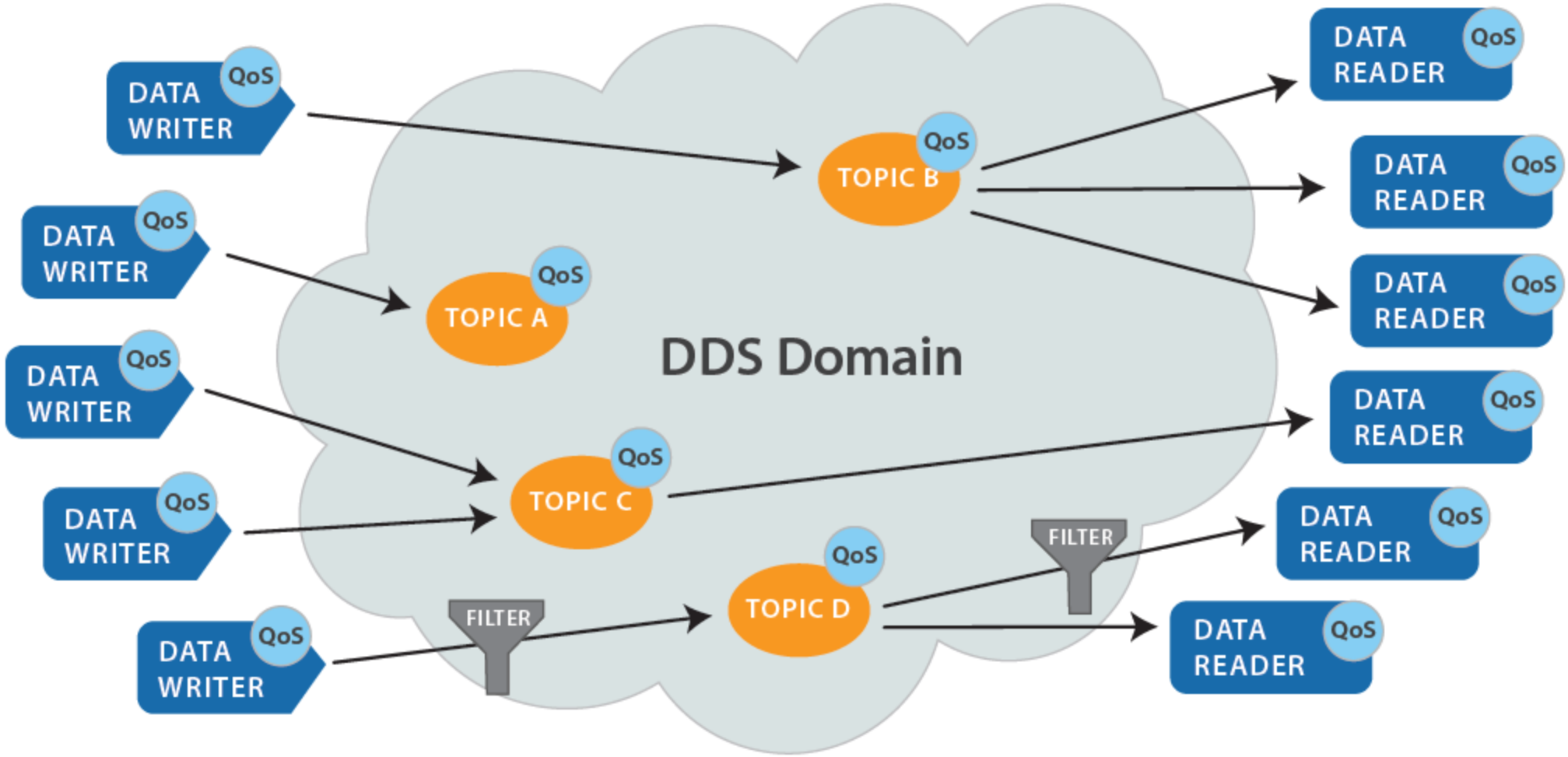
Monitoring of RTI Connext DDS with Prometheus

