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Title	**Problems with Initial Ranging in OFDM PHY and a Solution**
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Re:	Supporting document for Comment to 802.16maint.
Abstract	Changes required in order enabling good operation of 802.16 systems.
Purpose	The document is intended for consideration within the comments resolution process.
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Problems with Initial Ranging in OFDM PHY and a Solution

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January 2005

References

[1] IEEE, "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems," IEEE Std 802.16-2004.
[2] IEEE, "IEEE Draft Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems," IEEE P802.16-REVd/D5-2004.
[3] IEEE, "Corrigendum to IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems," 80216maint-04/10.

Introduction

The changes proposed in this document are to correct errors in the description of Initial Ranging, and in particular the lack of detailed specification for the use of sub-channelised initial ranging for the OFDM PHY mode, as described in IEEE 802.16-2004 [1, 2].

Description of Problem

Subchannelized Ranging

In section 8.3.7.2 [2, page 479] there are a number of statements regarding the mechanism a sub-channel capable SS is to adopt during initial ranging. However, there are no STL diagrams showing the actions of either the BS or the SS during these phases. This requires modifications in section 6.3.9.5 [2, page 177 forward] and changes to the diagrams in figures 61, 62. In addition, the process described in 8.3.7.2 is unclear as to whether it is a single-shot subchannelized initial ranging, or can be attempted multiple times. No timers are defined indicating whether this should be done once or many times., nor is it clear when an SS might change from normal to subchannelized initial ranging. It therefore does not make sense for the SS to be constrained by a process. In section 8.3.7.2 it is suggested that an SS may switch to Subchannelized IR when the Ptx is beyond its maximum supported power. This means that an SS may start subchannelised initial ranging at any attempt. Moreoever, the subchannelized IR capable BS must be prepared to receive SCIR at any time. As it is unclear how to specify the change, we propose to remove all constraints on when an SS may switch to subchannelized IR.

Page 182, Line 34
Test "Time to increase power?" does not seem to have a timer associated with it. It is in conflict with the text at [2, page 178, line 53 and page 179, line 6]. In these lines the power is required to be increased at each step. However, the change in power is not defined in the standard, and so the power step could be zero or changed dynamically. We suggest replacing the power step with an instruction to adjust the power.

Another problem in the subchannelized initial ranging is that the text specifies that SS shall attempt subchannelization IR if the BS supports that. However, there is a problem, because the SS does not know at this stage whether the BS actually is capable of subchannelization. This capability is currently negotiated only at the SBC stage. One solution is that the BS shall report the subchannelized IR capability in the UCD message, as indicated in the text changes that follow.

T19 Problem:

When the SS fails to range properly on a given downlink channel, the spec (clauses) instructs the SS to mark the channel as unusable and start a timer T19 during which the channel remains unusable. This timer is SS specific (see section 10.1) and has no lower bound defined. An SS can implement this timer as 0.

We believe this timer T19 belongs to the scanning algorithm which is implementation dependent. As a consequence, this timer should be removed from the specification.

Text Changes

Text changes are relative to [3].

Insert section as follows:

6.3.9.5 Initial ranging and automatic adjustments

6.3.9.5.1 Contention based Initial ranging and automatic adjustments

[*Modify the second paragraph as indicated*:]
For SC, SCa and OFDM PHY, the SS shall put together a RNG-REQ message to be sent in an Initial Ranging Interval. The CID field shall be set to the non initialized SS value (zero). For the OFDM PHY, the initial ranging process may include a subchannelized mechanism specified in 8.3.7.2. For the OFDMA PHY, the initial ranging process shall begin by sending initial-ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3), instead of RNG-REQ messages sent on contention slots.

[Modify the following paragraph:]
For SC, SCa and OFDM PHY, the SS shall send the RNG-REQ at a power level below PTX_IR_MAX, measured at the antenna connector. If the SS does not receive a response, the SS shall resen~~t~~d the RNG-REQ at the next appropriate Initial Ranging transmission opportunity ~~at one step higher~~ and adjust its power level. If the SS receives a response containing the frame number in which the RNG-REQ was transmitted, it shall consider the transmission attempt unsuccessful but implement the corrections specified in the RNG-RSP and issue another RNG-REQ message after the appropriate backoff delay. If the SS receives a response containing its MAC Address, it shall consider the RNG_RSP reception successful.
If the SS does not receive a response, the SS shall resen~~t~~d the RNG-REQ at the next appropriate Initial Ranging transmission opportunity ~~at one step higher~~ and adjust its power level.

