IEEE P802.11  
Wireless LANs

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| PDT MAC on L4S | | | | |
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Abstract

This document proposes draft spec text for L4S support in 802.11bn.

It resolves following two CIDs:

* 3949, 707

**Revisions:**

* Rev 0: Initial version of the document.
* Rev 1: Updates based on offline feedback
* Rev 2: Added email addresses of co-authors

CIDs and proposed resolution

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 3949 | Binita Gupta | 37 | 67.05 | L4S architecture is defined by IETF to provide low queuing delays, low packet loss, and finer rate adaptation for latency-sensitive applications such as video collaboration, multiplayer games etc. L4S uses ECN field in the IP header to signal early occurrence of congestion to the sender via the receiver, so that sender can adjust its data rate.  In 802.11 MAC Tx queues at the AP can build up leading to congestion being experienced at the MAC layer. In such a scenario, the L4S ECN marking can be performed to signal congestion to the sender for rate adaptation. An MLME interface can be defined to notify congestion to the upper layer for L4S ECN marking. | Define MLME interface at the AP to notify the upper layer when congestion is experienced in the MAC layer transmit queues. Based on this notification the upper layer can perform ECN marking in the IP header. Also, enhance MA-UNITDATA MAC SAP to provide indication of L4S MSDUs to enable MAC layer to implement DualQ AQM for L4S traffic. | Revised.  Agree in principle. Added L4S related text and MLME primitive changes.  TGbn editor, please make changes tagged with CID #3949. |
| 707 | Jay Yang | 6.3.7 | 25.04 | L4S primitive is missing, please add it. | please add some L4S primitive to support L4S function. | Revised  Agree in principle. Same resolution as for CID #3949. |

***TGbn editor: please add the following new clause (CID #3949)***

**37.x Support for L4S**

**37.x.1 General**

Low Latency, Low Loss, and Scalable Throughout (L4S) architecture is defined in the IETF (RFCs 9330, 9331, 9332) with the purpose of providing low queuing delays, low packet loss, and fine rate adaptation for latency-sensitive flows.

L4S uses the explicit congestion notification (ECN) field in the IP header to signal early and frequently the occurrence of network congestion to the receiver. The receiver relays congestion information back to the sender (e.g. in TCP acknowledgement packets or RTCP report) and the sender adjusts its sending data rate accordingly. This early congestion notification and fine grain rate adaptation by the sender minimizes queuing delay and packet drops due to congestion.

In 802.11, MAC layer transmit queues can build-up when the ingress rate exceeds the egress rate and as well when media access delays occur because of high level of channel contention. When congestion is experienced at the MAC layer due to transmit queue build up, the L4S ECN marking can be supported to signal the congestion back to the sender to trigger sender adapting its data rate. An MLME interface is defined on the transmit side to notify the upper layer when congestion is experienced in the MAC layer transmit queues. Based on this notification the upper layer can perform ECN marking in the IP header.

**37.x.2 L4S AP operation**

An AP that has dot11L4SActivated equal to true is called an L4S AP.

An L4S AP shall be capable of identifying L4S MSDUs received from the MAC SAP based on the L4S field in the MA-UNITDATA.request primitive (see 5.2.4.2 MA-UNITDATA.request). The L4S field is used in addition to the priority and/or SCSID fields of the MA-UNITDATA.request for handling of the corresponding MSDU.

An L4S AP should support buffering of L4S MSDUs in shallow queue(s) as per recommendation in IETF RFC 9330, RFC 9331 and RFC 9332. The specific implementation of queuing for L4S MSDUs is beyond the scope of this standard.

The L4S AP shall initiate the MLME-L4S-CONGESTION-EXPERIENCED.Indication primitive (see 6.5.xx.2 (MLME-L4S-CONGESTION-EXPERIENCED.Indication)) to signal to its upper layer that the congestion is experienced at the MAC layer for L4S traffic by setting the congestion experienced parameter to true. Upon receiving the MLME-L4S-CONGESTION-EXPERIENCED.Indication primitive, the upper layer performs ECN marking in the IP header of subsequent packets to signal congestion experienced. If the MAC layer congestion for L4S traffic is no longer experienced, then the L4S AP shall initiate another MLME-L4S-CONGESTION-EXPERIENCED.Indication primitive (see 6.5.xx.2 (MLME-L4S-CONGESTION-EXPERIENCED.Indication)) to signal to the upper layer that L4S congestion has cleared by setting the congestion experienced parameter to false.

NOTE — The conditions and criteria based on which the MAC layer determines to signal the notification for L4S congestion experienced and clearing of L4S congestion to the upper layer is implementation specific and is outside the scope of this specification. Section 5 of RFC 9331 provides general requirements for a network node to support L4S and can be adapted for implementation in the MAC.