Overview and demonstration

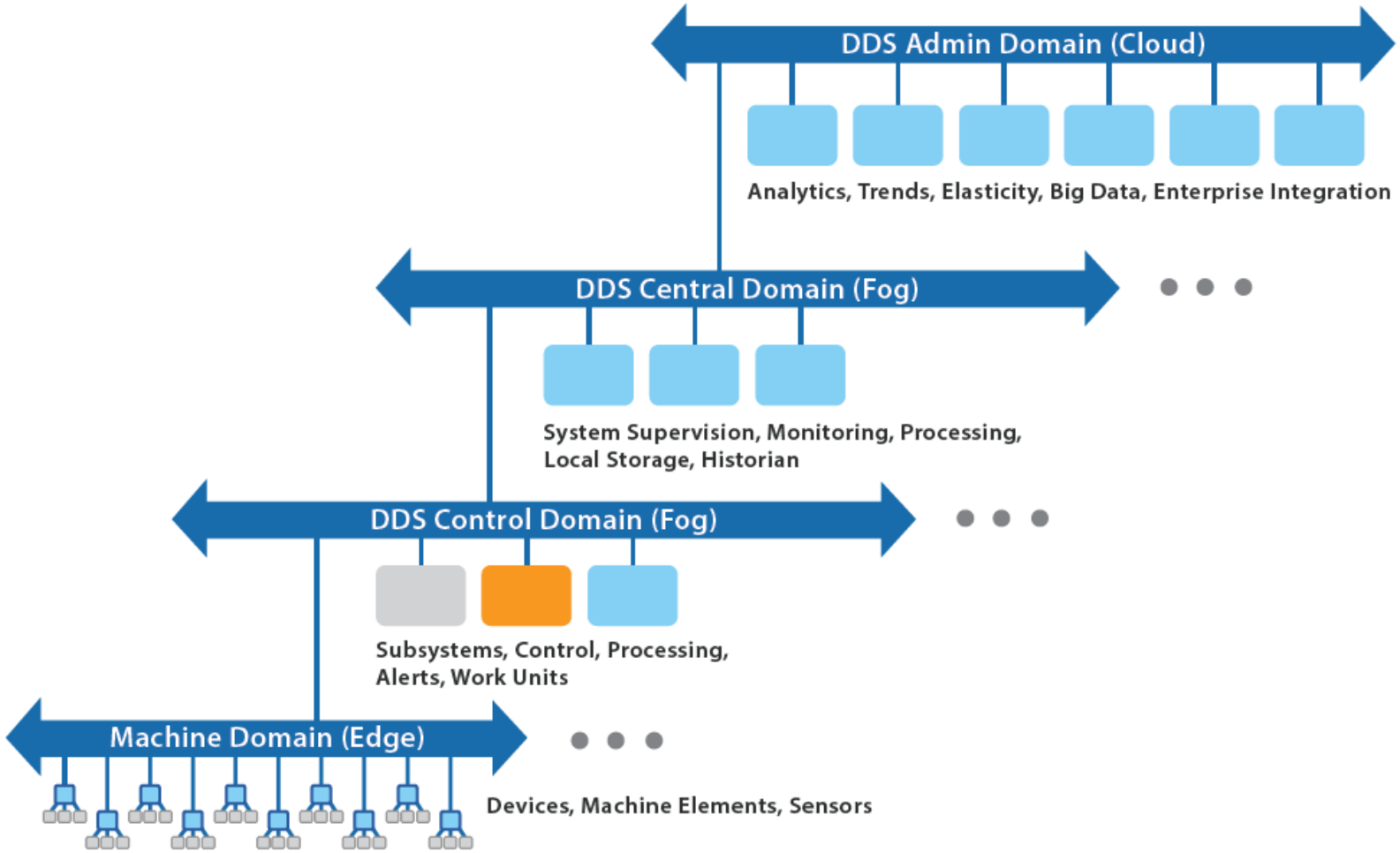
Data Distribution Service

> The Data Distribution Service (DDS) for real-time systems is an Object Management Group (OMG) machine-to-machine (sometimes called middleware or connectivity framework) standard that aims to enable dependable, high-performance, interoperable, real-time, scalable data exchanges using a publish–subscribe pattern.

Data Distribution Service - Overview



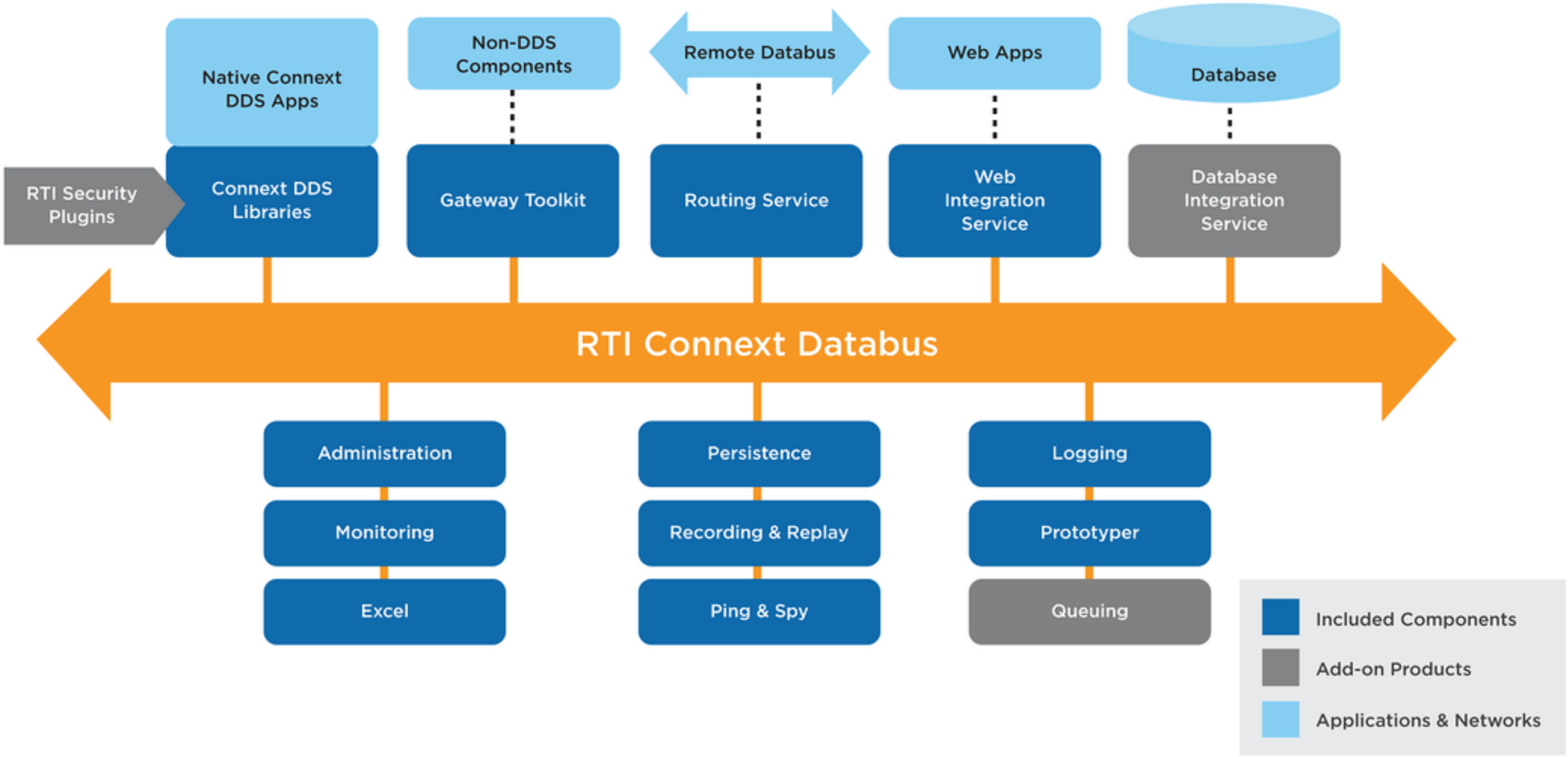
Data Distribution Service - Layered Data Bus



RTI Connext DDS

> RTI Connext DDS implements the Data-Centric Publish-Subscribe (DCPS) API within the OMG's Data Distribution Service (DDS) for Real-Time Systems. DDS is the first standard developed for the needs of real-time systems. DCPS provides an efficient way to transfer data in a distributed system.

