Technology and innovation

Packet Data Capacity, UE power consumption, optimization proposals

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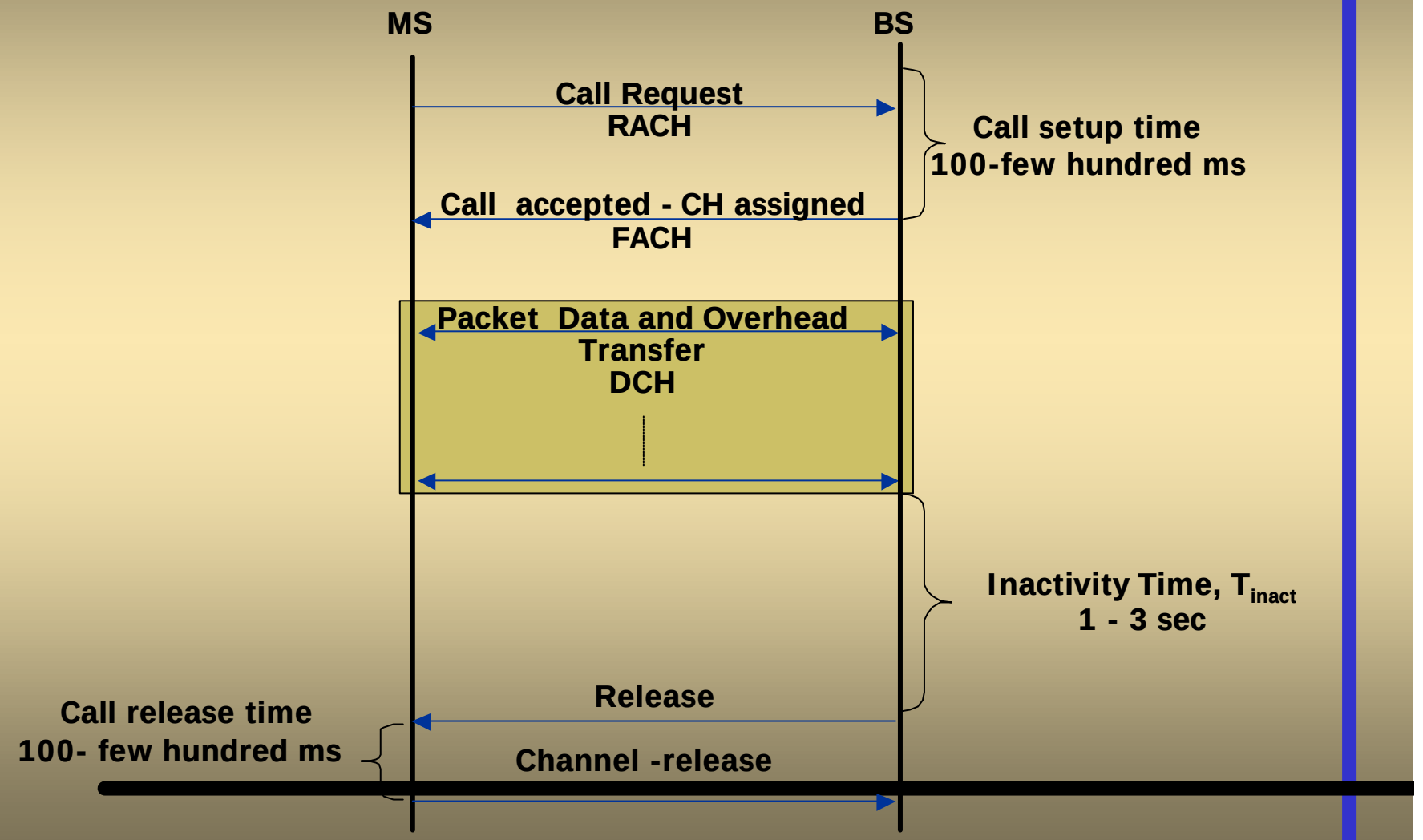
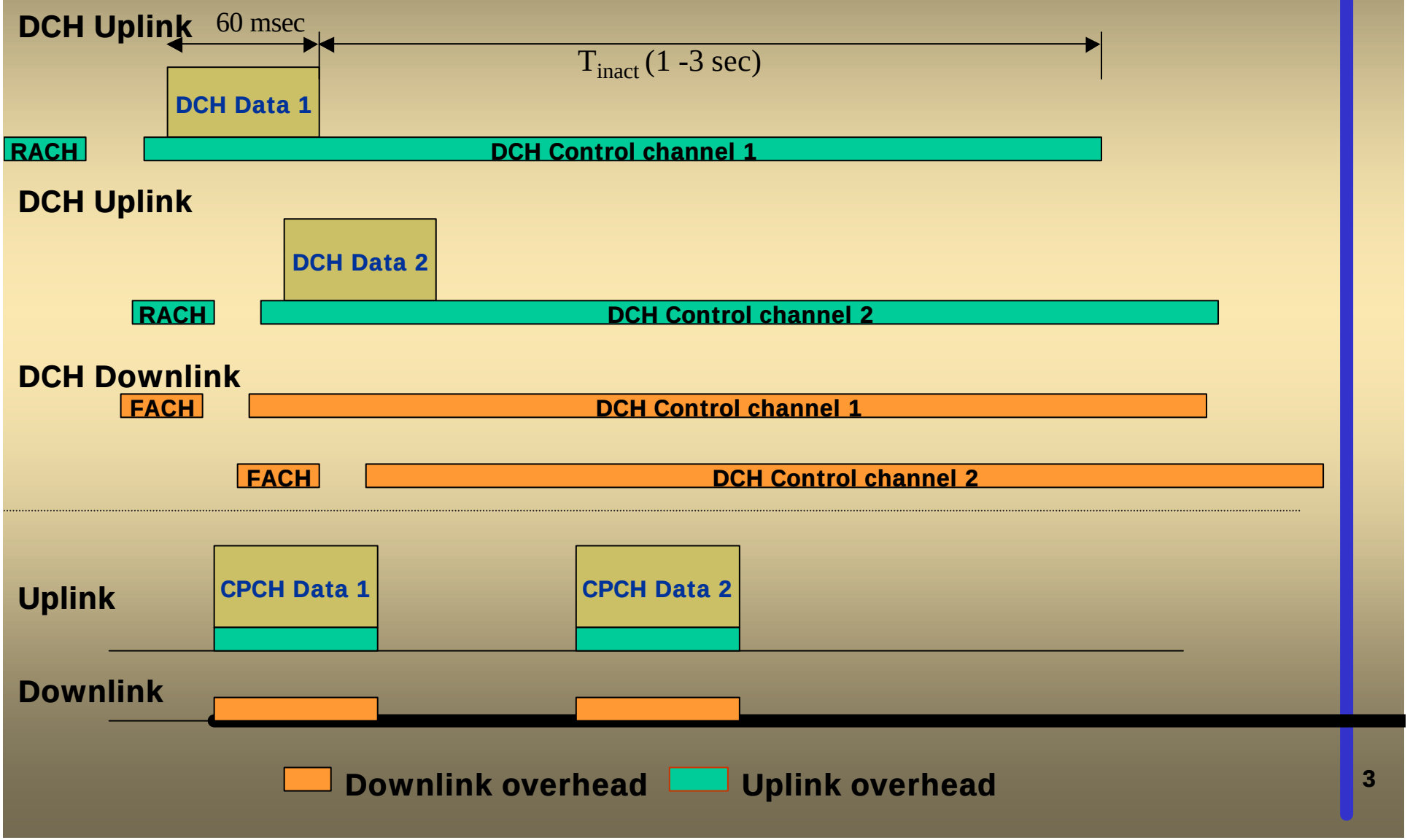
Golden Bridge Technology, USA