﻿**5.2.4 MA-UNITDATA.request**

***TGbn editor: please make following changes in this clause (CID #3949)***

5.2.4.1 Function

﻿5.2.4.2 Semantics of the service primitive

The parameters of the primitive are as follows:

MA-UNITDATA.request(

source address,

destination address,

routing information,

data,

priority,

drop eligible,

service class,

station vector,

MSDU format,

radio environment request vector,

SCSID,

L4S

)

A table with numbers and words

Description automatically generated

Figure x ECN field definition ([RFC 9331])

The L4S parameter is a Boolean that indicates whether the corresponding MSDU is an L4S MSDU, for processing by an L4S AP. If the MSDU has the ECN bits set to 01 or 11 in the IP header (see Figure x ECN field definition ([RFC 9331])) contained within the MSDU then the L4S parameter is set to true, otherwise this parameter is set to false. The L4S field is present if dot11L4SActivated is true; and is not present otherwise

**6.5 MLME SAP primitives**

***TGbn editor: please add following new MLME primitive in this clause (CID #3949)***

**6.5.xx L4S explicit congestion notification**

6.5.xx.1 Introduction

This mechanism supports the notification of congestion experienced at the MAC layer for L4S MSDUs to the higher layer for marking of ECN bits at the IP layer for L4S congestion experienced (CE) signalling.

6.5.xx.2 MLME-L4S-CONGESTION-EXPERIENCED.Indication

﻿6.5.xx.2.1 Function

This primitive provides an indication that the congestion is experienced at the MAC layer for L4S MSDUs.

6.5.xx.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-L4S-CONGESTION-EXPERIENCED.Indication(

source address,

destination address,

priority,

SCSID,

congestion experienced,

MSDU congestion marking probability,

congestion information,

)

﻿The source address (SA) parameter is an individual MAC address and is set to the SA field of an L4S MSDU that experienced congestion at the MAC layer.

The destination address (DA) parameter is an individual MAC address and is set to the DA field of an L4S MSDU that experienced congestion at the MAC layer.

﻿The priority parameter specifies the priority corresponding to an L4S MSDU that experienced congestion at the MAC layer. ﻿The allowed values of priority are described in 5.1.1.3 (Interpretation of priority parameter in MAC service primitives).

﻿The SCSID parameter is an integer that identifies the SCS stream (if any) to which the L4S MSDU that experienced congestion belongs. If the L4S MSDU experiencing congestion does not belong to an SCS stream, then SCSID is set to 0. This parameter is present if dot11SCSActivated is true; and is not present otherwise.

The congestion experienced parameter is a Boolean that is set to true to indicate that the congestion is experienced at the MAC layer for L4S MSDU(s) belonging to the specified priority or SCSID (if present and set to nonzero value). If the MAC layer congestion for L4S MSDU(s) is no longer experienced, then this parameter is set to false.

The MSDU congestion marking probability is a non-negative real number that provides the likelihood with which the upper layer should ECN congestion experienced (CE) mark subsequent downlink L4S MSDUs belonging to the specified priority and/or SCSID. This parameter is present if the congestion experienced parameter is set to true; and is not present otherwise. The computation of MSDU congestion marking probability is implementation dependent.

The congestion information parameter is an octet string that provides a container for further information related to congestion experienced at the MAC layer. This parameter is present if the congestion experienced parameter is set to true; and is not present otherwise.

6.5.xx.2.3 ﻿When generated

This primitive is generated by the MAC layer when congestion is experienced at the MAC layer for L4S MSDUs and the dot11L4SActivated is true.

6.5.32.2.4 Effect of receipt

The primitive triggers the upper layer to perform ECN congestion experienced (CE) marking of subsequent L4S MSDUs belonging to the specified priority and/or SCSID to signal that L4S congestion is experienced at the AP (by setting ECN=11).

**Annex C**

**C.3 MIB Detail**

***TGbn editor: Please add the following new MIB variable for L4S***

Dot11UHRStationConfigEntry ::=

SEQUENCE {

dot11CoRTWTOptionImplemented TruthValue,

dot11NPCAOptionImplemented TruthValue,

dot11DUOOptionImplemented TruthValue,

dot11UHRBSROptionImplemented TruthValue,

dot11DBEOptionActivated TruthValue,

dot11L4SActivated TruthValue

}

dot11L4SActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a control variable.

﻿It is written by an external management entity or the SME. Changes take

effect as soon as practical in the implementation.

This attribute, when true, indicates that the station supports L4S related capability. If this attribute is false, it indicates that the station does not support L4S related capability.”

::= { dot11UHRStationConfigEntry <ana> }