

A use-case based analysis of network management functions in the ONF SDN model

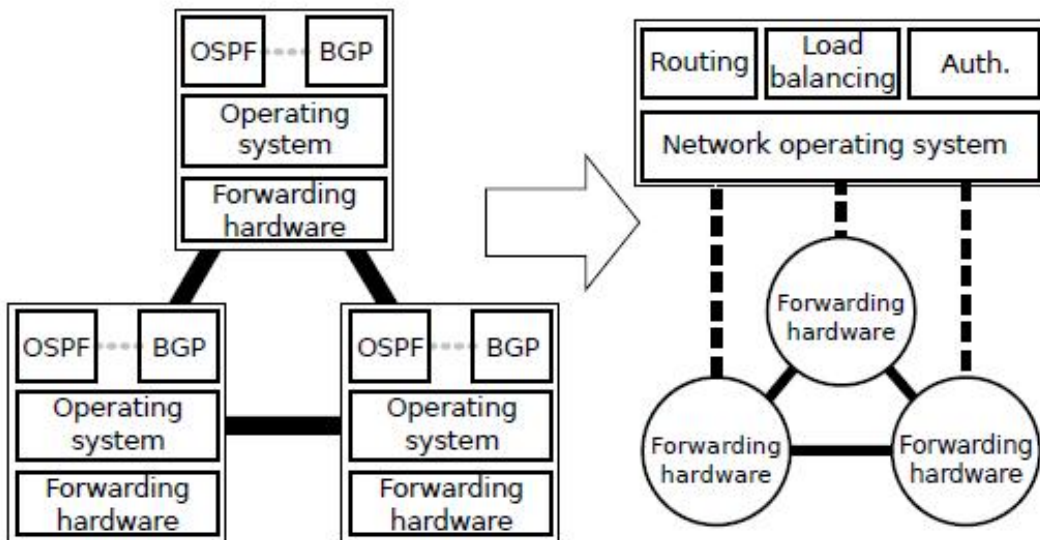
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- Background and motivation
- Status of network management in SDN (briefly)
- Use case: virtualized carrier-grade network
- Step-by-step configuration procedures of virtualized SDN on top of physical infrastructure
- Derived extensions to ONF models and protocols
- Conclusions

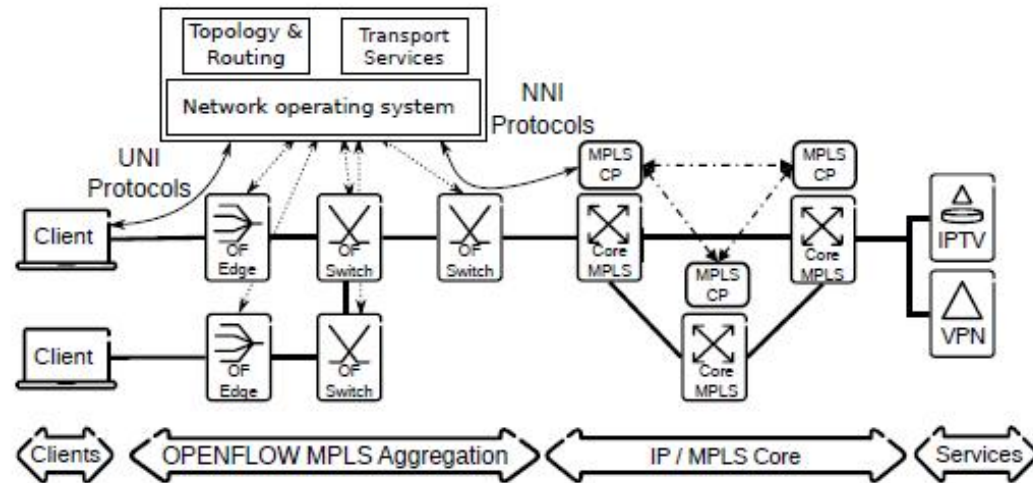
Carrier-grade requirements

| |
|-----------------------|
| Service management |
| Quality of Service |
| Reliability |
| Scalability |
| Standardized services |



