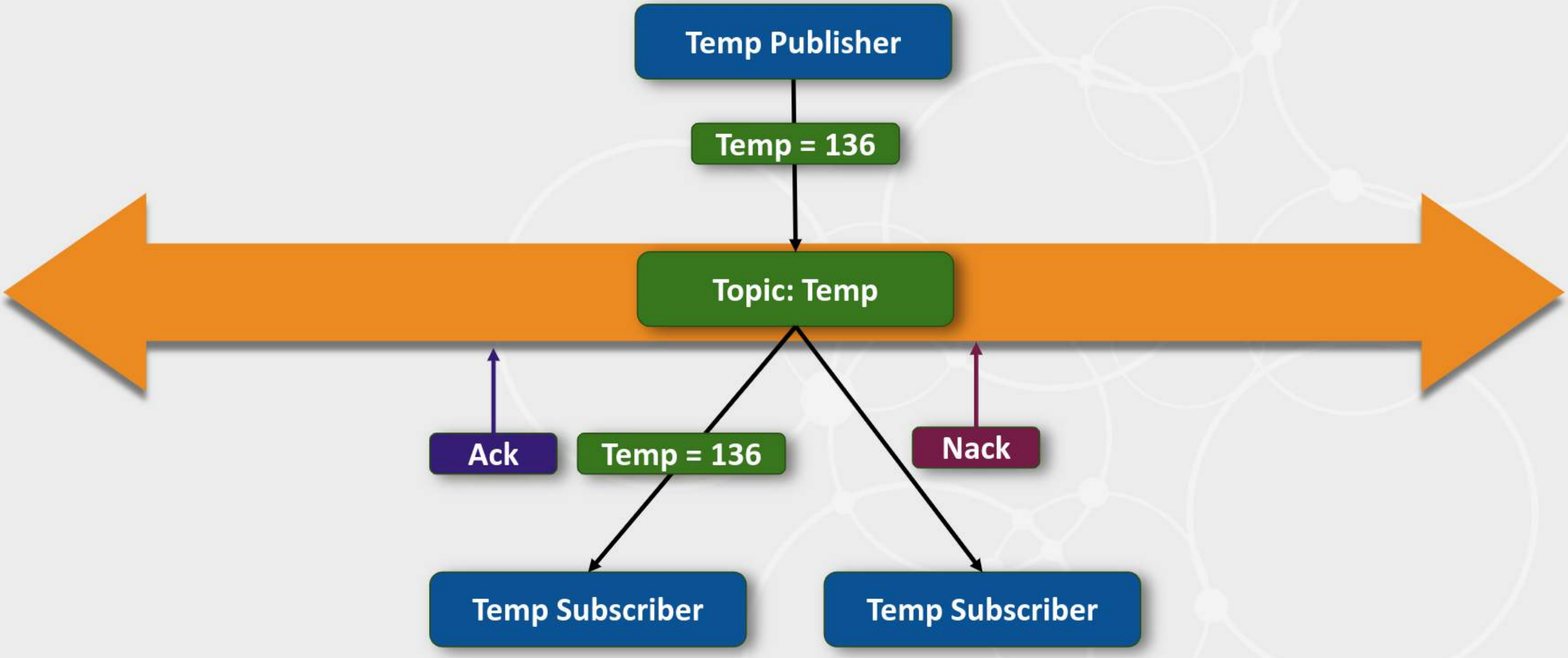
DDS is data-centric and supports content-based filtering