[Modify the following paragraph:]
For OFDMA, the SS shall send a CDMA code at a power level below PTX_IR_MAX, measured at the antenna connector. If the SS does not receive a response, the SS shall send a new CDMA code at the next appropriate Initial Ranging transmission opportunity ~~at one step higher~~ and adjust its power level. If the SS receives a RNG-RSP message containing the parameters of the code it has transmitted and status continue, it shall consider the transmission attempt unsuccessful but implement the corrections specified in the RNG-RSP and issue another CDMA code after the appropriate backoff delay. If the SS receives an UL-MAP containing a CDMA allocation IE with the parameters of the code it has transmitted, it shall consider the RNG_RSP reception successful, and proceed to send a unicast RNG-REQ on the allocated BW. More details on this procedure can be found in 6.3.10.3.

6.3.9.6 Ranging parameter adjustment

[Replace Figure 61 with the following figure:]

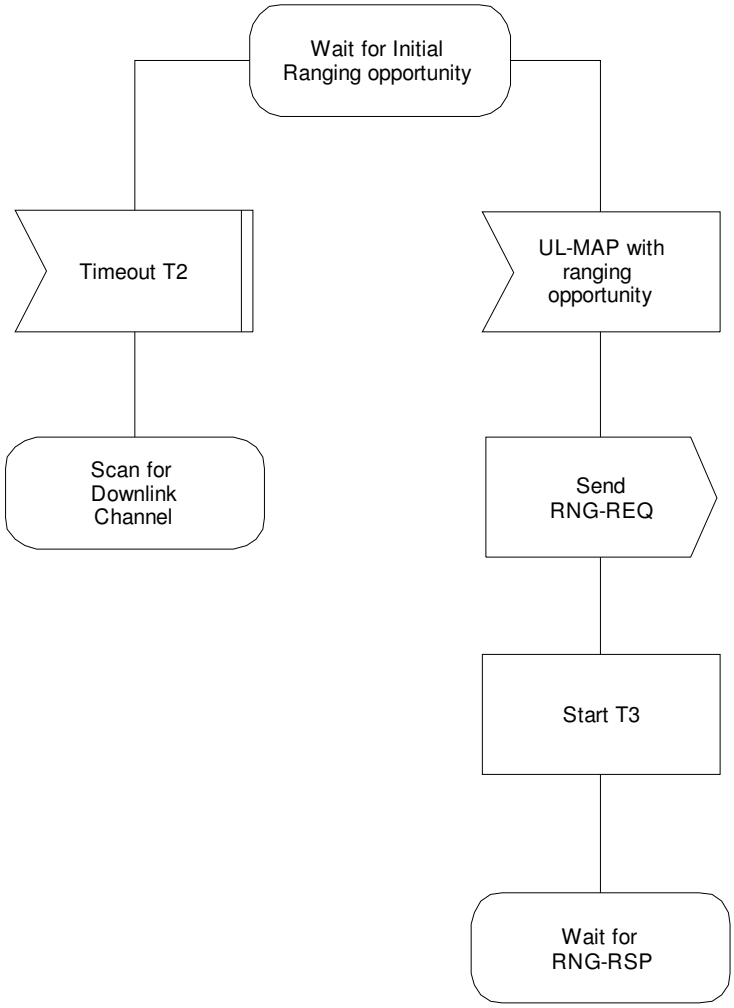

Figure 60 – Initial Ranging – SS (part 1)

NOTE 1 —Timeout T3 may occur because the RNG-REQs from multiple SSs collided. To avoid these modems repeating the loop in lockstep, a random backoff is required. This is a backoff over the ranging window specified in the UCD.T3 timeouts can also occur during multi-channel operation.
NOTE 2 — On a system with multiple uplink channels, the SS must attempt initial ranging on every suitable uplink channelbefore ~~marking the downlink channel unusable and~~ moving to the next available downlink channel.

