# Operator Mobility Review

**IEEE 802.16 Presentation Submission Template (Rev. 8.3)**

Document Number:

IEEE C802.16e-04/236

Date Submitted:

2004-07-07


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Venue:

Portland Plenary July 2004

Base Document:

Purpose:

FYI

# Operators view of Handoff & Mobility Requirements for 802.16e

***July, 2004***




# Contents

# Handoff Requirements

- The system design should support mobility for data services at 60 km/hr with an option to support 120 km/hr with graceful degradation of data rate.
  - Latency (data path interruption) with <1% packet loss
    - <150 ms between sectors in a BS
    - <150 ms between BS within same IP Subnet
    - <1s between IP Subnets
  - Frequency Re-Use - 1x1, 1x3 (Cell Re-Use x Sector Re-Use).
    - Sector to sector (Re-Use of 3 or 1 assuming 3 sectors)
    - Cell to Cell (Re-Use of 1)
  - Handoff Support
    - Frequency HO (i.e. F1 to F2)
      - Assume 1:3 frequency re-use per BS
      - Multi-frequency per sector (load balance)
    - Make Before Break vs. Break Before Make
      - Must meet latency requirements as above
    - Investigate FFT/BW HO (sectors/BS with different FFT/BW)
  - Assumption is that IP based applications will continue during handoff and buffers will maintain session continuity

# Future Mobility Requirement

- Real-time applications (including VoIP) with seamless handoff is future requirement
  - Latency (data path interruption) with 1% packet loss
    - <50 ms between sectors in a BS

# Position Statements/ Clarifications

- **Frequency Re-Use** :Sprint will design to 1X3 frequency reuse cells. (Same frequency plan per cell, three sectors with different frequencies). Cells will be augmented using multiple carriers within sectors and load balancing amongst carriers is expected of the system. We are open to 1x1 re-use under certain conditions.

- **Ping-Pong:** Methods to prevent ping pong from sector to sector or cell to cell need to be considered. Macro-diversity must be enabled in the system.

- **Realtime/fixed:** We are requiring the metrics presented above for 802.16e. We will not be requiring VoIP support for Mobile users day one. We will however require IP QoS support for fixed/portable users day one so realtime applications can be supported. In 802.16d optional SS initiated service flow creation must be supported 802.16d5 section 6.3.14.7.1.1. Service Class support which is optional in 802.16d is required as described in 802.16d/5 6.3.14.3.

- **BBM:** If Modeling of break before make handoff is done and our required minimum performance metrics cannot be met we will reevaluate our position on the metrics and other handoff methods.

- **Fast-Cell Switching**: We are looking for the highest capacity and aggregate throughput per sector and cell possible with data handoff/mobility. Fast Cell Switching or Hybrid need to be investigated although are challenged by potential high overhead and Back Haul requirements. A method of setting a thresholds that could later be adjusted and allows for these enhancements to be installed initially and reconfigured to enhance mobility later would be desirable.

- **SHO:** Soft Handoff is the least desirable handoff method due to Capacity considerations for cell/sector capacity and backhaul requirements.

# Handoff Considerations

- 3 frequency parameter exchanges:
  - center frequency (<11 GHz)
  - BW (1.25-20 MHz)
  - FFT size (128, 256, 512, 1024, 2048)
- Local Neighbor List
  - <20 neighbor BS per BS
  - Statically vs. Dynamically assigned
- Active BS set (limit to serving BS and target BS

