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ITU-T G.1020 -IP aware QoS management

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Supplement 61 to ITU-T G.1020 series of Recommendations

ITU-T G.1020 -IP aware QoS management

Summary

This proposed Supplement documents a packet oriented (IP-centric) QoS management model. This model is applicable to a wireless Access Point (e.g. WiFi AP, eNode B, Node B), referred to as "IP aware Access Point". In the supplement a possible cross-layer design for this model in LTE/EPC networks is described. Some implementation challenges are highlighted, together with possible solutions implying only minor modifications in the eNode B. Performance of this proposal compared to various implementations of the 3GPP QoS model is evaluated using the ns-3 simulator in realistic scenarios.

Keywords

QoS management; IP aware; LTE

Introduction

The mobile data landscape is rapidly changing. Today's mobile devices as smartphones and tablets have better connectivity capabilities, which are close to or even better than fixed devices. Usages and traffic patterns have also changed. For example, video and music streaming are available on a widespread basis today, but did not almost exist some years ago. Furthermore, the LTE/EPC network offers increased possibilities thanks to higher data rates and lower latency, which favours the emergences of new services.

The joint evolution of mobile usages and services (e.g. VoLTE), results in an important challenge for operators. Indeed, current mobile standards have not yet fully integrated this expectation of open, cheap and flexible web oriented internet access. Notwithstanding the claimed "all IP" basis of the LTE system, current 3GPP QoS management for LTE/EPC networks is still circuit oriented. Namely, LTE QoS management is based essentially on virtual tunnels called "bearers", which provide for end-to-end transport service with specific QoS attributes. Contrary to usual QoS models of the fixed internet (IP networks) such as Diffserv, additional signalling procedures are then required in order to establish a dedicated bearer for each desired QoS level. This circuit oriented model was inherited from TDM-based transport, and it was well adapted to early mobile data services deployments when the amount of data exchanged was low and multitasking rather inexistent.

However, managing the QoS of mobile networks using a circuit-based model raises some tricky issues considering the high volumes and variability of mobile data traffic generated by smartphones applications of today, such as: scalability of the architecture due to the number of tunnels to be maintained, additional signalling traffic required to establish or modify the parameters of the tunnels, time to establish or modify a tunnel, etc.

As an alternative, a lightweight QoS model has been introduced in [1], [2], [3] and [4] mainly inspired by IP policies commonly found in fixed networks. This model offers loose QoS differentiation in a heterogeneous traffic environment which solves the aforementioned limitations. The so-called "IP-centric" approach has already drawn interest amongst some major actors of the mobile industry.

Note however that both models could be simultaneously deployed: a circuit based model could be used for managed services when signalling traffic is exchanged prior to starting the service (a typical example might be VoLTE), while the proposed packet oriented model could be suitable to differentiate among the other services (e.g. Internet services).

1. Scope

Managing the QoS of mobile networks using a circuit-based model (as it is for instance the case for services like voice over LTE, see [ITU-T G.1028]) raises some tricky issues considering the high volumes and variability of mobile data traffic generated by smartphone applications of today, such as: scalability of the architecture due to the number of tunnels to be maintained, additional signalling traffic required to establish or modify the parameters of the tunnels, time to establish or modify a tunnel, etc.

As an alternative, this Supplement introduces a possible lightweight cross-layer design for the IP-centric model, which implies only minor modifications of an IP aware Access Point. This model offers loose QoS differentiation in a heterogeneous traffic environment which solves the aforementioned limitations.

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3. Definitions

3.1. Terms defined elsewhere

None

3.2. Terms defined in this Supplement

None

4. Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AM	Acknowledged Mode
AMC	Adaptive Modulation and Coding
AMR-NB	Adaptive Multi Rate Narrow-Band
AP	Access Point
ARQ	Automatic Repeat request
BE _{PF}	Bes Effort (per-flow QoS support)
COST	COopération européenne dans le domaine de la recherche Scientifique et Technique
CQA _{PF}	Channel-QoS Aware (per-flow QoS support)
DL	DownLink
DRB	Data Radio Bearer
DSCP	Differentiated Services Code Point
eNodeB	evolved Node B
EPA	Extended Pedestrian A (model)
EPC	Evolved Packet Core

EPS	Evolved Packet System
FTP	File Transfer Protocol
GBR	Guaranteed Bit Rate
GPRS	General Packet Radio Service
GTP	GPRS Tunneling Protocol
HARQ	Hybrid Automatic Repeat request
HAS	HTTP Adaptive Streaming
HTTP	HyperText Transfer Protocol
IP	Internet Protocol
ITU	International Telecommunications Union
LA	Link Adaptation
LENA	LTE EPC Network simulAtor
LTE	Long Term Evolution
MAC	Media Access Control
MOS	Mean Opinion Score
PDCCP	Packet Data Convergence Protocol
PF	Proportional Fair (for an algorithm)
P-GW	Packet Data Network GateWay
PLR	Packet Loss Rate
PLT	Page Load Time
PSS _{PF}	Priority Set Scheduler (per-flow QoS support)
QCI	QoS Class Identifier
QoE	Quality of Experience
QoS	Quality of Service
RB	Radio Bearer
RLC	Radio Link Control
RoHC	Robust Header Compression
SINR	Signal to Interference and Noise Ratio
TCP	Transport Control Protocol
TTI	Transmission Time Interval
TX	Transmisssion
UDP	User Datagram Protocol
UL	UpLink
UM	Unacknowledged Mode
VoIP	Voice over IP