

Proposal for IEEE 802.16m Interruption Free Overlay Handover

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Venue: IEEE 802.16m-08/024 Call for Comments and Contributions on Project 802.16m System Description Document (SDD), on the topic of “upper MAC concepts - mobility management”.

Base Contribution:C802.16m-08/628r2

Purpose: Discussion and approval of the proposal into the IEEE 802.16m System Description Document

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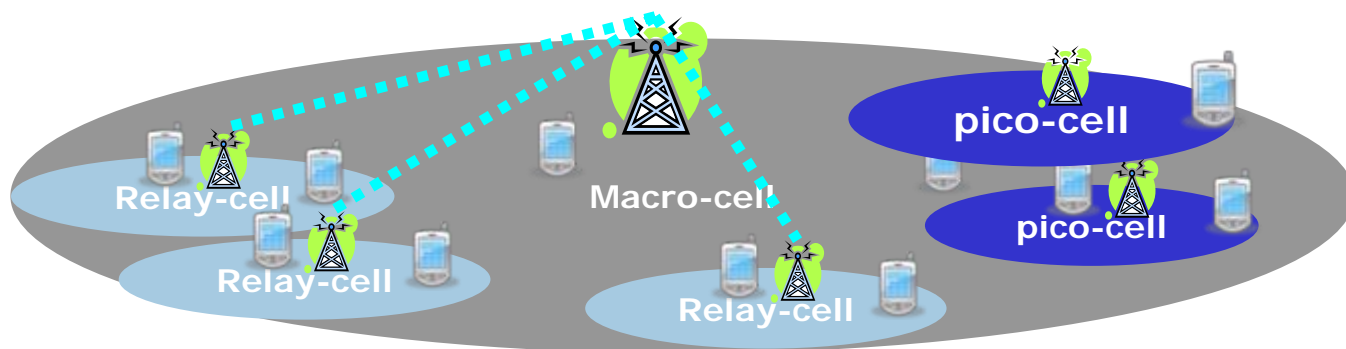
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HO in overlay network

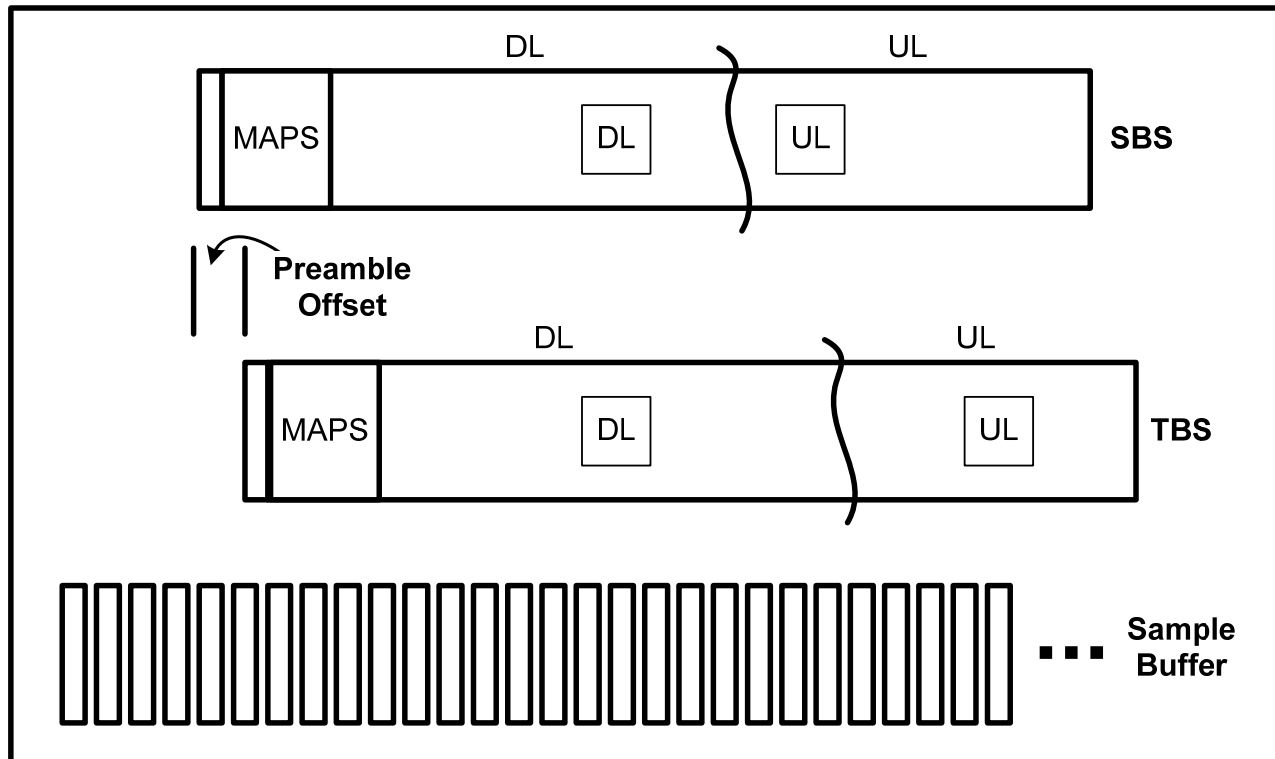
- IEEE 802.16m will support different cell types with possible overlay deployment [1]
 - Macro, micro, pico, femto cells
 - Overlay of a macro cell with smaller cells for capacity, load balancing
- mobility management should be improved for overlay HO
 - Uplink synchronization required due to cell size difference. Service interruption time should be minimized
 - MOB_NBR-ADV efficiently handles many overlay cells of different type