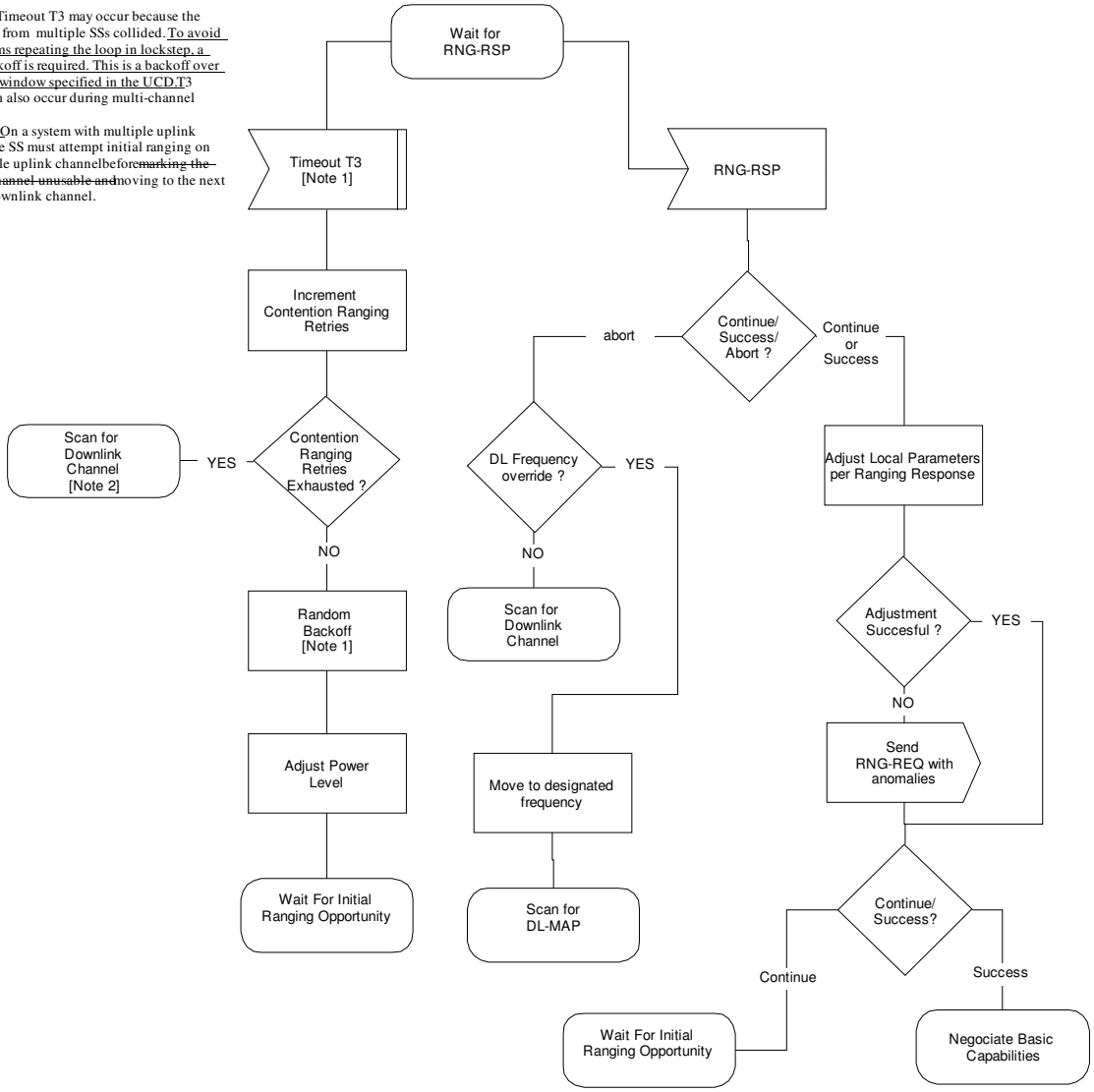

Figure 61 – Initial Ranging – SS (part 2)

