IEEE 802.16m Update

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These slides are available on-line at:

http://www.cse.wustl.edu/~jain/wimax/16m0706.htm

- Requirements:
  - General requirements
  - Functional Requirements
  - Performance Requirements
  - Operational requirements
- 802.16m Evaluation Methodology: ToC

TGm Technical Documents

- System requirements document (SRD)
  - Requirements to be met by 16m
  - Defines scope of SDD and TGm amendment
  - Similar to stage 1 in 3GPP
- Evaluation methodology
- System description document (SDD)
  - Describes complete 16m end system
  - Captures technical decisions
  - Similar to stage 2 in 3GPP
- TGm Amendment: Detailed specification

IEEE 802.16m Overview

- Candidate for IMT-Advanced evaluation process
- IMT-Advanced next generation mobile networks ITU-R report M.2072
- Amendment to 802.16-2004 and 16e.
- Advanced air interface for operation in licensed bands

General Requirements

- Meet all the IMT-Advanced performance requirements.
- System requirements for a system comprising of all new MSs and BSs.
- Legacy support: Mobile System Profile, Release 1.0 (Revision 1.4.0: 2007-05-02) [1].
  - 16m MS shall be able to operate with a legacy BS
  - 16m and 16e shall be able to operate on the same RF carrier, with the same/different channel bandwidth
  - 16m BS shall support a mix of 16m and legacy MSs
  - 16m BS shall support seamless handover of a legacy MS to and from legacy BS
- Minimize complexity and number of options

General Requirements (Cont)

- Operating frequencies: less than 6 GHz
- Operating bandwidths: 5 to 20 MHz and more.
- Duplex schemes: TDD and FDD, HFDD
- Both unpaired and paired frequency allocations
- UL/DL ratio should be configurable in both TDD and FDD
- Downlink-only configurations on a given carrier.
- Advanced antenna techniques
  - Minimum 2 Xmit and 2 Rcv For BS
  - Minimum 1 Xmit and 2 Rcv for MS
    => Minimum 2x2 downlink and 1x2 uplink

General Requirements (Cont)

- Support for government mandates and public safety first responders, military and emergency services such as call-prioritization, pre-emption, push-to-talk.
- Emergency Services (E9-1-1) [12] and Communications Assistance for Law Enforcement Act (CALEA) [13] [14]

Functional Requirements

- Peak data rate:
  - Downlink (BS->MS) > 6.5 bps/Hz,
    Uplink (MS->BS) > 2.8 bps/Hz
  - After phy overhead pilots, cyclic-prefix, guard bands and guard intervals.
  - 20 MHz => 130 Mbps
- Latency : Lower than 16e in all cases - air link, state transition delay, access delay, and handover.
  - Data latency: Deliver one one MAC PDU Downlink (BS->MS) 10 ms max, Uplink (MS->BS) 10 ms max
  - State transition latency: from idle to active mode in less than 100ms
  - Max Handover interruption time: Intra-frequency 50 ms, Inter-frequency 150 ms

Functional Requirements (Cont)

- QoS: Maintained when switching between radio access technologies (RATs)
- Service continuity during handover for both inter-RAT and intra-RAT handover.
- Enhanced multicast broadcast service (E-MBS) via a dedicated carrier.
- Optimized switching between broadcast and unicast services
- Max MBS channel reselection interruption times: Intra-frequency 1s, Inter-frequency 1.5s
- High resolution location determination.
- Reduce overhead associated with headers of higher layer protocols
- Multi-RAT operation: 802.11, 3GPP GSM/EDGE, UMTS WCDMA, LTE, CDMA2000

Performance Requirements

- 2x user throughput related to 16e
- 2x sector throghput (bps/Hz/Sector) in DL, and 1.5x in UL
- 1.5x VOIP capacity (active users/MHz/sector)
- Min 60 active VOIP users/MHz/sector assuming a 12.2 kbps codec with a 40% activity factor
- Mobility: Optimized for 0-15 km/h, marginal degradation 15-120 km/h, maintain connection 120-350 km/h
- 3 dB improvement in link budget over 16e
- Optimized for cell sizes of up to 5km. Graceful degradation in spectral efficiency for 5-30km. Functional for 30-100 km.

Performance Requirements (Cont)

- E-MBS services with 4 bps/Hz for inter-site distance of 0.5 km, 2 bps/Hz for 1.5km
- Both mixed unicast/multicast and dedicated MBS carriers
- Location-based services:
  - Handset-based position accuracy 50m (67% of time) 150m (95% of time)
  - Network-based position accuracy 100m (67% of the time) 300m (95% of the time)

Operational requirements

- Operate in lagacy 16e spectrum
- Operate in other legacy RAT spectrums
- 16m should provide enhancements to enable multi-hop relays.
- Synchronize frame timing and frame counters with BSs of same-technology neighboring systems
- Co-deployment with other networks
  - 16m is anticipated to be deployed in the same RF bands as the legacy network.
  - Co-deployable in same or overlapping geographical areas with other RATs