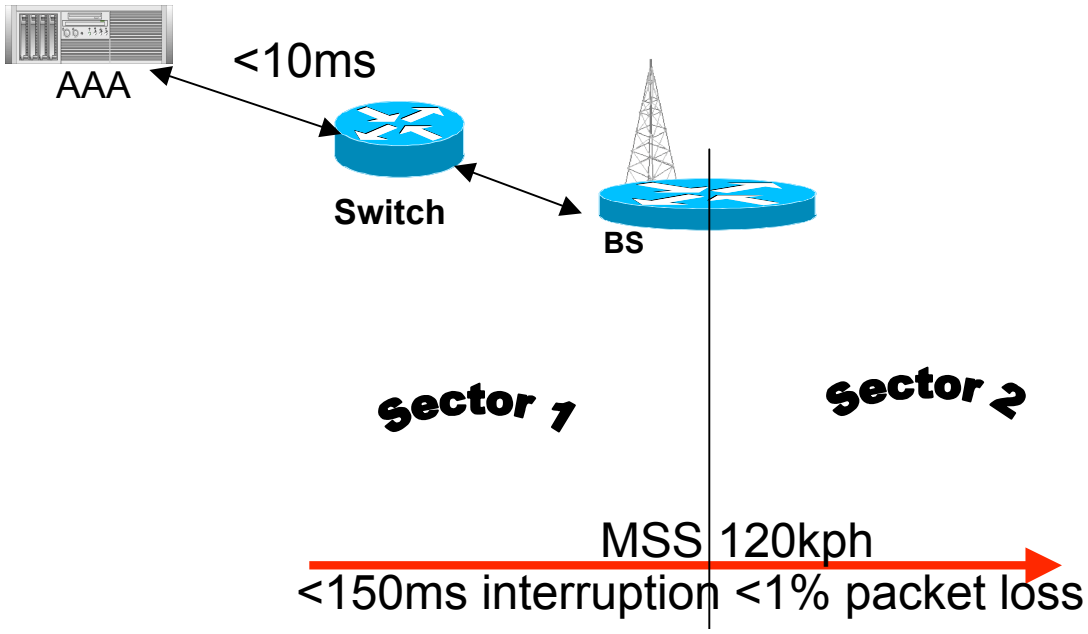
# Idle Mode HO

- Idle Mode HO should be a simple location (i.e. parameter) update
  - Compare “new” Paging Zone ID (with each new BS DL sync) with MSS’ stored Paging Zone ID and send an update only if different
  - Appropriate messaging sent back to “location register” (probably outside scope of 802.16e)

# Modeling Scenarios

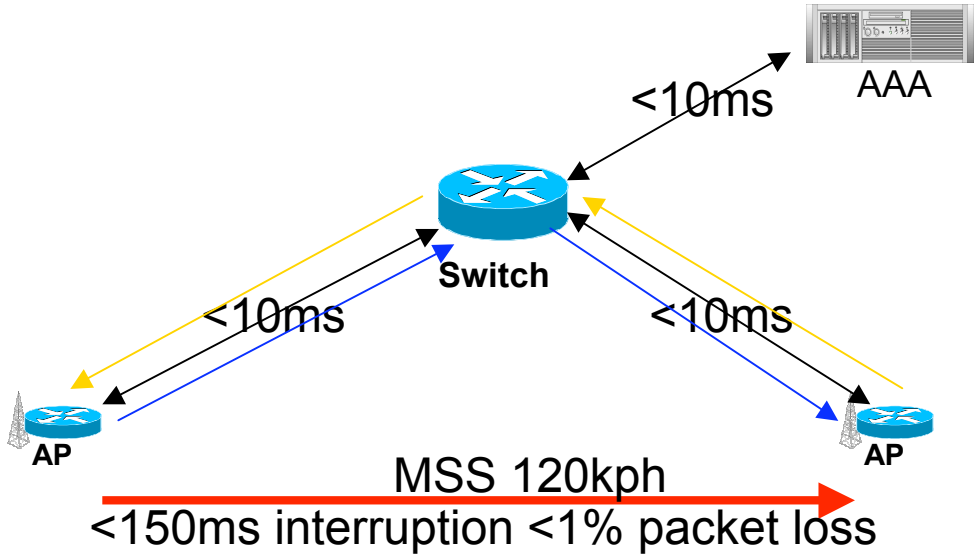
# Scenario: Inter sector same BS Break Before Make handover within same Subnet