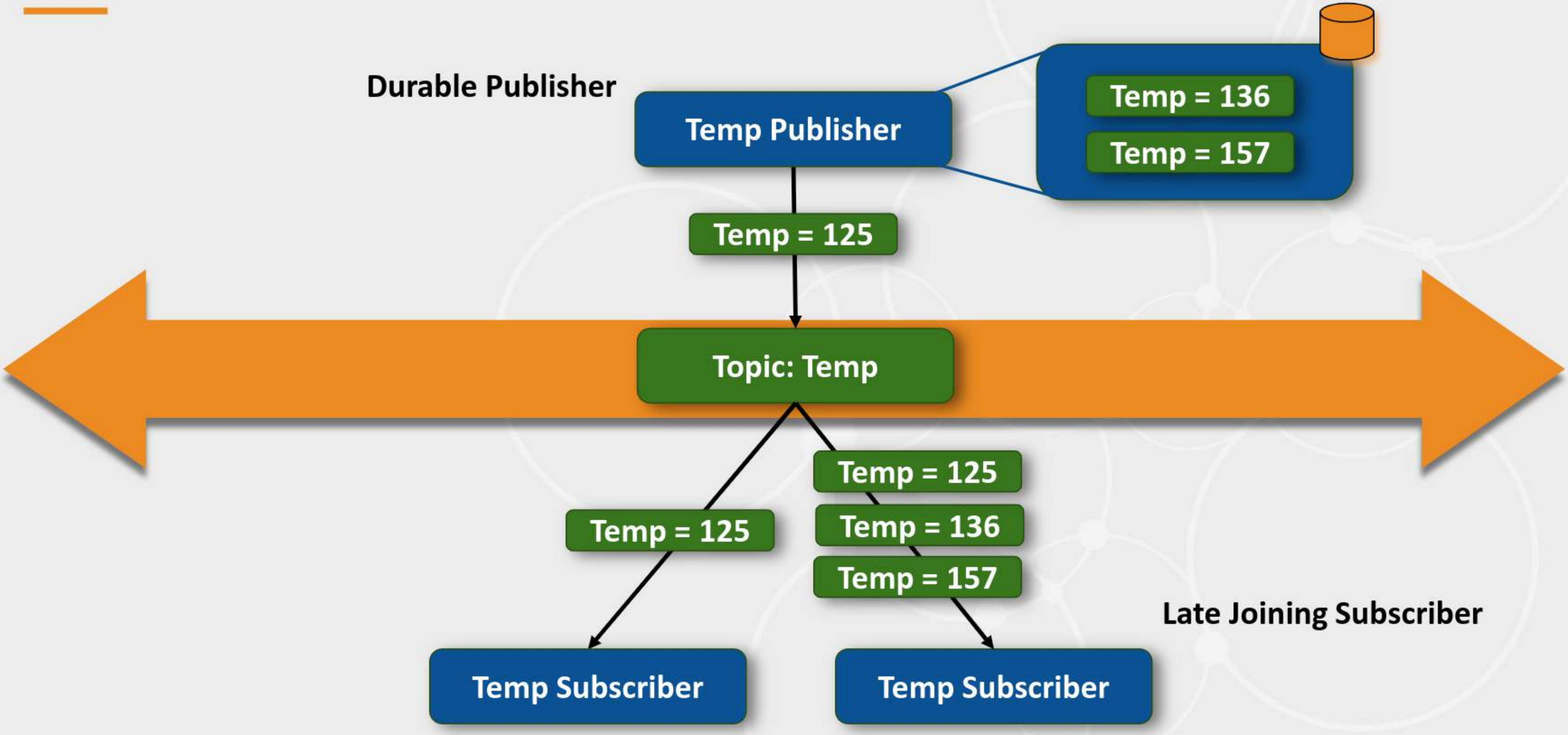
DDS can control data flows and resource usage

	Quality of Service	Quality of service	
Volatility	**DURABILITY**	USER_DATA	User
	HISTORY	TOPIC_DATA	
	READER DATA LIFECYCLE	GROUP_DATA	
	WRITER DATA LIFECYCLE	PARTITION	Presentation
	LIFESPAN	PRESENTATION	
Infrastructure	ENTITY FACTORY	DESTINATION ORDER	
	RESOURCE LIMITS	OWNERSHIP	Redundancy
Delivery	**RELIABILITY**	OWNERSHIP STRENGTH	
	TIME BASED FILTER	LIVELINESS	
	DEADLINE	LATENCY BUDGET	Transport
	CONTENT FILTERS	TRANSPORT PRIORITY	

