On QoS Support to Ofelia and OpenFlow

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European Workshop on Software Defined Networks, October 25th - 26th, 2012, Darmstadt, Germany.
Quality of Service in OpenFlow

- OpenFlow 1.0
  - enqueue action
    - packets can be forwarded to queues
  - controller can query queue-configurations
    - minimum guaranteed rate
- OpenFlow 1.1
  - enqueue renamed to set-queue
- OpenFlow 1.2
  - controller can query queue-configurations
    - minimum and maximum rates
- OpenFlow 1.3
  - rate-limiting via meter tables
- OpenFlow 1.3.1
  - clarifications in meter bands

OpenFlow protocol cannot configure queues
OpenFlow

Management tool

OpenFlow controller

OF-Config
- Netconf based protocol
- uses Yang data definition language
- OF-Config 1.0 -- (for OpenFlow 1.2)
  - create queues
  - set queue properties
    - minimum and maximum rates
- OF-Config 1.1 -- (for OpenFlow 1.3)

Standard-based
Network Management in OpenFlow

Standard-based

- OF-Config
  - Netconf based protocol
  - uses Yang data definition language
- OF-Config 1.0  -- (for OpenFlow 1.2)
  - create queues
  - set queue properties
    - minimum and maximum rates
- OF-Config 1.1  -- (for OpenFlow 1.3)

Available in testbeds

- Lightweight virtualization with FlowVisor
  - Expedient in Ofelia
  - FOAM in GENI
- Heavyweight virtualization
  - extends OpenNMS
  - runs different OF versions in parallel
Available in testbeds

- Lightweight virtualization with FlowVisor
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General Architecture of OFELIA Control Framework
extended with QoS support

Task
Study on case of
Extension to
OpenFlow

Switches

Agent
Server

Agent
Server

FlowVisor

Queue Manager Plug-in
QoS Extension
OF Plug-in
Plug-in X

Opt-In Manager
QoS Extension

Virtualization Aggregate Manager

GUI

Expedient

LDAP

Control Framework

NOX

GUI

AM X

NOX

Server

Switches
Switches

HP OpenFlow Switch
- Do not support the request action
- Map packets to priority queues based on IP Type of Service, Deliver Code-Point fields

NEC OpenFlow Switch
- Supports the standard error action

(custom) NetConf Interface
- OpenFlow Soft-switch
- QoS Extension

OF-CONFIG NetConf Interface
- OpenFlow Soft-switch
• Do not support the enqueue action
• map packets to priority queues based on IP Type-of-Service, Diffserv Code-Point fields
• supports the standard enqueue action

NEC
General Architecture of OFELIA Control Framework
extended with QoS support

Task summary

Study on capabilities and performance
Extension to Ofelia control framework
OpenFlow extensions
On QoS Support to Ofelia and OpenFlow

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Quality of Service in OpenFlow

- OpenFlow v1.0
- Port-based QoS
- Traffic classifier
- Traffic shaper

Network Management in OpenFlow

- Standard-based
- Network-wide management
- Flow and port configuration
- Group table
- OpenFlow version 2.0

Available in testbeds

- OpenDaylight
- Open vSwitch
- Open vRouter

Task summary

- Study on capabilities and performance
- Extension to Ofelia control framework
- OpenFlow extensions

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Virtualization

Integrated OpenFlow Virtualization Framework with Flexible Data, Control and Management Functions

B. Sonkoly, A. Gulyás, J. Czentye K. Kurucz, G.Vaszkun,
A. Kern, D. Jocha, A. Takács

OpenFlow Virtualization Framework with Advanced Capabilities

B. Sonkoly, A. Gulyás, F. Németh, J. Czentye, K. Kurucz,
B. Novák and G. Vaszkun
New forwarding mechanisms

Towards SmartFlow: Case Studies on Enhanced Programmable Forwarding in OpenFlow Switches

