Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>	
Title	Distinct OFDMA-based Ranging Code Sets for Relay Station and Mobile Station	
Date Submitted	2006-11-07	
Source(s)	Kanchei (Ken) Loa, Yung-Ting Lee, Yi-Hsueh Tsai, Heng-Iang Hsu, Shiann-Tsong Sheu Institute for Information Industry 8F., No. 218, Sec. 2, Dunhua S. Rd., Taipei City, Taiwan.	Voice: +886-2-2739-9616 Fax: +886-2-2378-2328 loa@nmi.iii.org.tw
	Hang Zhang, Mark Naden, Wen Tong, Peiying Zhu, Derek Yu David Steer, Gamini Senarath, G.Q. Wang Nortel 3500 Carling Avenue Ottawa, Ontario K2H 8E9	Voice: +1 613 7631315 WenTong@nortel.com
Re:	IEEE 802.16j-06/027: “Call for Technical Proposals regarding IEEE Project P802.16j”	
Abstract	This document is to define distinct OFDMA-based ranging code sets for relay station and mobile station in IEEE 802.16j-06/026.	
Purpose	Adopt the text proposal in this document	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE’s name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE’s sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.	

Distinct OFDMA-based Ranging Code Sets for Relay Station and Mobile Station

Introduction

The purpose of this document is to define distinct OFDMA-based ranging code sets for relay station and mobile station in IEEE 802.16j-06/026.

Explanation of Problem

Background

In IEEE 802.16 specifications, there are 256 CDMA ranging codes defined, which are partitioned into 4 code sets for initial ranging, periodic ranging, bandwidth request, and handover ranging, respectively. A BS broadcasts the information of used codes in the UCD message. Among the used codes, an MS, in general, randomly selects one ranging code for ranging or bandwidth request.

Problems for RS & MS Using Same Ranging Code

When RS and MS are sharing the same ranging code sets, RS and MS cannot be differentiated by MR-BS until capability negotiation phase during network entry or handover. That is, unnecessary overhead (radio parameters adjustment, CID allocation) may be introduced when a RS joins an MR network by trial and error approaches. Moreover, in an MR network RS should play more important operating role than MS especially for initial ranging, periodic ranging, handover ranging, and bandwidth request. So RS needs separate ranging code sets to avoid collisions with MS.

Requirements for RS Ranging Codes

1. Ranging codes shall be defined for RS initial/periodic/handover ranging and bandwidth request functionalities
2. MR-BS should be able to differentiate RS and MS by ranging codes
3. Collisions between RS and MS should be avoided

Proposed Remedy

Four new ranging code sets, namely RS IR (Initial Ranging); RS PR (Periodic Ranging); RS BR (Bandwidth Request); RS HR (Handover Ranging) are defined for RS. The allocation of the eight ranging code sets is determined by MR-BS

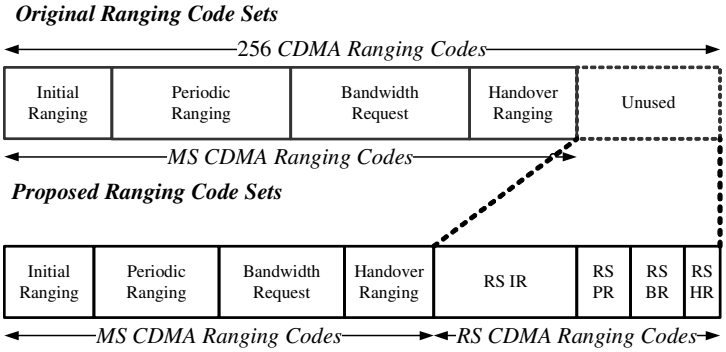

Figure 1 Comparison between Original and Proposed Ranging Code Sets

Advantages of Using Distinct RS Ranging Code Sets

1. Advantages of Using RS Initial Ranging Code Sets
   - *A. MR-BS can differentiate RS from MS in the initial ranging phase of network entry*
   - *B. MR network topology establishment can be achieved before using routing protocol when RS uses distinct ranging code set from the MS*
     - ✓ *MR-BS could configure one RS to be the endpoint of a relay path by setting the RS to ignore any request with RS initial ranging code*
     - ✓ *MR-BS could apply alternative topology control policy to RS initial ranging code*
   - *C. RS IR could be almost collision-free for fixed & nomadic RS*
2. Advantages of Using RS Handover Ranging Code Sets
   - *A. Similar to the advantages of RS initial ranging code sets*
   - *B. MR-BS could apply different policies for RS handover and MS handover*
3. Advantages of Using RS Periodical Ranging Code Sets
   - A. *MR-BS could apply different response policies to RS periodic ranging and MS periodic ranging*
4. Advantages of Using RS Bandwidth Request Code Sets
   - *A. MR-BS could apply different response policies to RS bandwidth request and MS bandwidth request*