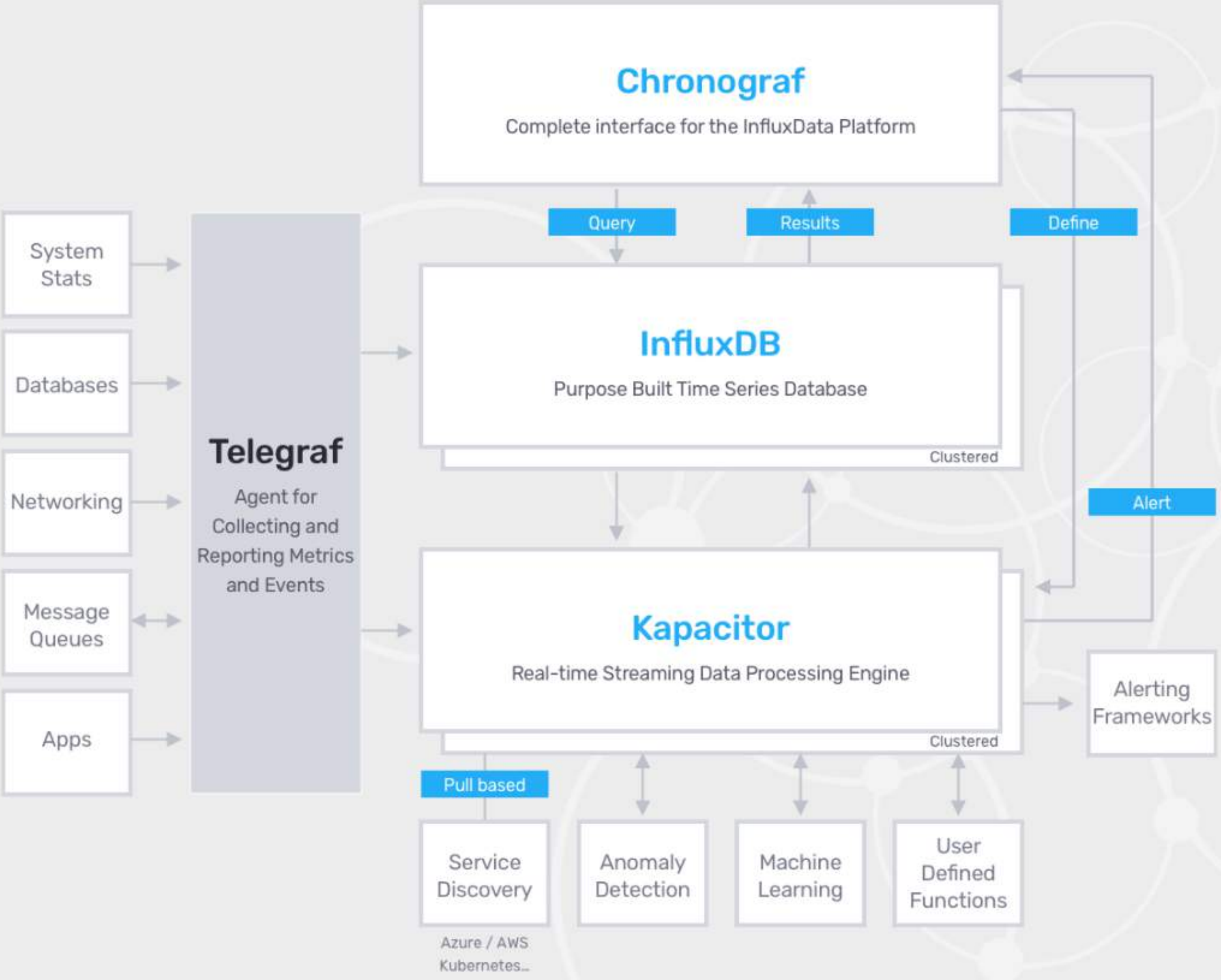
DDS supports reliable delivery on top of UDP and multicast