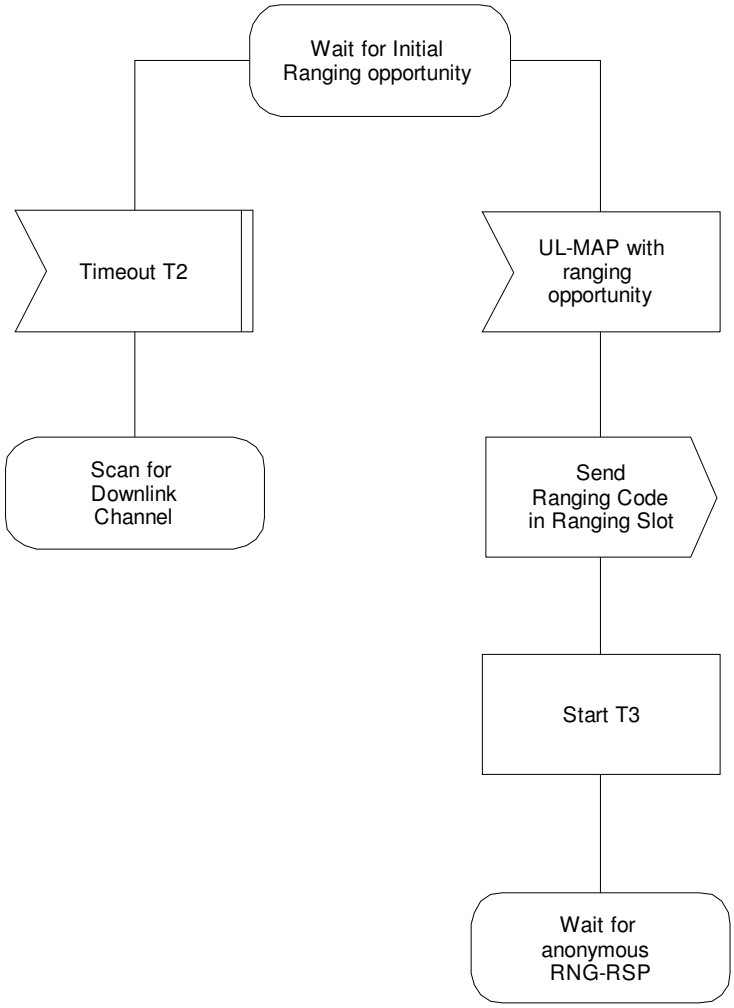

Figure 85 – CDMA Initial Ranging – SS (part 1)

NOTE 1 —Timeout T3 may occur because the CDMAcodes or the RNG-REQ from multiple SSs collided. To avoid these modems repeating the loop in lockstep, a random backoff is required. This is a backoff over the ranging window specified in the UCD. T3 timeouts can also occur during multi-channel operation.
NOTE 2 — On a system with multiple uplink channels, the SS must attempt initial ranging on every suitable uplink channelbefore ~~marking the downlink channel unusable and~~ moving to the next available downlink channel.

