IEEE P802.11
Wireless LANs

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| Proposed spec text for NGV ranging  |
| Date: 2021-03-11 |
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Abstract

This submission contains resolution for the following 4 CIDs:

* 1072, 1166, 1248, and 1071

As part of the resolution, it proposed spec text for ranging in NGV following the discussions in DCN 11-20/1761r2

Specifically:

* IEEE 802.11bd enables NTB ranging as defined in 802.11az for NGV STAs as an optional feature.
* IEEE 802.11bd enables 802.11az ranging in regular Wi-Fi bands for vehicular use cases using multi-channel operation such as IEEE 1609.4.
* IEEE 802.11bd enables differential distance computation.

Revision History:

* Rev 0: Initial version of the document

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Page.line** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| 1072 | 41.65 | 32.1.1 | Given the limited BW available in 5.9 GHz band for ranging, enable V2X ranging in regular Wi-Fi bands. | Define a multi-channel mechanism that enables ranging in non-5.9 GHz Wi-Fi bands. The commenter plans to submit a contribution for review by the group. | RevisedThe specification of raning in 11bd is completed by the text proposals in this contribution and DCN xx.Editor: implement the changes in https://mentor.ieee.org/802.11/dcn/21/11-21-0317-00-00bd-LB251-ranging-comments-resolutions.docx and https://mentor.ieee.org/802.11/dcn/21/11-21-0321-02-00bd-proposed-spec-text-for-ngv-ranging-ndp.docx |
| 1166 | 41.65 | 32.1.1 | The PAR states that "this amendment defines procedures for at least one form of positioning in conjunction with V2X communications" but there is only one line in the document that mentions ranging and no definition of procedures for positioning. | Add text to describe how 802.11bd supports "at least one form of positioning" | RevisedThe specification of raning in 11bd is completed by the text proposals in this contribution and DCN xx.Editor: implement the changes in https://mentor.ieee.org/802.11/dcn/21/11-21-0317-00-00bd-LB251-ranging-comments-resolutions.docx and https://mentor.ieee.org/802.11/dcn/21/11-21-0321-02-00bd-proposed-spec-text-for-ngv-ranging-ndp.docx |
| 1248 | 41.65 | 32.1.1 | Ranging in 10 and 20 MHz is identified as possible feature,however the functionality is not present in the document nor is the definitionof how ranging performed using the NGV PHY. | Develop or remove the feature. | RevisedThe specification of raning in 11bd is completed by the text proposals in this contribution and DCN xx.Editor: implement the changes in https://mentor.ieee.org/802.11/dcn/21/11-21-0317-00-00bd-LB251-ranging-comments-resolutions.docx and https://mentor.ieee.org/802.11/dcn/21/11-21-0321-02-00bd-proposed-spec-text-for-ngv-ranging-ndp.docx |
| 1071 | 41.65 | 32.1.1 | the details of RTT based ranging mechanism is not defined. the commenter plans to submit a contribution. | Add definition of specific RTT based ranging. (Commenter plans to submit a contribution) | RevisedThe specification of raning in 11bd is completed by the text proposals in this contribution and DCN xx.Editor: implement the changes in https://mentor.ieee.org/802.11/dcn/21/11-21-0317-00-00bd-LB251-ranging-comments-resolutions.docx and https://mentor.ieee.org/802.11/dcn/21/11-21-0321-02-00bd-proposed-spec-text-for-ngv-ranging-ndp.docx |

***---Editor please implement the following changes for resolution of CIDs 1072, 1166, 1248, and 1071---***

***Insert a new subclause at the end of clause 31:***

# 31.x Next Generation V2X (NGV) Ranging

# 31.x.1 Introduction

An NGV STA optionally supports NGV Ranging. NGV ranging consists of a subset of Fine timing measurement (FTM) functionalities as defined in 11.21.6; the supported functionalites are as follows:

* Fine Timing Measurement procedure negotiation for non-TB ranging as defined in 11.21.6.3 (Fine Timing Measurement procedure negotiation) with the modifications specified in this subclause.
* Non-TB Ranging as described in 11.21.6.4.4 (Non-TB Ranging measurement exchange) with the modifications specified in this subclause. PHY security is not specified for NGV STAs.
* NGV STAs may support differential distance computation as detailed in Annex P.3.

Additionally, an NGV STA may optionally support Fine Timing Measurement procedure outside the 5.9 GHz frequency band. An NGV STA that supports Fine Timing Measurement procedure outside the 5.9 GHz frequency band may optionally support PASN as defined in 12.12 (Pre Association Security Negotiation) with the modifications specified in this subclause.

