Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Proposed AWD Text on the Ranging Structures for Non-synchronized AMSs**
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Re:	IEEE 80216m-09/0020, "Call for Contributions on Project 802.16m Amendment Working Document (AWD) Content" "Comments on AWD 15.3.9 UL-CTRL"
Abstract	This contribution proposes the text of ranging channel section to be included in the IEEE 802.16m AWD.
Purpose	To be discussed and adopted by TGm for the IEEE 802.16m AWD
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Proposed AWD Text on the Ranging Structures for Non-synchronized AMSs

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1. Introduction

This contribution proposes the text of ranging channel section to be included in IEEE 802.16m AWD [1]. The proposed text is developed in order to be readily combined with IEEE P802.16 Rev2/D9a [2]. It is also based on the proposed text in [5-6] as compliant to the 802.16m SRD [3] and the 802.16m SDD [4]. The details of the simulation results with associated analysis for ranging structures are addressed in [7].

2. Proposed Ranging Channel Formats

Based on the [5-7], the proposed ranging channel formats with supportable coverage are shown in Table 1.

Table 1. Ranging channel formats supporting up to 100 km cell radius

Format No.	Format	T_{RP}	Δf_{RP}	Duplex mode (2)	Within subframe for data CP=1/8·T_b		Within type-1 subframe for data CP=1/16·T_b		Within type-2 subframe for data CP=1/16·T_b	
					T_{RCP}	$C_{\max}$	T_{RCP}	$C_{\max}$	T_{RCP}	$C_{\max}$
0	RCP+RP+RCP+RP	228.5714 μs ($4096\times T_{st}$)	Δf/2.5	FDD	57.1429 μs ($1280\times T_{st}$)(1)	6.852 km	43.8393 μs ($982\times T_{st}$)	5.708 km	76.2054 μs ($1707\times T_{st}$)	10.560 km
1	RCP+RP			TDD	75.7143 μs ($1696\times T_{st}$)(1)	9.636 km	54.8214 μs ($1227\times T_{st}$)	7.354 km	87.1429 μs ($1952\times T_{st}$)	12.206 km
2	RCP+RP+RP	228.5714 μs ($5120\times T_{st}$)		FDD	11.4286 μs ($256\times T_{st}$)	22.270 km(3)	5.7143 μs ($128\times T_{st}$)	17.988 km	5.7143 μs ($128\times T_{st}$)	32.549 km
				TDD	113.5714 μs ($2544\times T_{st}$)	15.311 km	82.1429 μs ($1840\times T_{st}$)	11.456 km	130.7143 μs ($2928\times T_{st}$)	18.737 km
3	RCP+RP	731.4286 μs ($6144\times T_{st}$)	Δf/8	Both	678.57143 μs ($15200\times T_{st}$)	70.237 / 95.934 km	672.85714 μs ($15072\times T_{st}$)	55.676 / 95.934 km	672.85714 μs ($15072\times T_{st}$)	99.340 / 95.934 km

(1) The number of samples with sampling time T_{st} for 20 MHz.

(2) It is assumed that the TTG is 105.714μs in 1/8 Tu CP or 82.853μs in 1/16 Tu CP, and maximum SSRTG is 50μs for TDD mode.

(3) It is assumed that first RP is used as RCP for Format 2 of FDD duplex mode.

Figure 1 shows the performance of proposed ranging channel according to ranging bandwidth in the modified pedestrian B channel model of 3km/h.

