

**IEEE P802.11
Wireless LANs**

Timing Measurement Enhancement for Synchronization of AV streams

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Author(s):

Name	Company	Address	Phone	email
Kevin Stanton	Intel Corporation	JF2-53 2111 NE Elam Young Pkwy Hillsboro OR 97124	(503) 712-1888	kevin.b.stanton@ieee.org
Emily Qi	Intel Corporation	2111 NE 25th Hillsboro OR 97124	503-264-7799	Emily.h.qi@intel.com

Abstract

AV media streaming requires accurate time synchronization when multiple networked devices render coupled streams (e.g. networked speakers) or when the media originates from a real-time source (e.g. source is from DVD player, tuner, or is multicast). Such streaming requires that an accurate, common representation of time is distributed among the relevant STAs.

Today, existing 802.11v Presence Request/Response primitives cause timestamp difference measurements to be made when certain frames are received or transmitted. This document describes enhancements to Presence Request/Response which make the timestamp capability usable for distributing the network clock between STAs and even non-WLAN stations (via p802.1AS).

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Background:

Synchronized and real-time media streaming applications require that link delays and clock offset be measured in such a way that time and frequency synchronization can be realized across LANs that include WLAN segments. Example applications include wireless speakers, media “push-mode” and real-time/live performance streams.

It is intended that this submission add sufficient p802.11v capabilities to allow the synchronization of time and frequency across multiple 802 LANs by the application of p802.1AS, which is based on IEEE1588 Version 2.

While the current Presence Request/Response methods measure link delay, this submission proposes several additions which make the protocol suitable for measuring both the link delay and the clock offset between communicating STAs, primarily through the return of both timestamps captured by the responder rather than the difference between the timestamps.

Modify Clause 7.3.2.40.1 as indicated below:**7.3.2.40.1 Presence Indication Parameters field**

The Presence Indication Parameters field contains STA presence reporting characteristics. The format of the Presence Indication Parameters field is shown in Figure v1.

Element ID (1)	Length (75)	<u>Report Interval Units</u>	Normal Report Interval	Normal number of frames per channel	In-Motion Report Interval	In-Motion number of frames per channel	Inter-frame Interval
1	1	1	2	1	2	1	1

Octets: 1 1 1 2 1 2 1 1

Figure v1—Presence Reporting Parameters

The Report Interval Units field contains the units used for the Normal Report Interval field and In-Motion Report Interval field, as indicated in Table v-1.

Table v-1—Report Interval Units Field

<u>Report Interval Units</u>	<u>Description</u>
<u>0</u>	<u>Seconds</u>
<u>1</u>	<u>Microseconds</u>
<u>2</u>	<u>Minutes</u>
<u>3</u>	<u>Hours</u>
<u>4 - 255</u>	<u>Reserved</u>

The Normal Report Interval is the time interval, expressed in the units indicated in the Report Interval Units field seconds at which the STA reports or is expected to report its presence when the STA is stationary.

The Normal Number of Frames per Channel is the number of Presence Request frames per channel sent or expected to be sent by the STA at each Stationary Report Interval.

The In-Motion Report Interval is the time interval, expressed in the units indicated in the Report Interval Units field ~~seconds~~ at which the STA reports or is expected to report its presence when the STA is in motion. If motion detection is not supported, this field is set to 0. The definition of motion and the means to determine motion are outside the scope of this standard.

The In-Motion Number of Frames per Channel is the number of Presence Report frames per channel sent or expected to be sent by the STA at each In-Motion Report Interval. If motion detection is not supported, this field is set to 0.

The Inter-frame Interval is the time interval, expressed in milliseconds between the transmissions of each of the Stationary or In-Motion frames per channel.

7.3.2.40.3 Presence Request Options Field

Add a new row to table v32 as indicated below:

Table v32—Presence Request Option Bit description

Bit	Included Field
3	Timing Offset Measurement
4-15	Reserved

Modify Clause 7.3.2.40.7 as indicated below:

7.3.2.40.7 Timing Measurements field

The Timing Measurements field contains timing information. The format of the Timing Measurements field is shown in Figure v2.

Element ID (7)	Length (6 or 18)	Timestamp Difference	Timestamp Difference Units	Timestamp Difference Accuracy	<u>Ingress Timestamp (optional)</u>
Octets: 1	1	4	1	1	<u>12</u>

Figure v2—Timing Measurements Field

The Timestamp Difference field contains the time difference between the time that a unicast Presence Request frame was received from a STA, defined to occur at the PHY-RXEND.indication of the received Presence Request frame, and the time that the corresponding ACK frame was sent to the STA, defined to occur at the PHY-TXSTART.confirm of the ACK frame transmission.

The Timestamp Difference Units field contains the units for the timestamp difference field, as indicated in Table V35.

Table v35—Timestamp Difference Units

Timing Difference Units	Description
0	Microseconds
1	Hundreds of Nanoseconds
2	Tens of Nanoseconds
3	Nanoseconds
4	Tenths of Nanoseconds
5 - 255	Reserved

The Timestamp Difference Accuracy field contains the expected standard deviation of the timestamp difference of the timestamp in the units indicated in the Timestamp Difference Units field.

The Ingress Timestamp field contains the time at which the unicast Presence Request frame was received by a STA, defined to occur at the PHY-RXEND indication of the received Presence Request frame. The Ingress Timestamp field is composed of the time fields defined in Table v-2. The Ingress Timestamp field is present when the Options field in the Presence Request Option element is set to the value of Timing Offset Measurement, as defined in 7.3.2.40.3.

Table v-2—Ingress Timestamp Field

<u>Octets</u>	<u>Type</u>	<u>Description</u>
6	<u>Unsigned Integer</u>	<u>Seconds</u>
4	<u>Unsigned Integer</u>	<u>Nanoseconds (always less than 1e9)</u>
2	<u>Integer</u>	<u>Timescale Offset (used to compute UTC (Coordinated Universal Time) from TAI (International Atomic Time)—these differ by the number of leap seconds applied to UTC since 1972)</u>

Insert the following text as Clause 11.15.4.5

11.15.4.5 Timing Offset Measurement Procedure

The Timing Offset Measurement is used to synchronize the time and/or the frequency of clocks as needed by Audio/Video and other applications.

A STA may request a Timing Offset Measurement from a peer STA that supports Timing Offset Measurement. To request a Timing Offset Measurement, the STA shall send a Presence Request frame with a Presence Parameters information element that includes the Presence Request Option to indicate that a Timing Offset Measurement is required.

A STA that supports Timing Offset Measurement and receives Timing Offset Measurement request shall respond with Presence Response frames that include a Time Measurement and a Presence Status element indicating the result of the request. If the responding STA is not able to provide Timing Offset Measurement, the STA shall send a response with a Presence Status element that indicates Incapable.

