Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** <**http://grouper.ieee.org/groups/802/20/**>
Title	**Evaluation Methodology for MBWA**
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Re:	MBWA Call for Contributions – Session # 2, May 12, 2003
Abstract	This contribution presents a methodology for evaluating MBWA systems.
Purpose	Review and Adopt
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Evaluation Methodology for 802.20 MBWA

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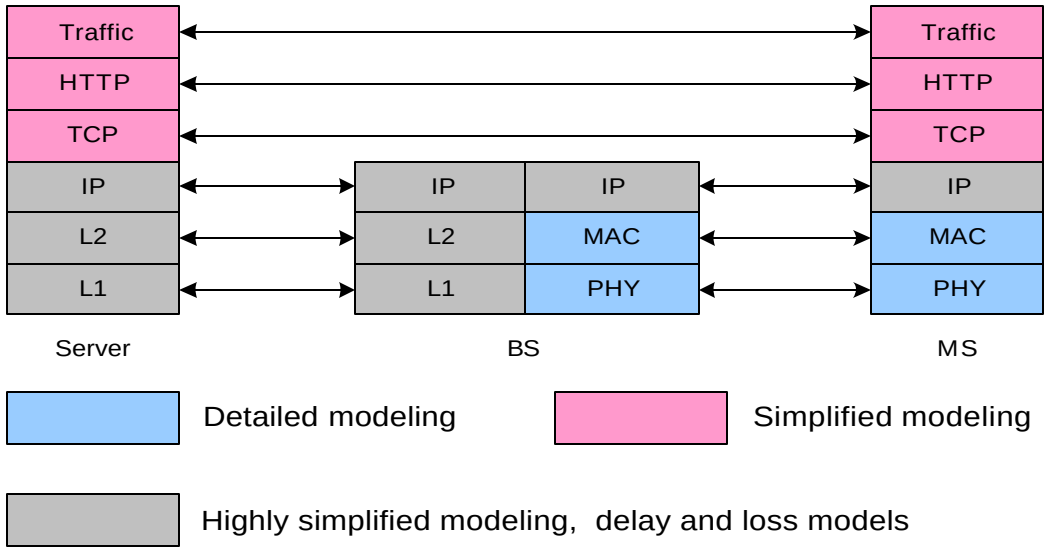
IEEE 802.20 MBWA

May 12-15, 2003

Evaluation Methodology

- A general Framework based on common set of definitions and assumptions:
  - Traffic models, channel models and link budget etc.
- Detailed description of the MBWA proposals
  - Including details of scheduling algorithms and predictors etc.
  - Allow people to simulate proposals independently
- A set of output metrics
  - Allow comparing technology components and/or Framework MBWA proposals.

Protocol Modeling



- End to End protocol Modeling in order to accurately asses the performance for Internet applications
- Simplified modeling for the higher layer protocols and the backhaul network between the base station and the host server.
- Detailed modeling of the Air-interface (MAC/PHY) protocols.

System simulations

- Dynamic multi-cell system simulations to assess system capacity:
  - Include shadow fading, Rayleigh and Rician fading and evolve in discrete steps (e.g. slot duration).
- Cell/sector layout
  - Site-to-site distance, shadow fading, correlation between cell sites, antenna pattern and cell layout/Wrap around etc.
- Link error methodology to model FER in system simulations, 2 options:
  - Use actual link level curves (require separate curves for each channel condition, decoder type and transmission frame duration etc.)
  - Define a methodology that can, for example, use AWGN curves.

Traffic Models

- A common set of traffic models used in the evaluation
- Non-Real time traffic types
  - HTTP, FTP, Email
- Real time traffic
  - VoIP, and video etc.
- Streaming Traffic
  - Audio and video streaming
- Interactive Traffic
  - Wireless Mobile Gaming etc.
- Simulations performed with different traffic mix scenarios.