The capability discovery for whether an NGV STA supports ranging as specified in this subclause is out of the scope of the 802.11 standard and is expected to be conducted by the higher layers. The higher layer negotiations are expected to identify the following:

* Whether an NGV STA supports Non-TB Ranging in 5.9 GHz band
* Whether an NGV STA supports ranging on 802.11 bands outside the 5.9 GHz band and if so which of the following: DMG positioning, Non-TB, and/or EDCA.
* For an NGV STA that supports ranging on 802.11 bands outside the 5.9 GHz band, whether PASN is supported, and if so, the contents of PASN Parameters element
* The channel number where ranging exchanges between peer STAs occur:

Note-- the channel number is not limited to 5.9 GHz band

* Role of STA: ISTA or RSTA
* LMR Feedback policy

The Fine Timing Measurement procedure negotiation is performed by NGV STAs as specified in 11.21.6.3 (Fine Timing Measurement procedure negotiation) with the following differences:

* For ranging in 5.9 GHz band, in the Ranging Parameters element included in the IFTMR frame:
	+ Status indication field and value field is reserved
	+ Secure LTF Req, Secure LTF Support is set to 0
	+ Device Class field is reserved
	+ Full BW UL MU-MIMO field is reserved
	+ Max R2I STS > 80 MHz field is reserved
	+ Max I2R STS > 80 MHz field is reserved

For ranging in 5.9 GHz band, non-TB ranging measurement exchange is used by NGV STAs as defined in 11.21.6.4.4 (Non-TB Ranging measurement exchange) with the following changes:

* Instead of HE Ranging NDP an NGV Ranging NDP is transmitted
* Instead of Ranging NDP Announcement frame an NGV Ranging NDP Announcement frame is transmitted.

For ranging on 802.11 bands outside the 5.9 GHz band, whether PASN is required is indicated by the higher layers. Two NGV STAs may establish PASN authentication if so indicated by the higher layer using the procedures as defined in 12.12 (Pre Association Security Negotiation) with the following change: the exchanges between STA and AP are done by two NGV STAs communicating OCB.

**3.2 STA Definitions specific to IEEE Std 802.11**

***Make the following change in the defition of OCB:***

**outside the context of a basic service set (BSS) (OCB):** A mode of operation in which a station
(STA) is not a member of a BSS and does not utilize IEEE 802.11 authentication except for optionally pre-association security negotiation (PASN) auhentication, association, or data confidentiality services.

**4.3.17 STA Transmission of Data frames outside the context of a BSS**

***Make the following changes in the 3rd paragraph:***

When dot11OCBActivated is true, a Data frame can be sent to either an individual or a group destination
MAC address. This type of communication is possible only between STAs that are able to communicate
directly over the wireless medium. It allows immediate communication, avoiding the latency associated with
establishing a BSS. When dot11OCBActivated is true, a STA is not a member of a BSS and it does not
utilize the IEEE 802.11 authentication, association, or data confidentiality services, except for PASN authentication which may be utilized by NGV STAs. This capability is
particularly well suited for use in rapidly varying communication environments such as those involving
mobile STAs in which the interval over which the communication exchanges take place is of very short
duration (e.g., on the order of tens or hundreds of milliseconds). Since IEEE 802.11 MAC sublayer
authentication services are not used when dot11OCBActivated is true except for PASN autenthication which may be utilized by NGV STAs, any required authentication services
are provided by the station management entity (SME) or by applications outside of the MAC sublayer, such
as those described in the IEEE 1609 [B17] family of standards.

**4.4.2 SS**

***Make the following changes:***

The SS is as follows:
a) Authentication (not used when dot11OCBActivated is true unless dot11PASNActivated is true)
b) Deauthentication (not used when dot11OCBActivated is true unless dot11PASNActivated is true)
c) Data confidentiality (not used when dot11OCBActivated is true unless dot11PASNActivated is true)

**4.5.4.2 Authentication**

***Make the following changes:***

PASN authentication is used in an RSN for an infrastructure BSS or between two NGV STAs communicating OCB when it is based on a PMKSA established by another RSN authentication protocol. Otherwise, it does not guarantee mutual authentication, and can be used as a non-RSN protocol in an infrastructure BSS or between two NGV STAs communicating OCB.

**11.3 STA authentication and association**

**11.3.1 State variables**

***Make the following changes:***

A STA for which dot11OCBActivated is true does not use MAC sublayer authentication, except for optionally pre-association security negotiation (PASN) authentication, or association and
does not keep this state variable unless dot11PASNActivated is true.