An heterogeneous overlay network

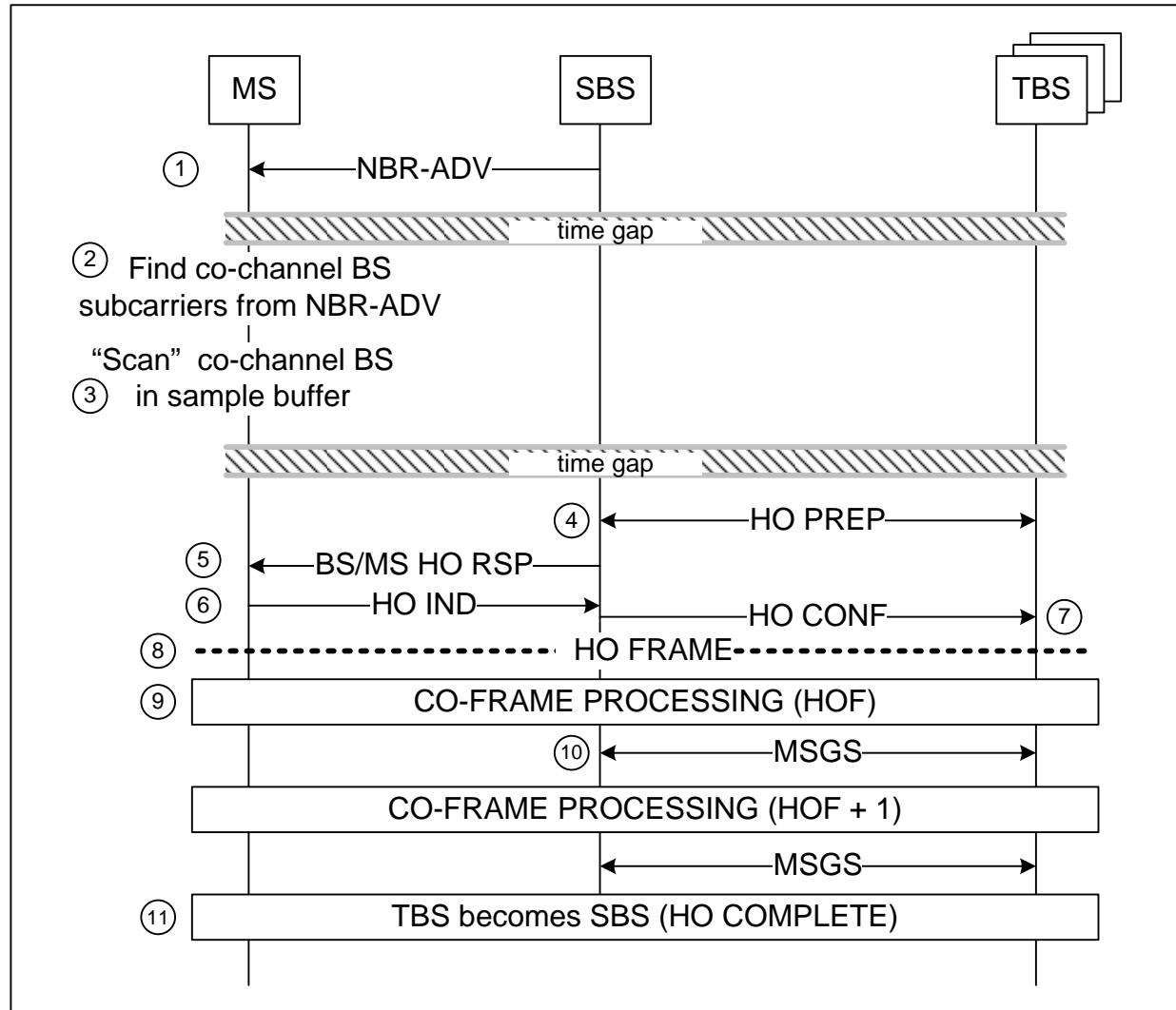
Co-frame processing capability of MS

- Applicable for overlay with same carrier frequency
- MS always receives a composite signal from all nearby BSs anyway
- MS processes the composite signal from S-BS/T-BS in its buffer
 - Read DL-Ctrl and obtain DL data
 - Transmit in UL in non-overlapping resources
 - Concurrent communications with TBS/SBS, NOT macro-diversity



Interruption free overlay HO

1. MS receives neighbor BS information from SBS.
- 2.3. MS performs scanning to determine existence of co-channel BSs and signal quality. (Not shown) Either MS or BS requests HO.
4. SBS negotiates with TBS for HO resources.
5. BS sends HO response to MS.
6. MS sends HO-IND to SBS.
7. SBS sends HO confirmation to TBS.
8. HO starts.
- 9.10. Co-frame processing and SBS/TBS messaging
11. HO complete



Scanning for co-channel BS

- MS obtains neighbor BS configuration via MOB_NBR-ADV broadcast
- MS collects signal samples and processes using the SBS subcarrier
- MS temporarily saves signal samples (enough for processing co-channel subcarriers)
- MS re-processes signal samples using BS1 subcarrier. MS determines signal strength and quality
- Repeat the last re-processing for other neighbor BSs
- During this “scan” processing, MS continues to process the SBS frame as usual.

Handover preparation by TBS and SBS

