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Agenda Item:

Source: Motorola

Title: Discontinuous Packet Data Transmission – Simulation Results Document for : Adhoc -14

Discontinuous Packet Data Transmission – Simulation Results

Abstract

In [1], a method of power control and channel estimation for Uplink Shared Channel (USCH) using preamble transmission was introduced. In this contribution, simulation results are presented using the reverse link simulator for a) continuous packet data transmission, b) discontinuous packet data transmission without preamble, and c) discontinuous packet data transmission with preamble transmission. It is shown that, with the use of preamble transmission, there is no significant degradation in performance.

1.0 Introduction

Convergence of the fast power control loop and the availability of good channel estimates at the base station are critical in the case of uplink packet data transmission where packets arrive in a bursty manner [2]. A simple solution is to essentially use a low rate bi-directional link maintenance channel between the packet bursts. The link maintenance consists of power-control commands and pilot symbols needed to preserve power control and synchronization of the dedicated physical channel. However, there is a cost associated with the use of the link maintenance channel since code and power resources are consumed even though no data is being transmitted. The cost increases linearly with the number of users engaged in a packet call.

In this contribution, simulation results are presented using the W-CDMA reverse link simulator for a) continuous packet data transmission, b) discontinuous packet data transmission without preamble, and c) discontinuous packet data transmission with preamble transmission.

2.0 Source Model

In both ETSI and TIA, data traffic has been modeled using a packet train with varying statistics based on the type of transfer as described in [3][4]. Figure 1, reproduced from [3], illustrates a typical packet data session. The traffic is modeled as distinct sessions with a Poisson arrival process. Each session marks a period of higher activity comprised of a number of packet calls. If the session models a Web browsing session, then the packet call models a Web page download and intermediate time models the think time used peruse the Web page. Each packet call consists of one or more packets whose inter-arrival time and length are respectively exponentially and geometrically distributed. This simulation focuses on multiplexing multiple UEs in an active packet call. The likelihood of one or more UEs in a packet call is a function of the channel utilization.

In the simulator, the packet data source model is represented by a function that produces a random draw of a new packet transmission time along with a subsequent inter-arrival time until the next packet. If the generated inter-arrival time occurs prior to the completion of transmission of the generated packet, a concatenation process occurs. Another packet is generated and appended to the original packet. This process continues until there is time for idle slots to occur. In the simulation the mean packet size is assumed to be 480 bytes and a code rate of two blocks per frame is used which translates into 144 Kbps UDD service. Figure 2 shows the CDF of consecutive idle frames within a packet call for system utilization values of 75% and 92%. It may be observed from the figure that as the system utilization increases the number of consecutive idle frames within a packet call also increases. The increase in idle frames is caused by a greater reliance on time multiplexing which occurs due to the higher likelihood of multiple active packet calls sharing the channel.

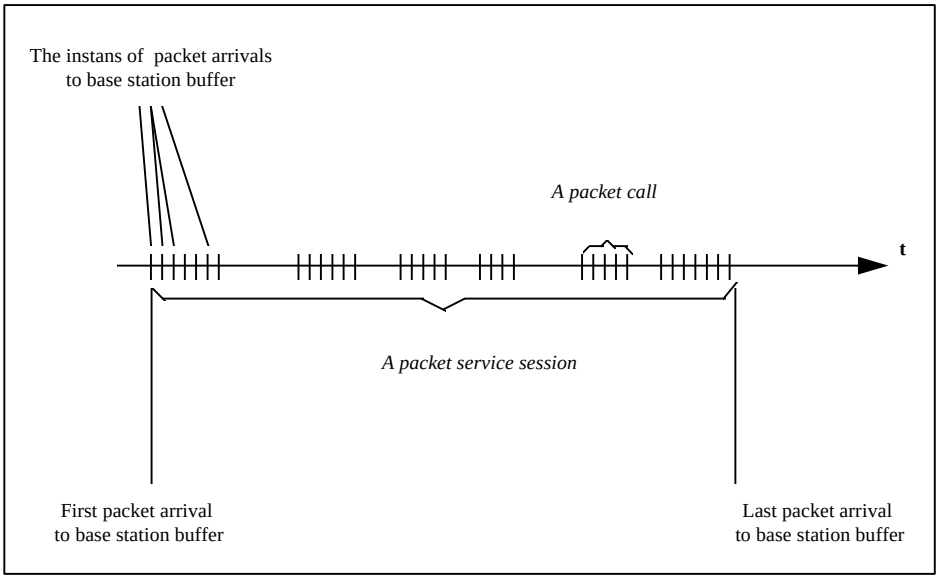

Figure 1 Illustration of a WWW browsing session.

3.0 Simulation Results

The W-CDMA chip level link simulator was used to evaluate the performance of continuous and discontinuous packet data transmission. The source model of Section 2 was used to model the discontinuous packet data transmission. The parameters used in the simulator are shown in Table 1.