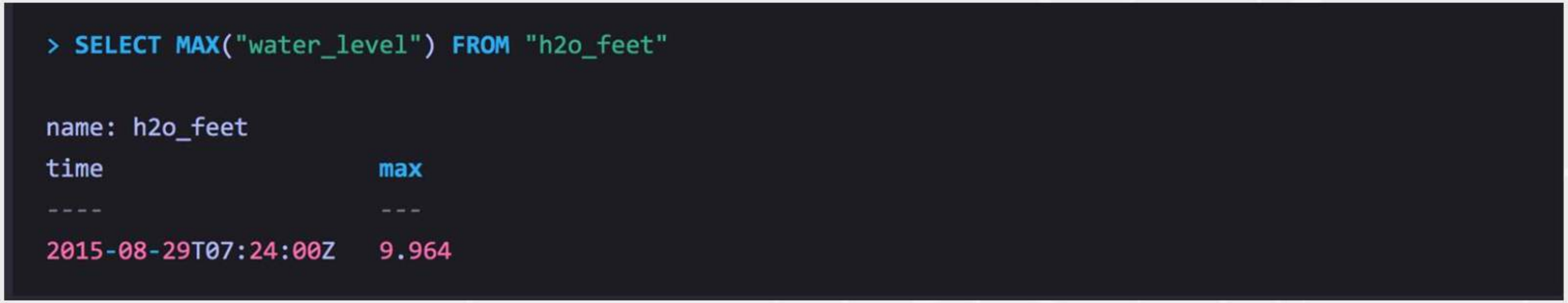
DDS can deliver historical data for late joiners



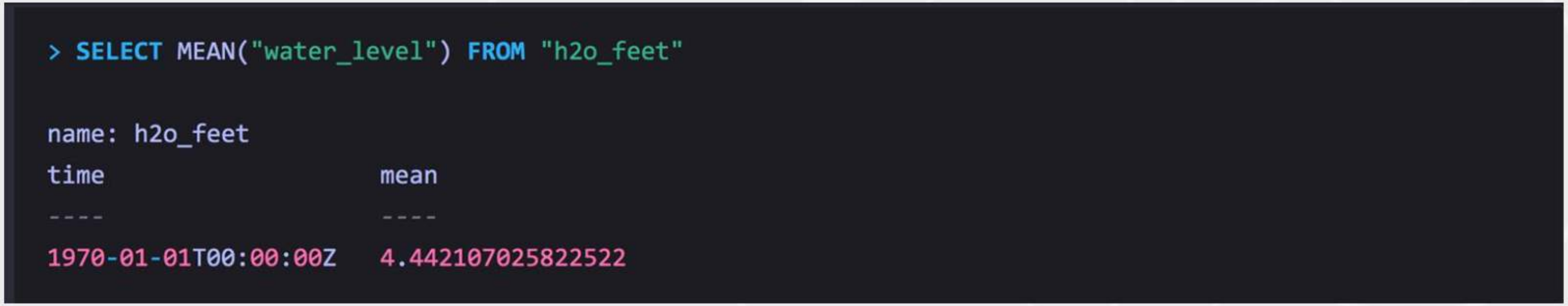
Telegraf has many out-of-the-box input plugins and plugin APIs to easily extend