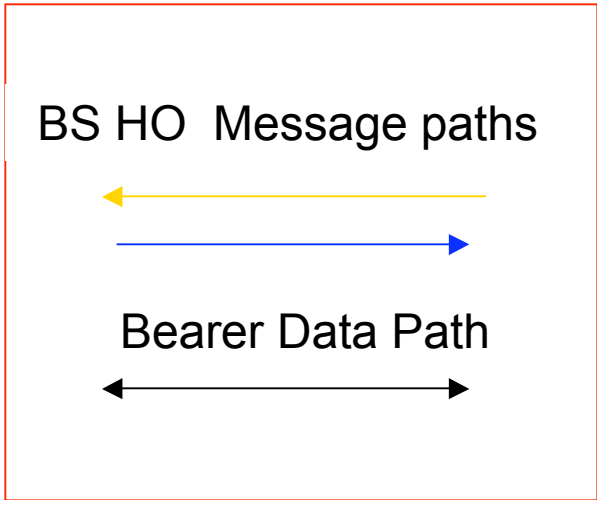
- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- Need modeling to prove or disprove feasibility of requirement being met.
- Assumes flat network with two sectors in one BS access switch providing only transport. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph.



# Decentralized Break Before Make Scenario BS to BS handover within same Subnet

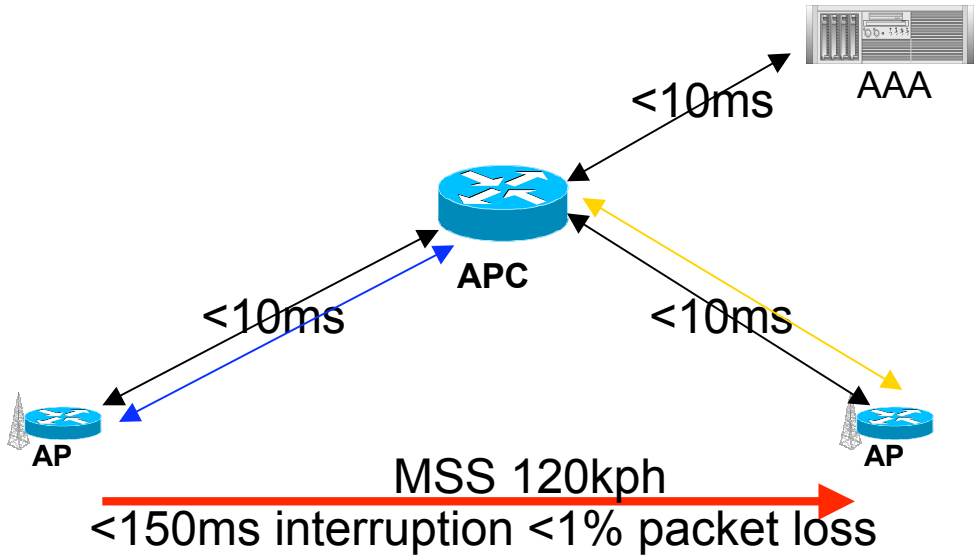
- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- Need modeling to prove or disprove feasibility of requirement being be met.
- Assumes flat network with two BS connected by links no more that 10ms each to a shared access switch providing only transport. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph.