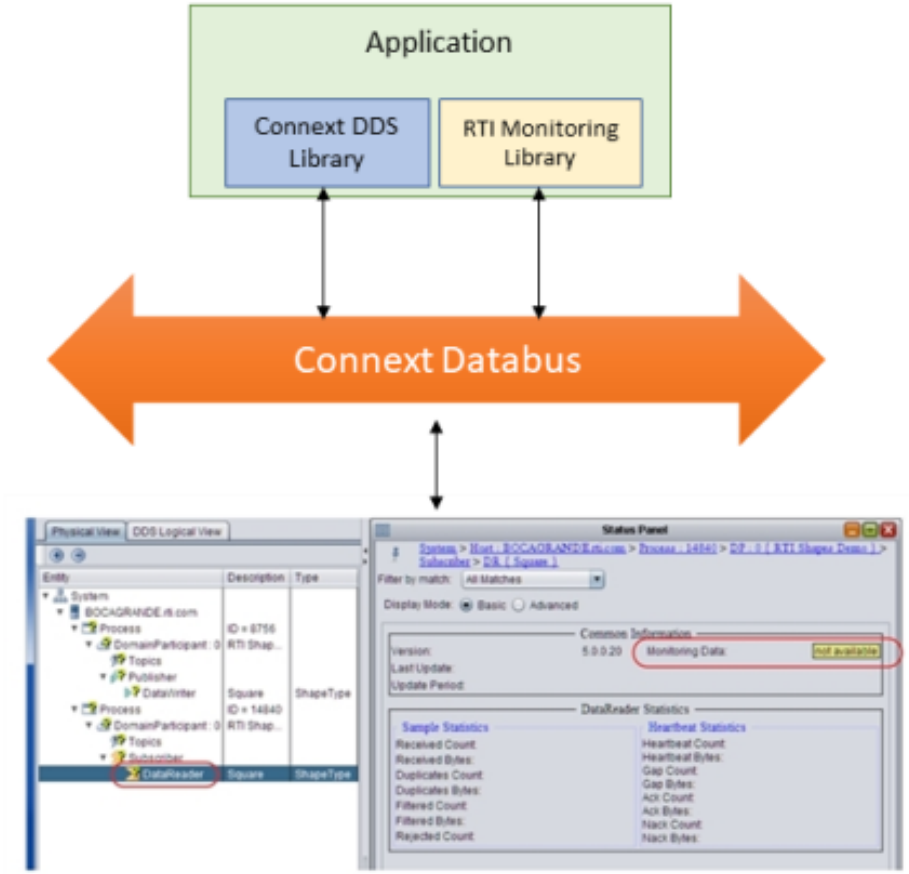
RTI Connext DDS



Monitoring Library

- Can be dynamically loaded and attached to RTI Connext DDS libraries
- Reads data from the core libraries and writes them to defined topics
- Several configuration parameters available, e.g. how often data is written
- RTI Monitor can read and show the monitoring data