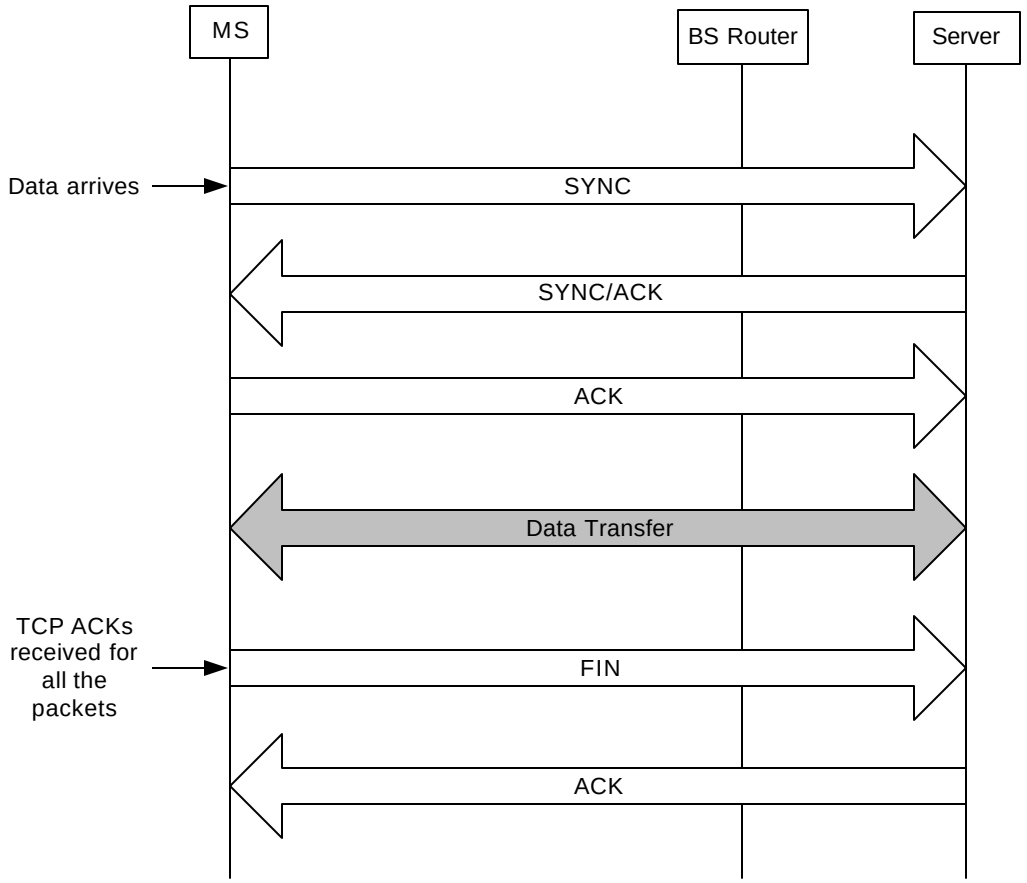
Higher Layer Protocol Modeling

- TCP modeling
  - Flow control modeling
    - Slow start and
    - Congestion avoidance
  - Timeouts and Exponential back-off etc.
    - TCP loss due to air interface FER (residual FER after MAC ARQ)
- HTTP modeling
  - HTTP page requests and response
- Models for other protocols such as RTSP and RTP etc. as applicable.

Round Trip Time Model

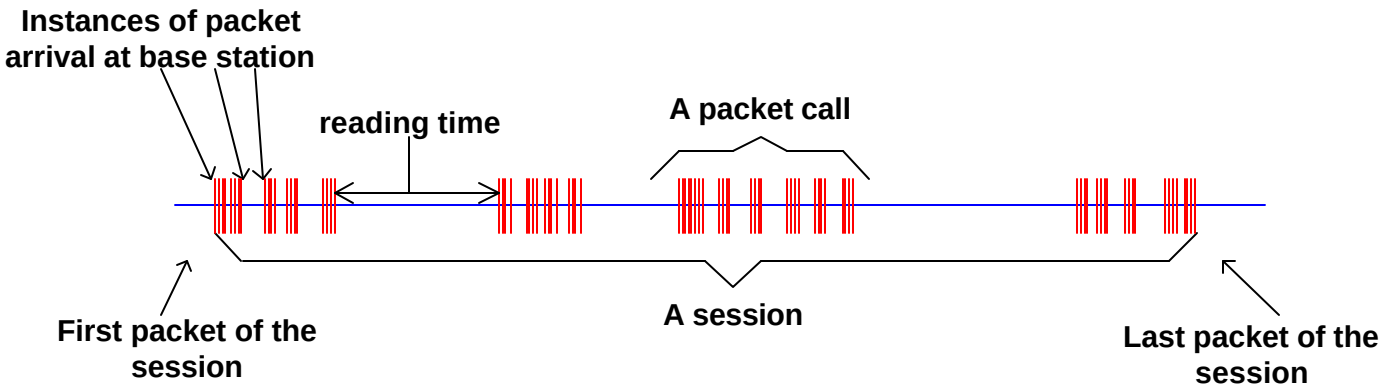
- Total round trip time can be divided into four delay components
  - RTT = t_{UL} + t_{N1} + t_{N2} + t_{DL}
  - t_{UL} Air interface delay between the mobile terminal and the base station router.
  - t_{N1} Network delay between the base station router and the host server.
  - t_{N2} Network delay between the host server and the base station router.
  - t_{DL} Air interface delay between the base station router and the mobile terminal.
- t_{UL} and t_{DL} determined in the simulations by air-interface transmission and queuing delays etc.
- Approximate models used for t_{N1} and t_{N2}.