802.16m Evaluation Methodology: ToC

1. Introduction
2. System Level Set-up
3. Duplex Schemes
4. Channel Models: TDL Models, TDL Models with Antenna Correlation, System Model Definition, Channel Mix, Interference Channel Modelling, Path Loss Model, Spatial Channel Model
5. Link-to-System Mapping: PHY Abstraction, Mutual Information/Capacity ESM, EESM
6. Link Adaptation: Adaptive Modulation and Coding, H-ARQ,Channel Quality Feedback,
7. HARQ: ACK/NACK Channel

802.16m Evaluation ToC (Cont)

8. Scheduling: DL scheduler UL scheduler
9. *Handoff: Single Mobile MS Model, Trajectories, Cell Topology, Handover Performance Metrics*
10. *Power Management (informative)*
11. Traffic Models: HTTP, FTP, VOIP, NRT Video Streaming, Gaming, Traffic Mixes
12. Simulation Procedure and Flow
13. *Simulation Outputs and Performance Metrics*
14. Template for Reporting Results

802.16m Evaluation ToC (Cont)

Appendix-A: Correlation of Angular Spread and Shadowing Factor

Appendix-B: Calculation of Circular Angular Spread

Appendix-C: Spatial Correlation Calculation

Appendix-D: Polarized Antenna

Appendix-E: LOS Option with a K-factor

Appendix-F: Antenna Gain Imbalance and Coupling

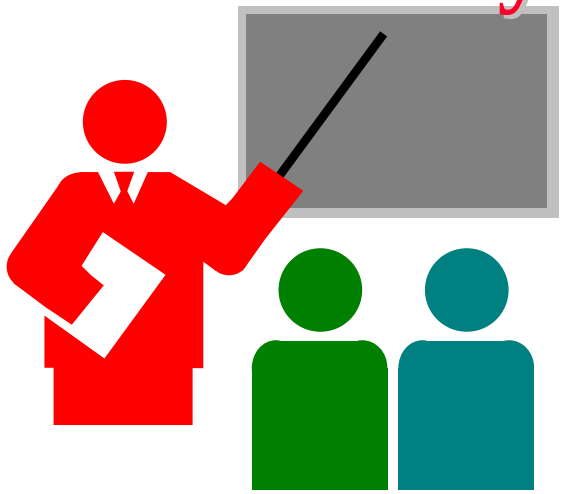
Appendix-G: 19-Cell Wrap-Around Implementation

Appendix-H: Calculation of PAPR and Cubic Metric

Appendix-I: Overhead Calculations

Appendix-J: Fixed User Locations For System Level Calibration

Summary



- Requirements document draft is almost complete
- Evaluation methodology document is being revised. New version to be released 6/18/07.

Abbreviations and acronyms

- CALEA Communications Assistance for Law Enforcement Act
- E-MBS enhanced multicast broadcast service
- LBS location based services
- MBS multicast broadcast service
- MBSFN multicast broadcast single frequency network
- MIH media independent handover
- MS mobile station
- NCMS network control and management services
- RAN radio access network
- RAT radio access technology
- RRM radio resource management

References

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- Draft IEEE 802.16m Evaluation metholodlogy document, April 17, 2007, http://ieee802.org/16/tgm/docs/C80216m-07_080r1.pdf

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[1] IEEE 802.16m PAR, December 2006, http://standards.ieee.org/board/nes/projects/802-16m.pdf

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[3] IEEE Std 802.16-2004: Part 16: IEEE Standard for Local and metropolitan area networks: Air Interface for Fixed Broadband Wireless Access Systems, June 2004

[4] 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 IEEE Std. 802.16-2004/Cor1-2005, Corrigendum 1, December 2005

[5] Recommendation ITU-R M.1645: Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000, January 2003

[6] ITU-R Document 8F/TEMP/495-E: Draft Guidelines for Evaluation of Radio Transmission Technologies for IMT-Advanced, January 2007

[7] ITU-R Document 8F/TEMP/496-E: Draft [Report on] Requirements Related to Technical System Performance for IMT-Advanced Radio Interface(s), January 2007

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[10] 3rd Generation Partnership Project 2, "cdma2000 Evaluation Methodology", 3GPP2 C.R1002-0 Version 1.0, December 2004, http://www.3gpp2.org/Public_html/specs/C.R100225 0_v1.0_041221.pdf

[11] WiMAX Forum System Performance White Paper, http://www.wimaxforum.org/technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf

[12] FCC Docket no 94-102 this includes order numbers 96-264, 99-96, 99-245.

[13] Communications Assistance for Law Enforcement Act of 1994 (CALEA), Pub. L. No. 10323 414, 108 Stat. 4279.

[14] Communications Assistance for Law Enforcement Act and Broadband Access and Services First Report and Order and Further Notice of Proposed Rulemaking. ET Docket No. 04-295, RM-10865, 20 FCC Rcd 14989 (2005).