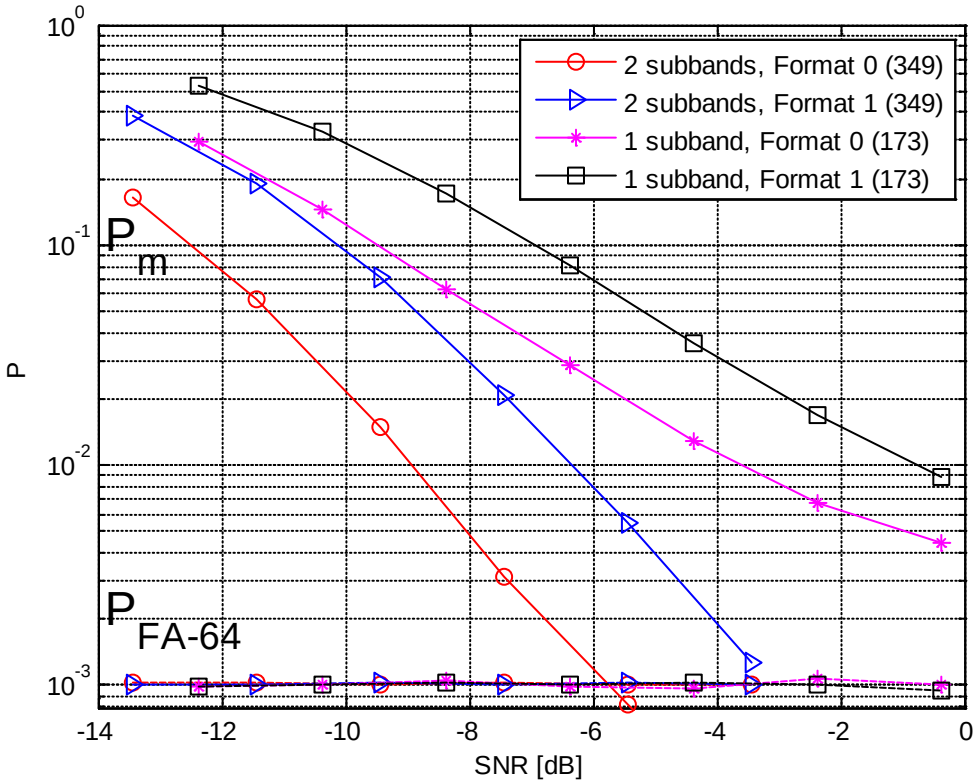


Figure 1. The performance of proposed ranging channel.

The details on the performance of the ranging channels are shown in [5-7].

3. References

[1] IEEE 802.16m-08/0010r1a, “IEEE 802.16m Amendment Working Document,” March 2009.

[2] IEEE P802.16Rev2/D9a, “DRAFT Standard for Local and metropolitan area networks / Part 16: Air Interface for Broadband Wireless Access Systems,” March 2009.

[3] IEEE 802.16m-07/002r8, “IEEE 802.16m System Requirements,” January 2009.

[4] IEEE 802.16m-08/003r8, “IEEE 802.16m System Description Document,” April 2009.

[5] IEEE C802.16m-08/0335r1, “Proposed Text of Ranging Section for the IEEE 802.16m Amendment,” January 2009.

[6] IEEE C802.16m-09/0696, “Proposed Text for the Draft P802.16m Amendment on the PHY Structure for Ranging channel,” March 2009.

[7] IEEE C802.16m-09/1091, “Considerations on the Non-Synchronized Ranging Channels,” April 2009.

Text proposal for inclusion in the 802.16m amendment

Black text: current text in [1]
~~Red Strike through Text~~: Deleted

Blue text: new text
[Bracketed Italic text]: Informative

[---------- Text Proposal #1 ----------]

---------- Text Start ----------

15.3.9.1.4.1. Ranging Channel Structure for Non-synchronized AMSs

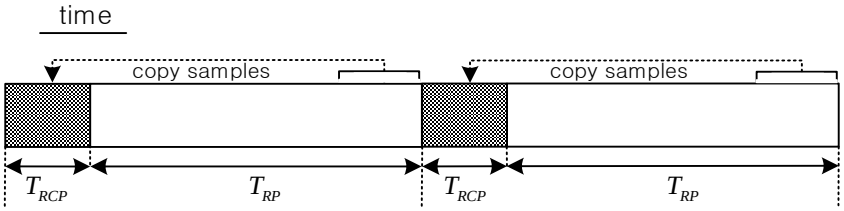
The ranging channel for non-synchronized AMSs is used for initial network entry and association and for ranging against a target BS during handover.

A physical ranging channel for non-synchronized AMSs consists of the ranging preamble (RP) with length of T_{RP} depending on the ranging subcarrier spacing $\Delta f_{RP,}$ and the ranging cyclic prefix (RCP) with length of T_{RCP} in the time domain.