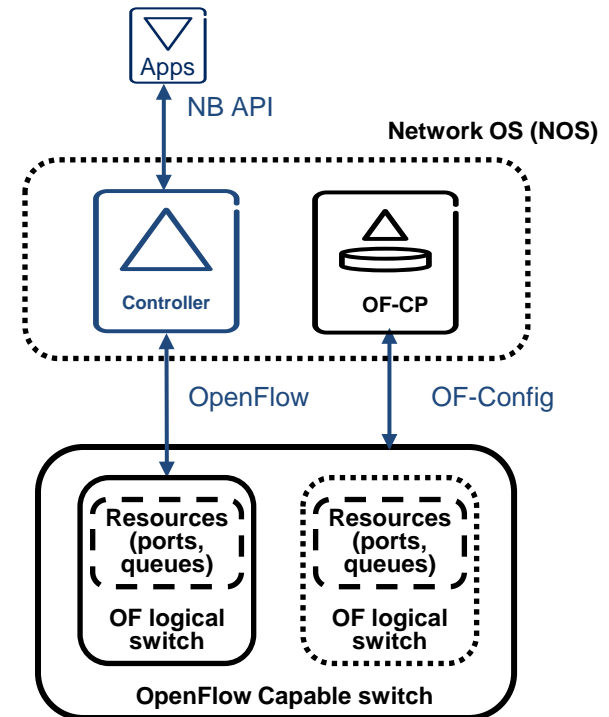
- **SPARC: Split Architecture for carrier-grade networks**
 - Applying SDN to the operator domain
 - Important requirement: Network and service management capabilities
- **Purpose of this paper**
 - Analyze the ONF model by applying it on a **virtualized carrier network shared by multiple tenants**
 - **Network Configuration**, as well as Fault and Performance management with a focus on automated processes

Prime use-case: →
access & aggregation networks

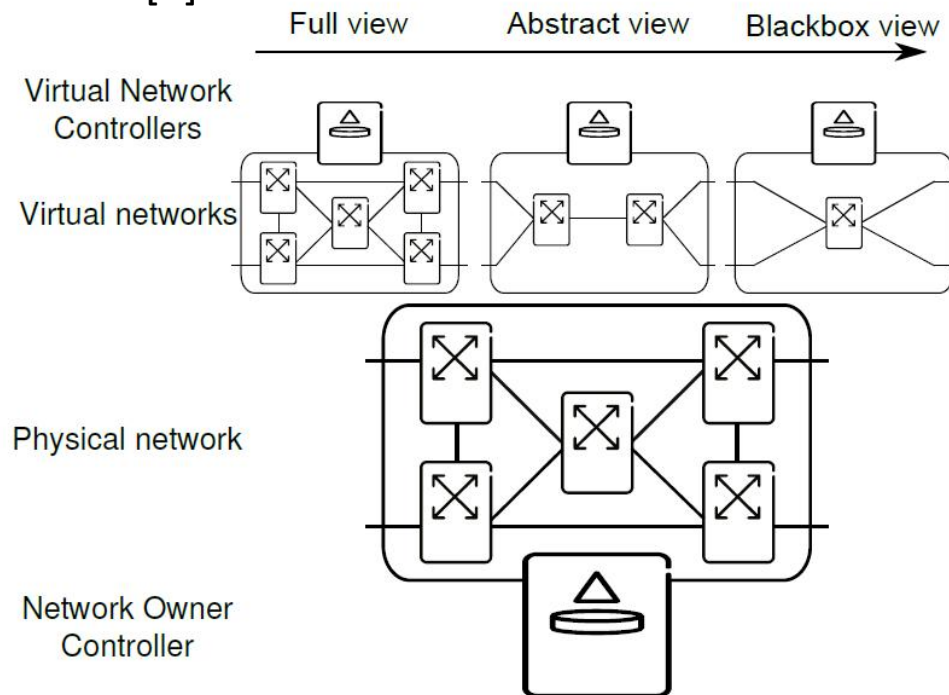


- Output so far: Specification for OF-config 1.0 and 1.1(.1)
 - OF-config: an OpenFlow configuration protocol
 - defining a schema to ensure there is a consistent representation of configuration elements
 - XML and Yang models, transport via NetConf
 - **OF-config 1.0 functionalities:**
 - Controller assignment; Configuration of queues and ports; Changing some aspects of ports (e.g. up/down)
 - **OF-config 1.1(.1) functionalities:**
 - Certificate handling; Capability discovery; Basic tunnel configuration (vxlan, nvgre, ip-gre)

- Current SDN architecture by the ONF
 - *OpenFlow Capable Switch*
 - Physical network element
 - Managed via *OF-config* by *OF-CP*
 - *OpenFlow Logical Switch*
 - Hosted within a capable switch
 - Controlled via *OpenFlow* by *OF Controller(s)*
 - *Network Applications (Apps)*
 - Use the network via the controllers *northbound API*
 - Relationship between controller and OF-CP
 - Deliberately **NOT** defined by the ONF
 - We consider both to be part of the *NOS*



