Interworking of NFV/SDN with QoE Monitoring in Mobile Networks

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Communication Networks

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Introduction - QoE Monitoring

• Current solution:

![Diagram showing network components and flows]

- DPI Traffic Classification and QoE Estimation (Flow based)
- Traffic Flow Manipulation (Policy Enforcement, PCEF)

• Pros & Cons
  (+) centralized solution with full coverage of traffic flows in monitoring
  (+) simple administration in central location
  (-) interface speed and traffic volume to be monitored -> does not scale
  (-) enforcement limited, if only possible at core site
Motivation for use of SDN and NFV Concepts

• How can SDN support QoE monitoring and enforcement?
  • Flow detection by means of matching rules
  • Flow selective copying for traffic monitoring
  • Enforcement function (prioritisation, traffic engineering)
• How can NFV support QoE monitoring and enforcement?
  • Distribute the monitoring and enforcement function into functional blocks, which are freely and smoothly instantiated and relocated
• Cost reduction and flexibility gained by software realization

Proposal:

**SDN/NFV based solution for QoE monitoring in mobile networks**

“ISAAR (Internet Service quality Assessment and Automatic Reaction) Framework”
ISAAR Functional Layout

- 3 functional components:
  - QoE Monitoring (QMON) – flow detection and assessment,
  - QoE Rules (QRULE) – policy rules and permission checking and
  - QoE Enforcement (QEN) – respective flow manipulation

[Diagram showing the functional layout with QMON F1, QRULE F2, and QEN F3 sections.]

* = Functions with SDN Support
ISAAR Function Split Options

- ISAAR function split – SDN only
ISAAR Function Split Options

- ISAAR function split – SDN + NFV light version
ISAAR Function Split Options

- ISAAR function split – SDN + NFV full version
  (Data path remains untouched)

DPI Traffic Classification and QoE Estimation (Flow based)
Traffic Flow Manipulation (Policy Enforcement, PCEF)
Lab Setup to demonstrate SDN Support

- Lab setup to demonstrate SDN support for QoE monitoring and enforcement
- Setup consists of 2 laptops implementing OpenFlow switches and one laptop as OpenFlow controller

Task 1: OpenFlow support to selectively copy out video flows from the traffic mix (match rule for flow detection + action set to implement the copy function)

Task 2: OpenFlow support to enforce traffic priority (OpenvSwitch action set to use different queues for the flows)
Lab Setup to demonstrate SDN Support

Video flow

Background traffic

Video Client

Internet

Video Server

OpenvSwitch

OpenvSwitch - Controller

Application selective tee-out

Prioritisation & Path selection

Glbt switch

Service Monitoring & CoE Estimation

Iperf to generate background traffic

Data Path

Control Path

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Results: Video QoE Reference + SDN QMON

- Reference setup = video flow transport across SDN platform without background traffic and without any flow manipulation

- WebM http video stream; Video player buffer: 10s ; Video bitrate: avg. 800Kbit/s
Results: Video QoE with Background Traffic + SDN QMON

- Video flow transport across SDN platform with background traffic but without any flow manipulation

- WebM http video stream; Video player buffer: 10s ; Video bitrate: avg. 800Kbit/s
- Emulated 2Mbps line speed + 1.4 Mbps background traffic
Results: Video QoE w. Backgr. Traffic + SDN QMON & QEN

- Video flow transport across SDN platform with background traffic and OpenvSwitch based flow manipulation

- WebM http video stream; Video player buffer: 10s; Video bitrate: avg. 800Kbit/s
- Emulated 2Mbps line speed + 2 traffic classes (1Mbps reservation for video & background)
- SDN prioritization by means of separate queues (video queue with 800kbps reservation)
Summary

- SDN/NFV augments QoE monitoring and enforcement
- ISAAR makes use of SDN to selectively copy out flows as well as to enforce flow manipulation actions
- The ISAAR functional block structure (QMON, QRULE, QEN with 10 functions F1.1 - F3.2.3) allows for direct NFV implementation
- Different function split options:
  - SDN only, SDN + NFV “light” and SDN + NFV “full”
- In a test lab setup a smooth interworking of ISAAR and OpenvSwitch with good QoE results has been proved
Next Steps

• Improved interworking of ISAAR with SDN (OpenFlow 1.0 ... 1.3) in terms of performance and OpenFlow capability usage

• Decentralized ISAAR implementation for NFV demonstration

• Feasibility and performance analysis of NFV-ISAAR in field trials (SDN testbed)