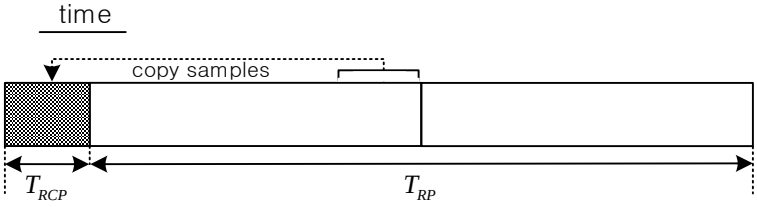
A ranging channel occupies a localized bandwidth corresponding to the [1 or 2] subbands.

~~Power control operation described in subclause [TBD] applies to ranging signal transmission.~~

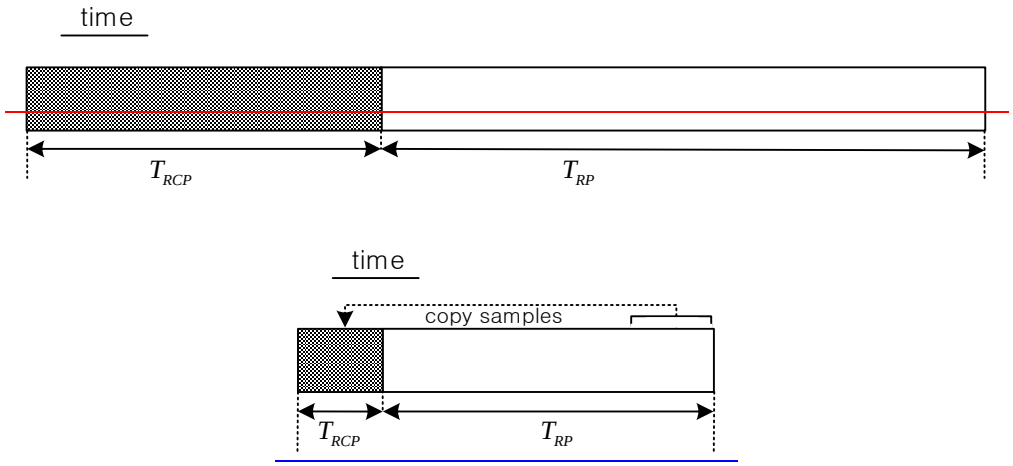
Figure 450 illustrates the ranging channel structures in the time domain.



(a) Structure 1



(b) Structure 2



(c) Structure 3

Figure 450 - The ranging channel structures in the time domain

Table 691 contains ranging channel formats and parameters.

Table 691 - Ranging Channel Formats and Parameters

Format No.	Ranging Channel ~~Format~~Structure	T_{RCP}	T_{RP}	Δf_{RP}
0	Structure 1	$T_g+k\times T_b$ (a)	$2.5\times T_b$	$\Delta f / 2.5$
1	Structure ~~2~~3			
2	Structure ~~3~~2	$\alpha+T_g$ (b)	$2\times 2.5\times T_b$ (c)	
~~…~~3	~~…~~Structure 3	$7\times T_b + T_g$	$8\times T_b$	$\Delta f / 8$

where T_s, T_b, T_g and Δf are defined in *Section 15.3.2.4 Derived parameters.*

(a): The T_{RCP} for Formats 0 and 1 depends on OFDMA parameters, subframe types and duplex mode as follows:

$$k = \left\lceil \left\{ \left[N_{sym} \cdot T_s + \alpha - 2 \cdot \left(T_{RP} + T_g \right) \right] / 3 \right\} \cdot F_s \right\rceil / N_{FFT}$$

where α is 0 for FDD and T_{TTG} -50μs for TDD. N_{sym} is the number of OFDMA symbols in a subframe as defined in *Section 15.3.8.1 Physical and logical resource unit.* F_s and N_{FFT} are defined in *Section 15.3.2.4 Derived parameters.*

(b): The T_{RCP} for Formats 2 depends on the duplex mode. α is the same as that of (a).

(c): T_{RP} for Format 2 denotes the total length of repeated ranging preamble.

