Proposal for IEEE 802.16m UL Access and Resource Request Channels

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Re: IEEE 802.16m-08/016r1 – Call for Contributions on Project 802.16m System Description Document (SDD), on the topic of "Uplink Control Structures"

Purpose: Adopt the proposal into the IEEE 802.16m System Description Document

Scope

- This contribution proposes UL Initial/handover access, and resource request/renewal channels for IEEE 802.16m

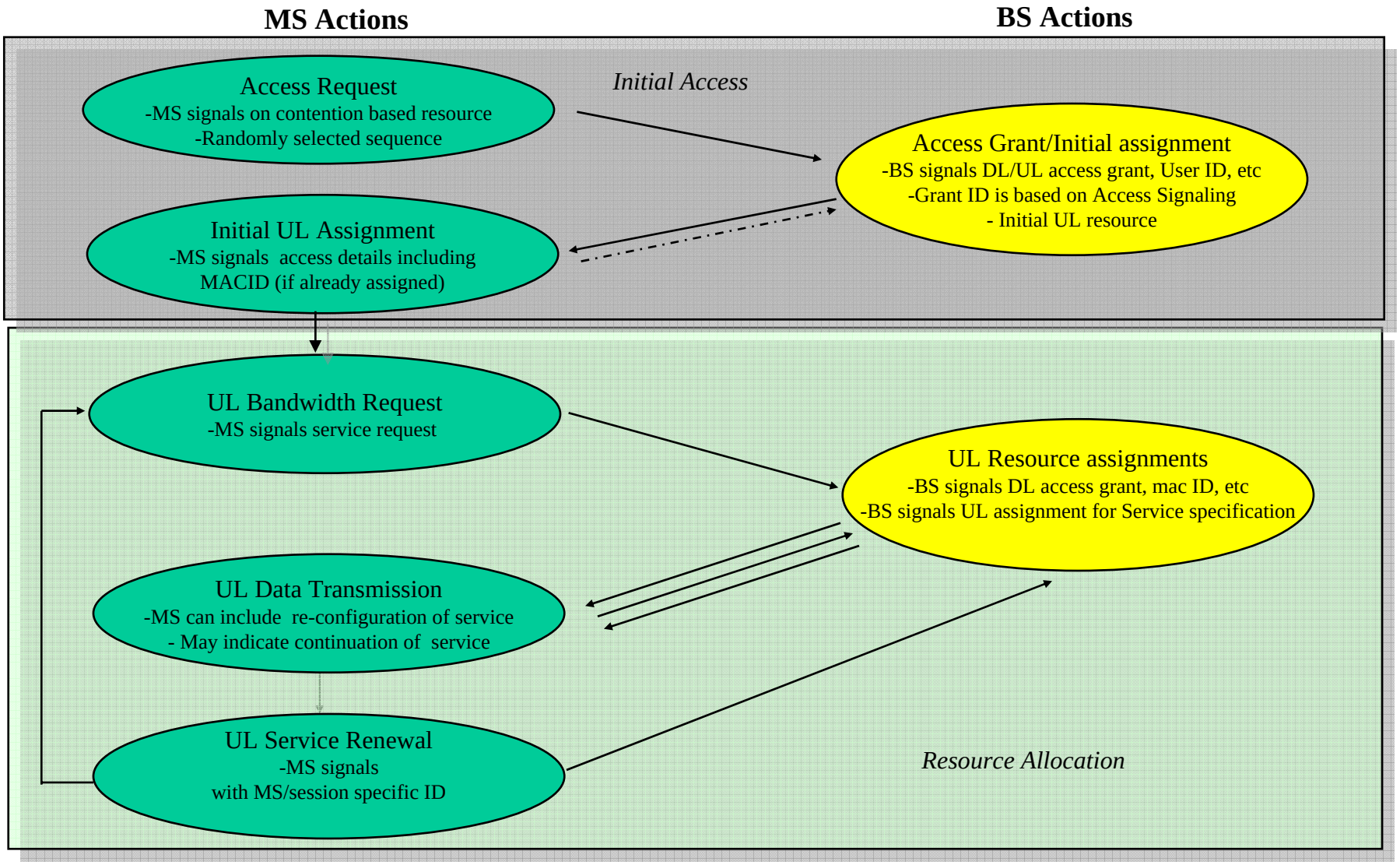
Introduction

- The following aspects of UL control channels for access and resource request are proposed in this contribution:
  - Initial Access and handover access to system
  - Resource request
  - Trigger continuation of negotiated service
  - Allocation re-configuration header
- Other types of UL control channels and control structure for non-random access signaling are given in contribution C802.16m-08/351.

UL Resource Used for Different Types of Signaling

UL resource	Contention based Random Access Region	Non-Contention based Random Access Region	MS specific UL control resources	MAC header sent in conjunction with UL traffic
Signaling types	• Initial access • Handover access • Resource renewal request	• Ranging	• Resource request • Resource renewal request	• Resource request • Resource renewal request • Additional service requirements/requests

