Agenda item:	**11.3.1**
Source:	**Motorola**
Title:	**MBMS System Level Performance & Requirements**
Document for:	**Discussion**

1. SUMMARY

Upper bounds on MBMS system level performance with existing physical layer features are studied. It is shown that a basic 64kbps MBMS service is feasible, particularly when STTD is used with the longer interleaving available in the 384kbps UE capability class. More demanding services, such as those requiring higher data rates, greater coverage, lower BLERs, or multiple MBMS physical channels, become less feasible as the demand increases and as the UE capability class decreases.

More specifically, a continuously transmitted 64kbps traffic channel requires around 10% allocation to reach 1% BLER with 80ms interleaving in a multipath channel at 3kmph when transmitted with STTD. By contrast, when the same traffic is transmitted without STTD using 40ms interleaving (the largest supported by the 64 kbps UE capability at this data rate), it requires around 68% allocation to reach 95% coverage at 0.1% BLER. A 384 kbps UE supporting a 128 kbps channel with 40ms interleaving without STTD will require around 50% allocation to reach 90% coverage at 1% BLER.

Given this relatively wide variation in physical layer requirements caused by the different service assumptions, it would be helpful to have clarification on the following issues:

1. If STTD is to be assumed in order to determine minimum physical layer requirements.
2. The minimum QoS requirements for MBMS services (especially bit rates, BLER or BER, and delay)
3. The fraction of cell capacity is acceptable for these services, and what is the minimum acceptable coverage.
4. If multiple MBMS physical channels are required.

2. SIMULATION METHOD

We use a simple simulation technique in order to obtain reasonable bounds on system level requirements for MBMS for various configurations. The method computes approximate short term faded BLER curves by calculating the average SINR during the block at a given geometry and computing the coded BLER assuming a Gaussian channel. The approximate short term BLER curves are then used in the system simulation to determine the BLER at a given allocation. A 2 equal path channel model was used for simplicity. (Note that the results compare well with earlier published results, as will be described in the sequel). We only report results for 3kmph, since slow speed conditions are likely to be the limiting factor for MBMS performance.

The system simulation parameters are below:

Parameter	**Explanation/assumption**	**Comments**
Cellular layout	Hexagonal grid, 3-sector sites	57 sectors (3 rings)
Simulation type	Snapshot	10,000 drops
Cell radius	1000 meters	
Antenna Pattern	Gain=min (12(Θ/Θ3dB)^2,20)	Front-to-back-ratio=20dB Half-power-beamwidth=70 degrees
Propagation Model	PL=128.1+37.6log10(d)	d in Km
Lognormal std.	8dB	
Correlation between sectors	1	
Site-to-site correlation	0.5	
Carrier frequency	2GHz	
Node B antenna gain	14dB	
Noise & Interference	None	Assuming interference limited; Interference modeled as AWGN
Node B total power	17Watts or 42.3dBm	
User Distribution	Users dropped uniformly in the whole cell	

Parameters used to compute the BLER are:

Parameters	**Value**
Channel	2-Path Rayleigh
Mobile Speed	3 kmph
Channel Estimation	Ideal
Channel Coding, Modulation	Turbo, QPSK
Receiver	Ideal Rake
Interleaver Frame Size	40 and 80ms
Number of Soft Handoff Branches	1

3. RESULTS AND DISCUSSION

Figures 1 through 3 plot coverage against required power to reach the coverage. Figure 1 contains results for 64kbps traffic at 1% BLER, using 40 and 80 ms interleaving, with single antenna transmission or STTD. We note that when STTD is used, 90% coverage can be achieved with less than 15% allocation. Without STTD, around 18% and 26% allocation are required for 80 and 40ms interleaving, respectively.

Also, note that the allocation requirements are comparable to those observed in [1]. The allocation observed here for 90% coverage can be compared with the results of [1] by observing that about 90% of the geometries observed in our system simulation are above -3 dB. The Ec/Ior requirements can be approximately compensated for the difference in geometry by subtracting 2.5 dB. Since –4.2 dB Ec/Ior or so was required for 64kbps with 80ms interleaving and single antenna transmission at -6 dB geometry, we predict about –6.7 dB Ec/Ior would be required for near 90% coverage. Observing that –6.7 dB Ec/Ior is 21% allocation, we conclude the result compares well with the 18% allocation requirement observed here.

Figure 2 contains results for 64kbps traffic at 0.1% BLER, using 40 and 80 ms interleaving, with single antenna transmission or STTD. The tighter BLER requirements about double the power requirements for the 90% coverage point for the single antenna cases, but increase the STTD case by a

factor of about 1.5. If we consider the 95% coverage points, the single antenna cases require about 40% and 68%, for 80 and 40 ms interleaving, respectively.

Figure 3 contains results for 128 kbps using 40 ms interleaving with and without STTD. Examining the curve for STTD, we see that 90% coverage requires around 26% of power. About 53% allocation is needed without STTD.