Figure 2 illustrates advantages of using RS Initial Ranging Code. RS3 cannot join the MR network via RS1 due to policy restrictions (hot count limit, RS limited capability, … etc). There are two possible ways for RS3 joining the MR network shown in Figure 2. RS3 could ramp up its transmission power of initial ranging until MR-BS can decode the initial ranging message correctly, and alternatively RS1 could forward the initial ranging message to MR-BS and MR-BS tells RS3 how to adjust radio parameters so that the RS3 can do initial ranging with MR-BS directly.

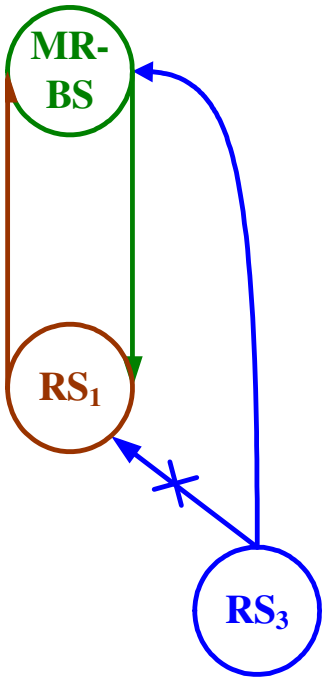

Figure 2 RS cannot join a 2-hop MR network via RS

Summary

We propose to define distinct code sets for RS and MS, respectively. The MS code sets are used in the access link whereas RS code sets are used in the relay link. By using distinct code sets for RS and MS, the MR-BS can apply different policies at the earliest stage regarding network entry, handover, and bandwidth request.

Text Proposal

Insert the section “8.4.7.3 Ranging Codes” in section 8.4.7 of IEEE 802.16j-06/026

Insert the following text in section 8.4.4.3 of IEEE 802.16j-06/026

8.4.7 OFDMA ranging

8.4.7.3 Ranging codes

Change the fourth paragraphs as indicated:

The number of available codes is 256, numbered 0..255. Each BS uses a subgroup of these codes, where the subgroup is defined by a number S, $0 <= S <= 255$. The group of codes will be between S and ((*S*+*O*+*N*+*M*+*L*+*K*+*J*+*I*+*H*) mod 256).

— The first N codes produced are for initial-ranging. Clock the PRBS generator $144 \times (S \ mod \ 256)$ times to $144 \times ((S + N) \ mod \ 256) - 1$ times.

— The next M codes produced are for periodic-ranging. Clock the PRBS generator $144 \times ((N + S) \ mod \ 256)$ times to $144 \times ((N + M + S) \ mod \ 256) - 1$ times.

— The next L codes produced are for bandwidth-requests. Clock the PRBS generator $144 \times ((N + M + S) \ mod \ 256)$ times to $144 \times ((N + M + L + S) \ mod \ 256) - 1$ times.

— The next O codes produced are for handover-ranging. Clock the PRBS generator $144 \times ((N + M + L + S) \ mod \ 256)$ times to $144 \times ((N + M + L + O + S) \ mod \ 256) - 1$ times.

— The first J codes produced are for RS initial-ranging. Clock the PRBS generator $144 \times ((N + M + L + O + S) \ mod \ 256)$ times to $144 \times ((J + N + M + L + O + S) \ mod \ 256) - 1$ times

— The next I codes produced are for RS periodic-ranging. Clock the PRBS generator $144 \times ((J + N + M + L + O + S) \ mod \ 256)$ times to $144 \times ((I + J + N + M + L + O + S) \ mod \ 256) - 1$ times.

— The next H codes produced are for RS bandwidth-requests. Clock the PRBS generator $144 \times ((I + J + N + M + L + O + S) \ mod \ 256)$ times to $144 \times ((H + I + J + N + M + L + O + S) \ mod \ 256) - 1$ times.

— The next K codes produced are for RS handover-ranging. Clock the PRBS generator $144 \times ((H + I + J + N + M + L + O + S) \ mod \ 256)$ times to $144 \times ((H + I + J + K + N + M + L + O + S) \ mod \ 256) - 1$ times.

Appendix