InfluxDB supports built-in time-series functions

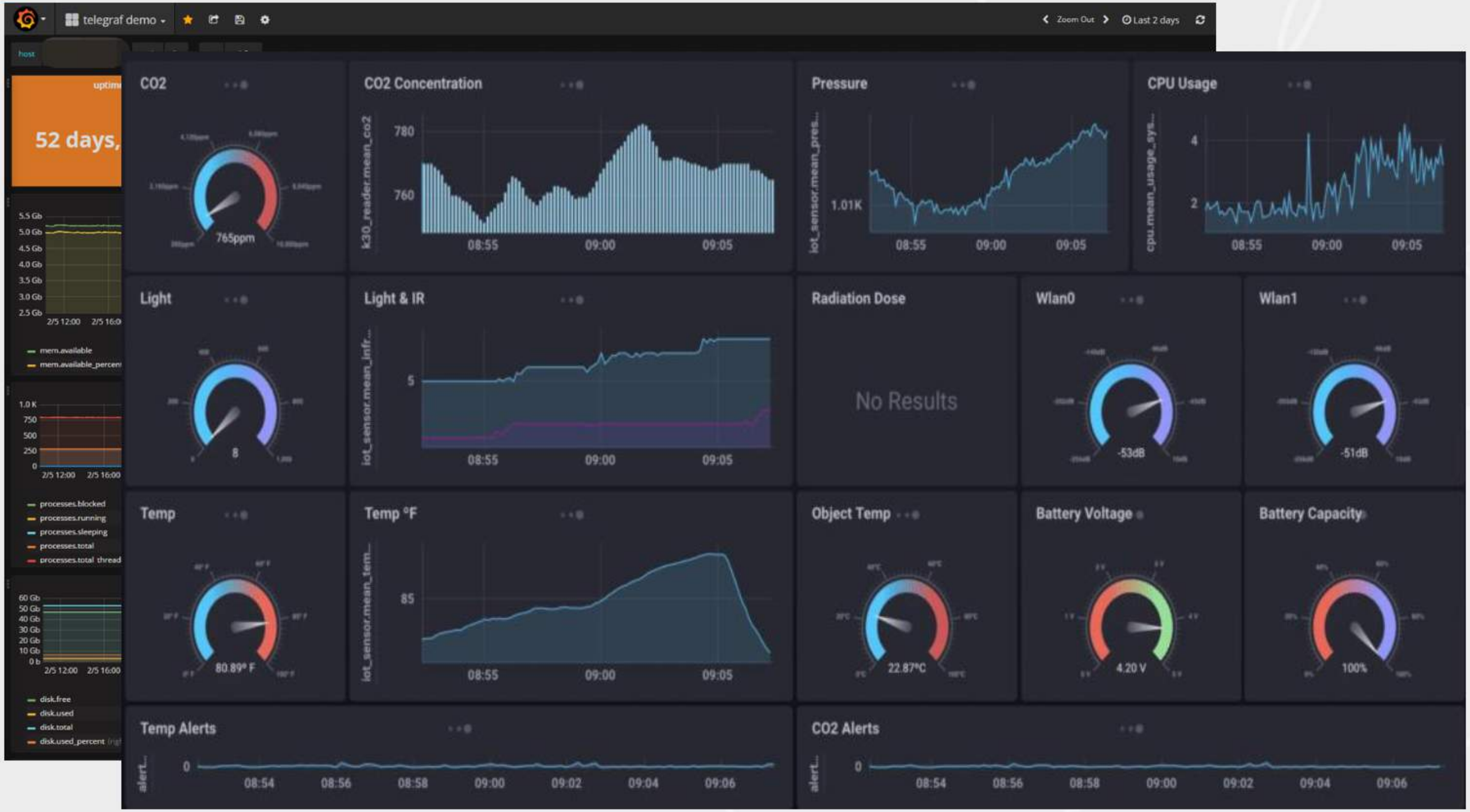


```
> SELECT MAX("water_level") FROM "h2o_feet"

name: h2o_feet
time                   max
----                   ---
2015-08-29T07:24:00Z   9.964
```



