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Mapping PMIP Quality of Service in WiFi Network
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Abstract

This document proposes a model for mapping PMIP QoS parameters of a mobile network session to the corresponding connection at a WiFi Access Point. In congested network conditions, it is possible that a user’s flows from the WiFi AP are metered and shaped at the WLC to match the bandwidth constraints or service priority of the user’s subscription and PMIP QoS parameters. Applying similar QoS policing at the WiFi AP allows optimal use of scarce radio network resources. Currently, the WiFi AP does not have information on the MNs subscribed bandwidth, or relative priority of its flows or services for per user QoS handling at the WiFi AP. This document provides a model for mapping PMIP QoS to corresponding 802.11e QoS parameters.

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1 Introduction

This document provides a description of how the QoS profile for a PMIP session maps to QoS for the corresponding 802.11 connection segment of the MN (Mobile Node). When a mobile network user attaches via a WiFi access, the WLC (MAG) obtains a QoS profile for each PMIP session. [PMIP-QoS] proposes a mechanism by which QoS policy parameters in the mobile network are delivered from the LMA to the the WLC (MAG) using PMIP QoS extensions. [PMIP-QoS] further describes how the DSCP value for the PMIP session is mapped to corresponding 802.1p value that may be used by IP backhaul network or WiFi APs to prioritize IP flows of a host (MN).

[PMIP-QoS] outlines a model in which the QoS in PMIP flows can be reflexively mapped to IP flows over 802.11 or backhaul network. The WiFi AP can infer the QoS priority associated with an IP flow based on the the DSCP value in the downstream packets of the PMIP flow, and apply the same priority to upstream packets of the flow. It should be noted that the WLC (MAG) uses DSCP priority as well as other parameters of the MN such as subscribed bandwidth and service priority in [PMIP-QoS] to police IP flows of the MN. In congested network conditions, it is possible that upstream flows from the WiFi AP are throttled by the WLC to match the bandwidth constraints or service priority. This will result in sub-optimal use of network resources. Currently, the WiFi AP does not have information on the MNs subscribed bandwidth, or relative priority of its flows or services. In addition to uneven policing between WiFi AP and WLC, when the WiFi network itself is congested, the MN subscribed bandwidth and service priority can be useful to schedule and use the radio network resources more effectively.

This proposal aims to provide the WiFi AP with per MN QoS profile to allow more effective overall use of network resources - both WiFi radio and IP backhaul. The QoS parameters needed are available to the WLC during MN authorization and establishment of the PMIP session with QoS extensions. Since an MN may establish tunneled IP flows, direct IP connections or offloaded connections, the relationship of PMIP QoS to 802.11e QoS is explained. It is possible that an MN (with a single 802.11 interface) has more than one PMIP session. The QoS policy for the MN may be applied by the AP to schedule and control WiFi radio network resources and upstream user flows in the IP backhaul network. If per session QoS policy is not available, the AP may be provisioned to apply QoS based on the subscribed QoS values obtained during 3GPP user authorization.

In order to provision QoS in the WiFi network, a consistent mapping of QoS parameters and values between 3GPP and 802.11e is needed. Recommendations to map 3GPP QCI to DSCP for mobility sessions are available in [PMIP-QoS]. This document adds the configuration of QoS per PMIP mobility session to a WiFi radio access.

The rest of the document is organized as follows. Chapter 2 outlines the QoS mechanisms in 3GPP mobile networks and 802.11 networks. Chapter 3 provides an overview of the architecture in which QoS is provisioned on the WiFi AP. Chapters 4 and 5 describe the connection model in the access network and the QoS mapping itself.

1.1 Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

1.2 Definitions

1.3 Abbreviations

3GPP	Third Generation Partnership Project
AAA	Authentication Authorization Accounting
ARP	Allocation and Retention Priority
AP	Access Point
DSCP	Differentiated Services Code Point
EPC	Enhanced Packet Core
GBR	Guaranteed Bit Rate
MAG	Mobility Access Gateway
MBR	Maximum Bit Rate
MN	Mobile Node
PDN-GW	Packet Data Network Gateway
QCI	QoS Class Indicator
QoS	Quality of Service
Tspec	Traffic Conditioning Spec
WLC	Wireless Controller

2. QoS Mechanisms

2.1 QoS in Mobile Networks

3GPP has standardized QoS for EPC (Enhanced Packet Core) from Release 8 [TS 23.107]. 3GPP QoS policy configuration defines access agnostic QoS parameters that can be used to provide service differentiation in multi vendor and operator deployments. The concept of a bearer is used as the basic construct for which the same QoS treatment is applied for uplink and downlink packet flows between the MN (host) and gateway [TS23.401]. A bearer may have more than one packet filter associated and this is called a Traffic Flow Template (TFT). The IP five tuple (IP source address, port, IP destination, port, protocol) identifies a flow.

