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Title	**Desired Characteristics for an MBWA Air Interface**
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Re:	IEEE 802.20 Session#1 Call for Contributions
Abstract	This accompanying presentation discuss desired characteristics for an MBWA Air Interface
Purpose	For informational use only
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Desired Characteristics for an MBWA Air Interface

John L. Fan

IEEE 802.20 MBWA

March 10-13, 2003

Outline

- **Overview**
- Existing characteristics
- PHY-related characteristics
- MAC-related characteristics

High-level Characteristics of MBWA

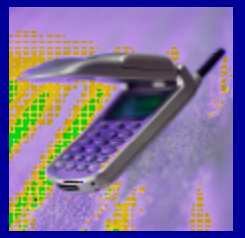
- Wireless Data Links for Mobile Devices
- Operating in Licensed Cellular Spectrum
- Designed for IP-based Data Services

Wireless Data Links for Mobile Devices

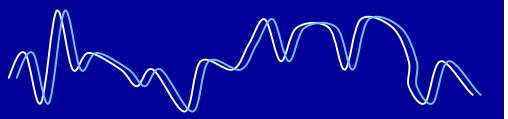
Handheld and portable data devices

- Laptop computers (via PC Card)
- Personal Digital Assistants
- Digital Cameras
- Data Enhancement for Mobile Phones
- Mobile Gaming Devices




Characteristics

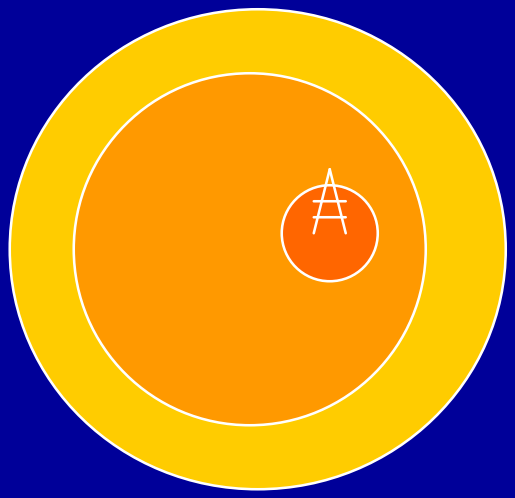


- Provides the user with “always on” connectivity
- Supports robust performance over vehicular wireless channel
- Enables low power, low cost and small form factor
- Inter-technology roaming, open interfaces, QoS support

Operating in Licensed Cellular Spectrum

- Use deployment parameters typical of cellular systems
  - Coexistence with existing wireless systems
  - Leverage existing infrastructure (e.g., cell towers)
  - Benefit from mass market RF components and equipment

- Characteristics
  - Spectrum (< 3.5 GHz)
  - Channel bandwidth (e.g., 1.25 MHz)
  - Cell size
  - Sectorization
  - Frequency Reuse



Designed for IP-based Data Services

- Take advantage of vast content on the Internet and the ubiquity of IP-based applications
  - World Wide Web
  - Electronic mail
  - File download and uploads
  - Video and audio streaming
  - Voice over IP (VoIP)
  - Virtual Private Network (VPN)
  - Financial transactions
  - Online multiplayer gaming
  - Instant messaging
- Provide robustness and throughput equivalent to a wireline link
- Characteristics
  - High throughputs for DL and UL (peak, sustained)
  - Low latency link (fast ACK)
  - User states based on IP data traffic models

MBWA Characteristics (from PAR)

Parameter	Value for *1.25 MHz paired FDD* *2.5 MHz unpaired TDD*
Spectrum	< 3.5 GHz
Peak user data rate (DL)	*> 1 Mbps*
Peak user data rate (UL)	*> 300 Kbps*
Peak aggregate DL data rate per cell	*> 4 Mbps*
Peak aggregate UL data rate per cell	*> 800 Kbps*
Mobility	Up to 250 km/h
Spectral efficiency (sustained)	> 1 b/s/Hz/cell
Airlink MAC frame RTT (ARQ loop time)	< 10 ms