F. Németh, Á. Stipkovits, B. Sonkoly, A. Gulyás

Stateless multicast with Bloom filters

Fix sized flow tables with Greedy routing

200% link utilization with Network Coding

Our case studies support that introducing only lightweight and low-level enhancements, numerous networking operations may become available in OF.
Our existing and ongoing theoretical work

Greedy routing and embedding

Poincare: ICDCS/DCPerf 2012
- we proposed data center architecture embedded into the hyperbolic plane
- based on hyperbolic tessellations
- with greedy routing
- with OpenFlow implementation

Intership at T-Labs Berlin

On Greedy Network Formation: ACM SIGMETRICS/Performance W-PIN WS
- question: can the routing explain the topology
- network formation games in euclidean grids with greedy navigation
- negative result: small worlds cannot emerge finite dimensional euclidean space

Greedy Network Formation Games: ACM PODC 2012
- definition of hyperbolic game from which realistic networks emerge as equilibrium topologies

Compact routing

Are there any deep theoretical reasons behind the super liner growth of the FIBs?
- And we cannot use sub-optimal paths (stretch cannot help this) Compact Policy Routing: Springer Distributed Computing 2012

Can we compress current router FIBs to their entropy to fit into fast memory?
- Yes, "Compressing IP Forwarding Tables for Fun and Profit": ACM HOTNETS 2012 (parallel with EWSDN)
On QoS Support to Ofelia and OpenFlow

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Virtualization

Integrated OpenFlow Virtualization Framework with Flexible Data, Control and Management Functions
B. Seresky, T. Cserenyi, K. Kacsuk, A. Gulya, G. Vaszkun, A. Vas, K. Fricska, T. Tóth

OpenFlow Virtualization Framework with Advanced Capabilities
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New forwarding mechanisms

Towards Scalable Case Studies on Enhanced Programmable Forwarding in OpenFlow Switches
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Our existing and ongoing theoretical work

Greedy routing and embedding

Compact routing

FP7-ICT-2013-11

opening on 14/01/2014

closing on 16/04/2015
Objective ICT-2013.1.1 Future Networks

The target is the development of future broadband (fixed and mobile) networks which will be energy-efficient, secure, and robust, and will use spectrum flexibly and efficiently. Future networks will be the infrastructure which connects the future Internet of people, content, clouds and things, and will meet the targets of the DAE (Digital Agenda Europe). The focus in WP2013 is on a restricted set of technology priorities, which are key to achieving the targets.

a) Next generation heterogeneous wireless and mobile broadband systems, based on flexible spectrum usage and reduced EMF and interference.

b) High throughput low-latency infrastructures, based on dynamic all-optical networks and hybrid wireless and cable networks.

c) Internet architectures enabling innovation in network virtualization, specifically through programmability of network functions and protocols.

d) Tighter integration of satellite and terrestrial communications technologies, as a critical infrastructure, in particular for public safety/security applications.

e) Coordination and support actions for (re)structuring the research effort in the sector.

Expected Impact

- Developing key enabling technologies for the future generations of the European high-speed broadband and mobile network infrastructure (factor of 10 overall capacity increase, plus factor of 10 radio efficiency increase).

- Improved flexibility and economic, spectral and energy efficiency of access/transport infrastructures. (factor of 4 reduction in watts/bit).

- Strengthened positioning of European industry in the fields of Future Internet technologies, mobile and wireless broadband systems, optical networks, and network management technologies.

- Contributions to standards and regulation as well as the related IPR.

- Adoption by network operators of integrated all-optical networks and of spectrum-flexible broadband wireless systems (by 2020).

Funding Schemes:

a), b), c), d): IP, STREP
c) CSA

Indicative budget distribution:

IP/STREP: EUR 46.5 million, of which a minimum of 50% to IPs and 30% to STREPs
CSA: EUR 2 million

Call:

FP7-ICT-2013-11

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1 Photonic devices for communication networks supporting the overall vision and requirements of Objective 1.1 are developed in Objective 3.2.
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