Monitoring Library

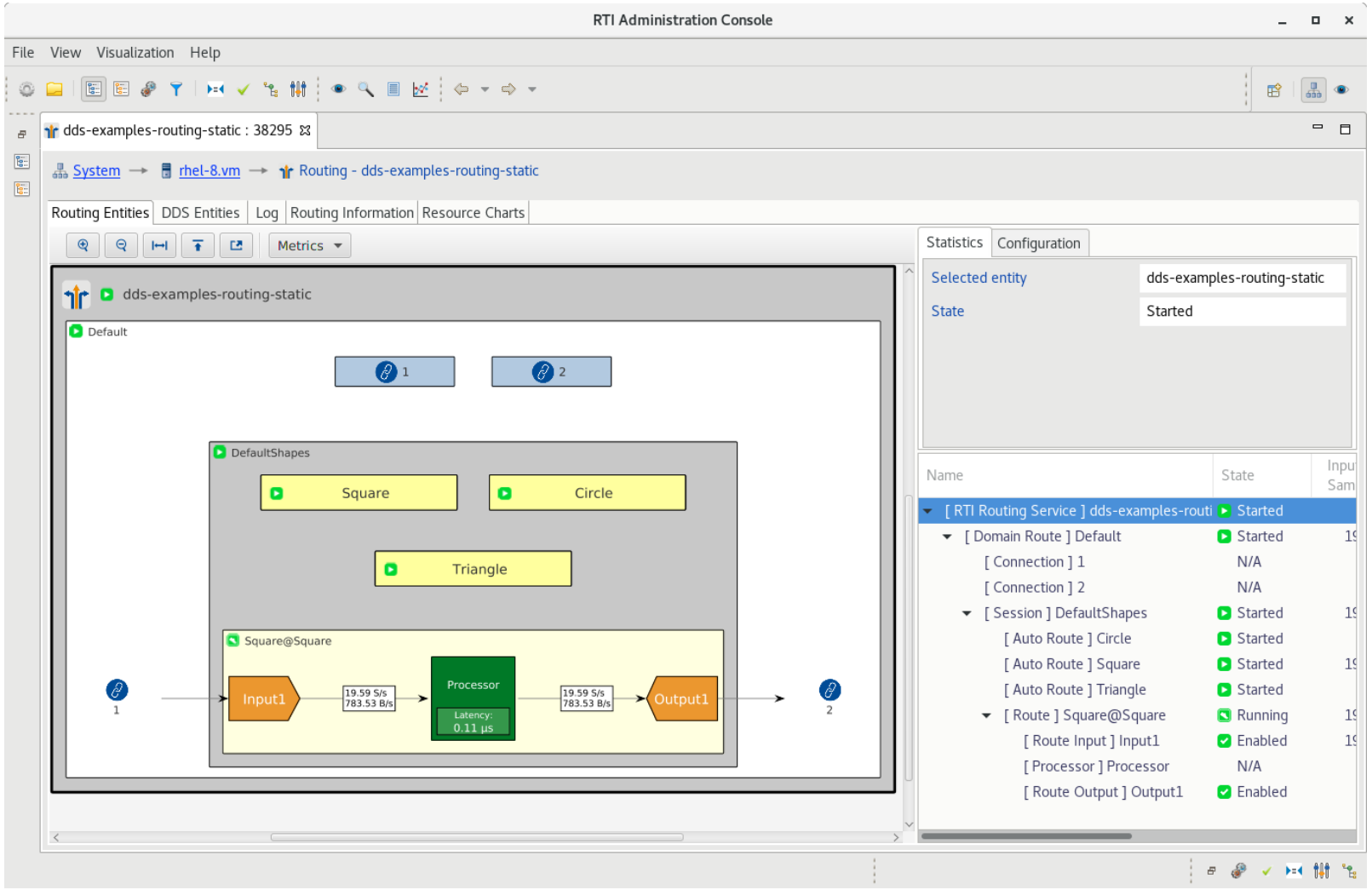


RTI Monitor

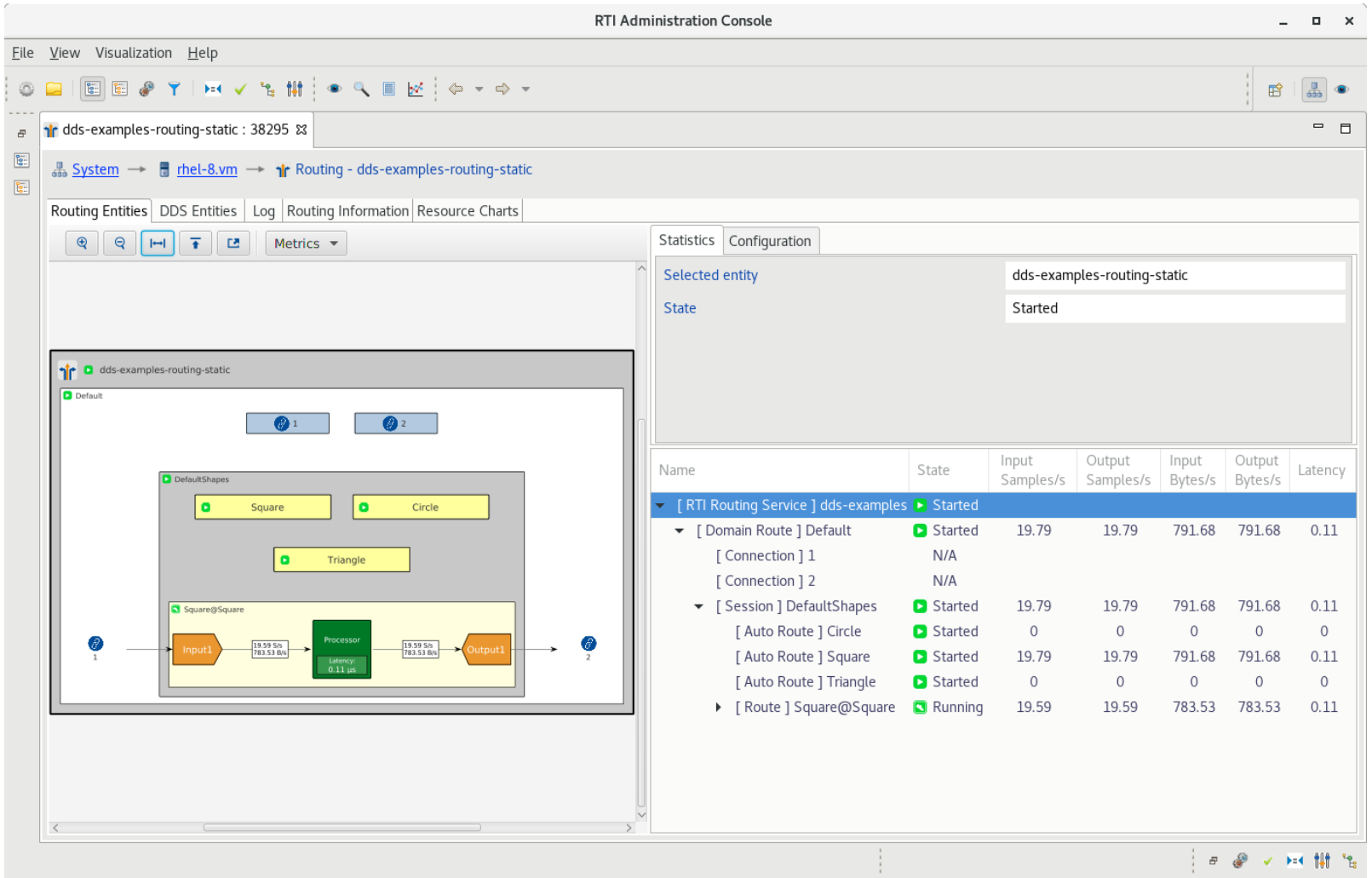
Monitoring of Routing Service

- If enabled, Routing Service writes monitoring data to defined topics
- Several configuration parameters available, e.g. how often data is written
- RTI Admin Console can read and show the monitoring data

Monitoring of Routing Service



Monitoring of Routing Service



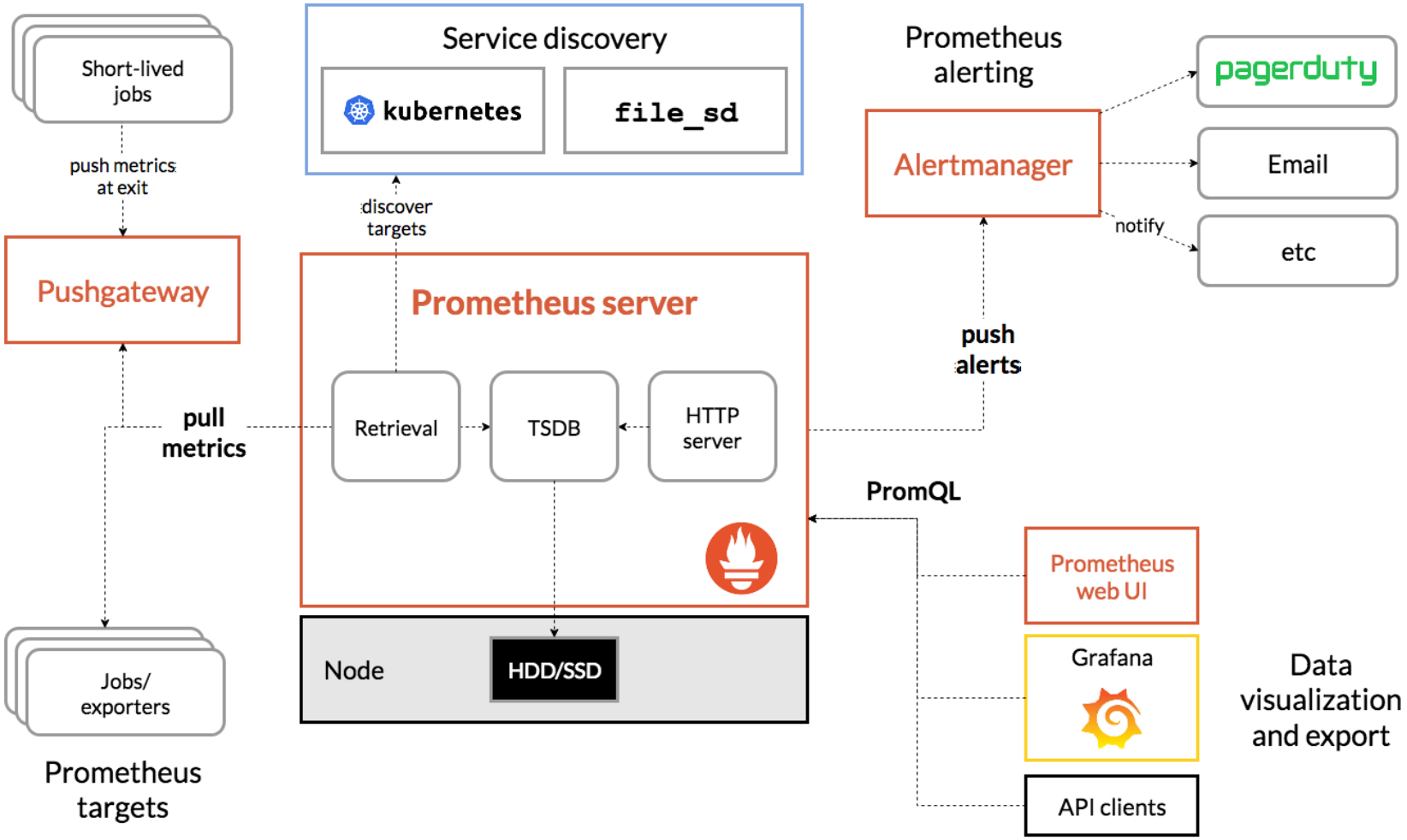
Prometheus

> Prometheus, a Cloud Native Computing Foundation project, is a systems and service monitoring system. It collects metrics from configured targets at given intervals, evaluates rule expressions, displays the results, and can trigger alerts if some condition is observed to be true.