- HO is triggered either by the MS or the SBS. For MS-initiated HO, MS determines Handover type based on scanning. For BS-initiated HO, BS determines Handover type using the scan results provided by the MS.
- SBS negotiates with one or more TBSs for HO start frame, MS identification update, and pre-allocated SBS/TBS bandwidth grants for MS. The SBS and TBS must agree on non-overlapping uplink bandwidth allocations (downlink bursts can overlap).
- There are options for MS resource grants during HO depending on MS capabilities. If the MS is capable of processing both the SBS and TBS DL-MAP and UL-MAP in time to receive and transmit to the SBS and TBS, then dynamic bandwidth grants (specified in MAPs) can be used. If not, then bandwidth grants during HO must be static (specified before HO). This is FFS.

Efficient MOB_NBR-ADV broadcast in overlay network

- The message format should allow overhead reduction in various deployment scenarios
 - Heterogeneous cell type/configurations
 - Overlay with possibly dense deployment
 - Femto-cell is a special case, high density and non-public access, and thus should not be in NBR-ADV broadcast
- Classify system configuration parameters into
 - Common part: frequency, BW, multiplexing mode, CP ...
 - Unique part: HO type, trigger/action, load ...
- Optimize encoding format – mapping to each parameter is FFS
 - Fixed length fields, less overhead more flexibility
 - TLVs, flexible but at the cost of overhead, allows delta info compression