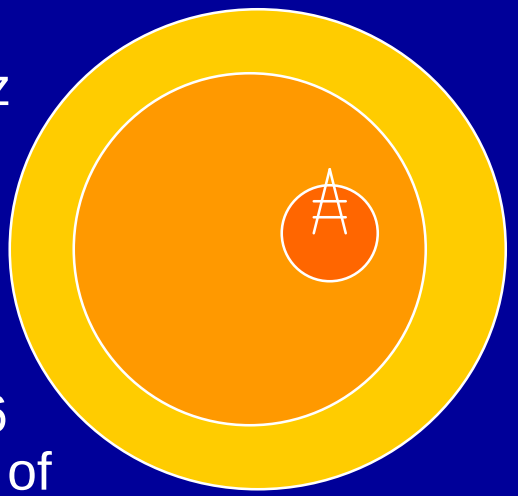
These values are directly dependent on the channel bandwidth

Outline

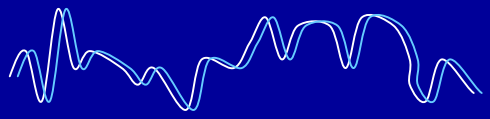
- **Overview**
- Existing characteristics
- **PHY-related characteristics**
- MAC-related characteristics

Cellular Wireless Characteristics

- **Cell Size**: Typical of macro-cellular operation.
- **Channel Bandwidth:** For full performance evaluation of FDD systems, use paired 1.25 MHz spectrum.
- **Carrier Frequency:** For full performance evaluation, use 1.9 GHz. For informational evaluation, consider 800 MHz.
- **Sectorized Operation:** System should support 6 or more sectors per cell (with typical deployment of 3 sectors/cell).
- **Universal Frequency Reuse**: System should allow same frequencies to be reused in all cells and sectors (frequency reuse factor =1 or less).



Robustness on Wireless Channel



- **Doppler Tolerance**: Support Doppler spread of more than 400 Hz, with graceful degradation of data rates and performance for higher Doppler.
- **Delay Spread Tolerance**: Based on channel models, the system should tolerate 10 microseconds of delay spread, with graceful degradation for longer multipath.
- **Advanced coding:** The forward error correction (FEC) should achieve state-of-the-art performance in terms of coding gain. For a rate ½ code, the required SNR for 10^{-2} FER should be within 1.5 dB of theoretical limit on a binary-input AWGN channel (which is Eb/N0=0.2 dB). Thus the required Eb/N0 is 1.7 dB.

Summary of PHY Parameters

Parameter	Proposed value
Channel Bandwidth	1.25 MHz paired spectrum for FDD
Carrier Frequency	1.9 GHz for full evaluation; 800 MHz for informational evaluation
Sectorized Operation	Supports 6 or more sectors/cell (typical deployment 3 sectors)
Doppler Tolerance	> 400 Hz
Delay Spread Tolerance	> 10 us
FEC Gap from Capacity at rate ½ for FER=10^{-2}	< 1.5 dB

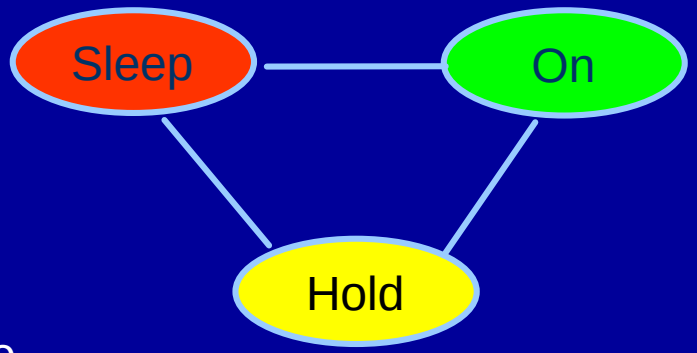
Outline

- **Overview**
- Existing characteristics
- PHY-related characteristics
- **MAC-related characteristics**

MAC states

- Corresponding to user states based on the data traffic models, there should be MAC states for efficient use of system resources.

