TSG RAN WG1#4 **TSGR1#4(99)370**
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Agenda item: Packet Mode Operation
Source: Golden Bridge Technology
Title: Feasibility of increasing the payload sizes
Document for: Discussion

Abstract:

This contribution is a summary of discussions on the possibility of increasing the payload size on RACH. We also address some more issues concerning the fast convergence, which necessitates power-control of the mobile prior to data transmission. The issue of the base station power control is also addressed. This is required prior to transmission of the L1 ACK so that the L1 ACK messages are sent at the right power level. This reduces the wastage in capacity as well as reduces the collision probability.

Background

Questions from WG2 (RAN) to WG1 (RAN):

1. Possibility of increasing the payload size and data rate on RACH

R1#3Tdoc: 224: Closed Loop Power Control for Random Access Channels
R1#3Tdoc 225-226: Throughput Delay analysis of DSMA-CD

Conclusions:

It is recognized that Closed Loop Power Control is beneficial for the CPCH (as an extension of RACH) for longer payload durations and high data rates. (Data rates and Duration breakpoints are for FFS)

It is recognized that a fast collision detection mechanism is beneficial for the operation of the CPCH.

2. Feasibility of L1 aspects of the CPCH proposal

R1#3Tdoc 195: Uplink Common Packet Channel (T1P1.5/TR46.1)
R1#3Tdoc 264: UL-CPCH with DL-Dedicated Control Channel (GBT)

Conclusions: There were no immediate flaws identified with the CPCH concept by WG1. More details were required for further feasibility consideration.

Payload Sizes and Data Rates

1. Payload sizes for various rates:

Rate (kbps)	Payload size (bytes)@ 10 ms Raw information (from TCP/IP)	Payload size (bytes)@ 50 ms Raw Information (from TCP/IP)
16 kbps (1/4)	5 Bytes	25 Bytes
32 kbps (1/4)	10 Bytes	50 Bytes
64 kbps (1/4)	20 Bytes	100 Bytes
128 kbps (1/4)	40 Bytes	200 Bytes
144 kbps (1/3)	45 Bytes	225 Bytes
384 kbps (1/3)	120 Bytes	600 Bytes
2048 kbps (1/3)	636 Bytes	3180 Bytes

Traffic Burstiness as a function of data rate

Data rate (kbps)	Packet Length in time (500 bytes)
64 kbps	250 ms
144 kbps	110 ms
384 kbps	40 ms
2048 kbps	10 ms

Dynamics of Fade Rate, Packet Duration (n x 10 ms) and Convergence

1. CLPC is required at low fading rates, since the negative impact on capacity is significant when the frame arrives at higher Eb/N0 values.
2. Convergence of closed loop power control at high fading rates within a frame
3. This table shows why fast convergence is critical at high fade rates
4. It also clearly demonstrates why we should have closed loop power control on packets longer than a frame especially at higher rates.

	Fade Rate in Hz	Average Fade Arrival time in ms	Max. offset in dB in 2.5 ms
Delta = 30 dB	10	100 ms 1 fade per 100 ms 1 valley in 50 ms	Offset1= 2.5 x 30 / 50 Offset1 = 1.5 dB
Delta = 30 dB	20	50 ms 1 Fade in 50 ms 1 valley in 25 ms	Offset = 3 dB
Delta = 30 dB	50	25 ms 1 valley every 12.5 ms	Offset = 6 dB
Delta = 30 dB	100	12.5 ms 1 valley every 6.25 ms	Offset = 12 dB

Fast Convergence

- After the L1 ACK slot, the TPC slot is transmitted in the DL direction to force convergence prior to data transmission.

- At SF of 512, the rate is 8 kbps, which means that we have 80 bits per 10 ms or 5 symbols per slot. Perhaps the first frame can operate in that rate if necessary.

Number of Slots @ 8kbps	Number of TPC steps
1	5 dB correction
2	10 dB correction
3	15 dB correction

Base Station Power Control by the UE After Preamble Detection

- If the base station is power-controlled prior to L1 ACK transmission, then transmission of several simultaneous L1 ACKs will not consume the Base Node power (capacity) as much. If the L1 ACKs are not sent without any open loop power control, they will have to reach the cell edge (power requirement is similar to DL Common Control Channels).

- If the L1 ACK is sent to the entire cell, the probability of collision increases significantly. This is due to the fact that any mobile in the entire cell, which has picked the same sequence, will assume that it has the control of the channel.

- Power control of the base node prior to L1 ACK transmission is beneficial in both not wasting the capacity as well as reducing the collision probability.

Conclusions

- Increasing the payload size (higher data rates and longer payload sizes) is feasible using a scheme similar to the current RACH scheme. (WG2)

- Fast convergence of the power control is a requirement prior to data transmission (WG1)

- **Power control of the base node prior to L1 ACK transmission is beneficial in both not wasting the capacity as well as reducing the collision probability. (WG1)**