KPN's Vision On and Steps to Reach On a Fully Programmable Telco Network

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KPN
Future vision on the network infrastructure architecture

A programmable network architecture

**Ambitions**
- Higher capacity
- Lower costs
- Increased continuity
- Impactless changes
- Realtime functionality
- Enhanced circularity

**Technology**

Disaggregate
- Software Defined
- Open
- Distributed
The programmable network architecture vision

Software Defined

Fully automated
- Intent driven, model based, closed loop

Virtualised functions
- Network and application functions

Programmable infrastructure
- VNF offload
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Distributed

**Content and services**
- CDN, 3rd party

**Network and application functions**
- Flexible placement towards the edge

**Topology**
- Leaf-spine
The programmable network architecture vision

- **Disaggregated**

**Hardware and Software**
- Decoupled lifecycles

**Forwarding and Control**
- Independent scaling and placement

**Network hardware / software**
- Modularity and flexibility
The programmable network architecture vision

Open

Open interfaces
- All layers
- Standardised, public specifications

Open source
- Software and hardware
- Leverage communities
Building blocks for an open programmable network architecture

CORD / NG-SDN (Open Networking Foundation)

- CORD and NG-SDN are key building blocks for an open programmable network architecture
  - CORD: datacenter concepts applied to central office, flexibility in service and function placement / creation
  - NG-SDN: programmable network layer introduced => VNF off-loading and flexible data plane
    - Not only applicable to CO(RD)

CORD

NG-SDN

www.opennetworking.org/cord/

www.opennetworking.org/ng-sdn/
Building blocks for an open programmable network architecture

Stratum (Open Networking Foundation)
Building blocks for an open programmable network architecture

P4 (Open Networking Foundation / P4.org)

Programmer declares the headers that should be recognized and their order in the packet

Programmer defines the tables and the exact processing algorithm

Programmer declares how the output packet will look on the wire
A Programmable Network Architecture

Overview

End-to-end automation of network services and operation

Open, automated, programmable network resource layer
A programmable ‘Central Office’ architecture

- Programmable, disaggregate ‘CO’
  - Combines CORD and NG-SDN
- Leaf – Spine topology (local and remote leaves)
  - Spines are service agnostic
  - Multi-homed access nodes (edge resilience)
- Separation of control and forwarding
  - ONOS controller
- Programmable forwarding plane (VNF off-loading)
  - STRATUM / P4
- Fixed – Mobile convergence
  - Data plane: transport efficiency
  - Control plane: reduction of functions
Use cases under development

**Intercept & Monitoring**

- Programmable traffic filtering & replication
  - Network traffic received via optical splitters
  - Specific filtering functions (L3 … L7 headers)
  - Specific forwarding functions (tagging, replication)
    - interested and authorized receivers
Use cases under development
Programmable ‘central-office’: IP VPN

- IP VPN: baseline functionality for central office
- Multi-vendor / multi-chip setup: Barefoot Tofino + Broadcom
- Two approaches: custom pipeline + predefined pipeline
  - Separate ONOS instances to avoid conflict
  - Custom pipeline: custom app for pipeline control
  - Predefine pipeline: modified version of segment routing app
- Separate app for configuration of NOS based border leaf
  - NetConf
Use cases under development

Programmable ‘central-office’: Hybrid Access

- Hybrid: fixed and mobile access

- Programmable forwarding plane
  - Barefoot Tofino (initial development on Tofino model)
  - STRATUM: P4RT to control pipeline

- ONOS based control plane
  - HAG app to program forwarding state
  - Separate session manager application to avoid session signalling impact on ONOS

- CUPS – like architecture
  - In band ‘P4’ signalling channel (to be used for both fixed and mobile)
  - State control interface (using P4RT interface of STRATUM)

- In development on Tofino model, porting to HW planned
  - SW model key in development
KPN Fabric Simulation for Fabric & Function development

Based on similar ONF developments within for example µONOS, Atomix etc

FabricFramework Controller

FabricFramework Controller API

FabricService

FabricSwitchSet Service

µONOSSet Service

Control Application Service

Test execution Client

Kubernetes Controller(s)

resources

deploy

deploy

deploy

deploy
The programmable network architecture

The programmable network architecture is software defined, distributed, disaggregate and open in nature.

Open interfaces and open (source) specifications are key building blocks

- CORD, ONOS, NG-SDN, STRATUM

Development started on different of use cases
- Research / PoC stage, baseline for next steps
Thank You