-- State 1a: Authenticated via PASN Authentication. Association is not possible from

this state without non-PASN IEEE 802.11 Authentication. This state is used by STAs that wish to
perform secure ranging but do not wish to exchange MSDUs or NGV STAs that wish to perfrom secure ranging.

**11.18 STAs communicating Data frames outside the context of a BSS**

***Make the following changes:***

When dot11OCBActivated is true in a STA:
a) Synchronization, ~~authentication,~~ association, and frame classes as defined in 11.1 (Synchronization)
~~and 11.3 (STA authentication and association)~~ are not used. Authentication, frame classes as defined in 11.3 (STA authentication and association) are not used unless dot11PASNActiviated is true in which case PASN authentication and related frame classes as defined in 11.3 (STA authentication and association) are used. Data confidentiality as defined in Clause 12 (Security) is not used. The STA may send Action frames and, if the STA maintains a TSF
Timer, Timing Advertisement frames. The STA may send Action frames and, if the STA maintains a TSF Timer, Timing Advertisement frames.
b) The STA may send Control frames, except those of subtype PS-Poll and CF-End.
c) The STA may send Data frames of subtype Data, Null, QoS Data, and QoS Null.
d) The STA shall set the BSSID field in all Management and Data frames to the wildcard BSSID value.

**9.4.2.298 Ranging Parameters element**

***Make the following changes:***

**Table 9-322h23fb—Format and Bandwidth subfield (#2247)**

|  |  |  |
| --- | --- | --- |
| Field value  | Format  | Bandwidth |
| 0  | HE  | 20 |
| 1  | HE  | 40 |
| 2  | HE  | 80 |
| 3  | HE  | 80+80 |
| 4  | HE (two separate RF Los)  | 160 |
| 5  | HE (single RF LO)  | 160 |
| 6 | NGV | 10 |
| 7 | NGV | 20 |
| ~~6~~8-63  | Reserved  | Reserved |

**10.23.2.8 Multiple frame transmission in an EDCA TXOP**

***Insert the new paragraph after the following paragraph:***

— One of the following:

— a VHT NDP Announcement frame followed after SIFS by a VHT NDP followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames, or

— a Beamforming Report Poll frame followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames or

— a Ranging NDP Announcement frame followed after SIFS by an HE NDP followed after SIFS by an HE NDP followed after SIFS by an LMR frame or

— an NGV Ranging NDP Announcement frame followed after SIFS by an NGV NDP followed after SIFS by another NGV NDP followed after SIFS by an LMR frame or

-- an NGV Ranging NDP Announcement frame followed after SIFS by an NGV NDP followed after SIFS by another NGV NDP followed after SIFS by an LMR frame followed after SIFS by another LMR frame.

**11.21.6.2 FTM capabilities**

***Make the following changes:***

A STA which is not an NGV STA and in which dot11NonTriggerBasedRangingRespImplemented is true shall set the non-TB ranging Responder field of the Extended Capabilities element to 1.

….

A STA which is not an NGV STA and in which either dot11NonTriggerBasedRangingRespImplemented is true or dot11TriggerBasedRangingRespImplemented is true shall set the I2R LMR Feedback Policy field of the Extended Capabilities element to 1 if dot11I2RLMRFeedbackPolicy is true. The STA shall set the I2R LMR Feedback Policy field of the Extended Capabilities element to 0 if dot11ISTA2RSTALMRFeedbackPolicy is false

**11.21.6.3 Fine Timing Measurement procedure negotiation**

**11.21.6.3.3 Negotiation for TB and non-TB Ranging measurement exchange**

If the I2R LMR Feedback subfield in the IFTMR frame is set to 0, and the I2R LMR Feedback Policy field in the Extended Capabilities element is set to 1 by the RSTA or ortherwise indicated by higher layer, then the RSTA shall not reject the request because the I2R LMR Feedback subfield in the Ranging Parameters field was set to 0, and shall set the I2R LMR Feedback in the Initial Fine Timing Measurement frame to 0.

If the I2R LMR Feedback subfield in the IFTMR frame is set to 0, and the I2R LMR Feedback Policy field in the Extended Capabilities element is set to 0 by the RSTA or otherwise indicated by higher layer,….

…

An RSTA which is not an NGV STA and in which dot11PhaseShiftFeedbackImplemented is true shall set the Phase Shift Feedback Support field in the Extended Capabilities element to 1 to indicate RSTA’s capability. If an RSTA has set the Phase Shift Feedback Support field to 1 in the Extended Capabilities element, then to request the phase shift feedback mode for the R2I LMR, an ISTA shall set the R2I TOA
Type subfield in the Ranging Parameter field in an IFTMR frame to 1.