MS Access and UL Resource allocation Flow



Overview of Random Access

- Define two different regions:
  - Contention based region for random access for bandwidth request, initial access and handover access.
    - An MS picks a random index which is associated with a random location within the region and a random sequence (e.g. m-sequence).
    - Bandwidth/resource request for bandwidth/resource renewal using pre-assigned region and code. The region can be the same as the random access region.
  - Non-contention based and is pre-assigned periodic ranging region to each MS for MS that doesn't have dedicated UL control channel(s) assigned
    - Base station assigns MS sequence and periodic locations within the region for ranging

Overview of Access/Request Channel Structure

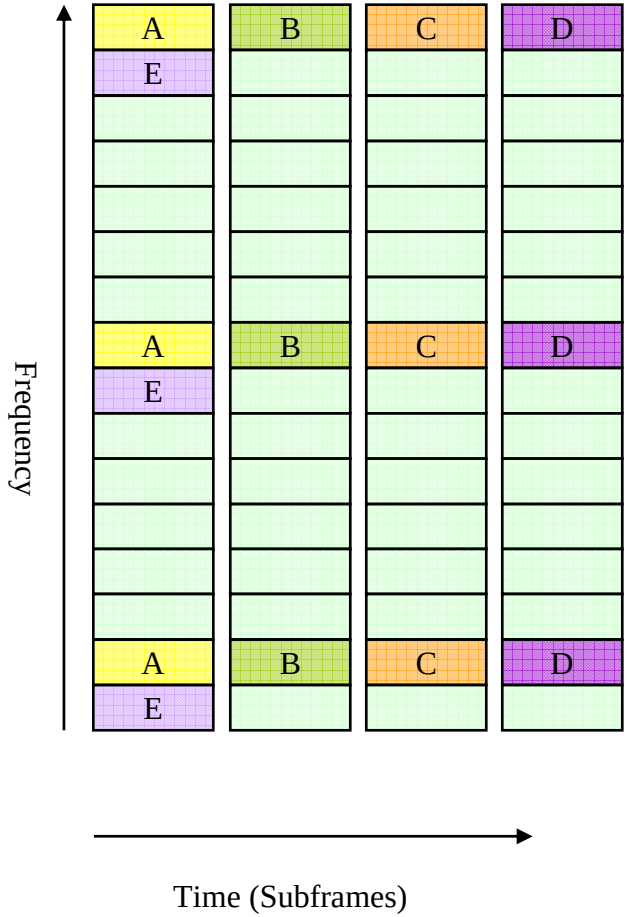
- Initial access channel (ACH)
  - Located in a defined resource for contention based signaling within each frame
  - For initial access and handover access
- Resource request channel (RRCH)
  - Resource/renewal request message :
    - Located in MS specific UL resources
  - Resource/renewal request indication:
    - Located in same defined resource as ACH
    - Located in MS specific UL resources