TCP 3-way handshake Model



TCP 3-way handshake modeling is important in assessing the System performance with short packets and performance sensitivity to round trip delays.

HTTP Model



- Session arrivals and departures need not be modeled
  - A fixed number of “always active” HTTP users (sessions) can be simulated in each run.
- HTTP/1.0 and HTTP/1.1 page requests and response procedures are modeled.

Channel Models

- Channel models for single-antenna simulations
  - ITU Pedestrian A, Pedestrian B and Vehicular A models etc.
- Channel models for multiple antenna techniques
  - For example, spatial Channel Model (SCM) for MIMO channels [2].
- Simulations performed for various Channel mix scenarios

Control overhead modeling

- Both UL and DL control overhead modeled dynamically
  - Control channels are actually simulated along with the data traffic.
- Examples of control signaling are scheduling grants transmission, channel quality feedback, and ARQ ACK/NACK Feedback etc.
- MAC states and signaling to enable state transitions modeled explicitly in the system simulations.
- Control channel signaling errors are also modeled.

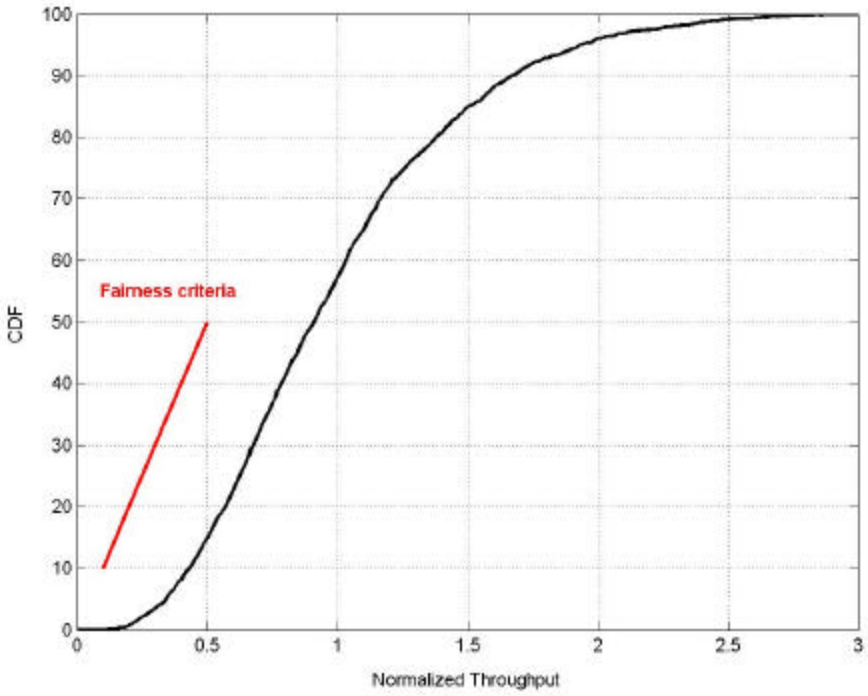
Output Metrics

- VoIP and video application:
  - Maximum number of voice/video users that the system can support within a sector with certain maximum outage probability
- HTTP, FTP and Email etc.
  - Number of users supported, data throughput per sector, Average packet call throughput, packet call throughput CDF and packet delay etc.
- Audio/Video streaming
  - Number of users supported, packet delay and loss.
- Wireless Gaming
  - Number of users supported, packet delay and loss.

Fairness criteria

- Guarantee minimal level of throughput to all users.
- The normalized throughput CDF should lie to the right of the Fairness criteria curve.

Normalized throughput w.r.t average user throughput	CDF
0.1	0.1
0.2	0.2
0.5	0.5



Normalized throughput for user k = Throughput(k)/(Average throughput across all users)

References

[1] 3GPP2/TSG-C.R1002, "1xEV-DV Evaluation Methodology (V10)", February 2003.

[2] IEEE 802.20-03/42, “Channel Modeling for MBWA”.