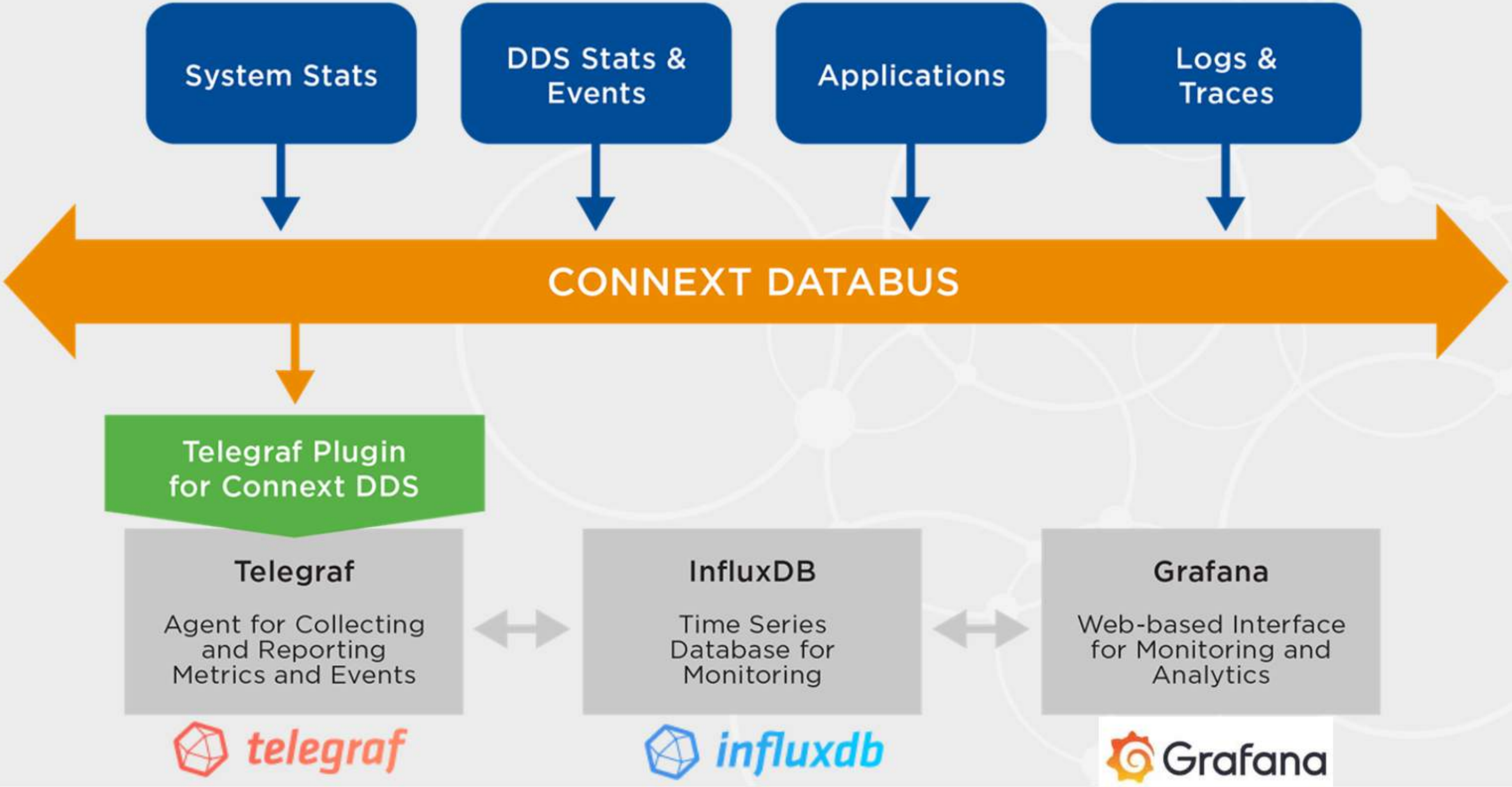
```
> SELECT MEAN("water_level") FROM "h2o_feet"

name: h2o_feet
time                   mean
----                   ----
1970-01-01T00:00:00Z   4.442107025822522
```

InfluxDB integrates visualization tools such as Grafana and Chronograf



Telegraf Plugin for RTI Connext DDS

Telegraf Plugin for Connext DDS enables monitoring architecture with DDS and InfluxDB



System Stats

DDS Stats & Events

Applications

Logs & Traces

CONNEXT DATABUS

Telegraf Plugin for Connext DDS

Telegraf

Agent for Collecting and Reporting Metrics and Events

InfluxDB

Time Series Database for Monitoring

Grafana

Web-based Interface for Monitoring and Analytics

telegraf

influxdb

Grafana

How is the plugin implemented?