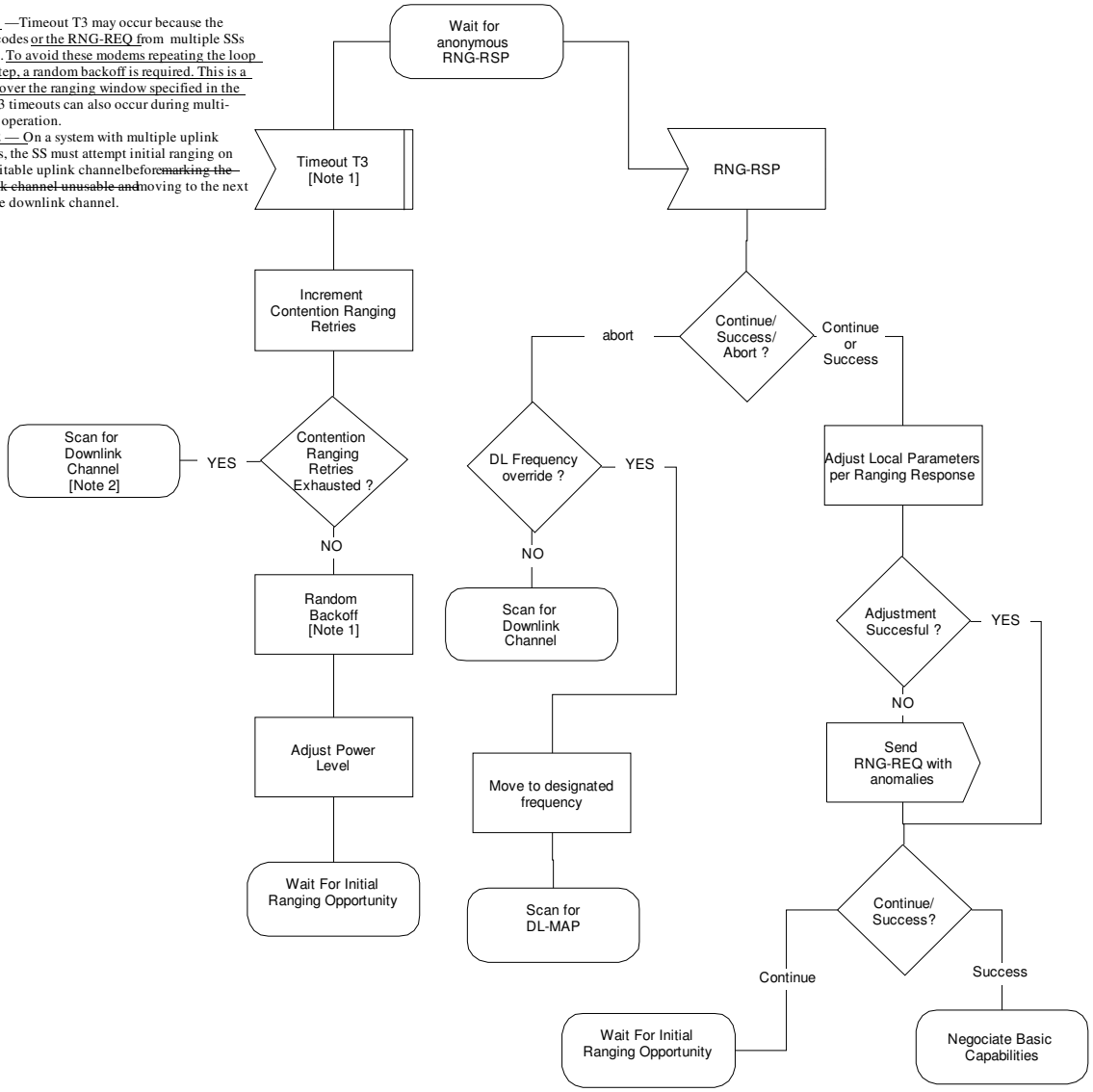

Figure 86 – CDMA Initial Ranging – SS (part 2)

[Alter section 8.3.7.2 as follows, and insert STL diagrams describing behaviour of SS during sub-channelised initial ranging:]
[Modify the 5th paragraph as follows:]

~~SSs that compute their $P_{TX\_IR\_max}$ to exceed their maximum power level and SSs which have attempted initial ranging with the maximum power level using RNG-REQ may, i~~If the BS supports subchannelization, an SS may attempt initial ranging in an initial ranging slot using the following burst format, as indicated in Figure 210a and Figure 210b:

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[Include the following diagrams in section 8.3.7.2:]