Table 1 Simulation Parameters

Parameter	Value
Information Bit Rate	60.8 kbps (144 kbps UDD)
Block Size	304 bits
Turbo Code	R=1/3, K=4
Turbo Code Interleaver	Random
No of iterations	8
Channel Estimation	Non -Ideal
Antenna Receiver Diversity	On
Inner Loop Power Control	On
Outer Loop Power Control	On
Power Control Step Size	0.5 dB
Power Control Delay	1 slot
Power Control Feedback Error	1%
DPCCH to DPDCH Power	-7dB
Pilot/TPC/TFI bits per slot	6/2/2
Channel Type	Flat
Searcher/DLL	Off
Chip Rate	4.096 Mcps
Carrier Frequency	2.0 GHz

The three cases simulated were a) continuous packet data transmission, b) discontinuous packet data transmission without preamble, and c) discontinuous packet data transmission with one frame preamble transmission. Simulations were run at three values of vehicle speeds (3, 30 and 120 kmph) under flat fading channel conditions for various values of system utilization's. Table 2 and 3 summarizes the received Eb/Nt for target Frame Erasure Rate (FER) of 10% and 1% at a system utilization of 75% and 92% respectively. Figures 3 and 4 give a pictorial representation of the summary.

Table 2 Received Eb/Nt at 1% and 10% at a system utilzation of 75%

Vehicle Speed (km)	Continuous (dB)		Discontinuous (dB)		Discontinuous with Preamble (dB)	
	1% FER	10% FER	1% FER	10% FER	1% FER	10% FER
3	2.2	1.2	3.6	1.5	2.4	1.4
30	5.9	3.3	6.1	3.5	6.0	3.5
120	5.1	3.3	5.3	3.3	5.3	3.4

Table 3 Received Eb/Nt at 1% and 10% at a system utilzation of 92%

Vehicle Speed (km)	Continuous (dB)		Discontinuous (dB)		Discontinuous with Preamble (dB)	
	1% FER	10% FER	1% FER	10% FER	1% FER	10% FER
3	2.2	1.2	4.1	1.7	2.5	1.4
30	5.9	3.3	6.4	3.5	6.2	3.5
120	5.1	3.3	5.4	3.4	5.4	3.4

The following observations are made from Tables 2 and 3.

a. At high and medium values of vehicle speed the degradation due to discontinuous packet data transmission is within 0.5dB. This is due to the fact that the power control does not track the fading at high values of Doppler.

b. The performance degradation at slow speed at 1% FER and high system utilization is approximately 2dB.

c. At operating FER of 10% the loss in performance due to discontinuous packet data transmission is less than at the 1% FER operating point.

d. The performance at slow speeds is improved for discontinuous transmission with one frame preamble transmission.

4.0 Conclusion

It can be concluded from the simulation results that, with the use of preamble transmission for packet data transfer, there is no significant degradation in performance with respect to continuous packet data transmission.

5.0 References

[1] Motorola, "Operation of the Uplink Shared Channel," TSGR1#2(99)064.

[2] SMG2 UMTS L2/3 Experts Group, "Liason from SMG2 L2/3 Expert Group to L1 Expert Group with regards to proposed USCH," SMG 2 UMTS L23 581/98.

[3] UMTS 30.03 v3.20 ," Selection procedures for the choice of radio transmission technologies of the UMTS", April 1998.

[4] Lucent, “Traffic Model for Packet Services”, *TIA, TR45.4 MAC Ad Hoc Meeting:* March, 1998.

[5] Motorola, “State Occupancy Estimations for Shared Channel Concept,” TSGR1#2(99)066

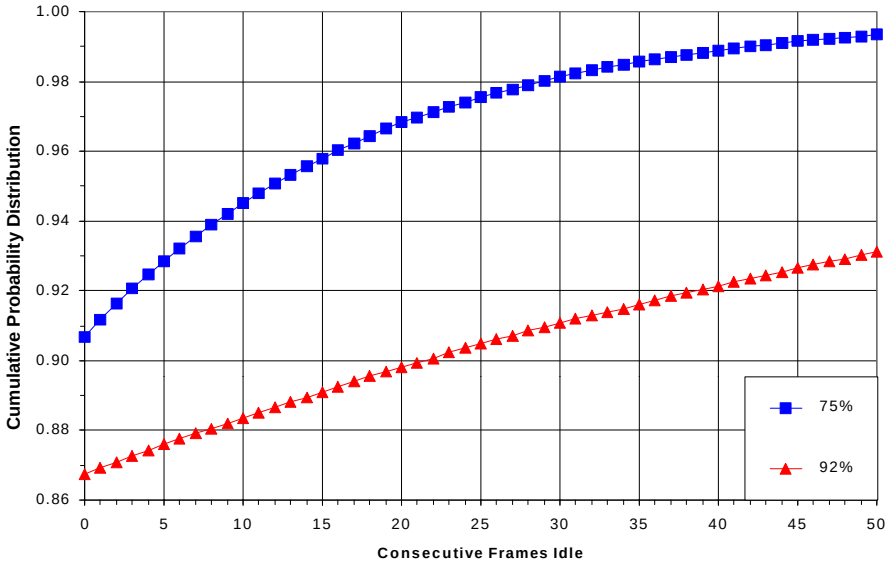

Figure 2 Consecutive idle frames within a packet call for various values of system utilization. Mean packet size is 480 bytes, and a code rate of two blocks per frame is represented.

