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

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE S802.16j-06/206

Date Submitted: 2006-11-07

Source:

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Venue:

IEEE 802.16 Session #46, Dallas, USA

Base Document:

IEEE 802.16j-06/027:“Call for Technical Proposals regarding IEEE Project P802.16j”

Purpose:

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

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

Based on current ranging code,

1. RS and MS cannot be differentiated by MR-BS
   - *Until capability negotiation phase for network entry & handover*
   - *Overhead (radio parameters adjustment, CID allocation) will be introduced when a RS joins an MR network by trial and error approach*
2. RS cannot avoid collisions with MS
   - *Number of RS << Number of MS*
   - *RS should play more important operating role than MS especially for initial ranging, periodic ranging, handover ranging, and bandwidth request*

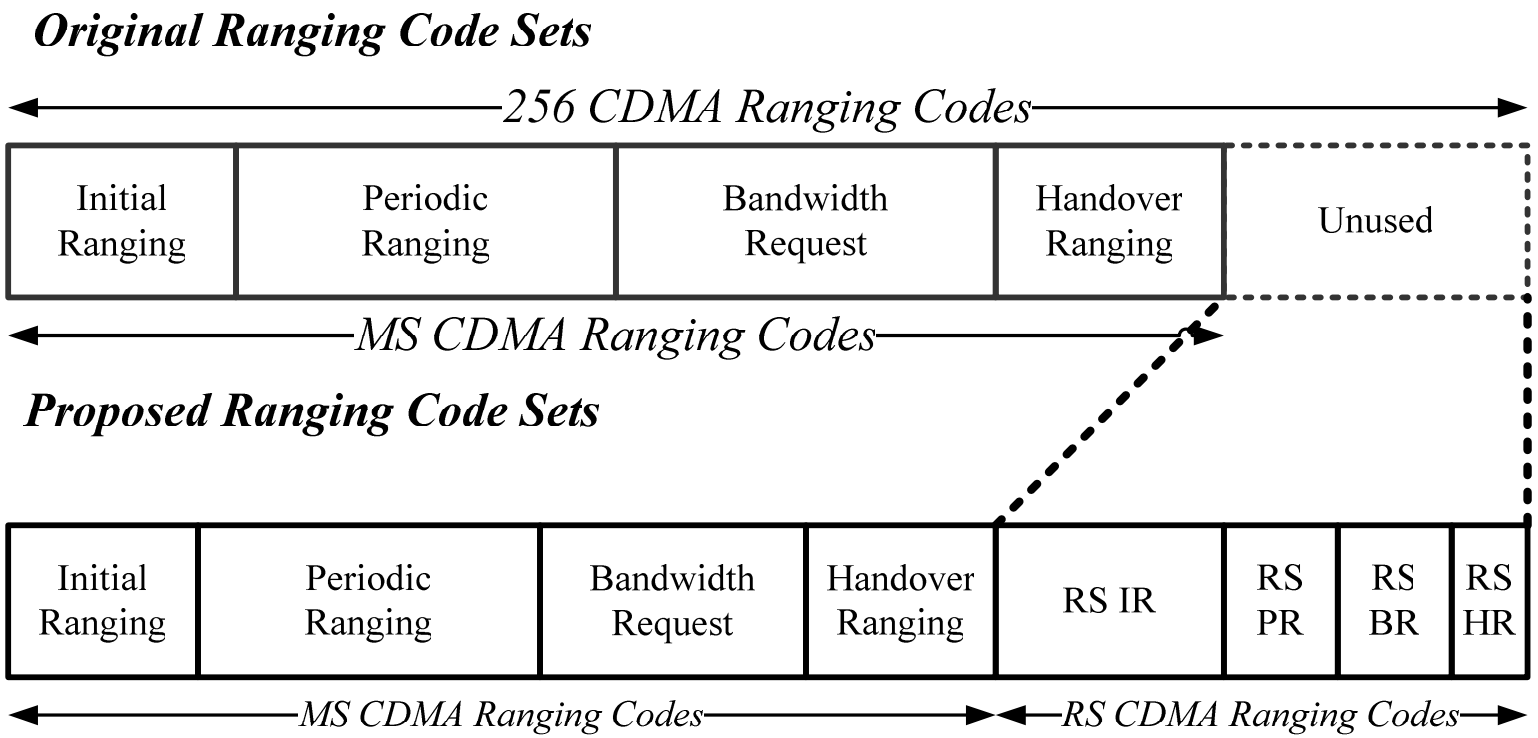
Requirements for RS Ranging Code

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

Design Alternatives

- Use dedicated ranging region
  - *Inefficient radio resource utilization due to it has to allocate dedicated resources*
- Use distinct CDMA ranging code sets for RS and MS
  - *Better radio resource utilization with minimized overheads*

Proposed Ranging Code Sets



- 4 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 8 ranging code sets is determined by MR-BS

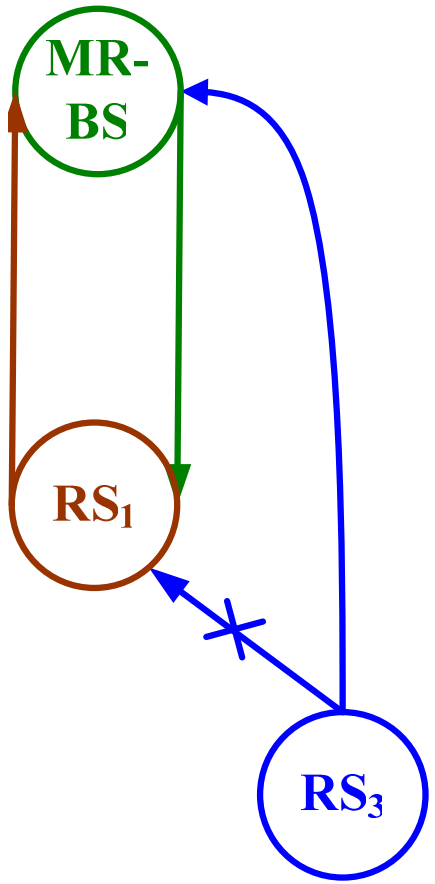
Advantages of Using RS Initial Ranging Code Sets

- MR-BS can differentiate RS from MS in the initial ranging phase of network entry
- 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*
- RS IR could be almost collision-free for fixed & nomadic RS

Advantages of Using RS Initial Ranging Code Sets

(*Example: RS cannot join a 2-hop MR network via RS*)

- 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
  - *RS3 could ramp up its transmission power of initial ranging (IR) until MR-BS can decode the initial ranging message correctly, and alternatively*
  - *RS1 could forward the IR 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.*



Advantages of Using Distinct RS Ranging Code Sets

- **Using RS Handover Ranging Code Sets**
  - *Similar to the advantages of using RS initial ranging code sets*
  - *MR-BS could apply different policies for RS handover and MS handover*
- **Using RS Periodic Ranging Code Sets**
  - *MR-BS could apply different response policies to RS periodic ranging and MS periodic ranging*
- **Using RS Bandwidth Request Ranging Code Sets**
  - *MR-BS could apply different response policies to RS bandwidth request and MS bandwidth request*

Summaries

- We propose to define ***distinct code sets*** for RS and MS, respectively
  - *The MS code sets are used in the access links*
  - *The RS code sets are used in the relay links*
- 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