“Software-Defined Data Plane Enhancing SDN and NFV”

Pursuing “Deeper Programmability”

Aki Nakao
TTC
(The University of Tokyo)

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SDN Architecture

Applications

Network Applications

Control Plane

Control-Plane Elements

Data Plane

Data-Plane Elements

North Bound Interface (NBI)

South Bound Interface (SBI)
Application Driven Thinking

Applications

Network Applications

Control-Plane Elements

Data-Plane Elements

Control Plane

Data Plane

Current SDN (bottom up)

Future SDN should be (top down)
Application-Driven Thinking

Premise:

Programmable networking has been enabled by SDN and NFV

App-Driven Thinking:

• Think of “(killer) applications” first and then design network functions and interfaces APIs for SDN and NFV
• Not just OPEX/CAPEX reduction, but create new values via SDN and NFV
Lets start with an example application!

“Next-Gen MVNO”
MVNO Customers Need More Flexible Subscription

App-specific traffic control enables more fine-grained subscription plans that can get an MVNO out of the “ever-lower-cost” competition.
Our Proposal

FLARE (Deeply Programmable Node)
Parse and remove “trailers” and map between flows and apps

SDN Controller
Traffic Engineering based on headers

Packet Marking
Smartphones
NTT Docomo

FLARE Network (SDN/NFV Enabled)
MVNO Backhaul

Smartphones attach app/device information to packets
FLARE detects app/device information and creates mapping between flows and apps/devices
App-Specific Traffic Control

Remote console of programmable network node (FLARE)

Smartphone connected to our MVNO
Benefits

• Application Specific Traffic Engineering for MVNO
  • Application Name Based
  • Application Process Based (Fore/Background)
  • Device Type Based
  • Device State Based (Context / Location Aware)
• Parental Control
  • Not by apps on devices, but by networking
• Additional Value-Add services for specific applications
  • Differentiation for competing apps
    (e.g., Chrome vs. Firefox)
Application Driven SDN

Some ISPs need more direct SDN Southbound Interface

• Flow abstraction in Southbound Interface is for operators
  <Flow Pattern> <Action> <Stat>

• App/Device abstraction is useful and intuitive
  <App/Device> <Action><Stat>
Application Driven SDN QoS

Bandwidth Control According to Apps!

Smartphone

FLARE
Deeply programmable network node
With software defined data plane

Chrome: Pass Thru
Firefox: Block
YouTube: Rate Limit
We won the best demo award!
GEC20@UC Davis
Software Defined Data Plane

Applications

Network Applications

North-Bound Interface (NBI)

Control Plane

Control-Plane Elements

Data Plane

Programmable Data-Plane Elements

Packet Process

E.g. OpenFlow Switches

Publish API
Innovation Cycle

Operation and Evaluation Feedback

Network Applications

Southbound Interface

Data-Plane Elements

Application Driven Thinking
ITU-T Y.3300 (Y.SDN-FR)
“Framework of software-defined networking,”

Figure 2 – High-level architecture of SDN
Sliceable Software Defined Data Planes

Applications

Network Applications

Packet Process

North-Bound Interface (NBI)

Control-Plane Elements

Packet Process

Publish API

Control Plane

Data Plane

Programmable Data-Plane Elements

E.g. OpenFlow Switches
SDN data plane and NFV could be unified

SDN for Network Control

NFV for Data Processing

Applications

Network Applications

Packet Process

Orchestrator

Control Plane

Control-Plane Elements

Packet Process

Data Plane

Programmable Data-Plane Elements

Programmable Data-Plane Elements

Programmable Data-Plane Elements

Programmable Data-Plane Elements

E.g. OpenFlow Switches
Hierarchical Resource Management

- General Purpose Processor(s)
- Network Processor(s)
- ...and more types of processors
Toy-Block Networking GUI
Summary

Missing from the current landscape of SDN and NFV

- **Application Driven Thinking**
  - Top-down, dynamic update of software
  - User, app, device, service oriented modeling
- **Deep (Data Plane) Programmability**
  - SDN data plane as a network function in NFV
  - Data plane slicing (virtualization)
  - Evolve-able APIs
  - New protocol handling
- **Programming Model**
  - Toy-Block Networking
  - Accommodate a wide range of programmers
  - Marketing of reusable network function blocks