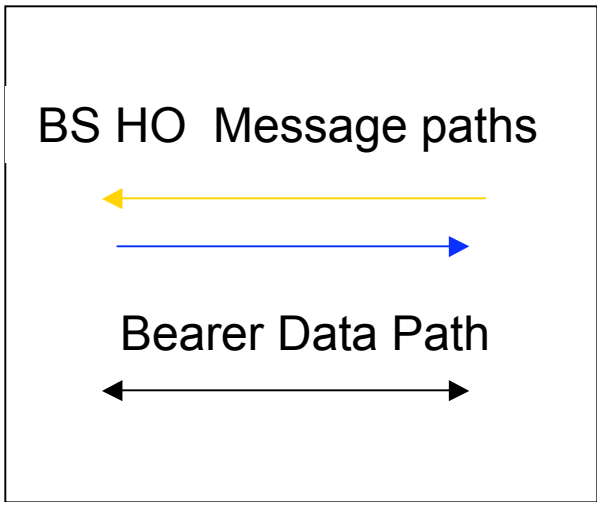


## Anchored Break Before Make Scenario BS to BS handover within same Subnet

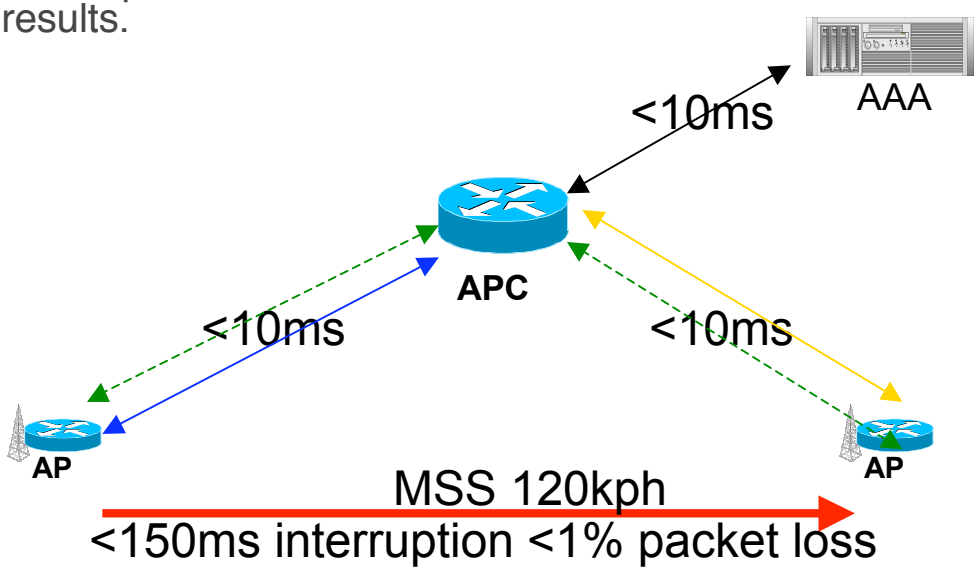
- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- Need modeling to prove or disprove feasibility of requirement being be met and estimate enhancement over decentralized architecture.
- Assumes flat network with two BS connected by links no more that 10ms each to a shared access switch providing enhanced switching BSC/APC like functionality. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph.

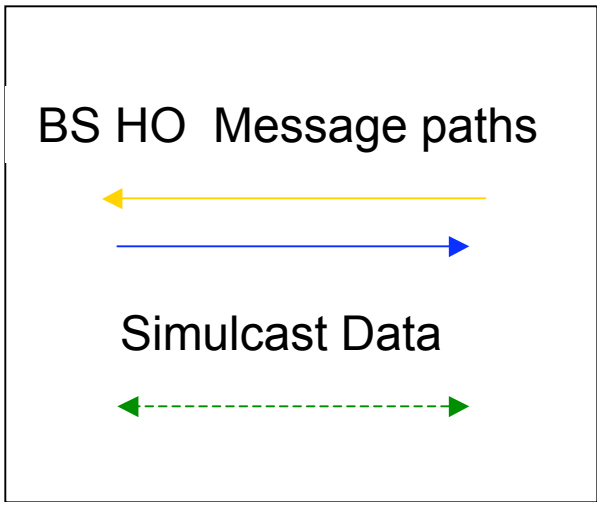


# Anchored Fast Cell Switching

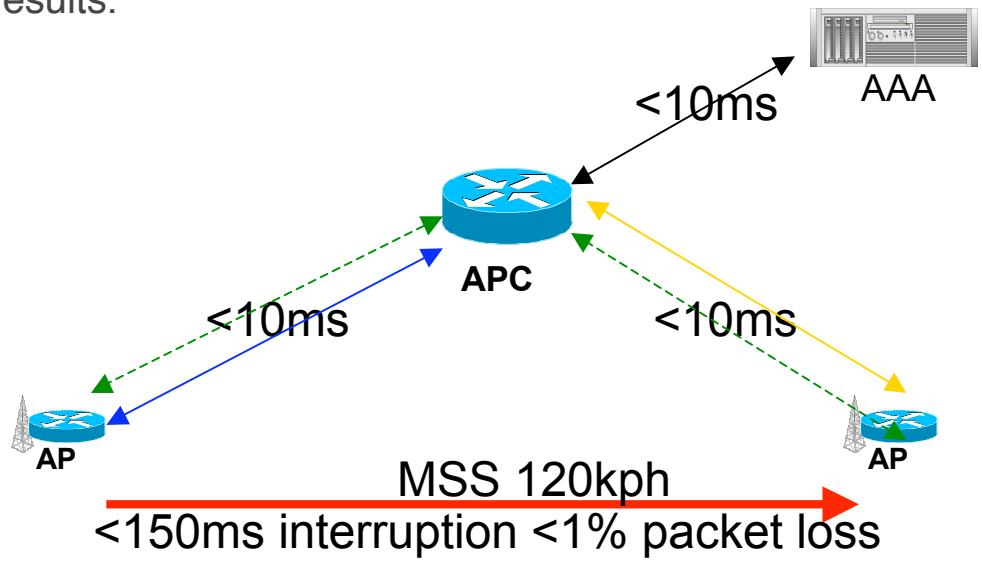
- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- This scenario assumes a central BSC/APC like device that bicasts the bearer data to current and target BS the MSS receives data only from the current BS. At handoff the data source is switched and the data is already at the target BS so delivery is almost instant.
- Need modeling to prove or disprove feasibility of requirement being be met and estimated enhancement over centralized architecture without Fast Cell Switching. Back haul and AI resources required to support the signaling and the data bicast must also be modeled and broken out. Any mechanism that keeps bicasting form occurring on all MSS that can see two sectors must be described.
- Assumes flat network with two BS connected by links no more that 10ms each to a shared access switch providing enhanced switching BSC/APC like functionality. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph. If it is estimated that VoIP and video conference would survive present the results.

