

Advanced Handover Schemes in IMT-Advanced Systems

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Introduction

- As diverse wireless communication services proliferate, and anytime-anywhere communication is becoming a norm in mobile communication
- IEEE 802.16m and Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) -Advanced, are designed with stringent requirements on interruption time during handover
- IEEE 802.16m and 3GPP LTE/LTE-Advanced air interface specifications provide enhanced link layer handover mechanisms providing short handover interruption time.



Introduction

- For IEEE 802.16m, its physical layer frame structure is designed with the legacy IEEE 802.16e in mind.
- Two zones are partitioned, the legacy zone (Lzone) and IEEE 802.16m zone (Mzone), to support both IEEE 802.16e operating devices and IEEE 802.16m operating devices.
- IMT-Advanced has clear latency requirements on handover, which will be a key performance measure for any fourth-generation (4G) technology.



The general network architecture



The general network architecture of a) E-UTRAN; b) an IEEE 802.16m-based WiMAX system.



The general network architecture



- a) greenfield deployment (new spectrum); b) mixed deployment, carrier reuse;
- c) mixed deployment, carrier overlay.



The general network architecture



Overall handover procedures

- Handover in both systems, the serving BS tries to negotiate with one or more candidate target BSs for handover preparation by sending a handover request message to each candidate BS.
- The preparation includes resource reservation at the target BS
- setup of a data forwarding path between the serving BS and target BS
- allocating dedicated random access code/opportunity for the MS to access the random access channel during network re-entry
- he target BS replies with a handover response message in response to the handover request
- Such information is forwarded to the MS via the serving BS.



Overall handover procedures





Handover Exception Handling

 The MS is required to complete the network re-entry procedure within a duration defined by the target BS during handover preparation.

If the MS has failed to do that, the handover is considered failed.

• the MS performs cell reselection to find an alternative target BS and performs the network re-entry procedure.



Entry Before Break (EBB) handover

- EBB handover is one important handover optimization defined in the specification.
- When performing EBB, based on its capability, the MS performs network re-entry at the target BS during the negotiated network re-entry procedure intervals, while maintaining communications with the serving BS for data exchange up to the point of completion of network re-entry at the target BS.
- EBB can be finely scheduled to minimize the total interruption time during handover.



EBB handover



• General EBB handover procedures: a) single-carrier.





• General EBB handover procedures: b) multicarrier.

Legacy supported handover

- Handover from a 16e BS to a mixed-mode 16m BS
- Handover from a 16e BS to an advanced only 16m BS
- Handover from an advanced only 16m BS to a 16e BS
- Handover from a mixed-mode 16m BS to a legacy 16e BS



Handover from a 16e BS to a 16m Mixed Mode BS

- When a 16m MS performs handover from a 16e BS to a mixed-mode 16m BS, it follows the conventional IEEE 802.16e handover procedure.
- In the conventional IEEE 802.16e handover, the MAC address of the 16e MS is signaled to the target 16e BS without any security measures, and hence is prone to malicious location tracking of such devices.
- The IEEE 802.16m handover provides a T-STID, which is used for security key agreement.



Handover from a 16e BS to a 16m Mixed Mode BS





Handover from a 16e BS to a 16m Only BS

- This case incurs the largest interruption time, since the 16e BS and 16m BS may not have an interface to support full handover optimization for network re-entry in the 16m air interface.
- In case of a legacy ASN : MAC context setup are still required.
- In case of a 16m ASN:16m MS has to perform full network entry to reestablish its context with the network



Handover from a 16m BS to a 16e BS

- This may be done in two ways.
- The 16m MS may zone switch to the LZone and perform a legacy handover to the 16e BS.
- The other case is where the 16m MS performs direct handover from the serving 16m BS's MZone to the target 16e BS.



The handover framework of LTE

- The LTE handover framework is a hard handover similar to IEEE 802.16m, but only allows BBE operation.
- LTE's handover is more tightly controlled by the network in terms of both handover initiation and target selection.
- The LTE user plane handover procedure also supports two different modes: seamless handover and lossless handover.



CONCLUSION

- IMT-Advanced candidate air interface specifications IEEE 802.16m and 3GPP LTE-Advanced provide advanced handover mechanisms in order to provide enhanced user experience during handover.
- In this article will enhance the user experience substantially by providing reduced handover interruption time and less of a coverage hole due to new system deployment.

