

Broadband Mobile Systems

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Purpose:

To help 802.16 MBWA SG in the PAR discussions. To provide technical material in support of the mobility PAR.

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Broadband mobile systems

Outline

- Definition of Service
- Essential Requirements
 - business case
 - Technical
- Benefits and Advantages of Spatial Processing
- A Good MBWA Solution
 - design for spatial channels and mobility
- Conclusion

MBWA Service

- Wide-area coverage
- Ubiquitous, always on
- Low cost
- High-speed Internet
- Delivered to mobile users at a range of speeds

MBWA Business Case Requirements

- Cellular-like coverage
 - macrocell economics permit consumer pricing
 - outdoor & reasonable indoor coverage for ubiquity
- Mobility implies deployment below 3 GHz
- Below 3 GHz implies small spectrum blocks
- Large number of users near peak data rates
- High data rate (peak user data rate > 1 Mbps)
 - data rates > 1 Mbps mobilize most IP applications
- Low cost modem hardware that easily integrates into subscriber unit

Technical Requirements

- Spectral efficiency greater than 3 b/s/Hz/cell in a fully loaded system
- Support for vehicular mobility
- Frequency Reuse < 1
- Matching of UL and DL range in mobile environment
- Low power user terminals

Spatial Processing Benefits Summary

<p>Selective Uplink Gain</p> <p>*Receive processing at base station</p>	<p>Increased Range, Coverage, Link budget</p> <ul style="list-style-type: none">•$10 \cdot \log_{10}(M)$ gain•13dB – 17dB diversity gain•Lower terminal transmit power•Uplink Multipath Immunity
<p>Uplink Interference Mitigation</p> <p>*Receive processing at base station</p>	<p>Improved Signal Quality</p> <ul style="list-style-type: none">•Robust to interference from multiple uplink interferers•30dB – 40dB interference immunity <p>Higher spectral efficiency</p>
<p>Selective Downlink Gain</p> <ul style="list-style-type: none">•Transmit strategy based on uplink information and feedback from terminal	<p>Increased Range, Coverage, Link budget</p> <ul style="list-style-type: none">•$20 \cdot \log_{10}(M)$ gain•13dB – 17dB diversity gain•Reduced base station PA sizing•Reduced Downlink Multipath
<p>Downlink Interference Mitigation</p> <p>Transmit strategy based on uplink information and feedback from terminal</p>	<p>Improved Signal Quality</p> <ul style="list-style-type: none">•Automatically reduces signal transmission to co channel interference•Increases system-wide downlink signal quality•30dB – 40dB interference immunity <p>Higher Spectral Efficiency</p>

Spatial Processing Advantages

- Beamforming
 - Higher capacity/Larger range
 - Cheaper power amplifiers
 - Interference rejection
 - Fading mitigation, equalizer simplification
 - Low frequency re-use, improved capacity
 - Spatial Channels
 - Higher capacity/Larger range
 - “Soft” collision
- ☞ Significant benefits even with Smart Antenna at BS only

A Good MBWA Solution

- Critical design issues for spatial channels and mobility
 - Use of TDD
 - Fully leverage channel reciprocity for downlink beamforming
 - Training for downlink
 - Matching the range of broadcast, control and traffic channels
 - Collision resolution using spatial processing
 - Sufficient and unique training data per spatial channel
 - MAC support of spatial channels design aspects
 - Reduce dependence on broadcast/multicast information
 - Leverage smart antenna advantages

Conclusion

- The MBWA business case and technical requirements call for a highly spectrally efficient air interface
 - Design for spatial processing provides an excellent solution to MBWA challenge
 - TDD option to best leverage spatial processing techniques
 - Design for spatial processing has implications for both MAC/PHY
- ☞ We support a new WG in IEEE 802 for MBWA