Reference Measurement Points for Validation end-to-end QoS in Heterogeneous Multiple Domain Network

Andrzej Bęben, Wojciech Burakowski, Marek Dąbrowski

Institute of Telecommunications
Warsaw University of Technology, Poland
Outline

- Introduction
- Reference Locations of Measurement Points
- Management of measurements
- Summary
Introduction (1)

Modern IP networks:

- usually consist of multiple domains built based on different technologies, like IP DiffServ, xDSL, WLAN, LAN, etc.
- should provide QoS guarantees (by offering a set of network services with different QoS objectives)
Introduction (2)

The role of Monitoring and Measurement System (MMS) is essential to:
- Validate the actual QoS level offered to users
- Support traffic control, like admission control, traffic engineering

The key elements of MMS we deal with are:
- proper location of measurement points (MP) inside a network
- effective management of measurements
Reference Locations of MPs (1)

Goal: define places in a network that allow to collect required measurements, related with offered QoS, carried traffic...

Constraints:

- different technologies,
- different network services offered:
  - by particular network technologies
  - inside particular domains and on inter-domain links
Reference Locations of MPs (2)

Solution:

- to perform measurements on IP layer
- to place MPs in the points where particular service begins or ends to operate
Reference Locations of MPs (3)

**For core network:**

- $\text{MP}_a^X$ – at input interface of the ingress border router
- $\text{MP}_b^X$ – at entrance to the queue of output interface of the ingress border router.
- $\text{MP}_c^X$ – at input interface of the egress border router.
- $\text{MP}_d^X$ – at entrance to the queue on the output interface of the egress border router.

**For access network:**

- $\text{MP}_t^X$ – at IP interface of the user terminal
Deployment of measurement equipment (1)

- Deployment of MPs require to:
  - overcome limited access to the routers
  - consider different types of measurements (active and passive)
  - take into account internal architecture of access network

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Deployment of measurement equipment (2)

Exemplary WLAN access network scenario:

WT_1 : Wireless Terminal i=1,..N
AMP: Active Measurement Point
PMP: Passive Measurement Point

AP: Wireless Access Point
H: Passive hub

AMP_{t-1}
WT_1
WT_N
AMP_{t-2}

IEEE 802.11
Border router
Inter-domain link

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Management of measurements (1)

- management with a central controller
- management with domain controllers and with measurement control protocol
- management with domain controllers without measurement control protocol
Management with a central controller

**Strengths:**
- simplicity
- straightforward implementation

**Drawbacks**
- not scalable!
- hard to deploy in multi-provider network

Exemplary possible measurements:
- Border router
- MP for inter-domain measurements
- MP for intra-domain measurements
- Controlling the MPs
- Central Measurement Controller
- Exemplary possible measurements

All measurement results are collected by the Central Measurement Controller
Management with domain controllers and control protocol

- **Strengths:**
  - Scalability
  - Independency in measurements

- **Drawbacks:**
  - Complexity
  - Accuracy of results

**Diagram:**

- DMC1
  - AS1
  - Measurement results collected by DMC1

- DMC2
  - AS2
  - Measurement results collected by DMC2

- DMC3
  - AS3
  - Measurement results collected by DMC3
Management with domain controllers but without control protocol

**Strengths:**
- scalability
- independency in measurements

**Drawbacks:**
- complexity
- accuracy of results

Measurement results collected by the CMC1

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Summary

- The reference MPs for validation of QoS in multiple domain, heterogeneous network were proposed
- The exemplary deployment of MPs was proposed
- Three schemes for managing measurements were discussed