Scalable QoS Measurements in Multicast Environments

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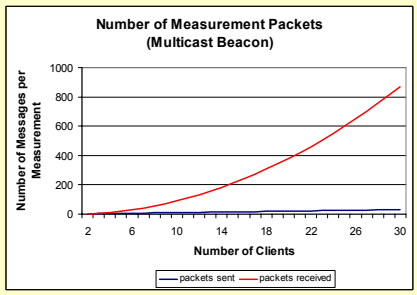
Introduction

The importance of providing quality of service (QoS) in communication networks for various types of real-time applications is widely accepted. QoS measurements in communication networks are required in many representations [1, 6]. Many of the most current multimedia applications use IP multicast for an efficient one-to-many transmission over the network. Thus, the employed measurement tools have to work in multicast environments as well [7]. Unfortunately, all the existing approaches for such measurements show perspicuous drawbacks. Especially the scalability of such tools is an issue.

The focus of this work is to describe the a scalable environment for QoS measurements in IP multicast networks. The presented approach, named Multicast Quality Monitor (MQM, [4, 5]), is built on new concepts providing an optimum scalability. First, the so named MQM ping mechanism is a distributed and decentralized mechanism to allow the employment of high-scalable QoS measurements in the internet. Secondly, the so named MQM beacon mechanism focuses on the requirements of individual multimedia services. It was designed to reduce the impact on the network as much as possible by allowing a passive behavior using the multicast capabilities of the network by joining active multicast sessions and by analyzing the received traffic. Additionally, a central control instance is employed to prevent unnecessary and unnecessarily long lasting measurements.

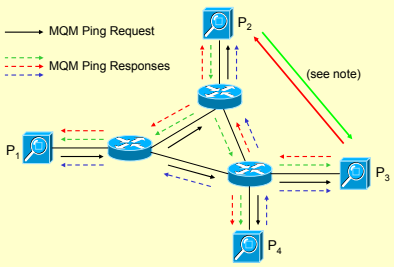
Related Work

- Multicast Reachability Monitor (MRM, [2]), IETF-Draft
- Multicast Beacon (National Laboratory for Applied Network Research, [3])

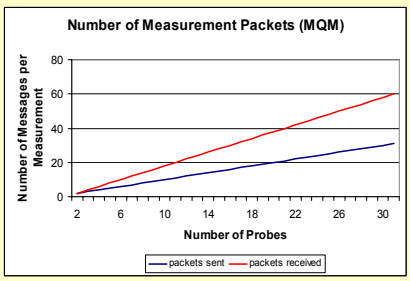


Typical scalability behavior of multicast measurements. An increasing number of clients in the measurement results in an exponential increase of the number of measurement packets (shown for the Multicast Beacon, the same applies to the MRM.

MQM Ping Mechanism



Using a single request packet sent to a multicast group, the response messages can be used to determine the network behavior between all responding probes as well (as shown in this example between P_2 and P_3).



The MQM ping mechanism shows a linear increase of measurement messages while the number of measurement probes increases.

Multicast Quality Monitor

fundamental criterion is the scalability

Differentiation

MQM Ping Mechanism

- decentralized, distributed
- minimal impact on the network
- connectivity / reachability
- delay (one-way delay, round-trip time)
- (jitter, packet loss ratio)

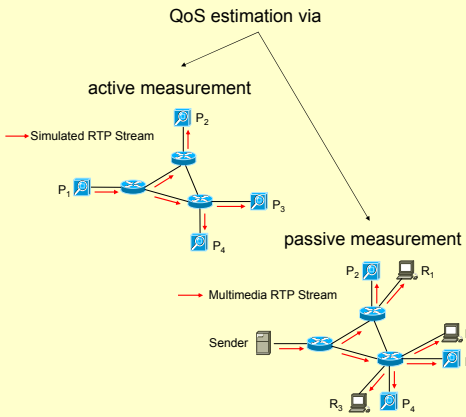
MQM Beacon Mechanism

- centrally coordinated
- any combination of senders and receivers
- configurable characteristics of the measurement data streams
- jitter, delay
- packet loss ratio

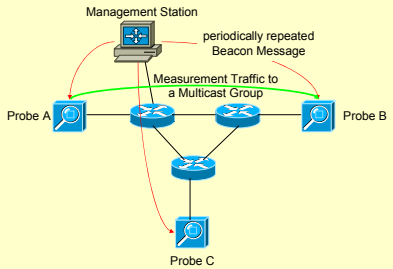
	Multicast Reach-ability Monitor	Multicast Beacon	MQM Ping Mechanism	MQM Beacon Mechanism
Scalability (smooth adoption to a large network environment)	o	--	++	+
Completeness / Extensibility (possibility to measure all the required parameters and to detect the typical problems)	--	+	+	+
Variability (characteristic of the measurement data flows is freely configurable)	-	--	--	++

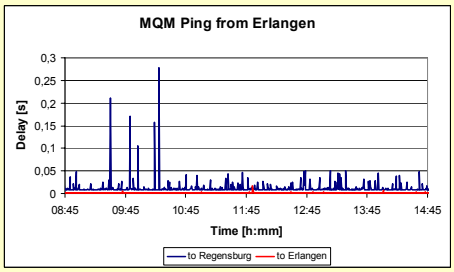
MQM Beacon Mechanism

based on RTP (Real-time Transport Protocol)



Prevention of unnecessary and unnecessarily long lasting measurements → central coordination

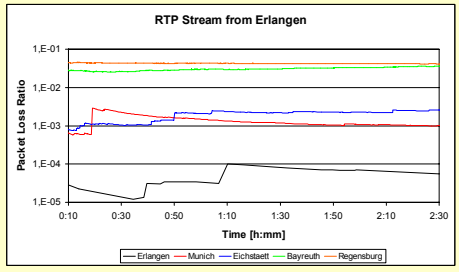




Measurement Results

Two sample measurements are shown:

1. On the left: MQM ping measurement from Erlangen to another host in Erlangen and to a host in Regensburg; shown is the delay distribution
2. On the right: MQM beacon measurement (passive) from Erlangen to hosts distributed all over Bavaria, Germany; shown is the packet loss ratio during a video transmission



Summary and Outlook

Quality of service is the most important attribute of future communication networks

- quality of (real-time) multimedia transmissions
- economical relevance

Measurements of the quality of service in multicast networks using the MQM are

- scalable (usable even in large networks)
- complete and extensible (cover all typical parameters, detect the well-known problems)
- variable (the characteristic of the measurement traffic flows is freely configurable)

The MQM, which is available as a prototype, may be the first step towards an universal framework for QoS measurements in the internet (unicast as well as multicast).

References

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