Initial Access Channel

- The mobile attempts to access the system. At this point the mobile has already synchronized with a serving sector. Access to the system may provide the mobile with a User ID, and allow the user to receive resource allocations (UL and/or DL) from the base station.
- The access channel (ACH) is used for the user to initially access the system.
- A mobile randomly selects a ACH signaling ID. An ACH signaling ID uniquely identify the spreading sequence, time-frequnecy location, and sub frame.
  - The set of signaling ID options are known to users, and also the index associated with each signaling ID option.
- When BS receives the transmission from MS on the ACH,, the base station assigns the following:
  - An UL Control message
    - The FL control segment message sent to the MS from the BS identifies the MS based on the randomly selected ACH signaling ID option selected by the MS for initial access.
    - A user ID to the user (embedded in UL control channel)
    - Resource allocation for mobile to begins communicating capabilities, resource request, etc
  - The base station can further give a DL resource assignment requesting information from the mobile, and additional details

UL Initial Access Channel (1/2)

- UL random access channel is a contention based channel for multiple MSs to request initial access
  - A designated resource is allocated for these initial access request
- The request is spread across the N resources tiles (e.g. N =3) used for Initial access
  - Spread in frequency domain over OFDM resources allows for frequency diversity
  - Spreading length over N resources is *L*
- Selection of access channel signaling ID:
  - The MS randomly selects from one sequence *L* sequences
  - The MS randomly selects from *M* locations within the subframe, and F subframes (eg. A, B, C etc)
- The number of distinct codes/resource/subframes per subframe is $N = LMF$. *M* and *F* are configurable by the base station



UL Initial Access Channel (2/2)

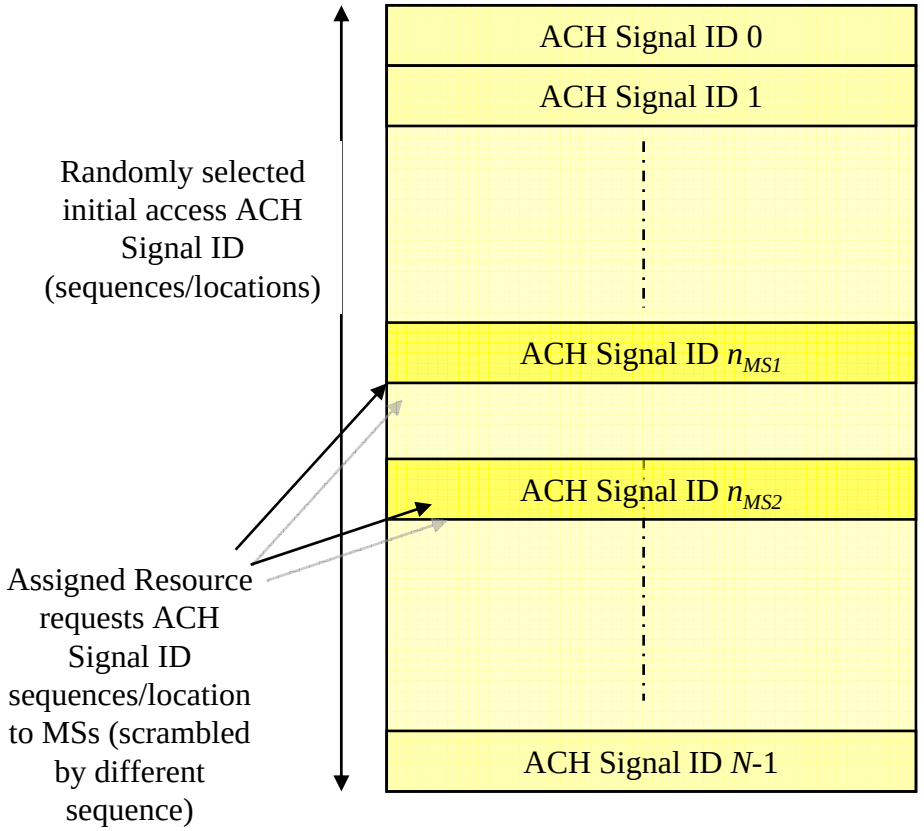
- Sequences are scrambled by sector ID and access/request type
  - For Initial access channel, the access type specifies whether an MS has already been assigned a User ID, such as user in handoff
- Sequences are FFS.