We used RTI Go Connector for developing Telegraf plugins

- RTI Go Connector is **simplified API** for DDS in Golang
  - Built on top of DDS C API
  - Very few methods
  - Experimental products developed by the RTI research team
  - Free!

https://github.com/rticommunity/rticonnextdds-connector-go

The DDS consumer input plugin is developed as a service input plugin

```
type ServiceInput interface {
   Input

   // Start the ServiceInput.
   Start(Accumulator) error

   // Stop stops the services and closes any necessary channels and connections
   Stop()
 }
```

Initially, it creates DDS entities and a service thread

```
func (d *DDSConsumer) Start(acc telegraf.Accumulator) error {
    // Create a RTI Connector
    d.connector, err = rti.NewConnector(d.ParticipantConfig, d.ConfigFilePath)

    // Get a DDS reader
    d.reader, err = d.connector.GetInput(d.ReaderConfig)

    // Start a thread for processing DDS samples
    go d.process()
}
```

A service thread reads and processes DDS data samples

```
// Take DDS samples from a DataReader and ingest them to Telegraf outputs
func (d *DDSConsumer) process() {
        for {
                d.connector.Wait(-1)        // Wait until a new DDS sample arrives
                d.reader.Take()             // Take DDS samples
                numOfSamples := d.reader.Samples.GetLength()
                for i := 0; i < numOfSamples; i++ {          // Iterate the DDS samples
                        json, err := d.reader.Samples.GetJSON(i)     // Return a DDS sample
in JSON
                        metrics, err := d.parser.Parse(json) // Parse the JSON object
                        // Add metrics to an output plugin
```

How to use the plugin?

Creating an XML configuration file

```xml
<dds>
<!-- Data Types -->
<types>
    <struct name="ShapeType" extensibility="extensible">
        <member name="color" stringMaxLength="128" id="0" type="string" key="true"/>
        <member name="x" id="1" type="long"/>
        <member name="y" id="2" type="long"/>
        <member name="shapesize" id="3" type="long"/>
    </struct>
</types>
```

Creating an XML configuration file

```
<!-- Domain Library -->
<domain_library name="MyDomainLibrary">
    <domain name="MyDomain" domain_id="0">
        <register_type name="ShapeType" type_ref="ShapeType"/>
        <topic name="Square" register_type_ref="ShapeType"/>
    </domain>
</domain_library>
```

Creating an XML configuration file

```
<!-- Participant library -->
<domain_participant_library name="MyParticipantLibrary">
    <domain_participant name="Zero" domain_ref="MyDomainLibrary::MyDomain">
        <subscriber name="MySubscriber">
            <data_reader name="MySquareReader" topic_ref="Square"/>
        </subscriber>
    </domain_participant>
</domain_participant_library>
</dds>
```

Creating a TOML configuration file

```
[[inputs.dds_consumer]]
  # XML configuration file path
  config_path = "example_configs/ShapeExample.xml"

  # Configuration name for DDS Participant from a description in XML
  participant_config = "MyParticipantLibrary::Zero"

  # Configuration name for DDS DataReader from a description in XML
  reader_config = "MySubscriber::MySquareReader"
```