11.21.6.4.6 Transmission of a ranging NDP

***Add the following new paragraphs at the end of the subclause***

An RSTA transmitting an NGV Ranging NDP to an ISTA shall set the TXVECTOR
parameter as follows:
 — The FORMAT parameter is set to NGV

— The CH\_BANDWIDTH parameter is set to the same value as the RXVECTOR parameter CH\_BANDWIDTH in the preceding I2R NDP frame

— The NGV\_LTF\_TYPE parameter is set to 1 to indicate NG\_LTF\_2X is used in the NGV Ranging NDP.

— The NUM\_SS parameter is set to the same value as the R2I NUM\_STS in the STA Info field in the preceding Ranging NDP Announcement frame

— The APEP\_LENGTH parameter is set to 0

— The PSDU\_LENGTH parameter is set to 0

— The LTF\_REP parameter is set to the same value as the R2I LTF\_Rep in the STA Info field in the preceding Ranging NDP Announcement frame

An ISTA transmitting an NGV Ranging NDP to an RSTA shall set the TXVECTOR
parameter as follows:
— The FORMAT parameter is set to NGV— The CH\_BANDWIDTH parameter is set to the samevalue as the TXVECTOR parameter CH\_BANDWIDTH in the preceding Ranging NDP Announcement frame

— The NGV\_LTF\_TYPE parameter is set to 1 to inidicate NG\_LTF\_2X is used in the NGV Ranging NDP.

— The NUM\_SS parameter is set to the same value as the I2R NUM\_STS in the STA Info field in the preceding Ranging NDP Announcement frame

— The APEP\_LENGTH parameter is set to 0

— The PSDU\_LENGTH parameter is set to 0

— The LTF\_REP parameter is set to the same value as the I2R LTF\_Rep in the STA Info field in the preceding Ranging NDP Announcement frame

**12.12 Pre Association Security Negotiation
12.12.1 General**

***Make the following changes:***

It is primarily intended for use in Infrastructure networks for a STA and an AP or two NGV STAs communicating OCB to establish a PTKSA using a three message authentication frame exchange. Some salient aspects of this protocol are:

12.12.3 Key establishment with PASN authentication12.12.3.1 Overview

***Make the following change in the first paragraph:***

This subclause defines the procedure for establishing a PTKSA and the corresponding shared keys
between a PASN capable STA and AP or two PASN capable NGV STAs. The PASN frame sequence used is depicted in Figure 12-
55a 1 (PASN Authentication). It consists of three Authentication frames with Subclause 9.4.1.1
(Authentication Algorithm Number field) set to 7 (PASN Authentication) and the corresponding
1Authentication Transaction Sequence Number field (9.4.1.2) set to 1, 2, and 3 respectively

*Ad****d the following note to******Figure 12-55a—PASN authentication:***

Note—Beacon is only present when the authenticator is an AP and not otherwise, for example it is not present when authenticator is an NGV STA

12.12.3.2 PASN Frame Construction and Processing ***Make the following changes:***

If non-AP STA chooses to initiate PASN authentication, it first selects the following authentication parameters

— Base AKM from among AKMs advertised by the AP or provisioned by the higher layer (applicable for NGV STAs communicating OCB) if RSNA authentication is desired. Otherwise, if dot11NoAuthPASNActivated is true, Base AKM chosen is the PASN AKM, indicating that PTKSA is to be established without mutual authentication i.e. without a corresponding PMKSA.

**P.3 Differential Distance Computation using Fine Timing Measurement
frames**

***Add the equation number to the following two equations:***

*DSR* = *c T* × (*TSO-TRO*) (P-1)

*DSR* = *c* × (*tc1-tc2-T-(t1-t4)*) (P-2)

***Add the following new paragraphs at the end of the subclause:***

In Figure P-2 (Parameters recorded by PSTA when monitoring Non-TB Ranging measurement exchange) the observing or passive STA (PSTA) that supports NGV Non-TB ranging is able to listen to the NGV Non-TB ranging measurement exchange between ISTA and RSTA. The time of flight of a line of sight transmission between the ISTA and RSTA is denoted as T. At the PSTA, the TOAs of the I2R NDP frame and the R2I NDP frame are respectively tc1 and tc2. At the ISTA, the TOD of the I2R NDP frame and the TOA of the R2I NDP frame are t1 and t4 respectively. *DSR* can now be computed according to Equation (P-2). The PSTA might obtain t1 and t4 by receiving the I2R LMR frame or by higher layer information exchange.



**Figure P-2****—Parameters recorded by PSTA when monitoring Non-TB Ranging measurement exchange**