IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CIDs 1424, 1671, 1418 Regarding Fine Timing Measurement | | | | |
| Date: 2013-09-17 | | | | |
| Author(s): | | | | |
| Name | Company | Address | Phone | Email |
| Naveen Kakani | CSR |  |  | Naveen.kakani@csr.com |
| Jon Rosdahl | CSR Technologies Inc. | 10871 N 5750 W  Highland, UT 84003 | +1-801-492-4023 | jrosdahl@ieee.org |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Abstract

Proposed resolutions for CIDs 1424, 1671, 1418 regarding Fine Timing Measurement

The changes marked in this document are based on **802.11mc Draft 1.0 Specification.**

**Revision Notes:**

**Rev0 :** Initial resolution proposal

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 1424 | 605.00 | 10.24.6 | Allow the use of FTM to be able to support Receive Only and RSSI based mechanisms for Location Determination | Please see changes in doc 11-13/0072r1.  https://mentor.ieee.org/802.11/dcn/13/11-13-0072-01-000m-client-positioning-using-timing-measurements-between-access-points.pptx |
| 1418 | 1247 | 10.24.6 | The Fine time measurement added to IEEE 802.11mc does not scale for large number of users. The procedure described in the specification is of order N\_APxN\_STA. As the number of stations increases the overhead of FTM also increases. This is described in submission IEEE 802.11-13/0072r1. | Please consider addition of informative text as described in IEEE 802.11-13/0072r1 which leads to an order N\_AP mechanism. This mechanism does not scale with the number of users. |
| 1671 | 1247 | 10.24.6 | The fine time measurement added to IEEE 802.11mc may cause an undesirable large overhead when many users want to use it for round-trip-time measurement as part of a trilateration scheme to determine their position. This is described in submission IEEE 802.11-13/0072r1. | Please consider adding informative text as described in IEEE 802.11-13/0072r1 |

***Proposed resolution for CIDs 1418, 1424 and 1671:*** *Agree in Principle make the changes as shown in doc: IEEE 802.11-13/xxxxrx.*

***Motivation*** *:*

The Fine Timing measurement as proposed in 802.11mc Draft 1.0 can be used by non-AP STAs in a way to determine its differential distance with the two STAs that are involved in the Fine Timing Measurement message exchange. This allows for the system to provide a scalable solution for location determination using Fine Timing Measurement message exchange. The added informational text to be added to the informative annex explains the calculations that are necessary for a STA to compute its differential distance with the STAs that are involved in Fine Timing Measurement exchange.

***Instruction to Editor: Please make the following changes:***

Add the following text at the end of Annex T:

# T.3 Differential Distance Computation using Fine Timing Measurement

In Figure aa.bb, the Observing STA is able to listen to the Fine Timing Measurement frame exchange between the Sending and Receiving STAs. The Time of Flight of a line of sight transmission between the Sending and Receiving STAs is denoted as “T”. At the Observing STA, the Time of Arrival (ToA) of Message M and its Ack frame are respectively t\_c1 and t\_c2. At the Sending STA, the Time of Departure (ToD) of Message M and the ToA of its Ack are t1 and t4 respectively.

The differential distance between the Observing STA and each of the Sending and Receiving STAs, denoted as D\_send\_rcv, is defined as:

D\_send\_rcv = c\*[ToF between Sending STA and Observing STA – ToF between Receiving STA and Observing STA]

where “c” is speed of the light.

D\_send\_rcv can now be computed as: D\_send\_rcv = c\*[t\_c1 – t\_c2 - T – (t1 – t4)]

A Observing STA can use the ToA and the time stamps (t1 and t4) received in the following messages in the message exchange to refine its differential distance computation to the Sending and Receiving STAs.

In Figure aa.bb, the Receiving and Sending STAs can be AP STAs. The AP STAs can learn about their neighboring APs that support Fine Timing Measurement protocol and an AP STA can initiate Fine Timing Measurement message exchange on a periodic basis (e.g. the Beacon Interval or a multiple of the Beacon Interval) with its neighbor APs. Monitoring and receiving these messages can enable Observing STAs to estimate their differential distance with the AP pairs. A Observing STA that is able to determine its differential distance to at least three pairs of Sending and Receiving STAs can determine its location by the principle of Hyperbolic Navigation. Potentially a Observing STA can determine its location by monitoring the Fine Timing Measurement exchanges of a single AP (Sending STA) if there are three or more neighbor APs of the Sending STA that support Fine Timing Measurement.



**Observing STA**

**t\_c2 = ToA(ACK)**

**t\_c1 = ToA(M)**

Figure aa.bb Parameters recorded by Observing STA when monitoring FTM message exchange