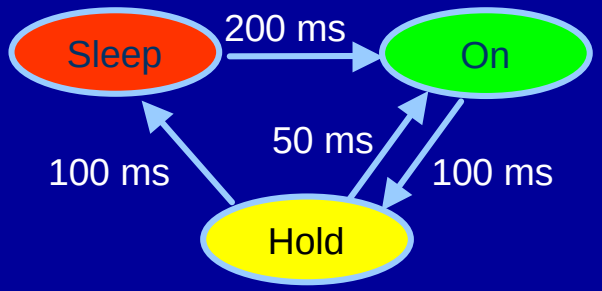
- **MAC States:**
  - "On" state - user is actively using system resources to transmit and receive data.
  - "Hold" state - for conserving air-link resource usage when users are temporarily not using the system
  - "Sleep" state, where the mobile is inactive.



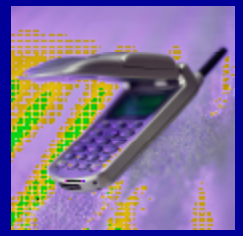
- **Number of users:** Should support more than 100 active users per sector/cell.
- **State transitions:** Should be fast and dynamic

Transitions

- **State transitions:** Fast transitions between states improve system capacity while maintaining user experience (e.g., good TCP/IP performance).
  - From “On” to “Hold” in < 100 ms.
  - From “Hold” to “On” in < 50 ms.
  - From “Hold” to “Sleep” in < 100 ms.
  - From “Sleep” to “On” in < 200 ms.

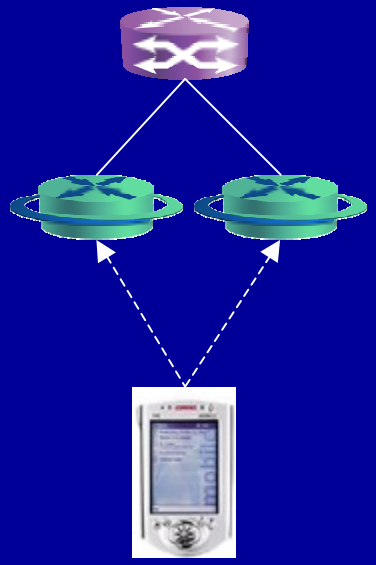


- **Paging**: For users that conserving power in Sleep state, the paging mechanism wakes users up and bring them into an active state.
  - Frequent paging supports applications such as voice, push-to-talk and instant messaging.
  - Should support the ability to send paging signals at least once every 100 ms
  - To save mobile power and increase standby time, paging duty cycle should be < 1%, so paging duration should be < 1 ms.



Others

- **Resource allocation**: Should support fast resource assignment and release on the uplink and downlink
  - Fine scheduling granularity tailored for data traffic
  - Adaptive coding and modulation per codeword
  - Minimum scheduling interval should be < 2 ms.
  - The duration between opportunities for mobile requests for UL resource allocation should be < 10 ms.
- **Handoff**: Should support robust inter-sector and inter-cell handoffs at vehicular speeds
  - Mobile-controlled handoffs
  - Minimize packet loss and latency for robust and seamless IP packet transmission
  - Time required for handoff-related signaling and access should be < 200 ms, comparable with state transitions



Summary of MAC parameters

Parameter	Proposed value
Number of Active Users per Sector/Cell	> 100
Transition from On to Hold state	< 100 ms
Transition from Hold to On state	< 50 ms
Transition from Hold to Sleep state	< 100 ms
Access Time from Sleep to On state	< 200 ms
Paging Signal Periodicity	< 100 ms
Paging Signal Duration	< 1 ms
Minimum Scheduling Interval	< 2 ms
UL Request Time	< 10 ms
Inter-Sector/Cell Handoff Time	< 200 ms

Summary of MBWA Characteristics

- Leverage cellular wireless deployments in licensed spectrum
- Based on data and channel models, obtain numerical guidelines for the MBWA air interface
- Provide robust performance on mobile wireless channel
- Support IP data transport efficiently through MAC states with fast transitions and paging
- Support fine granularity scheduling, fast UL requests and fast mobile-controlled handoffs