4. REFERENCES

[1] NTT DoCoMo. "TTI length extension with/without STTD for MBMS," TSGR#31(03)0318, Tokyo, Japan, February 18th - 21st, 2003

Figure 1

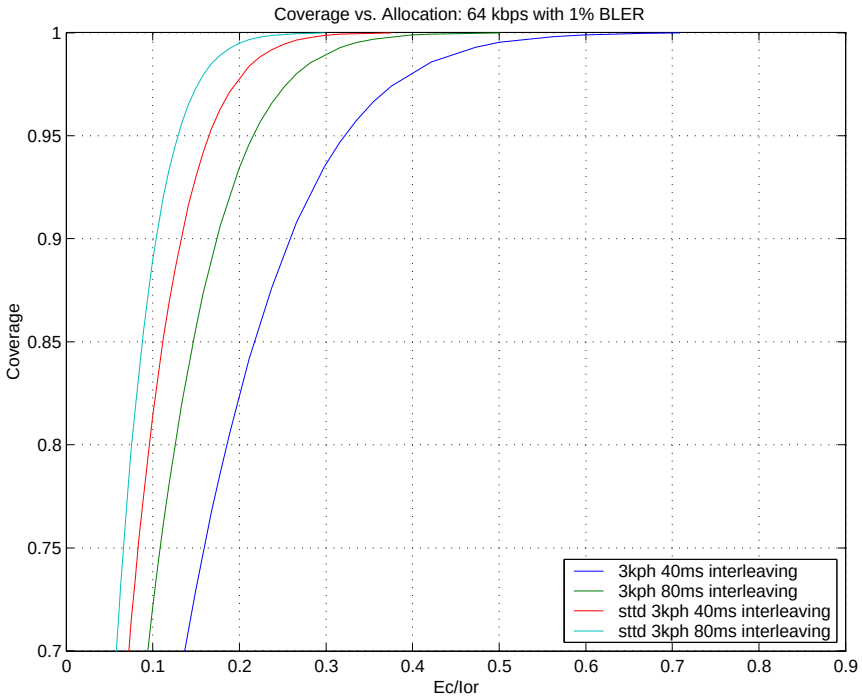

Figure 2

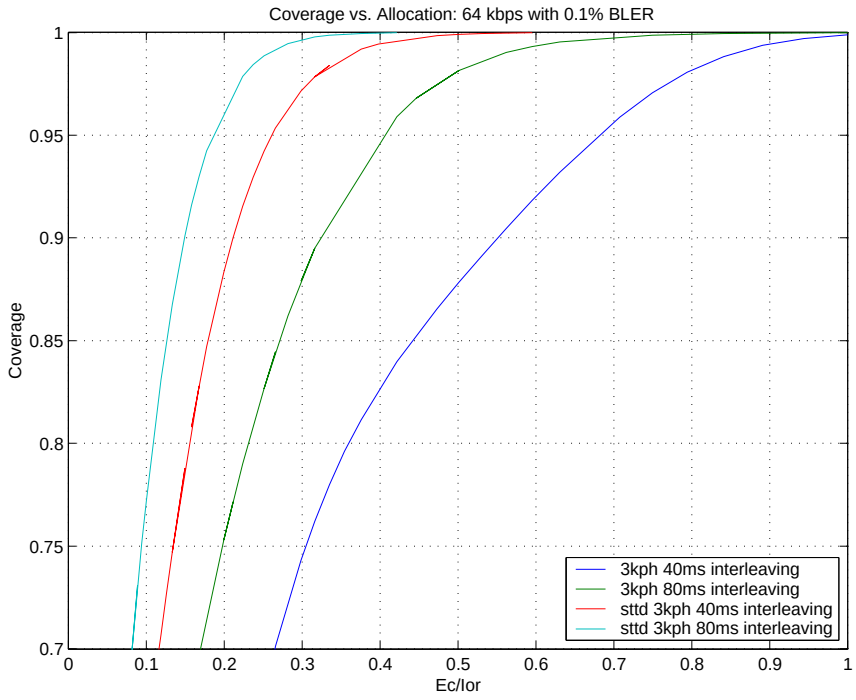
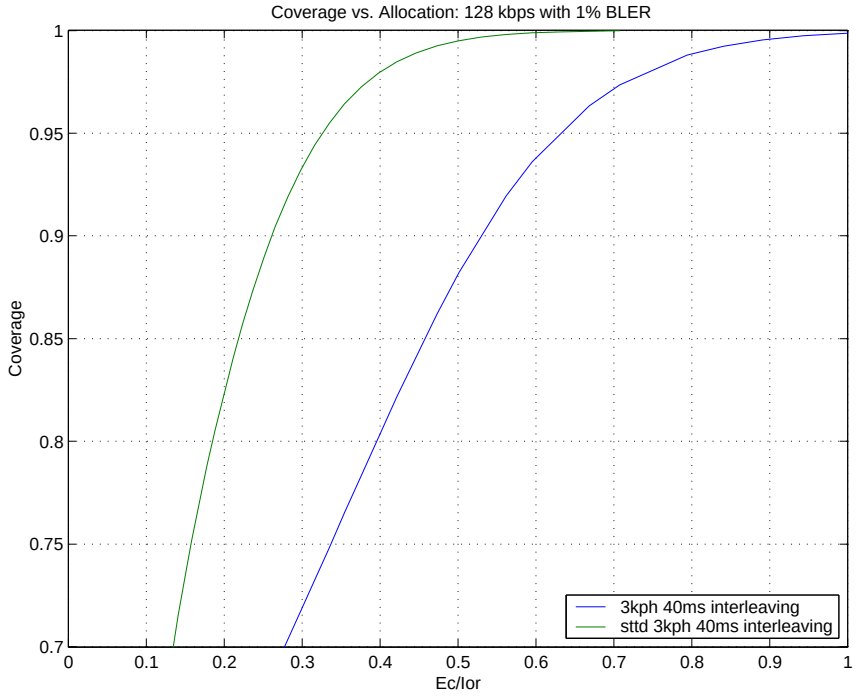
Figure 3