UL Resource Request

- The MS sends a resource request requires to obtain an uplink resource allocation. Two type of UL resource requests are defined:
  1. Resource/renewal request indication. An indication is sent to the base station specifying that the MS requires a resource assignment.
     - The BS responds with an allocation of a preconfigured resource assignment, and continuation of an existing service, or a default allocation.
     - The further configuration of the resource request can be specified in a MAC message embedded in the transmissions
     - Indication occurs using the ACH signaling ID's, but scrambled by a resource renewal specific scrambling sequence
     - Can also be sent on the user specific UL resources
  2. Resource/renewal request message
     - An message is sent to the base station specifying that the MS requires a resource assignment along with some parameters of the assignment (delay constraints, QoS, packet backlog, resource size, etc)
     - This message is sent on the user specific UL control resources
- The mobile can choose the form (and location) of the message
  - In some cases, if the mobile's assigned UL control resources may occur infrequently
- Sequences are scrambled by sector ID and access/request type
  - For resource request channel, the request type specifies a request for a pre-configured service or assignment.

Multiplexing of UL Initial Access Channel and Resource Request Channel

- A resource request indication can be sent on the signaling ID's for initial access.
  - Resource requests are scrambled by a different scrambling code
- The *N* signaling ID's are used for two types of indications
  - Access requests. MS randomly selects one N spreading sequences/locations
    - Scrambled by access request specific sequence
    - Specific sequence may also specify whether request is handoff or Initial access
  - Resource request. MS uses pre-assigned ACH signaling ID of N sequences/locations
    - Scrambled by resource request specific sequence
- Multiple signaling resources can be assigned to the same mobile for multiple service requests



UL Resource Request on MS specific UL Control Resource

- In basic operation, the request by the mobile for UL resources is made on resources within UL control tiles
- The UL control resources are specified persistently for each MS (see contribution IEEE C80216m-08/351 for further details)
  - These resources sizes may be different for different frames according to a pre-determined pattern. This sizes are known at the mobile and base station and do not need to be signaled after configuration
- The resource request occupies a field provisioned for some other message (CQI, ACK/NAK, precoder index etc).
  - The presence of a request is specified by the UL control message type.
  - The mobile sets this type to a message configuration that includes space for a resource assignment. Therefore, the size of the message is not changed from the specified size for that subframe.
  - The presence of the request field is dynamic, but does not affect the pre-determined size of the user's UL control.
- Resource request is encoded with other UL control data for user so that resource request can be reliably received
- Two types of resource request messages are specified dynamically by control message type:
  - Indication continuation or renewal of existing or configured allocation
    - Low impact or messages "replaced" in UL assignment
  - Request message containing further details of the resource request
    - delay constraints, QoS, packet backlog, resource size, etc are indicated
    - Further details of assignment can be given in a re-configuration message, or known from previous or default configurations.

UL Resource Allocation and Re-Configuration via MAC Header

- After a mobile has been assigned a UL resource, assignment can be further configured through additional MAC message encoded with data packet
  - Parameters for first transmission are specified by BW request, set to default based on capability negotiation, set to previous configuration based on renewal, or set in some other manner
  - The mobile can change the assignment parameters by including additional re-configuration message encoded with data, to take effect at the start of the next packet transmission
    - Takes advantage of HARQ for this control message
- ACK/NAK of packet transmission provides mobile with indication that re-configuration message was correctly received

Summary

- Channels for initial access and resource requests are proposed.
- Resources request indicators and messages are defined allowing for different amounts of information, and different urgencies in the request
  - Resource request indications are multiplexed with initial access requests or with UL control.
  - Resource request messages are multiplexed with UL control