The access agnostic QoS parameters associated with each bearer are QCI (QoS Class Identifier), ARP (Allocation and Retention Priority), MBR (Maximum Bit Rate) and optionally GBR (Guaranteed Bit Rate). QCI is a scalar that defines packet forwarding criteria in the network. Mapping of QCI values to DSCP is well understood and GSMA has defined standard means of mapping between these scalars [GSMA-IR34].

An MN may have more than one IP addresses associated with the same hardware (MAC) address corresponding to each of the networks than it is attached to. This corresponds to more than one PMIP mobility session for which QoS is provisioned in the WLC.

2.2 QoS in WiFi Networks

802.11e [802.11e] defined by IEEE provides an enhancement of the MAC layer in WiFi networks to support QoS. Basic 802.11 WiFi uses CSMA and collision avoidance to provide best effort access to the medium. 802.11e defines a Hybrid Coordination Function (HCF) that provides a priority based access and also admission control based access.

HCF contention based channel access provides prioritized access to the 802.11 medium. Four access categories (AC) are defined based on traffic type. Each arriving frame is mapped into one of four FIFO queues corresponding to different user priority (UP) values. The highest priority frame is transmitted when access is obtained in a contention window. Access categories and their mapping to 802.1D user priorities is provided [802.11e].

HCF controlled channel access uses a central coordinator to provide contention free access to the medium based on admission control. The HCCA (HCF Controlled Channel Access) based scheduling can use configured policies to grant exclusive access to a QSTA (user) for limited contention free slots.

3. Policy Provisioning Architecture

This section describes the architecture in which the PMIP QoS configuration of MN sessions is applied to the corresponding traffic flows in the WiFi Access Point. Following MN attach to the WiFi network and authentication with the mobile network, the WLC gets QoS parameters and other policy for the authorized MN. When the PMIP connection is created, the PDN-GW returns QoS policy using [PMIP-QoS] extensions.

In [PMIP-QoS], the Access Point (AP) is not directly provisioned with QoS for an MN connection. As a result, the AP is only able to prioritize flows based on observed downlink DSCP values. Additionally, the AP does not know the maximum bandwidth of a subscriber or flow to be applied on the WiFi radio network. This can result in sub-optimal utilization of scarce WiFi network resources, and of the overall access network. This solution provides a description to provision the AP with QoS policy associated to an MN.

The paragraphs that follow outline the overall architecture and subsequent chapters provide details on QoS parameters provisioned in the AP.

```
                                          +-----+
                                          | AAA |
                                          +--+--+
                                             |
                                             |Auth
                                             |
                  WiFi AP            WLC(MAG)|
                 +----------+         +------|------+
                 |+--------+|   QoS   | +----v----+ | PMIP-QoS +------+
                 ||QoS-Ctrl<------------+QoS-Ctrl <------------+PDN-GW+
                 |+---+----+| Policy  | +----+----+ |          +--+---+
                 |    |     |         |      |      |             |
          801.11 |+---v----+|  _____  | +----V----+ |   ________  |
      [MN]--------+  PEP   +--/ IP  )---+   PEP   +----/   IP   ) |
                 |+--------+| Network | +---------+ |  | Network|-+
                 +----------+ (     / +-------------+  (        /
                               -----                    .------.
```

Figure 1: Architecture for provisioning QoS Policy on WiFi AP

Figure 1 provides an overview of the architecture in which QoS for an MN is provisioned on the AP. MN QoS policy from initial session authorization and PMIP connection establishment is provisioned in the WLC QoS-Ctrl (logical function). QoS-Ctrl in WLC installs QoS to the WLC PEP as described in [PMIP-QoS].
In this solution, the WLC translates the 3GPP QoS policy to equivalent parameters for 802.11e and IP flows and sends them to the WiFi AP. The protocols used to exchange QoS parameters between the

WLC and AP are not discussed in this document. The AP maps the received QoS policy configuration and applies them to upstream and downstream forwarding of data packets in the WiFi radio network. The AP also applies these QoS policies for upstream user IP flows to the WLC. The WLC should provide the AP with a policy that applies to each MN (MAC address in WiFi network) and parameters per IP flow. This model is described further in the following chapter.