In the ranging channel Format 0, the repeated RCPs and RPs are used as a single time ranging opportunity within a subframe in Figure 450 (a). Format ~~1~~2 consists of a single RCP and repeated RPs within a subframe. Format ~~2~~1 consists of a single RCP and RP which is a part of the Format 0. When Format 1 is used, there are two time opportunities within a subframe. Format 3 has the same structure with Forma 1 but its length is different.

For the ranging opportunity of the non-synchronized AMS in the code domain, each AMS randomly chooses one of ranging preamble sequences from the available ranging sequence set in a ~~cell~~sector defined in *15.3.9.2.4.1.1* ~~TBD~~ Ranging preamble codes.

When the ranging channel format is configured as Format 0, 2, 3, or Format 1 using the first time-opportunity in the time domain, the transmission start time of the ranging channel is aligned with the UL subframe start time at the AMS for FDD mode and the transmission of ranging channel starts at T_{TTG} -50μs before the UL subframe start time at the AMS for TDD mode. For the Format 1 using the second time-opportunity, the transmission of the ranging channel starts at $T_{RCP}+T_{RP}$ in Format 1 after the start time of first time-opportunity in FDD and TDD mode.

---------- Text End ----------

[---------- Text Proposal #2 ----------]

---------- Text Start ----------

[Insert the following text into the section 15.3.9.2.4.1 Ranging channel for non-synchronized AMSs.]

~~Ranging signal transmission~~

15.3.9.2.4.1.3. Ranging signal transmission

~~<<Eqn. UL_7>>~~Equation (238) specifies the transmitted signal voltage to the antenna, as a function of time, during ranging channel format.

~~$s(t) = f_{ranging}()$~~

$$s(t) = \mathrm{Re}\left\{ e^{j2\pi f_C t} \sum_{k=-(N_{RP}-1)/2}^{(N_{RP}-1)/2} x_p\left(k+\left(N_{RP}-1\right)/2\right)\cdot e^{j2\pi\left(k+K_{offset}\right)\Delta f_{RP}\left(t-T_{offset}\right)} \right\} \quad (238)$$

where

~~$f_{ranging}()$ is a TBD function~~

t is the elapsed time since the beginning of the subject ranging channel.

N_{RP} is the length of ranging preamble code in frequency domain.

$x_p(n)$ is the p-th ranging preamble code with length N_{RP}.

K_{offset} is the parameter related to the frequency position and is defined by

$$K_{offset} = -\left\{\left(N_{used} - 1\right)/2 - 2 \cdot P_{sc} \cdot \left(2 \cdot k_0 - 1\right) + \left\lfloor 8 \cdot k_0 / N_{PRU} \right\rfloor\right\} \cdot \Delta f / \Delta f_{RP}$$ if 1 subband

or

$$K_{offset} = -\left\{\left(N_{used} - 1\right)/2 - 4 \cdot P_{sc} \cdot \left(2 \cdot k_0 - 1\right) + \left\lfloor 8 \cdot k_0 / N_{PRU} \right\rfloor\right\} \cdot \Delta f / \Delta f_{RP}$$ if 2 subbands

N_{PRU} is the total number of PRUs as defined *15.3.8.2.1 Subband partitioning.*

k_0 is a logical ranging channel parameter in the frequency domain as units of N_1, where N_1 is the number of the adjacent PRUs within a subband as defined *15.3.8.2.1 Subband partitioning.*

P_{sc} is the number of the consecutive subcarriers within a PRU in frequency domain as defined *15.3.8.1 Physical and logical resource unit.*

$\triangle f_{RP}$ is the ranging subcarrier spacing.

T_{offset} is the parameter related to the length of ranging cyclic prefix and is defined by

$$T_{offset} = \begin{cases} T_{RCP} & , \quad 0 \le t < T_{RCP} + R_{RP} \ \text{for all formats} \\ T_{RP} + 2 \cdot T_{RCP} & , \quad T_{RCP} + R_{RP} \le t < 2 \cdot \left(T_{RCP} + R_{RP}\right) \ \text{for format 0} \end{cases}$$

---------- *Text End* ----------