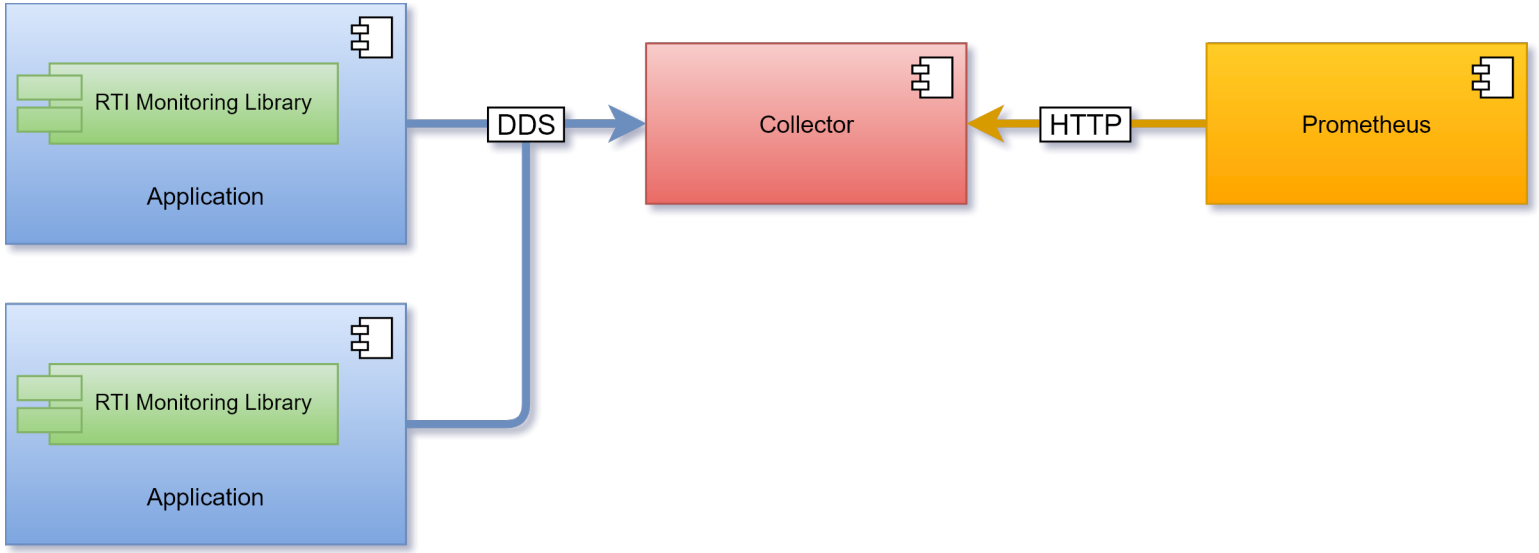
Grafana

> Grafana is an open source, feature rich metrics dashboard and graph editor for Graphite, Elasticsearch, OpenTSDB, Prometheus and InfluxDB.

Architecture



Collector - Data Flow



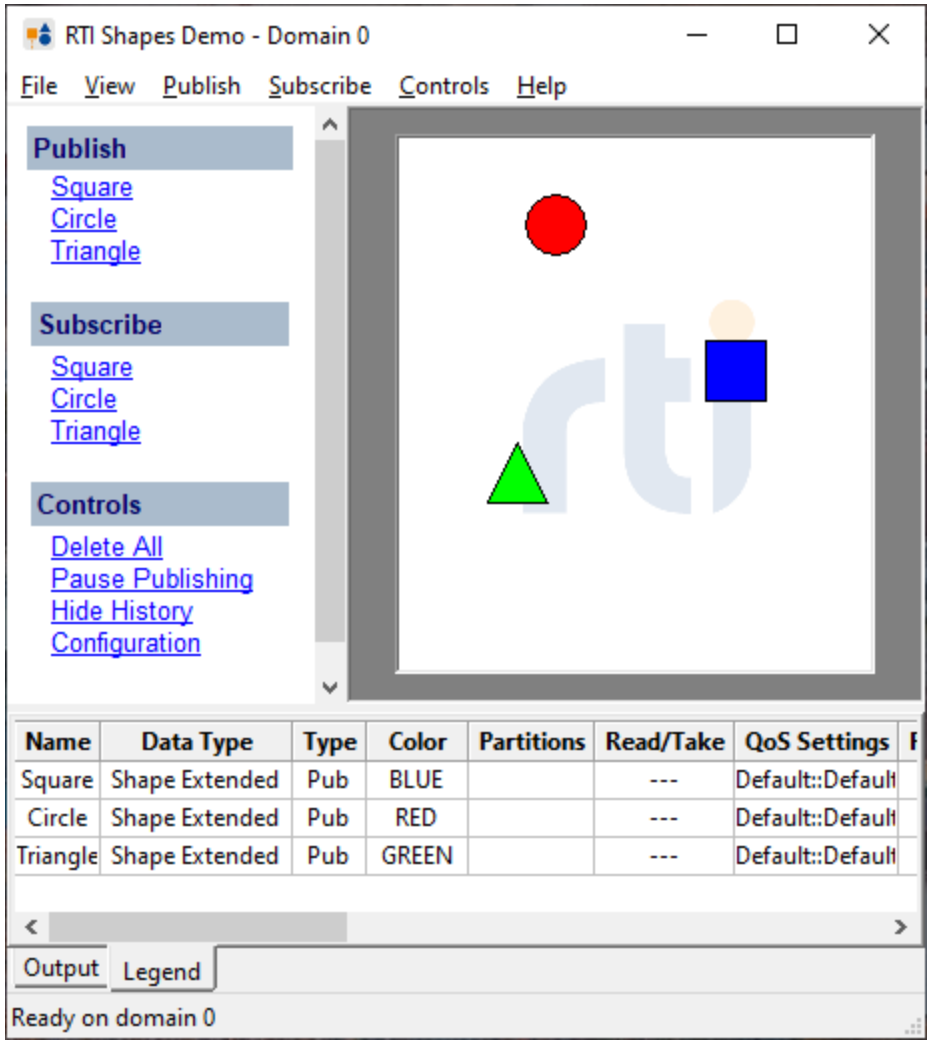
- Collector subscribes to DDS topics to receive the monitoring data
- Collector converts monitoring data into prometheus metrics (with labels)
- Prometheus is scraping the collector regularly to read metrics