DCH/DCH: Circuit Mode of Operation



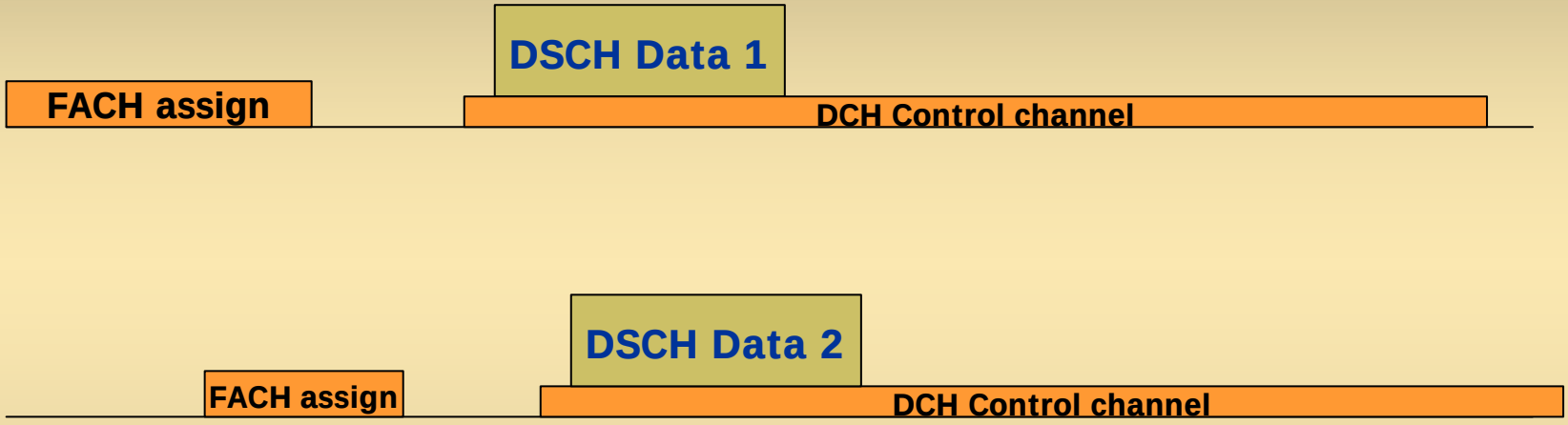
USE OF DCH FOR UPLINK HURTS DOWNLINK CAPACITY

