NETCONF and YANG integration in ONOS Southbound Interface

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#ONOSProject

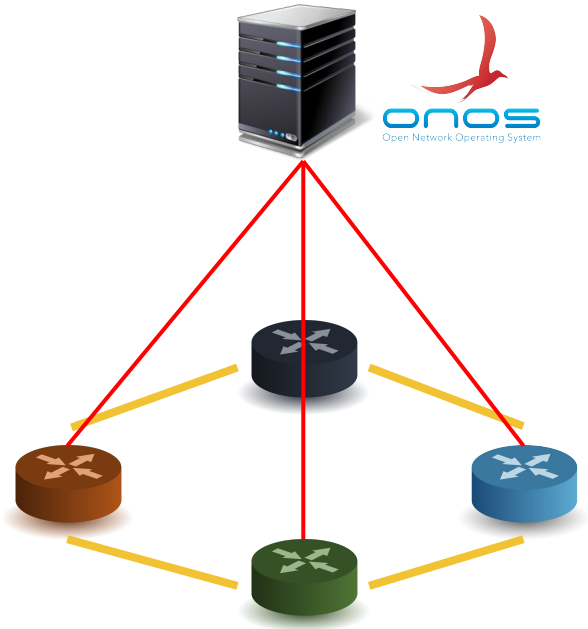
ONOS
Open Network Operating System

Outline

- Why NETCONF and YANG in ONOS
- ONOS Architecture
- Implementation goals and challenges
- NETCONF in ONOS
- Utilities for YANG
- Driver: tying everything together
- Accomplishments
- Looking Ahead
- Q&A
- Documentation

Why NETCONF?

- Broaden ONOS device configuration capabilities
  - enable high-level, protocol-agnostic interaction with devices
- Simple but powerful configuration and management protocol
  - RPC operations and device notifications
  - XML-defined messages
  - robust transactions for multiple devices
- Support multiple device families from different vendors
  - IETF standard



Why YANG ?

- Device information and data model
  - configuration and state description
- High-level human readable language
- Modularity and extensibility
- Natural choice for NETCONF
  - one-to-one NETCONF XML mapping
- Widespread adoption
  - IETF defined data model language

YANG:

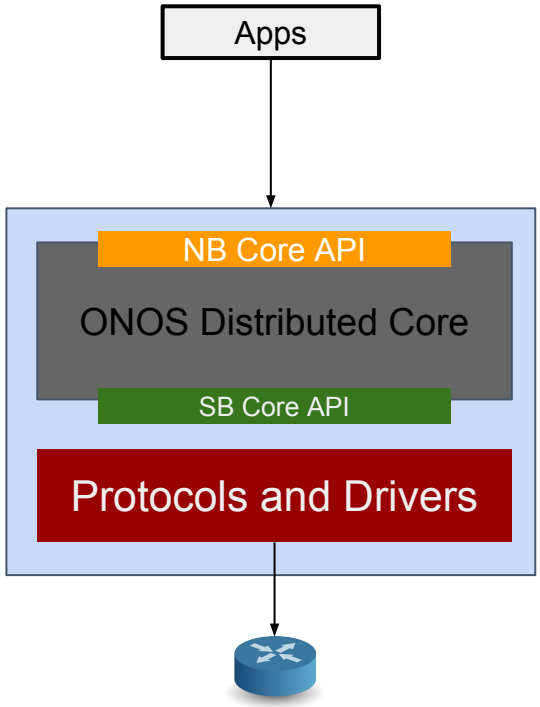
```
leaf host-name {
        type string;
        description "Hostname for this system";
      }
```

XML:

```
<host-name>my.example.com</host-name>
```

ONOS Architecture

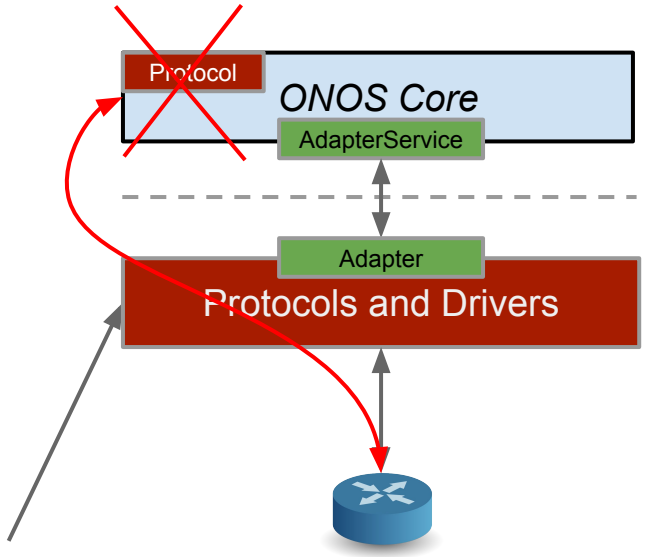
- Scalability, High Availability & Performance
  - sustain demands of service provider networks
- Northbound & Southbound abstractions, modularity
  - allow customization without changing the core code-base
- Protocol and device model independency
  - avoid protocol or model specifics and dependencies in the core
  - hidden complexity to upper layers
  - testability, extensibility, customization