The proposed MOB_NBR-ADV format

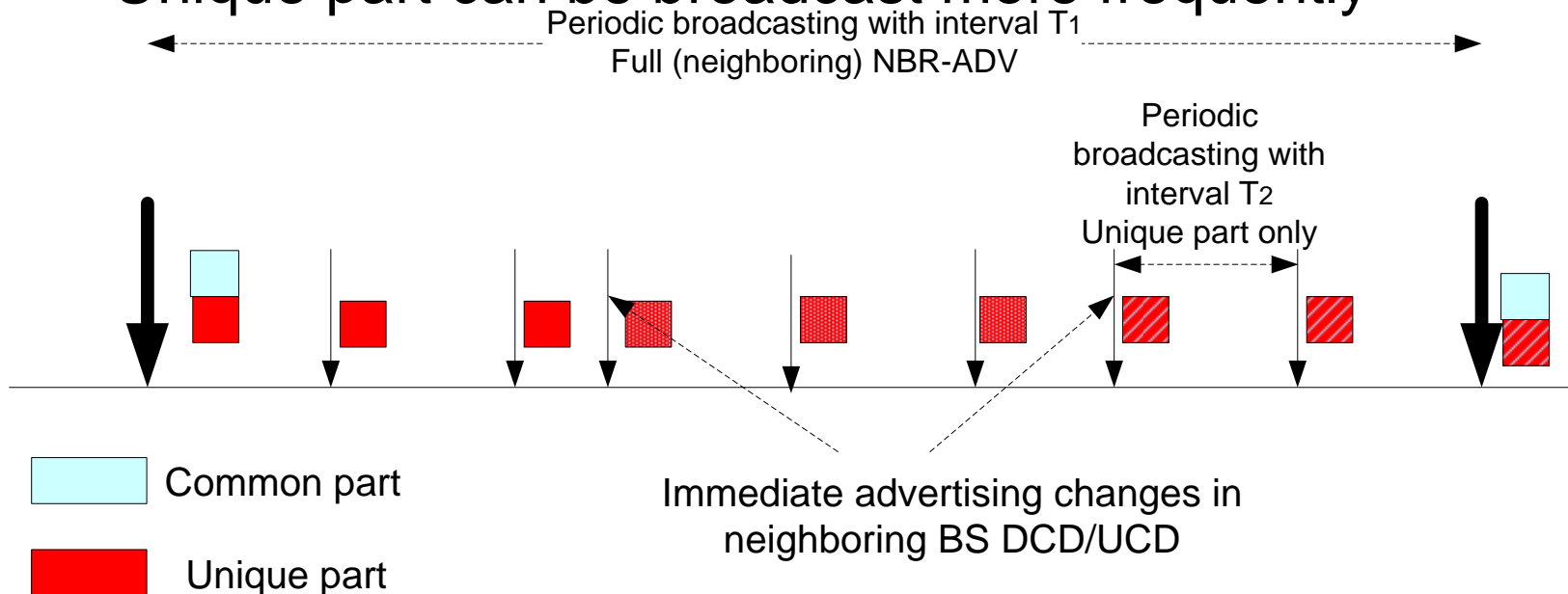
NBR-ADV

```
{
  For cell-type = 0:m
  {
    [common part (cell specific)] //optional based on broadcast schedule
    //First BS in this cell type
    For BS = 1
    {
      BS_ID
      other configuration info in TLV; //A typical cell in this cell type
    }
    //other BS in this cell type
    For BS = 2:k
    {
      BS_ID
      delta TLV; //Only delta information
      //From the typical cell above
    }
  }
}
}
```

Loop by cell types allows compression

MOB_NBR-ADV broadcast scheme

- Common part can be broadcast less frequently
 - TBD version number for common part frequently
 - Not likely change frequently
 - MS can cache common part history
- Unique part can be broadcast more frequently



Proposed IEEE 802.16m SDD text change

Insert the following text into MAC Layer clause (Chapter 10 in [IEEE 802.16m-08/003r3])

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

10.x Handover procedures

Overlay handover is supported to allow load balancing across different cell types.

10.x.1 Network topology acquisition

10.x.1.1 Network topology advertisement

The serving BS periodically broadcasts NBR-ADV message so that MS may learn the network topology for handover preparation. The NBR-ADV message sorts neighbor BSs(RSs) according to their cell types. Within each cell type, configuration parameters are classified into common part and unique part. Either fixed-length or TLV encoding is used and the format mapping for each parameter is FFS. In NBR-ADV broadcast, a typical cell is chosen for each cell type so that other entries in the same cell type only requires delta information for overhead reduction. The BS can adaptively broadcast common part and unique part at different frequencies for overhead reduction.

NBR-ADV broadcast does not include femto-cells.

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

Proposed IEEE 802.16m SDD text change

Insert the following text into MAC Layer clause (Chapter 10 in [IEEE 802.16m-08/003r3])

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

10.x.1.2 Scanning procedure

In single carrier overlay network, the MS has the option to perform interruption-free scanning. The MS process the composite signal it receives with both the SBS subcarriers and the TBS subcarriers. With the neighbor configuration received from SBS MOB_NBR-ADV broadcast, the MS can measure the neighbor BS signal quality while continuing communication with SBS.

10.x.2.x Interruption Free Overlay Handover

IEEE 802.16m supports an interruption free overlay handover procedure in single carrier overlay network. The MS processes the (same) composite signal it receives with both the SBS subcarriers and the TBS subcarriers. The MS is able to continue sending and receiving data with the SBS while performing control signaling with the TBS until the handover is complete. Uplink bandwidth allocations for the MS during Handover must be non-overlapping.

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

Reference

- [1] IEEE 802.16m-08/003r3, “Draft IEEE 802.16m System Description Document (SDD)”
- [2] IEEE Std. 802.16e-2005, IEEE Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands, and P802.16Rev2/D3 (February 2008).