Collector - Metric example

```
# HELP dds_routing_service_process_uptime_seconds Time in seconds elapsed since the running service process started.
# TYPE dds_routing_service_process_uptime_seconds gauge
dds_routing_service_process_uptime_seconds{routing_service="default",} 301.0
```

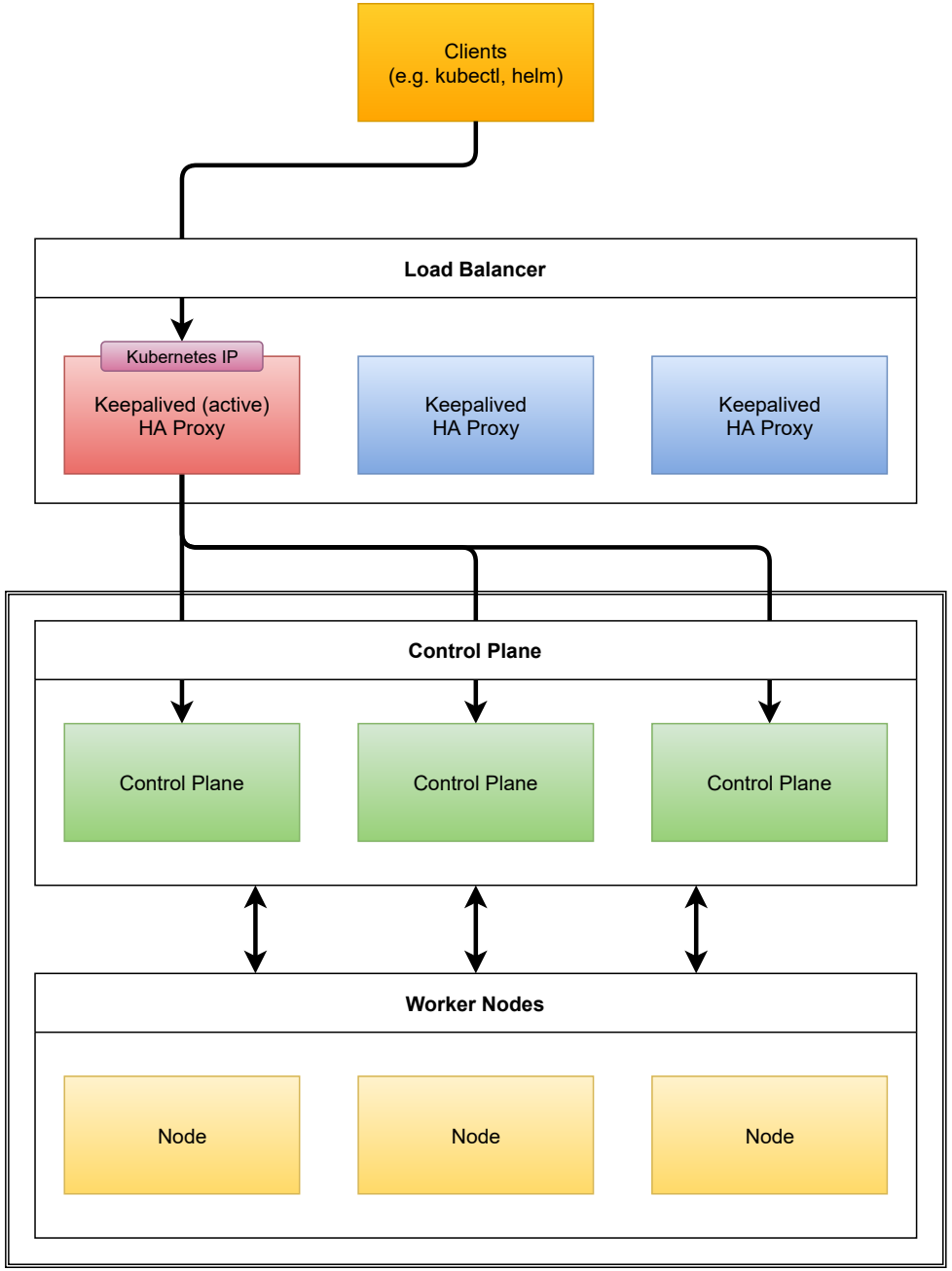
RTI Shapes Demo

- Usage to improve understanding
- Usage for compatibility tests
- Repository dds-examples provides the following console applications:
  - ShapePublisher
  - ShapeSubscriber