NETCONF, YANG Implementation Goals

- Clean abstraction to upper layers.
- Maintain separation of concerns
  - avoid other types of communication

  -> use existing SB architecture
- Technology and protocol independency
  - no YANG/NETCONF in ONOS core.
- On-demand use and activation
- Core stays independent



This is where the specifics are contained

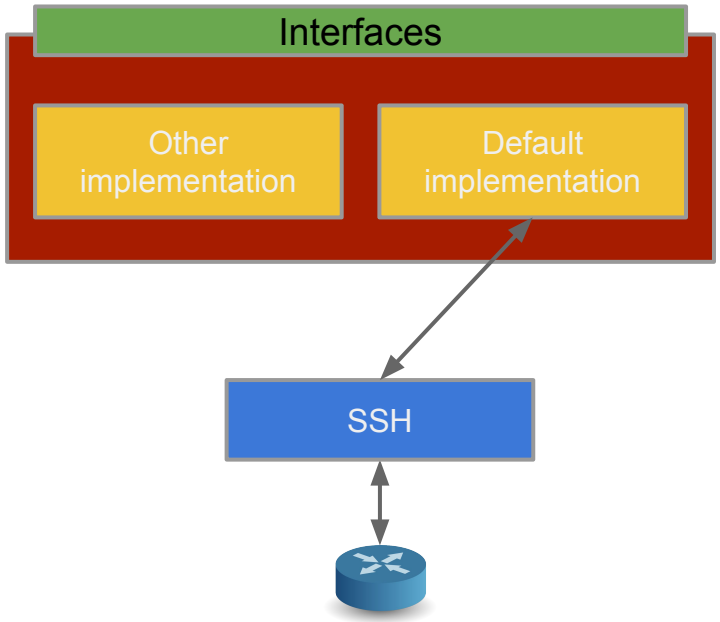
Implementation Challenges

- Translate YANG model to XML
- No standard content for NETCONF payload
  - the standard YANG IETF models are not used
  - always per-device models.
  - models overlap on features
- Lack of adequate tools for YANG
  - not general or standalone
  - not flexible enough

```
<rpc message-id="1" xmlns= "urn:ietf:
params:xml:ns:NETCONF:base:1.0">
                ?
</rpc>
```

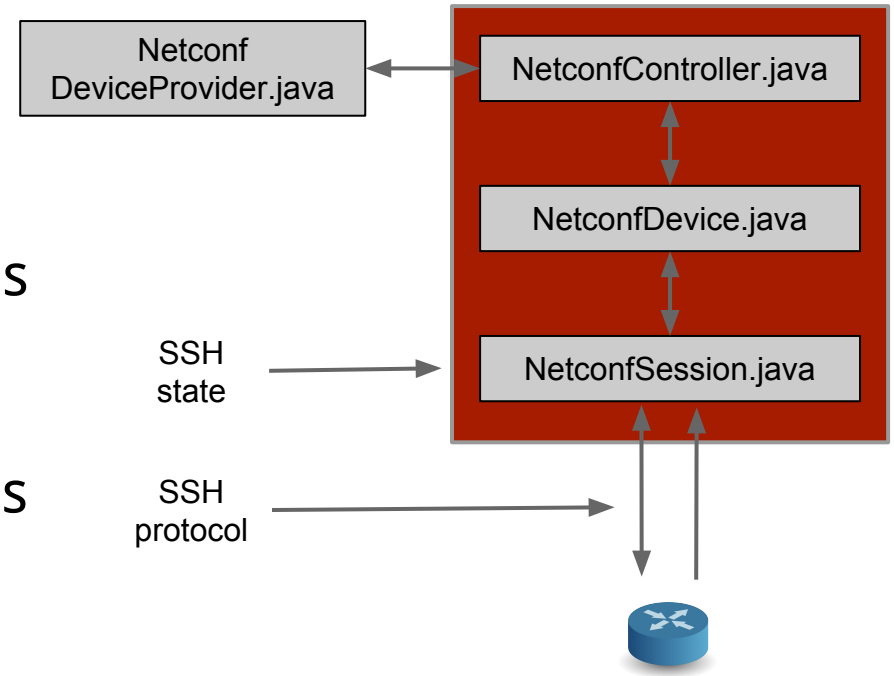
NETCONF Protocol library

- NETCONF protocol
  - self contained bundle
  - on demand activation
- Interaction via interfaces
- Modularity and extensibility
  - different transport protocol
  - different message handling
- NETCONF over SSH
  - secure and reliable
  - defined in RFC 6242