4. Connections and QoS Mapping

4.1 Connection Model

MNs that attach to the mobile network have QoS policies associated to the corresponding PMIP connection. This section outlines the connection model for QoS mapping on the WiFi AP.

```
                       WiFi AP                   WLC(MAG)
                      +----------+              +-------------+
                      |+--------+|              | +---------+ |
      +---+           ||  PEP   ||              | +   PEP   + |
      |MN |           |+--------+|              | +---------+ |
      | 1 ===========================[conn-1]=========<X>=======[PMIP-1]
      +---+           |          |              |             |
      +---+           |          |              |             |
      |MN +--------------------------[conn2a]---------<X>=======[PMIP-2]
      | 2 +--------------------------[conn2b]---------<X>     |
      +---+           +----------+              +------|------+
                                                       V
                                                   [offload
                                                path]
```

Figure 2: MN Connection and QoS Mapping

Figure 2 shows MN1 and MN2 attached to the WLC via a WiFi AP. An MN may have a tunneled connection to the mobile network (MN1, conn-1, PMIP-1), or an IP cpnnection to the mobile network (MN2, conn2a, PMIP-2) and an IP connection that is offloaded at the WLC (MN2, conn2b, offload). The connection segment between MN and WLC may be IP connections, or tunneled connections such as IPSec.

For an MN - WLC connection segment with IP address configured via PMIP (e.g. MN2 conn2a), the corresponding PMIP QoS would be

applicable to flows with this IP address and MAC address.
For tunneled connections in MN - WLC segment (e.g. MN1 conn-1), MN1 first gets a local IP address from the WLC. MN1 then establishes an IPSec connection to the WLC and in the IKE signaling indicates parameters for PMIP connection setup. The corresponding PMIP QoS parameters are applicable to flows identified by local IP address, port (IPSec source port at MN1) and MAC address.
WiFi AP may use a default QoS profile for connection flows that are offloaded (e.g. MN2 conn2b in figure).

The WiFi AP would get QoS traffic filters corresponding to PMIP flows. These flows would be identified by the tuple {MAC, IP address, port}. The port field may be specified for tunneled or NATed connections and wildcarded otherwise.

4.2 PMIP - 802.11e QoS Configuration

The WiFi Access Point (AP) gets QoS configuration per IP session from the WLC. The QoS information per IP session provided to the AP includes:

- Hardware (MAC) address of host for which PMIP session is established.
- IP prefix or address of PMIP mobility session.
- IP port address of tunneled flow or NATed connection.
- DSCP. Diffserv PHB value of PMIP QoS for the mobility session.
- QCI. The WLC provides the 3GPP QCI value if available, for example, from authorization profile of APN (i.e. subscribed values per established PMIP mobility session).
- ARP (Allocation and Retention Priority). This value is obtained from the PMIP QoS for the mobility session. It determines the priority of a flow (1 has highest priority).
- MBR (Maximum Bit Rate) for mobility session uplink and downlink. This should not exceed the AMBR (Aggregate MBR) of the subscription.
- GBR (Guaranteed Bit Rate) for mobility session uplink and downlink, if required.

The WiFi AP uses the above QoS configuration to implement classification, admission control and forwarding of MN flows. The WiFi AP maps DSCP (or QCI) to 802.11e AC (Access Categories) for each IP session / hardware (MAC) address of the host (3GPP user). The mapping from DSCP or QCI to 802.11e AC is shown in table in chapter 4 below.

In the WiFi radio network, the AP uses 802.11e AC values for contention (HCF) based forwarding based on priority. The AP schedules downstream flows in the WiFi radio network and for upstream IP backhaul to the WLC. For contention free scheduling (based on HCCA), the WiFi AP additionally uses the QoS configuration per user to admit flows based on 802.11e ADDTS (ADD TSpec) requests from the host (3GPP user). The WiFi AP may drops packet that fall outside the configured MBR and GBR. In case of severe radio congestion, the WiFi AP can use ARP in addition to DSCP drop precedence to determine the flows to be dropped.