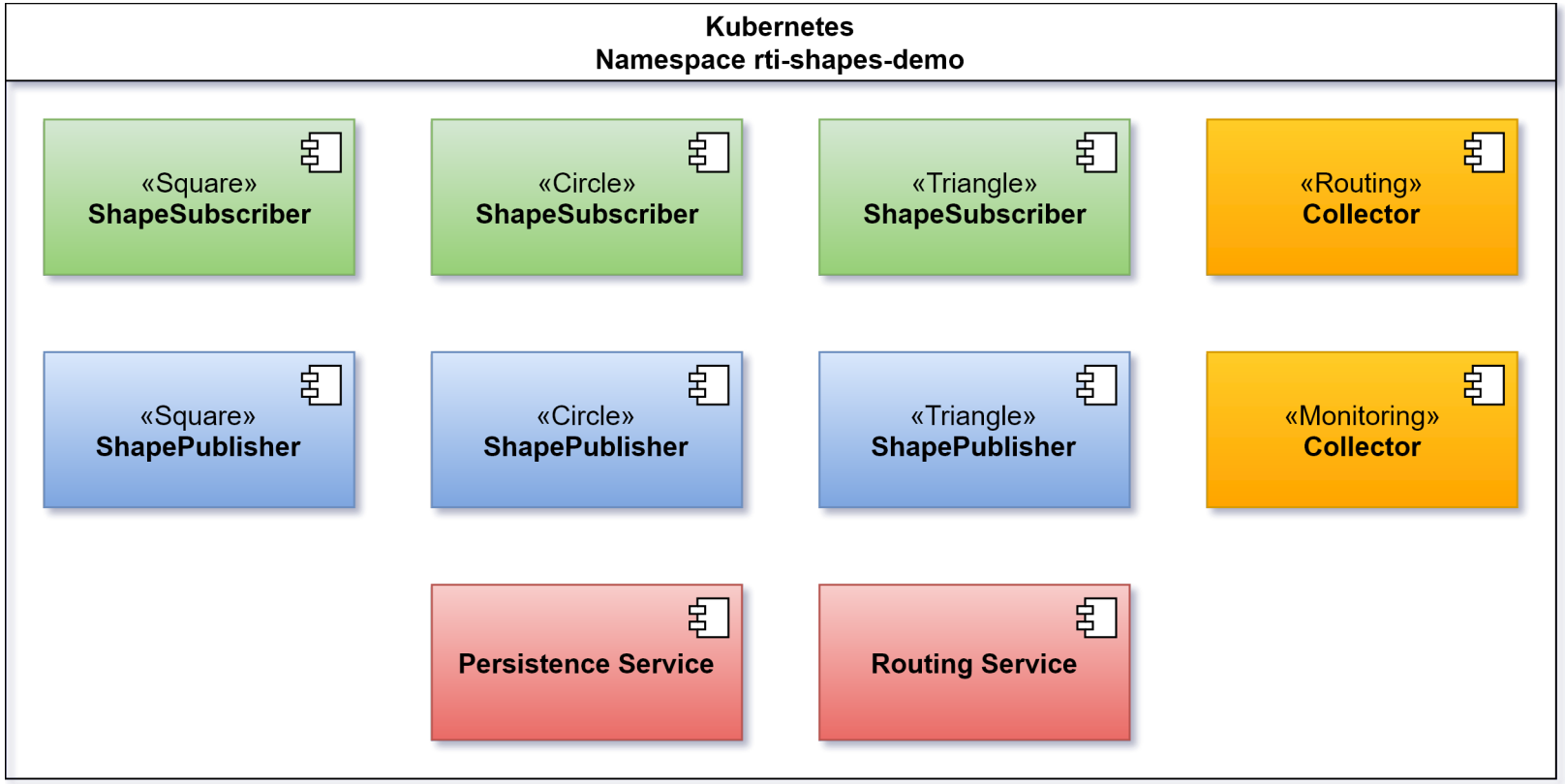


Deployment - Kubernetes Structure

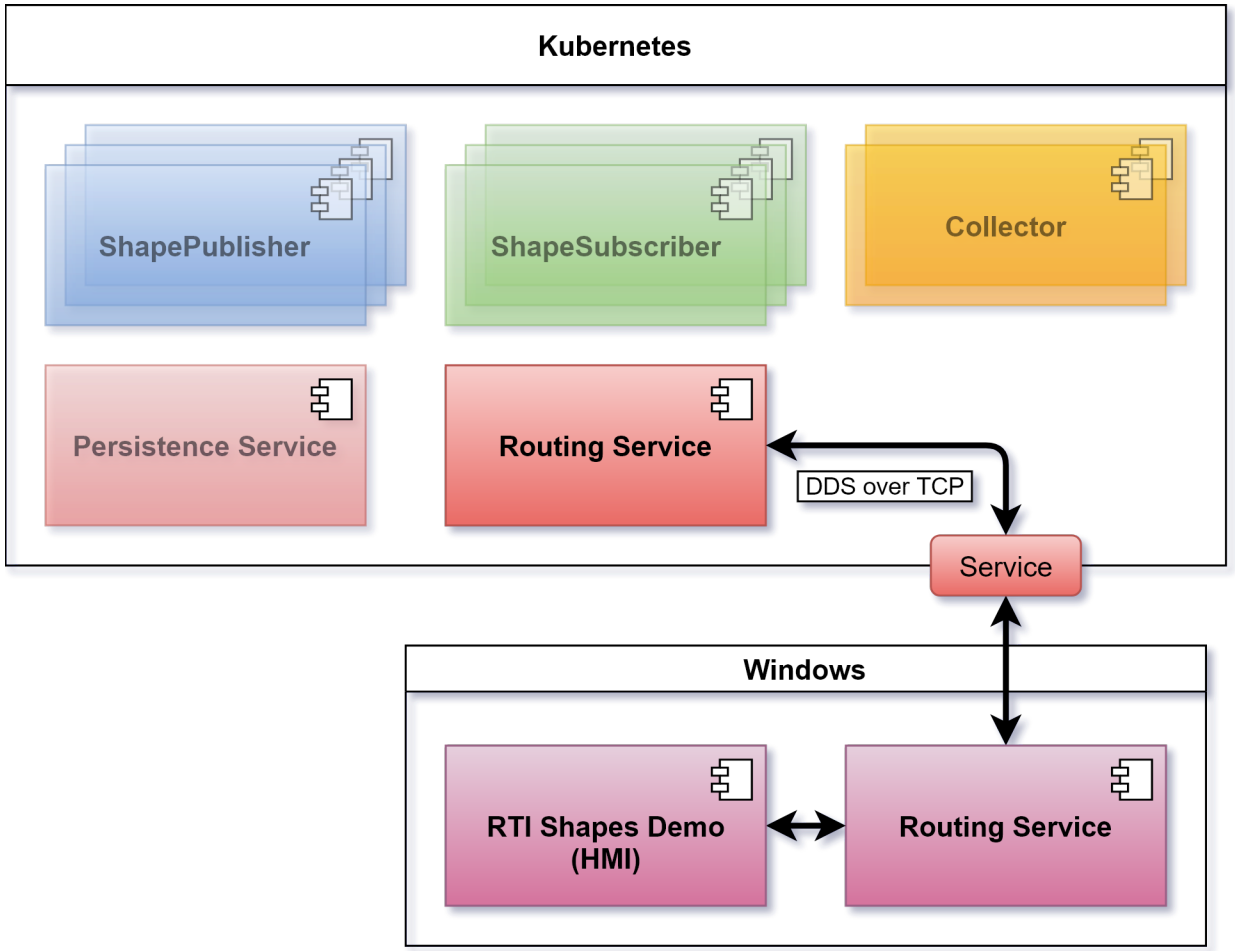
- Keepalived + HAProxy for load balancing of control plane
- metallb for external access to services (in L2 mode)
- rook-ceph for storage
- local docker-registry for images