- Sharing physical infrastructure among *virtual network operators (VNO)*
 - Network owner manages physical network and creates virtual networks
 - VNOs manage their virtual network
 - Allows offering different levels of abstractions to VNOs, virtualization on top of physical infrastructure [9]



- Device configuration and network bootstrapping

- 1a) Address (auto)configuration

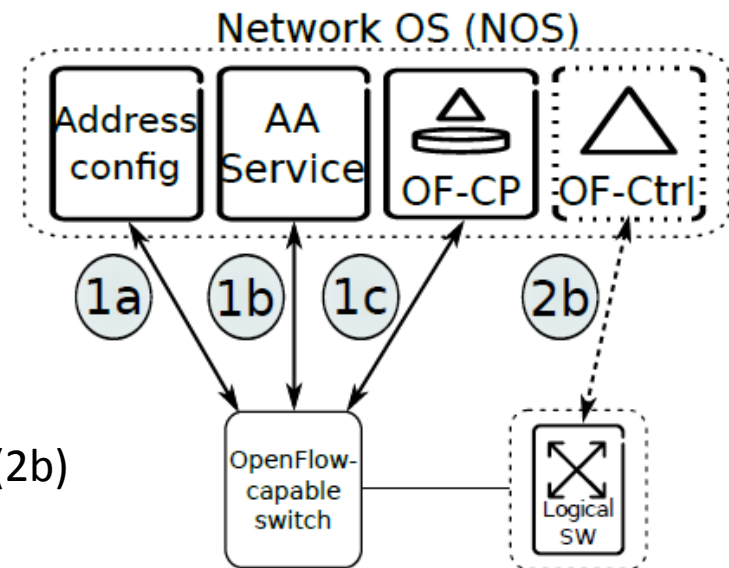
- Addresses of switch itself, OF-CP, and authentication (AA) service
 - Optional: protocol, port numbers
 - Example: DHCP