5. Mapping Recommendations and Default Values

The table below outlines a recommended mapping between 3GPP QCI, and 802.11e Access Category (AC) priorities. QCI packet delay budget and packet error loss rate may be used by the WiFi access point in scheduling contention free access when HCCA scheduling is used.

QCI	DSCP	802.11e AC	Example 3GPP service
1	EF	3 AC_VO	conversational voice
2	EF	3 AC_VO	conversational video
3	EF	3 AC_VO	real-time gaming
4	AF41	2 AC_VI	buffered streaming
5	AF31	2 AC_VI	IMS signaling
6	AF31	2 AC_VI	buffered streaming
7	AF21	0 AC_BE	interactive gaming
8	AF11	0 AC_BE	web access
9	BE	1 AC_BK	e-mail

Table 1: QoS Mapping between QCI, WMM, 802.11e AC

6. Next Steps

This document has described a basic model for mapping PMIP QoS parameters to 802.11e parameters. However, there are a few questions that need to be explored further.

The draft that the protocol between WLC and AP is not considered further here. There needs to be some work to determine the protocol parameters and other details if it is desired that WLC and AP should interwork.
Another aspect is this draft does not describe multiple PDN connections per MN in much detail. This is work in progress in 3GPP and the results should be compatible with the model in this draft.
RTC Web flows introduce cases where the same IP flow (5-tuple) can have multiple DSCP values - for example when the IP flow carries audio and video applications. This would impact the QCI and DSCP parameters of IP flows, but this is not only this description that is affected. A
Finally, the QoS values listed in the table in chapter 5 needs to be aligned with [PMIP-QoS] and GSMA.

7. Security Considerations

This document describes mapping of 3GPP QoS profile and parameters to IEEE 802.11e parameters. No security concerns are expected as a result of using this mapping.

8. IANA Considerations

No IANA assignment of parameters are required in this document.

9. References

9.1 Normative References

[KEYWORDS] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC1776] Crocker, S., "The Address is the Message", RFC 1776, April 1 1995.

[TRUTHS] Callon, R., "The Twelve Networking Truths", RFC 1925, April 1 1996.

9.2 Informative References

[EVILBIT] Bellovin, S., "The Security Flag in the IPv4 Header", RFC 3514, April 1 2003.

[RFC5513] Farrel, A., "IANA Considerations for Three Letter Acronyms", RFC 5513, April 1 2009.

[RFC5514] Vyncke, E., "IPv6 over Social Networks", RFC 5514, April 1 2009.

[PMIP-QoS] Liebsch, et al., "Quality of Service Option for Proxy Mobile IPv6", draft-ietf-netext-pmip6-qos-00, June 2012.

[RFC 2211] Wroclawski, J., "Specification of the Controlled Load Quality of Service", RFC 2211, September 1997.

[RFC 2212] Shenker, S., Partridge, C., and R. Guerin, "Specification of Guaranteed Quality of Service", RFC 2212, September 1997.

[RFC 2216] Shenker, S., and J. Wroclawski, "Network Element QoS Control Service Specification Template", RFC 2216, September 1997.

[TS23.107] Quality of Service (QoS) Concept and Architecture, Release 10, 3GPP TS 23.107, V10.2.0 (2011-12).

[TS23.207] End-to-End Quality of Service (QoS) Concept and Architecture, Release 10, 3GPP TS 23.207, V10.0.0 (2011-03).

[TS23.401] General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 11), 3GPP TS 23.401, V11.2.0 (2012-06).

[TS23.203] Policy and Charging Control Architecture, Release 11, 3GPP TS 23.203, V11.2.0 (2011-06).

[TS29.212] Policy and Charging Control over Gx/Sd Reference Point, Release 11, 3GPP TS 29.212, V11.1.0 (2011-06).

[802.11e] IEEE, "IEEE part 11: Wireless LAN Medium Access Control(MAC) and Physical Layer (PHY) specifications. Amendment 8: Medium Access Control (MAC) Quality of Service Enhancements" 802.11e-2005, 22 September 2005.

[GSMA-IR34]Inter-Service Provider Backbone Guidelines 5.0, 22 December 2010

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