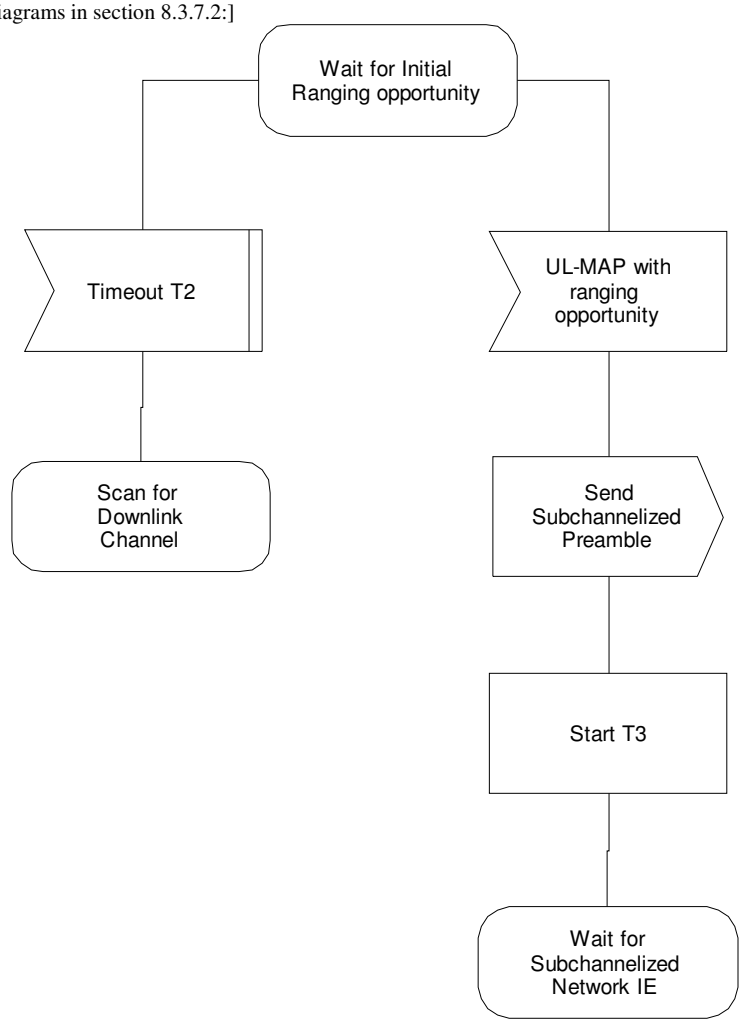

Figure 210a – Subchannelized Initial Ranging – SS (part 1a)

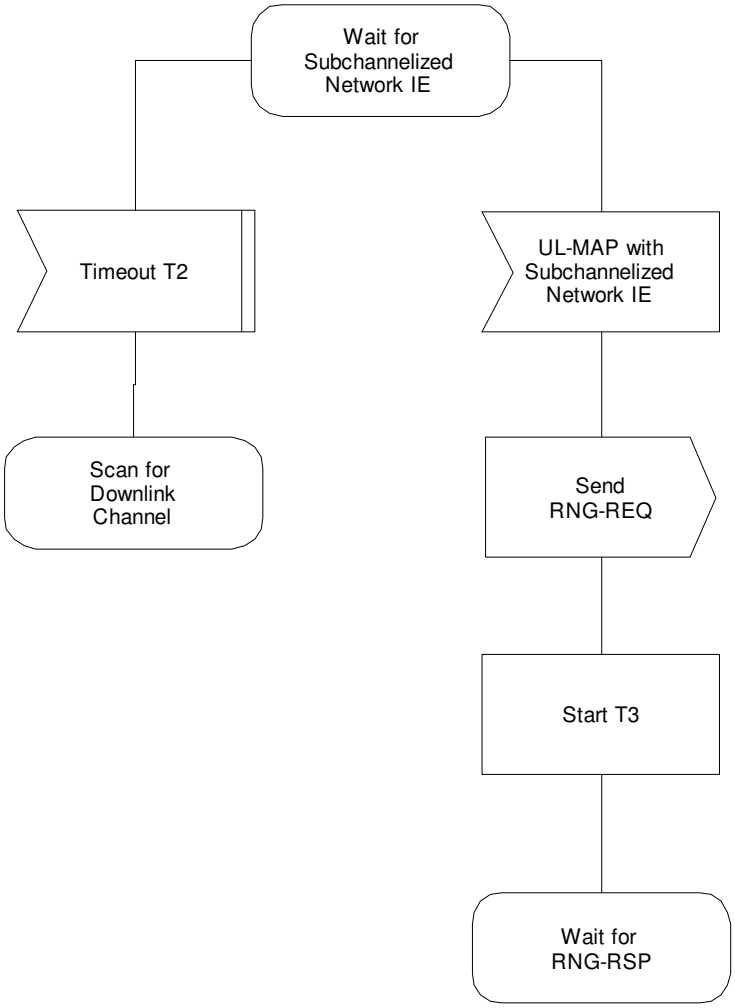

Figure 210b – Subchannelized Initial Ranging – SS (part 1b)

[Insert following text on page 75 line 8:]

Delete the row with value "T19" under the name column from Table 342.

Alter section 11.3 as follows to add the following capability descriptor to Table 350 – UCD PHY-specific channel encodings – WirelessMAN-OFDM:

11.3 UCD management message encodings

11.3.1 UCD channel encodings

[Insert new channel encoding at end of table 350:]

Name	Type (1 byte)	Length	Value
Subchannelized Initial Ranging capable BS	152	1	Indicator that the BS is capable of receipt of subchannelized Initial Ranging requests (see 8.3.7.2). Value 0 (default) indicates the BS is not capable of receiving subchannelized Initial Ranging Request. Value 1 indicates the BS is capable of receiving subchannelized Initial Ranging Request. All subchannelization capable BSs shall be capable of receiving the subchannelized Initial Ranging Request. Values 2-255 reserved.