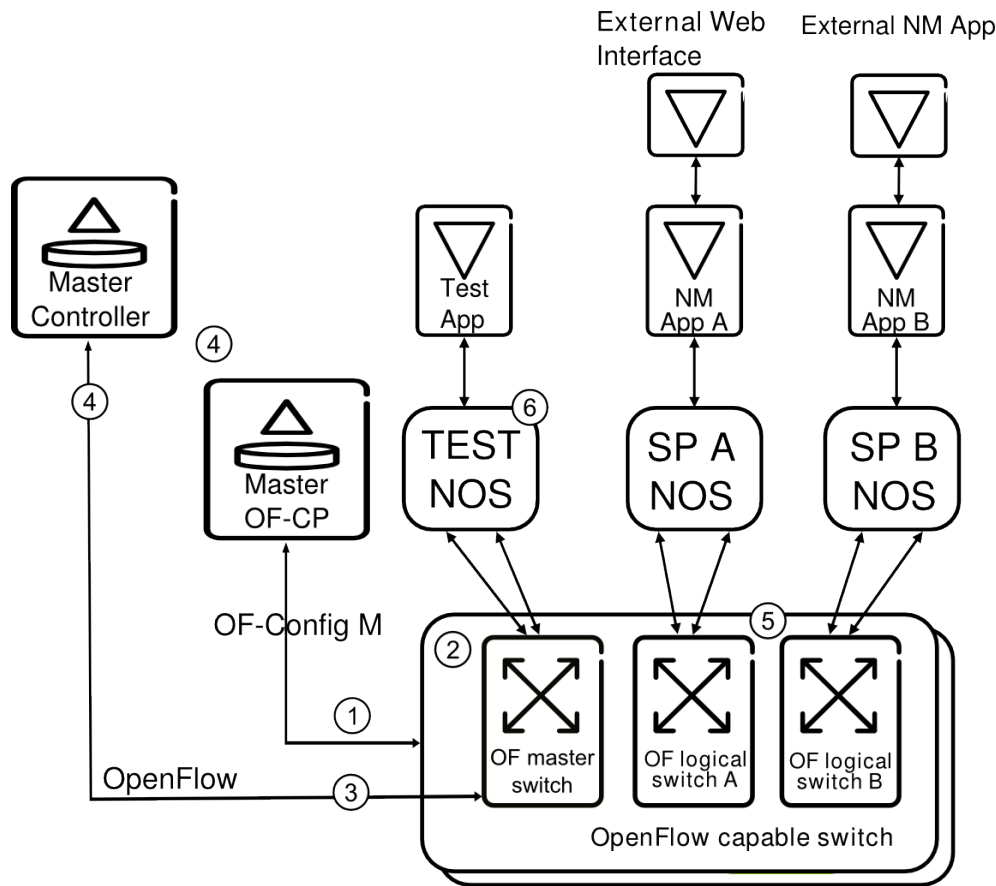
- 1b) Authentication and authorization

- Establishing initial trust with AA
 - Certificate exchange

- 1c) Establishing OF-config session

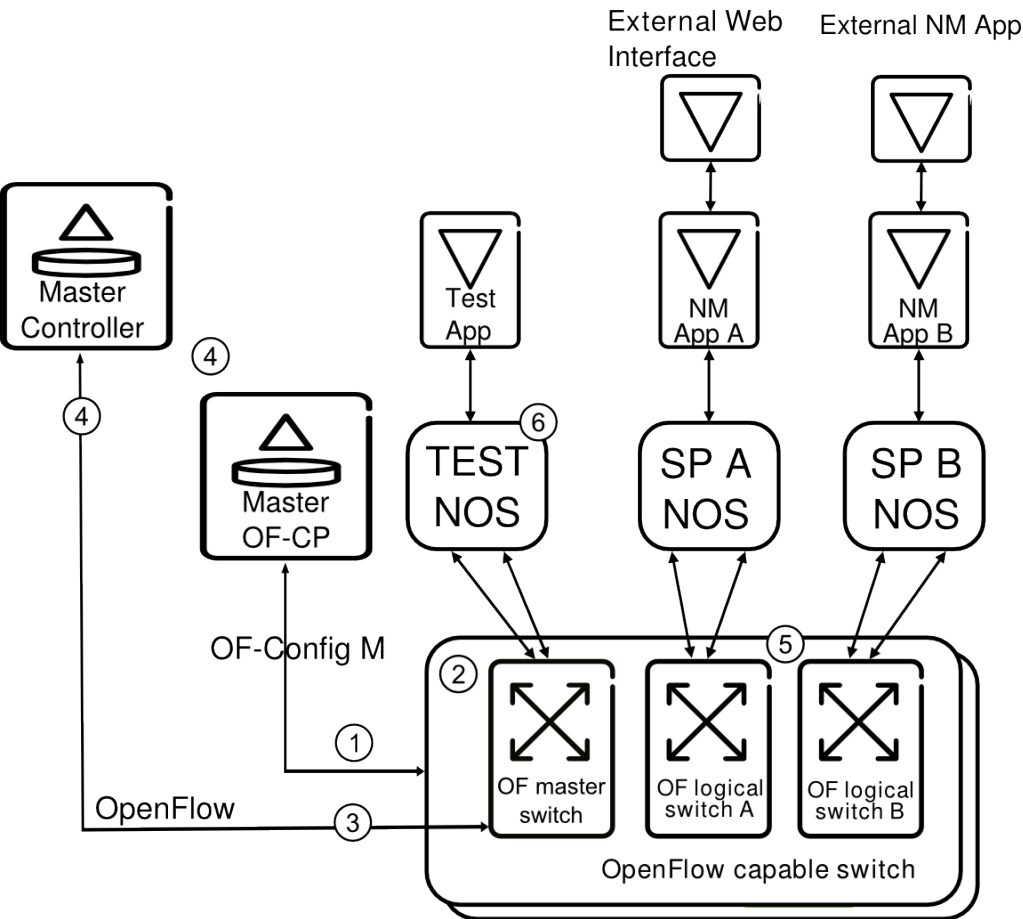
- Using obtained addresses and certificates
 - OF session with OF controller are not established before a logical switch is instantiated (2b)





