Charter: Configuration and Management Working Group

MOTIVATION

The primary value proposition of Software-Defined Networking (SDN) is agility—getting innovation into the network faster, thus reducing the time between innovations in physical and virtual switching to high-confidence deployment. Moreover, SDN’s must achieve large scale—up to tens of thousands of physical switches and hundreds of thousands of soft switches. Small errors in code and configuration can have widespread and catastrophic impact. One of the greatest shortcomings of conventional networks is the lack of robustness and graceful degradation. SDN’s aim is to bring both agility and robustness to networks, through refactoring functionality, simplifying switching mechanisms, and borrowing ideas from the distributed systems community for large scale and dependable control. Unfortunately, there are significant gaps in ONF specifications that have emerged to date that, unless addressed, will get in the way of creating and managing robust networks. In the data path, packets can be silently dropped for a plethora of reasons—within any of the multiple layers of buffers and table processing within individual switches, on physical interfaces, on links, or on end systems—through bugs, failures, or overloads. SDN lacks standard event tracing systems to localize such problems. In the control plane, incoherence can be lost across tables between switches and controllers, owing to failures or to bugs in the agents on the switches and controllers. The specifications lack mechanisms to maintain timely and consistent network-wide views.

There are no ONF standard mechanisms for discovery and continuously validating the integrity of switch-to-switch adjacencies and network paths. In short, ONF has focused to date on core functionality, rather than on core Operations, Administration, and Management (OA&M).

SCOPE

The Configuration and Management Working Group (CMWG) will address the following OA&M issues:

1. **Bootstrap:**
   a. Bootstrap refers to the process whereby an OpenFlow™ switch which does not have any configuration or flow entries except factory defaults is booted into an OpenFlow network. The CMWG will produce recommendations describing best common practices of bootstrapping, including the following steps:
   b. Provide connectivity between an OpenFlow switch and an OpenFlow configuration point (OFCP)
   c. Establish a management connection between the OpenFlow switch and the OFCP
   d. Detect the updated topology between OpenFlow switches
   e. Instantiate logical switches in the OpenFlow switch and assign them to controllers
   f. Provide connectivity between logical switches and controllers
   g. Establish control connection between logical switches and controllers

   The recommendations will leverage existing mechanisms such as, for example, DHCP and spanning tree where possible. Recommendations will include procedures for secure setup of management and control connections. Recommendations will cover in-band bootstrap as well as bootstrap over an out-of-band network.

2. **Out-of-band network:**

   The CMWG will investigate the use of Out-of-Band (OOB) networks for provisioning OpenFlow-based networks. An OOB network connects OpenFlow switches, OFCP, and controllers. It may be a separate physical network or may be a logical network sharing the same physical network. The OOB network may use legacy protocols.
The CMWG will produce recommendations for the use of OOB networks several use cases including, but not limited to:

- OOB network for bootstrapping, particularly to connect OpenFlow switches to an OFCP and to controllers.
- As fall-back solution for in-band communication between OpenFlow switches and controllers.

3. **Monitoring of the physical network connecting OpenFlow capable switches:**
The CMWG will produce recommendations describing best common practice for monitoring the physical network of OpenFlow switches, including:

- Link monitoring between OpenFlow switches
- Detecting the topology among OpenFlow switches

The recommendations will leverage existing mechanisms such as, for example, LLDP. These recommendations will not address methods for controller-driven (logical) topology discovery among OpenFlow logical switches. However, it will address potential conflicts and overlaps between the two topology discovery principles.

4. **Monitoring of the logical network between OpenFlow logical switches:**
Logical networks rather controlled by an OpenFlow controller than by the OFCP. The CMWG will investigate how his task should preferably be conducted, particularly if the OpenFlow connections should be used for it or if a separate association between OpenFlow controllers and OpenFlow logical switches is needed. The CMWG will create recommendations for monitoring of logical OpenFlow networks covering:

- Monitoring of local link between two OpenFlow logical switches
- Detecting the topology among OpenFlow logical switches
- Path monitoring in logical OpenFlow networks

Link and path monitoring are needed both for fault detection and isolation as well as for performance monitoring. The recommendations will leverage existing mechanisms such as, for example, BFD where possible.

5. **Event framework:**
The CMWG will specify a framework for OpenFlow switches reporting events to an OFCP, OpenFlow controllers, and other entities. An event mechanism is needed for the timely distribution of event information at OpenFlow switches, such as, for example, link failures, configuration changes, loss of connections to a controller, or authentication failures at a controller connection attempt.

The framework will be based on a publish/subscribe mechanism and open to be used for various tasks. The CMWG will choose between specifying a new event mechanism and using an existing event framework. The framework will support a clear separation of the publish/subscribe and notification mechanism on one side and the specification of event semantics and the information that is to be included in event notifications on the other side.

6. **OpenFlow switch event specifications:**
The CMWG will specify events at OpenFlow switches for which notifications can be sent using the event framework mentioned above. Specifications will include event semantics and the information that is to be included in an event notification message. Events of interest are to be selected based on use cases, such as failure detections, configuration changes, etc. Specification of event semantics and the information that is to be included in notification messages will be aligned with the data model for OpenFlow switch configuration specified by the OF-CONFIG protocol.
7. **Table consistency:**
   The Extensibility WG is already discussing table consistency among multiple tables within a switch. The CMWG will further elaborate requirements for table consistency checking across switches. The assumption is that there will be periods of time when different switches will have inconsistent table entries resulting in problems such as loops. The network must gracefully handle these temporary inconsistencies and drive the system to eventual consistency.

**MILESTONES**

The working group will target the following milestones:

- **January 2013:** Best Common Practice for OpenFlow network bootstrap
- **January 2013:** Specification of an event notification framework for OpenFlow switches
- **January 2013:** Specification of OpenFlow switch events
- **April 2013:** Physical Link monitoring and topology detection for connected OpenFlow switches
- **April 2013:** Logical Link monitoring and topology detection for connected OpenFlow logical switches
- **April 2013:** Recommendations for the use of OOB networks
- **June 2013:** Requirements and methods for table consistency checking between different switches.

**RESOURCING**

The WG has approximately seven regular participants on its conference calls. Several among these are active volunteers in developing and putting forward concrete proposals. As far as bandwidth within the WG, the WG realizes it needs to increase participation and representation from service providers. The working group already has a list of representatives from member companies in ONF and will reach out to them to solicit additional participation.