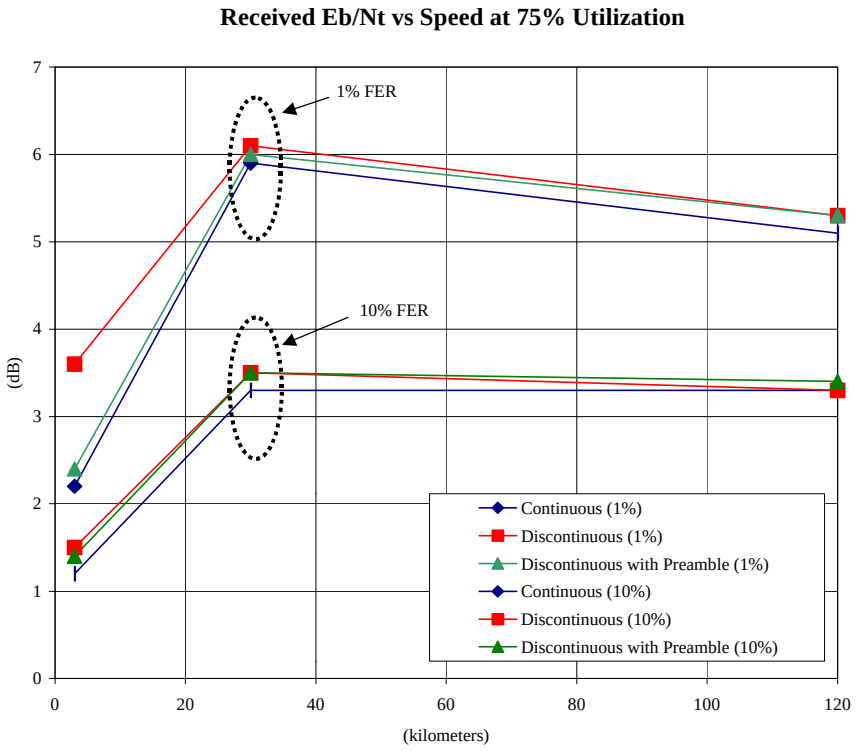

Figure 3 Received Eb/Nt vs Speed at 75% Utilization

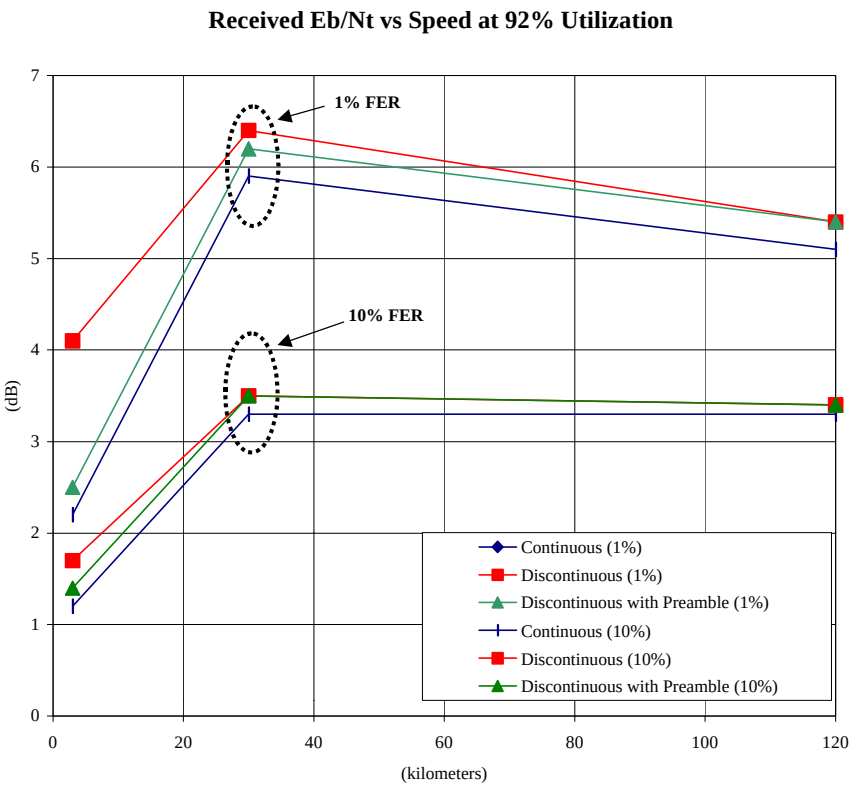

Figure 4 Received Eb/Nt vs Speed at 92% Utilization