NETCONF SubController

- Java future with message-ids
  - Request-reply mechanism
  - enable both synchronous and asynchronous communication
- Listener mechanism for messages
  - device generated
  - notifications, alarms, shut-down
- Manages devices and connections
  - SSH session and connection
  - maintained state
  - periodical retry



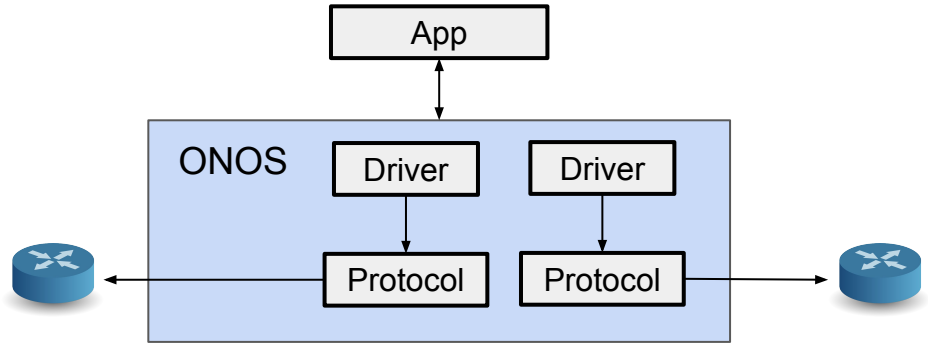
New YANG utility implementation

- YANG to XML skeleton conversion
  - *onos-convert-YANG* bash script
  - decoupled from ONOS controller
- YANG XML Utility
  - YangXmlUtils.java
  - encoding-decoding facility
  - hides language complexity
- Stepstone for future YANG to JAVA generator

ONOS driver architecture outline

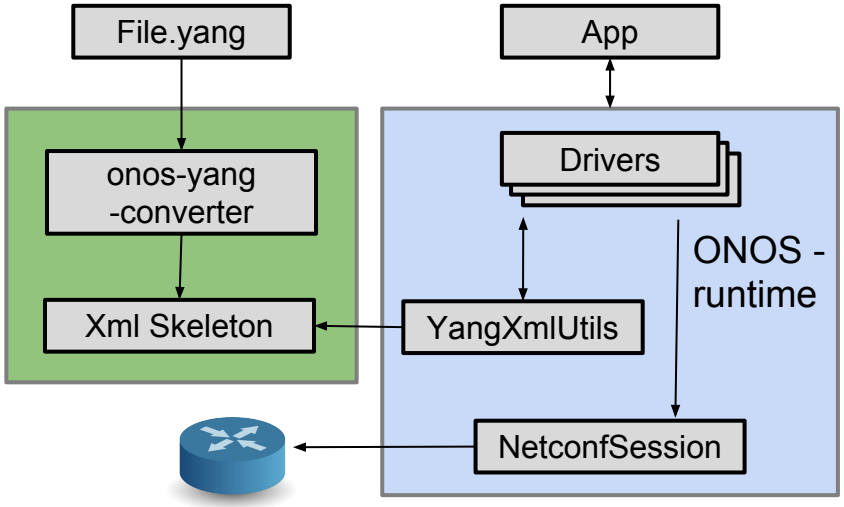
- Device specific driver
  - encapsulate specific logic and code
  - collection of behaviors
  - on-demand activation
- Abstraction via behaviors
  - define capabilities offered by the device
  - provide logic for operations
    - ports,controller,flowrule,power…
- Encapsulate interaction
  - protocol
  - information

```
<driver name="default"manufacturer="ON.Lab"
      hwVersion="0.0.1" swVersion="0.0.1">
        <behaviour api=InterfacePath
                  impl=ImpementationPath />
</driver>
```



NETCONF Drivers: tying everything together

- YANG, device information and NETCONF
- YANG Utils
  - YANG XML utilities
  - payload generation
- NETCONF
  - device specific calls
  - proper payload
- Abstraction of specific steps
  - operation results are returned



Accomplishments

- Use of NETCONF and YANG in drivers
  - well-defined interface
  - protocol and drivers on demand activation
  - extensibility
- Abstraction in Core maintained
  - no auto-generated code
  - no protocol or device specific logic
- Ease of use
  - device isolation
  - simple interaction with multiple and different devices
  - stepstone YANG tool for drivers

Final comments: looking ahead

- YANG to Java conversion
  - parser and translator
- Continue to make management plane easy and accessible
  - simple device and network configuration
  - abstract device access
- Define standard set of device commands
  - use standard IETF models
  - common YANG models

Q&A

Documentation

- Get Started with ONOS
- ONOS NETCONF wiki
- ONOS YANG Southbound utilities wiki
- Future YANG to Java implementation
- ONOS architecture
- NETCONF RFC 6241
- NETCONF over SSH RFC 6242
- YANG RFC 6020