Physical network configuration

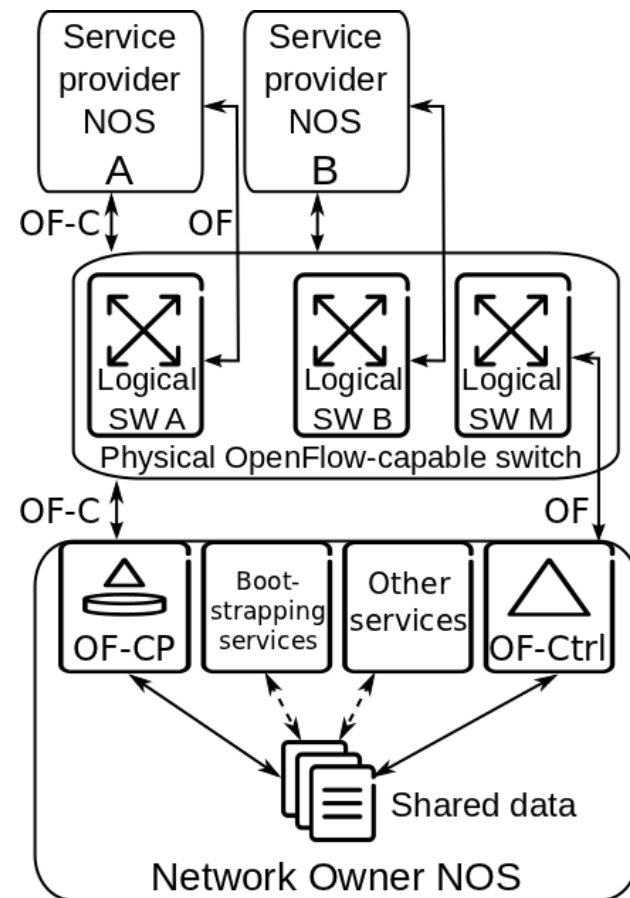
1. Discovery of physical resources, HW, and SW capabilities - OF-Conf session
 - OF-CP assigns connection identifiers and credentials to master controller
 - result: established OF session
2. Instantiate and connect master logical switch (with access to all physical ports) to master controller
 - OF-CP assigns connection identifiers and credentials to master controller
 - result: established OF session
3. Discovery of the physical topology
 - controller-based (pure OF switches)
 - centralized LLDP (NOX)
 - distributed manner (hybrid switches)
 - LLDP or STP
 - discovered topology shared with OF-CP



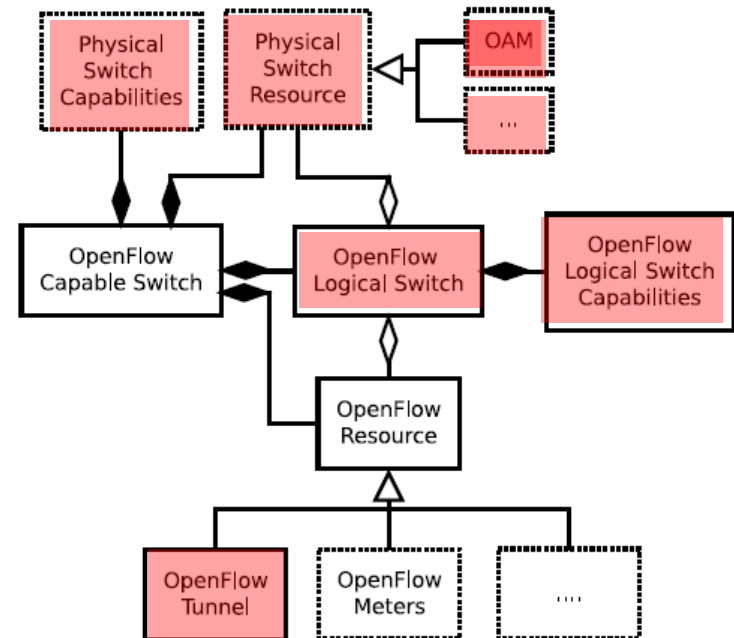
Virtual network configuration

4. Configure fault and performance monitoring
 - for physical links and switch resources
5. Virtual network setup
 - compute virtual topologies, create virtual links, instantiate logical switches for virtual network, validate
6. Virtual network operation
 - Handing over to a customer

- **Bootstrapping considerations**
 - automatic bootstrapping requires mechanisms for control network setup, address assignment, authentication, and transfer of credentials
- **SDN architecture and NOS model**
 - Need to share data between controller and OF-CP
 - Need to connect multiple OF-CPs with different views and capabilities
 - Full view for network owner (master)
 - Reduced view for VNOs
- **Extensions to OF-Config and OF protocol**



- Protocol and data model requirements
- To OF-config
 - Physical resource discovery
 - Logical link configuration
 - Logical switch instantiation
 - Device and link OAM config
- To OpenFlow or OF-mon
 - Alarm and notification propagation
 - Currently under discussion in ONF



- Purpose
 - Verify the applicability and usefulness of the ONF SDN model in terms of NM
 - The use case of a virtualized carrier network shared by multiple customers (VNOs)
 - We outline the steps required to configure and manage this type of virtualized SDN
 - we identified shortcomings and proposed necessary extensions to ONF SDN model in terms of NM
 - Provide pointers for the ONF config-mgmt WG
 - The highlighted extensions include: control network bootstrapping considerations, updates to the SDN and NOS model, and extensions to the OF-Config management data model.
 - We are active in contributing to ONF config & management WG
 - Bootstrapping, topology discovery, event framework, path monitoring