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Guest blog post: ADARA Message Queue contributions to ONOS Hummingbird

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With the announcement of ONOS Hummingbird release, Networking has taken a truly significant step forward. Software Defined Networking was conceived to address networking that had become petrified due to proprietary technologies and vendor lock-in; that model has

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begun to recur in Controller architectures. As evidence of this Network Control Applications are increasingly tied to specific vendors, and Controllers; these applications are often purposefully not interoperable between Controllers. This is why ONOS, a community based Open System, designed by and for the Service Provider, and consequently for their Enterprise, Residential and Mobile customers, is so inherently important.

These and other issues illustrated the need for Controller enhancements which enable multiple Network Control Applications to work on an Open System Controller Framework; ONOS, developed for and by Service Providers' and partners to operate in the most challenging heterogeneous environments was the correct platform for such an enhanced capability.

The ADARA contribution of an Enhanced ONOS Message Queue implement support for Real Time External Events, including Topological, Link, Device, Packet events which accelerate the drive to an industry wide goal for ONOS; to achieve the greatest level of functionality in the spectrum of Open System options. These enhancements are implemented as an ONOS Application, as a key part of the ONOS code-base, and they come pre-staged as part of the ONOS distribution, and as part of an ADARA ONOS distribution and as a selectable ONOS

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feature.

ADARA enhancements to Rabbit MQ

The enhancements to the Rabbit Message Queue are implemented to expose the ONOS Controller to an expanding universe of current and future Networking Applications; doing so greatly enhances the utility of ONOS in a myriad of deployment models, and use cases. The gateway role served by the Message Queue between ONOS and valued added Network Applications external to the Controller facilitates rapid development by a much wider ecosystem of contributors, and is an important step in increasing ONOS dynamism in response to Real Time conditions and ONOS capabilities for Service Providers. Now Application's such as Multi-Layer Multi-Constraint Packet Optical Performance Based Path Computation Engines, Real Time Bandwidth Calendaring Applications, Intelligent Workload Placement Engines, and Customer Portal Fully Automated Service Creation and Provisioning Engines are all possible and all within our reach. The ADARA contribution of an Enhanced ONOS Message Queue opens the ONOS System to External Networking Applications of all types by implementing support for Real Time External Events to communicate with ONOS:

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ADARA Supported Events:

- Device Event
  - Device Added
  - Device Removed
  - PORT Up
  - PORT Down etc
- Link Event
- Topology Event
- Packet Event
  - PKT_IN

Message Queue

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The Message Queue is especially important in ONOS; it enables gateway like behavior for external Network Control Applications; this is a critical function as its' role is to enable a large set of current and future Network Applications to interact with ONOS to support Use Cases for Service Providers and their Enterprise, Residential and Mobile customers. The Message Queue Framework in ONOS Hummingbird now has new features that improve interoperability, enabling many applications to interact with the Northbound protocol through message bus integration and support the industrywide move to services as network primitives.

Applications and New Real Time External Event Capabilities enabled by ADARA enhancements for ONOS Hummingbird

As Network Control Applications are increasingly tied to specific vendors and Controllers, due to their design, implementation and functionality, they recycle the issues of legacy Best Efforts networking into SDN architectures. Legacy infrastructures are typically statically configured; Controller architectures by design are intended to support dynamic configurability. In legacy networking, once a forwarding decision has been made, it cannot be revised until it expires;

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with SDN Controller systems, we natively alter packet flows during forwarding; this underscores the importance of Network Control Applications, the Message Queue, and the enablement of support for Real Time External Events. Controller based Networking enables dynamic routing and Traffic Engineering; previously, this was suboptimal as legacy routing protocols do not support dynamic weights or links.

By coupling support for External Events with Multi-Layer Performance Measurement, Calculation, Forwarding and Resource Allocation, we enable ONOS to expand its' capabilities with myriad Applications with wide ranging, novel emerging functionalities. This enables Multi-Layer Multi-Path, Multi-Constraint Performance Based Path Computation Engines capable of calculating Network selection's based on multiple constraints such as Real Time Bandwidth, Latency, Link Quality, Utilization, Spectrum, and Reach, in Multiple Networking Layers with constraints' specific to Packet, MPLS, WDM, OTN layers. Multi-Layer dynamism with Real Time Performance Based Path Computation deployed in Central Offices enables automated creation of services, enabling Automated Circuit creation with defined constraints and service types through User Portals. Automated Real Time Bandwidth calendaring to support both planned / predictable and unpredictable bandwidth demands; enabling Real Time

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Service for scheduled temporal reservations for backups and gaming, along with unscheduled demands for bandwidth that are in excess of capacity, typically these services are intolerant to delays. This support for Real Time External Events supports Intelligent Workload Placements of VNFs in Central Offices and Cloud Data Centers. In these and other scenarios, the ability of a Real Time External PCE Application to react to Virtual and Physical Packet Events along with Topological, Link, Device, State, Configuration Events and Multi-Layer Performance changes would enable the Path Computation Engine and the ONOS Controller to return many more options than initially requested, with all options meeting the required constraints.

Why do we need MQ messaging?

Message queues enable asynchronous communication between the sender and receiver. Messages placed onto the queue are stored until the recipient retrieves them. Message queues have implicit or explicit limits on the size of data that may be transmitted in a single message and the number of messages that may remain outstanding on the queue.

What are the uses of MQ messaging?

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In a typical implementation, a system administrator installs and configures message-queueing software (a queue manager or broker), and defines a named message queue. Or register with a message queuing service.

An application registers a software routine that “listens” for messages placed onto the queue.It may connect to the queue and transfer a message onto it. The queue-manager software stores messages until a receiver connects. The receiving application shall process the message in an appropriate manner.

There are often numerous options as to the exact semantics of message passing, including:

- Durability – Messages may be stored in memory, written to disk, or even committed to a DBMS if the need for reliability indicates a more resource-intensive solution.
- Security policies – Provides access control for application while accessing message
- Message purging policies – queues or messages are purged after the expiry time
- Message filtering – Messages queues support filtering data so that a subscriber can only

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see messages matching some pre-specified criteria of interest

- Delivery policies – Guarantees that a message is delivered at least once, or no more than once based on policy
- Routing policies – Defines what servers should receive a message or a queue's messages.
- Batching policies – Defines the policy for bundling multiple messages.
- Queuing criteria – Defines when a message be considered "enqueued"? When one queue has it? Or when it has been forwarded to at least one remote queue? Or to all queues?
- Receipt notification – Provides acknowledgement when all recievers receive the messages.
- All above considerations can have substantial effects on transaction semantics, system reliability, and system efficiency.

How RabbitMQ fits into existing ONOS container

The ONOS ADARA RabbitMQ module was designed and developed to support deployment as

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an independent module inside ONOS container. It can be built as a separate module; it can be installed / uninstalled independently from ONOS container without any impact on a running ONOS instance.

These and future enhancements will position ONOS to leverage new capabilities at an accelerating pace from industry-wide contributions to support Service Providers and their Enterprise and Residential Customers. ONOS has commenced writing a very exciting new chapter in Networking.

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