Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** **<http://grouper.ieee.org/groups/802/20/>**
Title	**Response to C802.20-05/83r1 and C802.20-05/84r1**
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Re:	802.20 Call for Proposals
Abstract	This contribution provides answers and clarifications on the question lists submitted as C802.20-05/83r1 and C802.20-05/84r1. Since most of the questions were duplicates between the TDD and FDD technologies, they are answered together. A further TDD-specific question is also addressed.
Purpose	FYI.
Notice	
Release	
Patent Policy	

1.0 Introduction

This document addresses questions presented in the contributions C802.20-05/83r1 and C802.20-05/84r1. Since the set of 40 questions in C802.20-05/84r1 includes all the 39 questions from C802.20-05/83r1 (only question 8 from C802.20-05/84r1 is not present in C802.20-05/83r1), we address here 40 questions in the order presented in C802.20-05/84r1. In the following section, questions (in black) are followed by answers (in blue).

2.0 Questions and answers

1. Why is there no 1.25 MHz mode for the AI?

There is no requirement to have a 1.25MHz mode.

2. Where is the calibration data for the link-to-system model used to derive the performance results?

The requested calibration data is in the MBFDD Performance Report 1 (C802.20-05/61r1) and MBTDD Wideband Mode Performance Report 1 (C802.20-05/66r1).

3. How is channel estimation error modeled?

Channel estimation errors are captured by the link curves.

4. How is Doppler-induced inter-carrier-interference modeled?

ICI is not captured in the link curves. A separate link performance analysis suggests that ICI effects are secondary w.r.t. channel estimation effects (checked for speeds up to 250km/h). Channel estimation effects are captured by the link curves.

5. Does the proposal meet the spectral efficiency requirements of the SRD with 1 antenna at the mobile terminals?

The SRD has no requirements on spectral efficiency using 1 receive antenna at the mobile terminal.

6. Support for FL SDMA is described in the specification. What is the performance of this mode? Can the FL SDMA be supported with good performance when the mobile terminals have only one antenna?

FL SDMA results are presented in MBFDD Performance Report 2 (C802.20-05/86r1) and in MBTDD Wideband Mode Performance Report 2 (C802.20-05/88r1). Simulations with single RX have not been carried out. Simulation results with dual receive diversity and no spatial interference mitigation suggest potential performance improvement due to SDMA with single receive antenna.

7. For the RL broadband pilot, what is the time required to sound the entire RL channel bandwidth? At what speed does this delay make the channel information unreliable?

The time required to sound the entire BW depends on the total system BW as well as RL control segment resources. With the minimum RL control segment allocation (4% overhead in 5MHz FDD), it will take 4*5.5ms=22ms to sound the entire band. This delay allows for reasonably accurate channel information for typical pedestrian users. More RL control overhead allows for a faster channel sounding.

8. What is the FL/RL split and the total TDD frame length for the presented results (e.g., 1:1, 3:2, etc)?

We used 1:1 partitioning (911us PHY Frame) for all the presented results.

9. The FFT occupancy seems to be much higher than other OFDM systems (480/512 = 94%, versus ~82% for 802.16 and 802.11g). What impact does operating so near the Nyquist sampling rate have on sampling rate conversions, anti-alias filters, etc?

Practical feasibility of OFDM system with such high bandwidth occupancy is not a fundamental issue. Oversampled FFT or IFFT is one possible solution. Also, the number of guard carriers can be configured as needed.

10. What is the effect of the 9.6 kHz sub-carrier spacing at very high Doppler (e.g. 350 Kmph) or 3.5 GHz carrier frequency?

The effect of ICI has been studied for speeds up to 250km/h and has been found secondary to the effect of channel estimation. Performance results presented in our reports include channel estimation effect.

11. How does the broadcast channel (F-pBCH0 and F-pBCH1) coverage compare to the traffic channel coverage? This is important since critical information is carried on these channels.

Broadcast channels (F-pBCH0 and F-pBCH1) are transmitted at a low spectral efficiency (<0.05bps/Hz) are designed to operate at low long-term SNR. As a result, the actual coverage will be limited by traffic channels rather than broadcast FL channels in practical scenarios.

12. Please explain clearly how pilots are used when transmitting on multiple antennas.

In Symbol Rate Hopping mode, F-CPICH and F-AuxPICH channels provide sets of orthogonal pilots for different effective antennas. Specifically, pilots for different antennas occupy different modulation symbols (see section 12.2 of the MBFDD and MBTDD Wideband Mode Technology Overview: C802.20-05/68r1).In Block Hopping mode, F-CPICH contains one pilot tone every 16 tones for every antenna at BTS within two OFDM symbols out of 48 OFDM symbols (~5.5ms). These pilots are used to measure/report channel quality per antenna. Data demodulation is based on dedicated pilots located within each tile (16 tones x 8 OFDM symbols). Dedicated pilots are clustered: each cluster occupies one tone over 3, 2 or 4 adjacent OFDM symbols depending on pilot pattern. Different MIMO layers and/or SDMA streams will be transmitting different orthogonal sequences of the appropriate size (3, 2 or 4) across pilot symbols within a cluster. Orthogonal codes are defined by the columns of DFT matrix of the appropriate size.