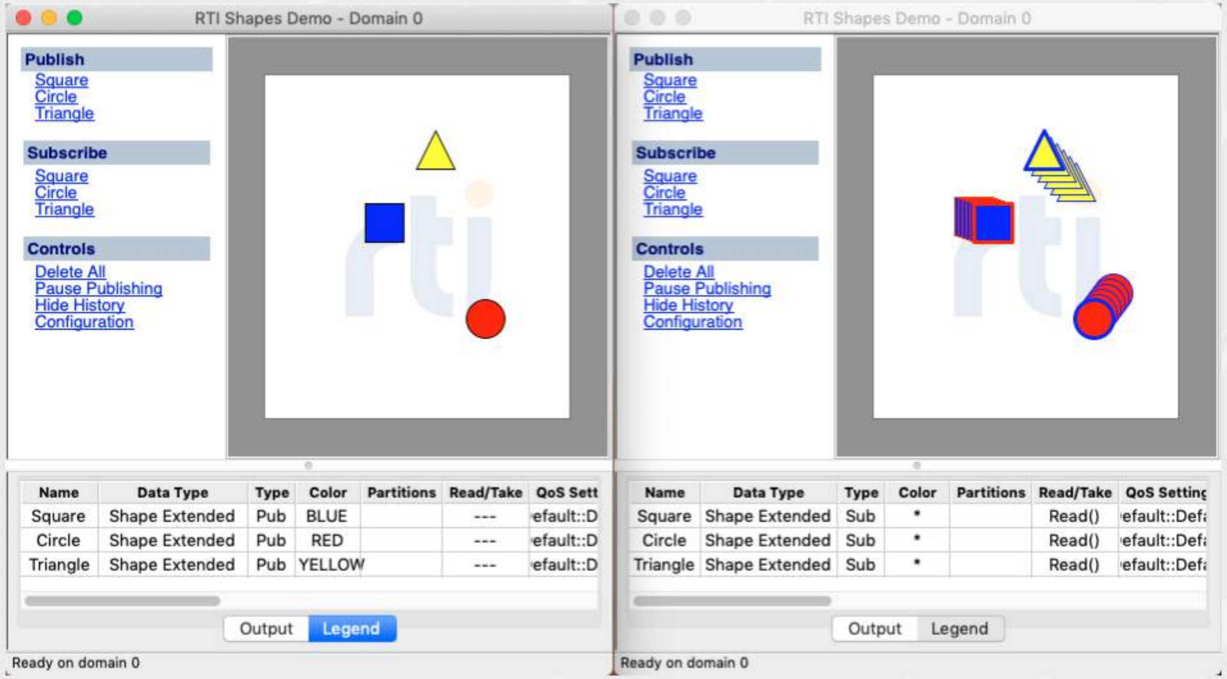
Creating a TOML configuration file

```toml
# Tag key is an array of keys that should be added as tags.
tag_keys = ["color"]

# Override the base name of the measurement
name_override = "shapes"

# Data format to consume.
data_format = "json"
```

Demo

Shapes Demo

- Telegraf Input Plugin for RTI Connext DDS
  - Delivering historical data for late joiners
  - Content-based filtering



Name	Data Type	Type	Color	Partitions	Read/Take	QoS Sett
Square	Shape Extended	Pub	BLUE		---	efault::D
Circle	Shape Extended	Pub	RED		---	efault::D
Triangle	Shape Extended	Pub	YELLOW		---	efault::D

Ready on domain 0

Name	Data Type	Type	Color	Partitions	Read/Take	QoS Setting
Square	Shape Extended	Sub	*		Read()	efault::Def
Circle	Shape Extended	Sub	*		Read()	efault::Def
Triangle	Shape Extended	Sub	*		Read()	efault::Def

Ready on domain 0

https://www.rti.com/free-trial/shapes-demo

Thank you!

rti.com
Free trial of Connext DDS

rtisoftware

@rti_software

connextpodcast

@rti_software

rti.com/blog

https://www.rti.com/developers/rti-labs

Submitting Questions, Exit Survey and Archive

Questions?

Type your question in the "Ask a Question" box on the Webcast Console and click "Send." We will get to as many questions as we have time for. Questions that are for today's presenters will be answered verbally during the Q&A session.

Exit Survey:

Please take a moment to answer a few questions on our exit survey that will pop up on your screen at the conclusion of the webcast. We use the answers to help make improvements to our webcast program.

Archive:

- Within 7 days, an archive with Q&A will be posted
- We will send an email to registered attendees with hyperlink
- Can also access from the controleng.com home page

Speakers

Presenter: Brett Murphy, Senior Director of Market Development, IIoT, RTI

Presenter: Kyoungho An, Senior Research Engineer, RTI

Moderator: Mark Hoske, Content Manager, Control Engineering and CFE Media & Technology rti Your systems. Working as one.

influxdata Act in Time

How to Remotely Monitor Systems with Time Series and DDS

Brett Murphy, Senior Director Market Development, Industrial IoT, RTI

Kyoungho An, Senior Research Engineer, RTI