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Mapping PMIP Quality of Service in WiFi Network
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Abstract

This document proposes a mapping for PMIP QoS parameters of each mobility session that a WLC configures on a WiFi Access Point. In particular there is a recommendation for consistent mapping between DSCP and QCI to 802.11e parameters. The document also discusses that these QoS parameters can be used by the WiFi Access Point to provide priority based services based on contention in WiFi radio network or reservation based services in contention free cycles in the WiFi radio network.

Table of Contents

1 Introduction

This document provides information on how to map 3GPP QoS profile to 802.11e. When a user with subscription in the 3GPP network attaches to a 3GPP EPC via a WiFi access, the 3GPP network can provides a QoS profile for each mobility session over PMIP (S2a interface) and during authorization over Diameter (STa interface). [PMIP-QoS] proposes a mechanism by which QoS policy parameters in the 3GPP EPC (Enhanced Packet Core) are obtained by the WLC (MAG). [PMIP-QoS] further describes how DSCP obtained via PMIP is mapped to 802.1p and used by WiFi APs to prioritize IP flows to/from a host (UE).

The QoS policy for the user should be applied in the WiFi radio network and to upstream user flows in the IP backhaul network. DSCP or 802.1D mapping can be used in the 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, it is useful to have a consistent mapping of QoS parameters and values between 3GPP and 802.11e. Recommendations to map a 3GPP QCI to DSCP for mobility sessions are available in [PMIP-QoS]. This document adds the explicit configuration of QoS per PMIP mobility session to a WiFi access (radio access).

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
PDN-GW	Packet Data Network Gateway
QCI	QoS Class Indicator
QoS	Quality of Service
Tspec	Traffic Conditioning Spec
UE	3GPP User Equipment
WLC	Wireless Controller

2. QoS Mechanisms

2.1 QoS in 3GPP 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 UE (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].

A 3GPP UE 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 802.11 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. QoS Configuration

3.1 Architecture Context

This section describes the context in which the 3GPP QoS configuration is applied to traffic flows handled by a WiFi Access Point. In this case, a 3GPP user attaches to the WiFi network and accesses services in the 3GPP EPC. The 3GPP EPC provides QoS parameters when the user is authorized (subscribed QoS) and for each connection to EPC as described in [PMIP-QoS]. At this point, the WLC has 3GPP QoS parameters for each user attached to the EPC. Access Points can use DSCP values in downlink IP flows associated with a user to provision 802.11e priority in WiFi network.

In [PMIP-QoS], the Access Point (AP) is not directly provisioned with QoS for a user connection. As a result, the AP is only able to prioritize flows based on observed DSCP values on downlink flows. 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. This solution recommends provisioning the AP with QoS policy associated to a user.

The paragraphs that follow outline the overall architecture and the next sub-chapter provides details on QoS parameters provisioned in the AP.

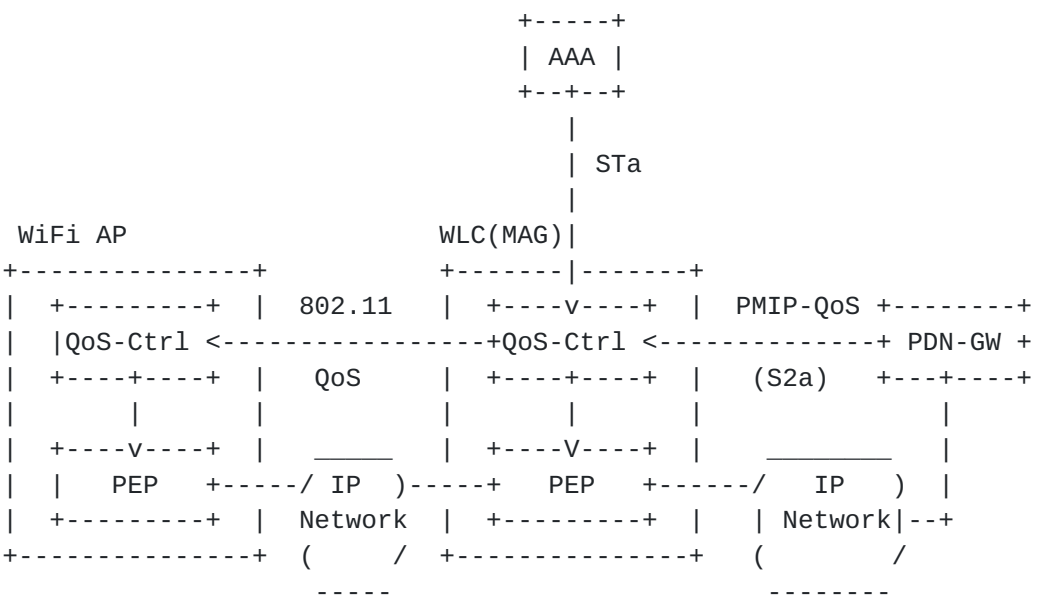

Figure 1: Provisioning 802.11 QoS parameters on WiFi AP

Figure 1 provides a view of the architecture in which the 3GPP QoS is provisioned on the AP. The end user (not shown in figure) attaches to the 3GPP EPC (Enhanced Packet Core) via the WiFi AP and WLC. The two QoS provisioning interfaces shown in the figure are STa for delivering subscriber policy as part of user authorization, and S2a PMIP for each connection to the EPC. QoS-Ctrl (logical entity) in WLC provisions QoS to the WLC PEP as described in [PMIP-QoS]. In addition, 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 on the WiFi radio network. The AP also applies these QoS policies for upstream user IP flows to the WLC.

The WLC takes subscriber policy and policy per connection to EPC network and translates it to equivalent 802.11e and DSCP parameters. It should be noted that 3GPP users may have more than one connection and policy associated with each of them. The WLC should provide the AP with a policy that applies to each user (MAC address in WiFi network) and parameters per IP flow.

3.2 QoS Configuration on WiFi AP

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
- DSCP. Diffserv PHB value of PMIP QoS for the mobility session.
- QCI. The WLC may provide 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 user flows. The WiF 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 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.

4. 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: QoS Mapping between QCI, WMM, 802.11e AC

5. 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.

6. IANA Considerations

No IANA assignment of parameters are required in this document.

7 References

7.1 Normative References

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