13. The performance slides show compliance with the spectral masks. Were these results from simulations or measurements of physical equipment? How much PA headroom is required to meet this requirement? What about bandwidths other than 5 MHz?

The results shown were based on simulations. They were obtained based on a peak-clipping PA model. The report has been updated to show emission results based on a measured PA model. Results are shown for 5MHz in bandwidth in the MBFDD Performance Report 1 (C802.20-

05/61r1) and for 10MHz bandwidth in the MBTDD Wideband Mode Performance Report 1 (C802.20-05/66r1).

14. The control channel overhead was assumed to be 10% for the FL results. Is this sufficient control information to handle the 4x4 MIMO mode with rate and rank adaptation?

The 10% control channel overhead was assumed for the case of full-buffer traffic. The 10% overhead can handle up to 4 assignment blocks in FDD 5MHz and 8 in TDD 10MHz. This number of assignment blocks is sufficient for the case of full-buffer traffic for the SISO mode as well as both MIMO modes. The FL control overhead required will in general depend on the traffic profile and the number of users.

15. How many users are you assuming to be scheduled per frame or superframe for the various traffic types?

The number of users scheduled per frame depends on the traffic mix and may be different for FL and RL Our signaling channel (F-SSCH) design allows us to generate up to 4 scheduling messages (total FL and RL) with the minimum overhead of 10% in 5MHz FDD (5% in 10MHz TDD). The actual number of simultaneously scheduled users can be higher. In packet-by-packet scheduling, the number of users per interlace is greater than the number of scheduling messages by the factor of the average number of H-ARQ transmissions. To handle scenarios with a large number of users per frame and a relatively small signaling overhead, our design supports persistent "sticky" assignments. A "sticky" assignment remains valid until de-assigned or re-assigned by the AP.

16. The subband size is 1.25 MHz. What is your opinion on performance if the subband size is reduced to half this value?

We have observed fairly insignificant difference in system performance when going to 64 tones per subband.

17. The overview slides show a peak spectral efficiency of 13 b/s/Hz. Under what conditions is this attained? The performance slides show forward link spectral efficiency of 9 to 12 dB at 25 dB SNR using various SCM (spatial channel model) assumptions. Please estimate the fraction of the coverage area that would see that high of geometry under typical deployment.

The quoted number (13bps/Hz) corresponds to the maximum decodable FL packet format (MCS) less all FL overhead. Performance results cited in the question are for a single codeword (SCW) MIMO mode which enjoys lower complexity than MCW mode. In the MCW mode, spectral efficiency of 13bps/Hz is achieved at about 21dB geometry. The fraction of coverage for this peak rate depends on the definition of a "typical" deployment. The exact number also depends on network loading and/or reuse configuration.

18. Are the spectral efficiency requirement based on full buffer traffic? What is the spectral efficiency for HTTP?

The spectral efficiency shown is based on full-buffer traffic. No simulations were carried out using only HTTP traffic. Simulations were carried out using the required traffic mix and these are shown in MBFDD Performance Report 2 (C802.20-05/86r1) and MBTDD Wideband Mode Performance Report 2 (and C802.20-05/88r1).

19. How does the spectral efficiency compare with DO-A and HSDPA for the 1x2 system? Looks like they are pretty close to each other based on contribution R1-051501 in 3GPP RAN1 in which the spectral efficiency of HSDPA was very close to 1.

To properly compare the two systems, one needs to develop common evaluation criteria. At this point, we do not have spectral efficiency numbers that can be compared.

20. What is the expected paging capacity of this proposal? How does the overhead required for paging compare to systems like HRPD?

Full pages in excess on one page per two superframes are carried over a traffic channel. Hence high capacity is achievable. More details can be found in MBFDD Performance Report 2 (C802.20-05/86r1) and MBTDD Wideband Mode Performance Report 2 (and C802.20-05/88r1). We have not done comparison with HRPD paging capacity.

21. Is fractional reuse used for overhead channels?

No. Overhead channels are designed to operate with the required performance / coverage with reuse factor 1.

22. What is the control plane latency?

Various latencies are described in the materials provided. We are unclear on the exact definition of "Control Plane Latency".

23. The overview slides describe a multi-carrier mode. Is this the preferred mode for operation?

Multi-carrier mode is designed to support low capability terminals, at the expense of a higher control overhead. The choice of the mode is up to the operator.