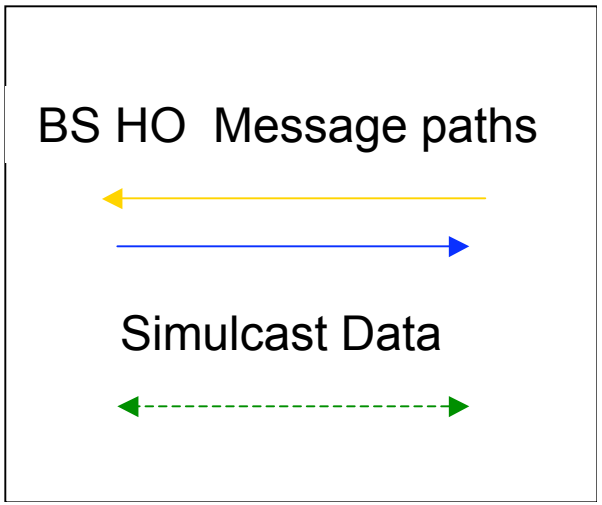


# Anchored Soft Handoff

- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- This scenario assumes a central BSC/APC like device that bicasts the bearer data to current and target BS the MSS receives data from the current and target BS. At handoff data is flowing to the MSS form more than one BS.
- Need modeling to prove or disprove feasibility of requirement being be met and estimated enhancement over centralized architecture with Fast Cell Switching. Back haul and AI resources required to support the signaling and the data bicast must also be modeled and broken out. Any mechanism that keeps bicasting form occurring on all MSS that can see two sectors must be described.
- Assumes flat network with two BS connected by links no more that 10ms each to a shared access switch providing enhanced switching BSC/APC like functionality. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph. If it is estimated that VoIP and video conference would survive present the results.



# Hybrid Soft Handoff with Fast Cell Switching

- Requirement <150ms interruption of data stream with under 1% packet loss with 1000ms spanning the event.
- This scenario assumes a central BSC/APC like device that bicasts the bearer data to current and target BS the MSS receives data from the current and target BS for low bandwidth high priority requirements the safety channel is used to transport this data. High Bandwidth handoffs use fast cell switching.
- Need modeling to prove or disprove feasibility of requirement being be met and estimated enhancement over centralized architecture with Fast Cell Switching only like VoIP support should be noted and capacity for this type of handoff.. Back haul and AI resources required to support the signaling and the data bicast must also be modeled and broken out. Any mechanism that keeps bicasting form occurring on all MSS that can see two sectors must be described.
- Assumes flat network with two BS connected by links no more that 10ms each to a shared access switch providing enhanced switching BSC/APC like functionality. AAA is within local network no more that 10ms additional hop and is shared by both BS.
- Data applications such as Http, Ftp, telnet, ssh, Pop3, SMTP, P2P, Tftp and one way streaming audio or video connections must be able to survive the interruption at 120kmph. If it is estimated that VoIP and video conference would survive present the results.