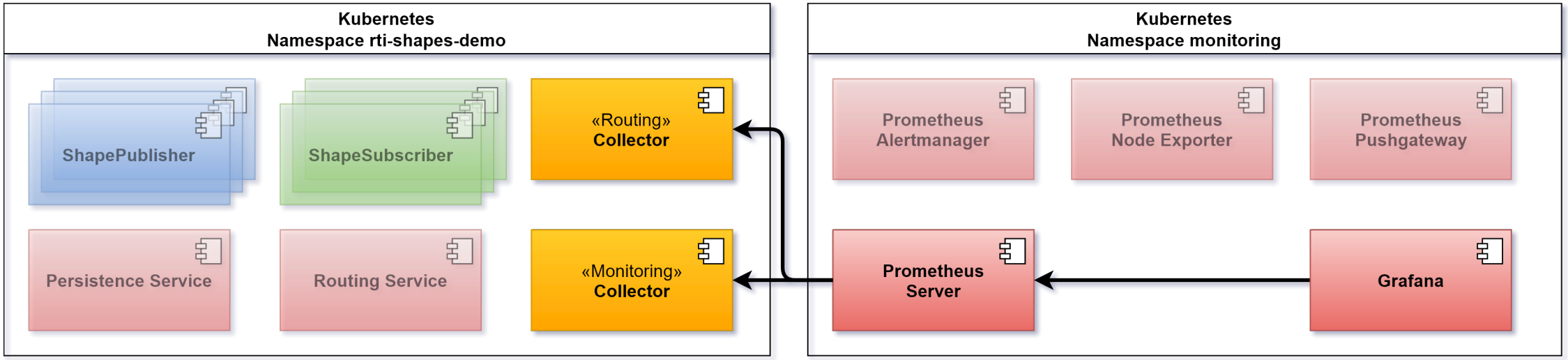
Deployment - Namespace for Shapes Demo



Deployment - Connection of HMI



Deployment - Scraping



Demo

Demo - Screenshot Overview

Demo - Screenshot Application

Demo - Screenshot Routing Service

Conclusions - Advantages

- ✅ Separation of monitoring, alerting from business logic
- ✅ Prometheus / Grafana is a powerful tool for queries and analysis
- ✅ can be used for long term monitoring and storage
- ✅ data aggregation/compaction is possible
- ✅ automatically taking advantage of new features available on the market

Conclusions - Disadvantages

- ⛔ Additional DDS traffic is generated for monitoring
- ⛔ Prometheus does not support text, so information like QoS cannot be tracked

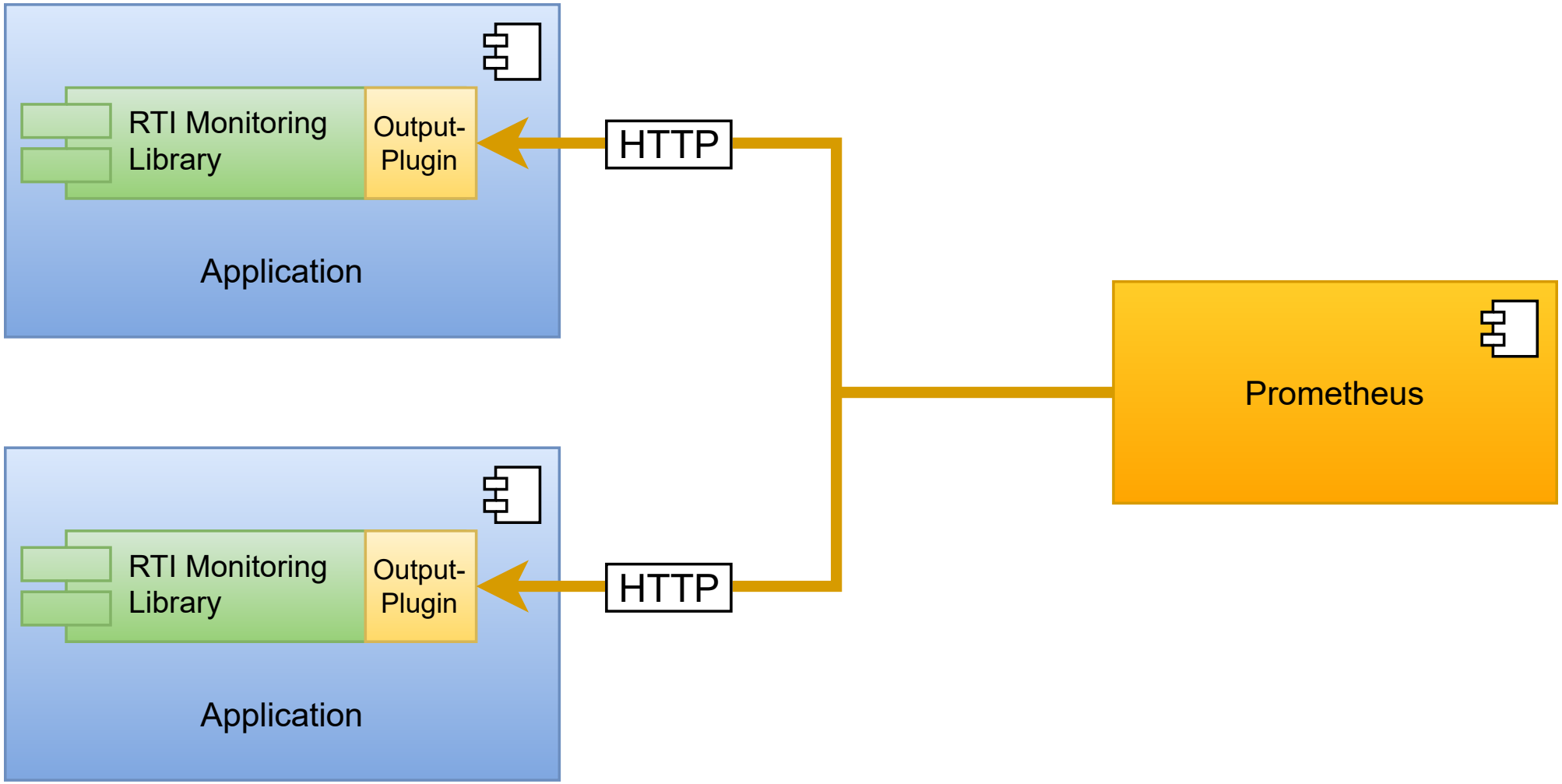
Conclusions - Things to think about

- 🤔 Revisit of labels to be used (new set of labels create a new series)
- 🤔 Usage of collector as side-car to have a more clear mapping to pods

Proposal

- split RTI Monitoring Library into collection and output part
- use plugin mechanism for output part to support multiple formats
- default plugin could be the todays interface
- foundation on OMG "Data Distribution Service (DDS) Status Monitoring"

Proposal - Architecture



Proposal - Advantages

- ✅ mapping of monitoring data to pods will work correctly
- ✅ supports both push and pull based collection
- ✅ saves resources by using no additional...
  - ...DDS resources
  - ...processes like collector
  - ...network traffic
- ✅ will allow easy integration of future technologies or custom solutions

🙏 Thank you for your attention!

Links

Presentation

https://www.github.com/aguther/presentations

Data Distribution Service

https://www.dds-foundation.org
https://community.rti.com/documentation

Code

https://www.github.com/aguther/dds-examples
https://www.github.com/aguther/deployment-kubernetes
https://www.github.com/aguther/deployment-containers-rti