24. Since the F-SSCH is essentially FDM-ed what is the latency in decoding the bearer channel due to waiting to demodulate this channel?

F-SSCH is FDM across one FL PHY Frame. FL traffic is transmitted in the same PHY Frame. Hence, there is no additional delay (beyond decoding delay) introduced by F-SSCH.

25. Is frequency diverse scheduling in addition to frequency selective scheduling used for both forward link and reverse link?

Both diversity mode and subband mode are available on FL and RL.

26. What is the target ACK->NAK and NAK->ACK error rates for both forward link and reverse link traffic?

The air interface does not mandate these error rates. ACK->NACK of 1% and NACK->ACK of 0.1% were used for performance evaluation, as described in Report II.

27. When handing off to another sector, how does the AT know that the AN has assigned new traffic channels? Is it implicit in the actual assignment? What if the assignment fails or is delayed?

AT monitors F-SSCH of serving sectors as well as the desired serving sectors. Assignment message received from the desired serving sector completes handoff. Handoff is not completed until assignment is successfully demodulated by the AT.

28. Since forward link pilot symbols are scattered, micro-sleep mode is not enabled. What is the effect on battery power saving since a micro-sleep mode is not provided?

In order to reduce power consumption in active state, we enable the AT to monitor only a subset of the entire set of interlaces. This subset can be negotiated between the AT and the AP. The effect for battery power saving is not quantified.

29. Was PA backoff accounted for in the reverse link simulation results?

PA backoff was not accounted for in the reverse link simulations since it was not required by the evaluation criteria.

30. What PAPR reduction techniques have been considered for the reverse link?

A variety of PAPR reduction techniques described in the literature which are air interface agnostic can be applied.

31. What is the default number of transmit and receive antennas at the AP and AT respectively?

There is no default number of AT/AP transmit/receive antennas. This is an implementation choice. The system supports an arbitrary numbers of physical antennas at AP and AT.

32. What is the effect on frequency selective gain since the average CQI for each subband is reported at a much lower frequency? What is the frequency of subband CQI reporting?

SFCH report interval is flexible: with minimum report interval of about 5.5ms. In addition, multiple SFCH (corresponding to different subbands) can be reported simultaneously.

33. Can you give us further details of the SIC receiver?

The standard SIC receiver has been used. The description is available in the literature.

34. What kinds of receiver structures were used in the forward link and reverse link?

Simulation results are available for MRC and MMSE receivers, for FL as well as RL.

35. The proposal claims that non-orthogonal reverse link capacity is linear with number of antennas and orthogonal reverse link is logarithmic with number of antennas. Are there any analytic results to back up this claim?

We have done internal analytical studies which verify this statement. Performance of this mode can be seen in the simulation results provided in MBFDD Performance Report 2 (C802.20-05/86r1) and MBTDD Wideband Mode Performance Report 2 (and C802.20-05/88r1).

36. Does self interference under frequency selective channels for bandwidths as great as 20 MHz degrade the performance of reverse link control channels? One needs really high spreading gain to mitigate this issue.

Self-interference is not an issue since RL control channel is designed to support many ATs. Interference from other channels dominates heavily over self-interference.

37. Do you switch between single stream and multi-frame MIMO based on SNR or some other measurement?

MIMO mode switching is message based and is initiated by the AP. Switching criterion is beyond the scope of the air interface. Long-term SNR (geometry) could be a possible criterion. Furthermore, switching takes into account AT capability to support the relevant MIMO mode.

38. Table 4-4 in the performance report (-061) shows a system spectral efficiency of 2.2 b/s/Hz in the forward link for the pedestrian B channel model at 3 km/hr. This also

assumes 1 km site to site spacing. What is the result for a 2 km site spacing which is more typical for existing systems?

Table 4-5 of MBFDD Performance Report 1 (C802.20-05/61r1) contains sector throughput results for both 1km and 2.5km site-to-site distance, for various channel models.

39. The total overhead for the forward link when using 4x4 MIMO appears to be 43% based on the assumptions stated in section 4.2 of the performance presentation (-61) as opposed to 30 to 35% for existing CDMA systems. Can you comment on this conclusion?

We find the actual overhead to be somewhat lower: it is less than 40%, with the actual number depending on the duplexing mode, bandwidth and the number of MIMO layers supported. In any case, a fair comparison of overheads with the existing CDMA systems is not possible since these do not support MIMO.

40. Link Budget: Should be designed with penetration loss of 15-20dB for deep indoor situation, the BTS transmit power of 49.64 dBm seems quite large, Log-normal fade margin is lower (should be designed for 90% edge and 96% area coverage).

Link budget computation is consistent with the evaluation methodology. Link budget numbers for different path loss/shadow fading and PA headroom can be readily obtained by adding/subtracting the appropriate amount to/from the presented baseline.