DCH:CPCH Overhead ratio = 20 :1



USE OF DSCH FOR DOWNLINK HURTS DOWNLINK CAPACITY

DCH / DSCH Downlink



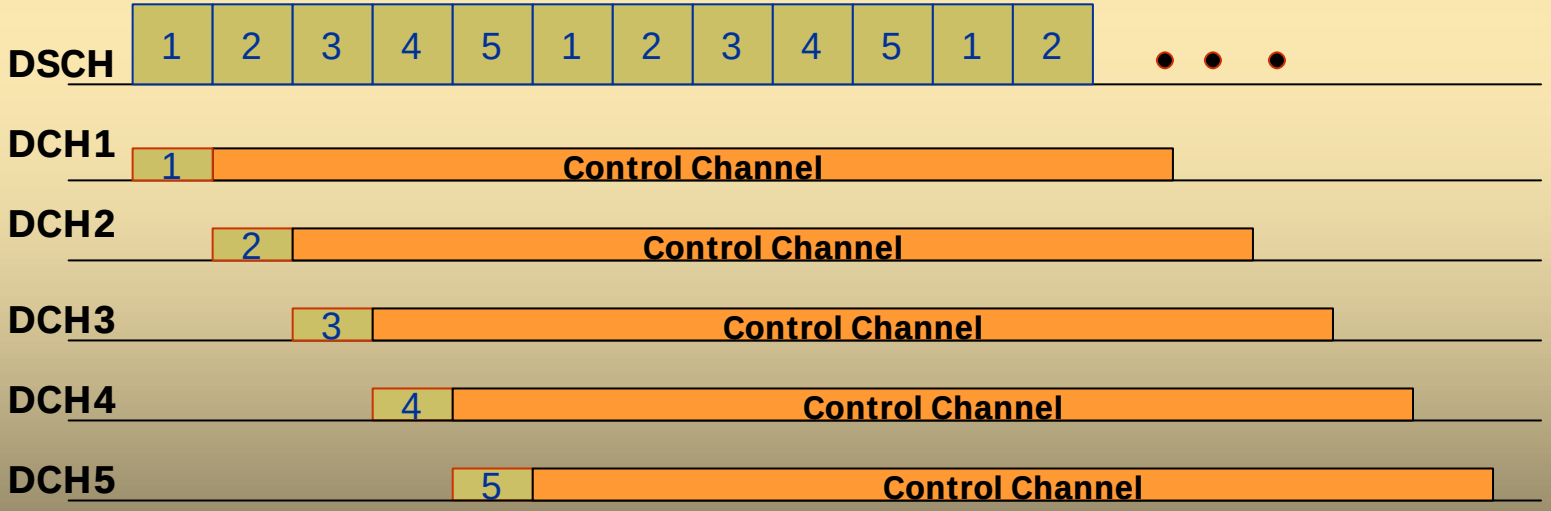
CPCH / FACH Downlink

Downlink Overhead

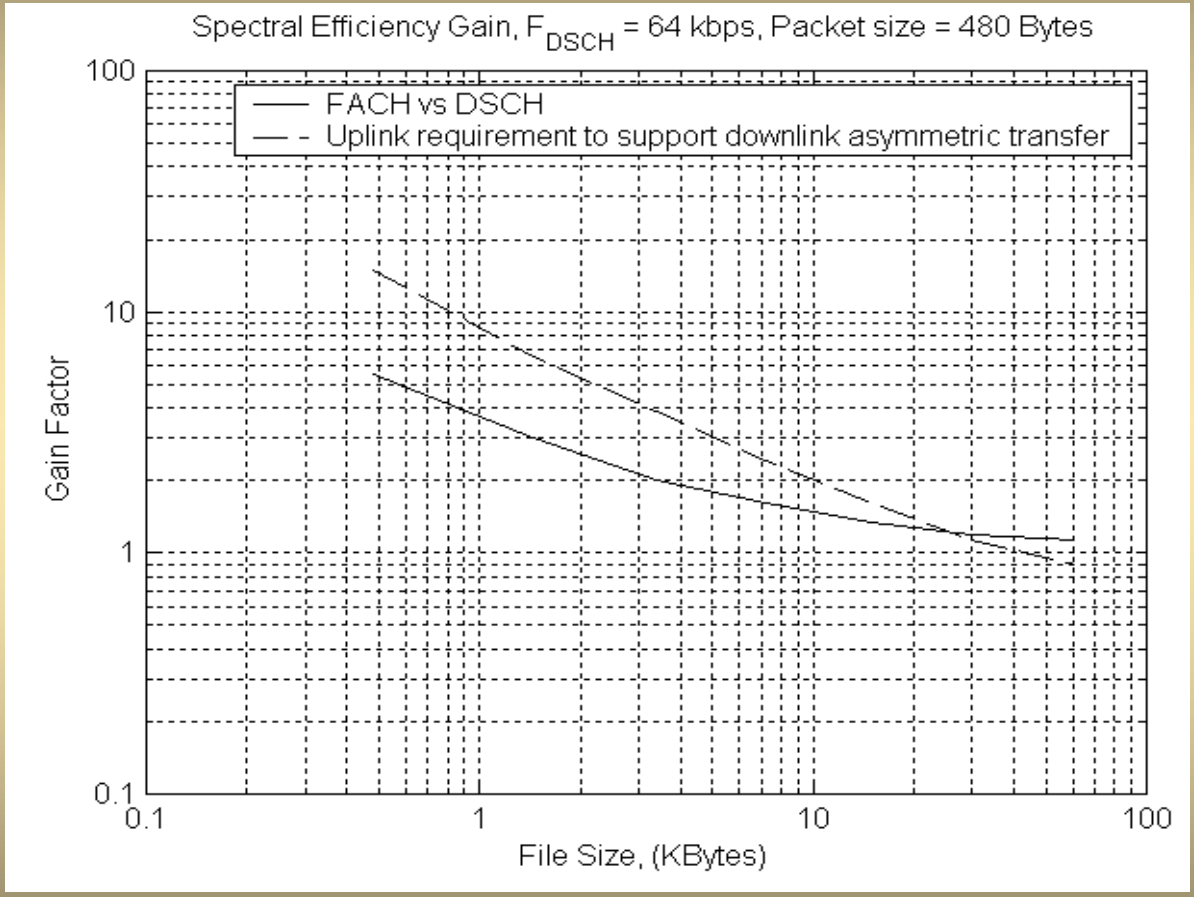
FACH/CPCH versus DSCH

COMMON CHANNEL SOLUTION:

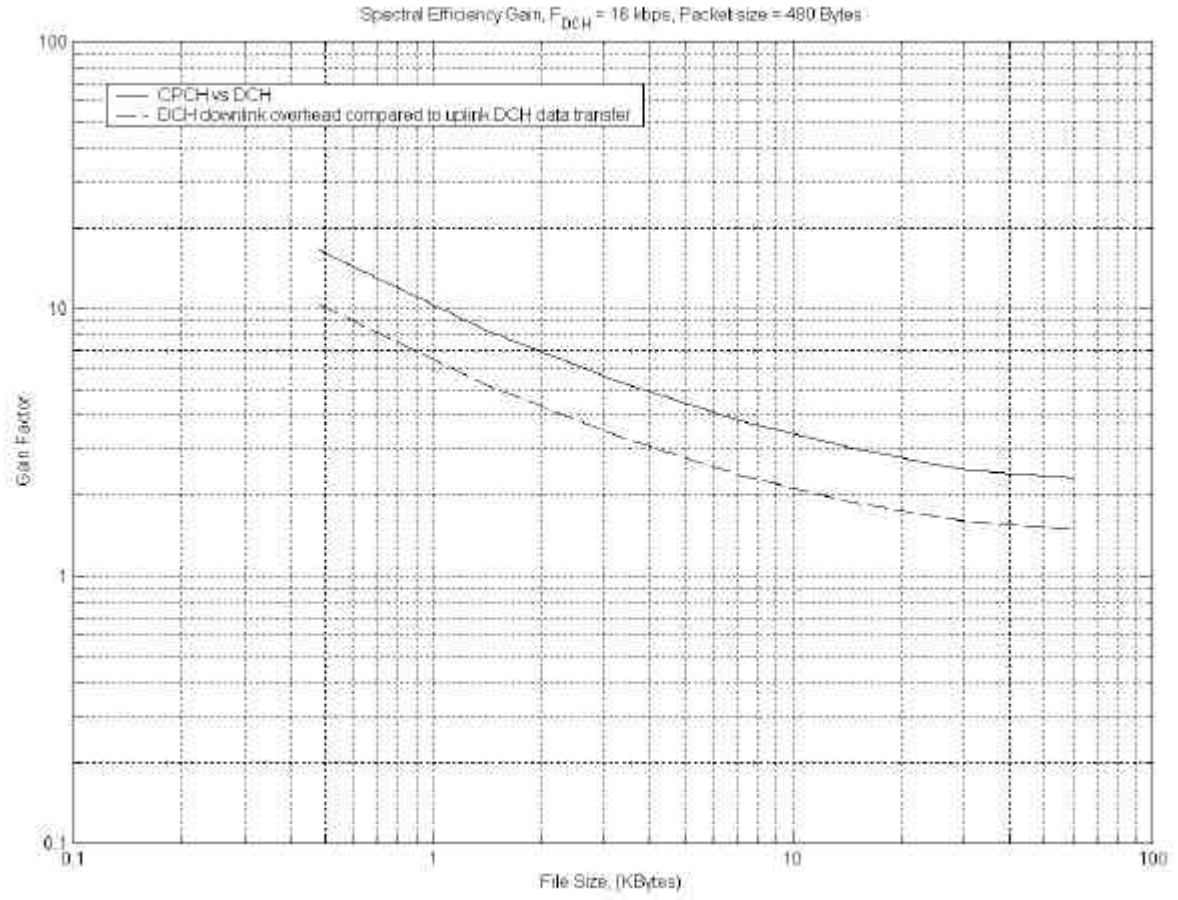
DEDICATED CHANNELS SOLUTION :



Capacity gain of CPCH/FACH over DCH/DCH+ DSCH or unidirectional downlink transfer

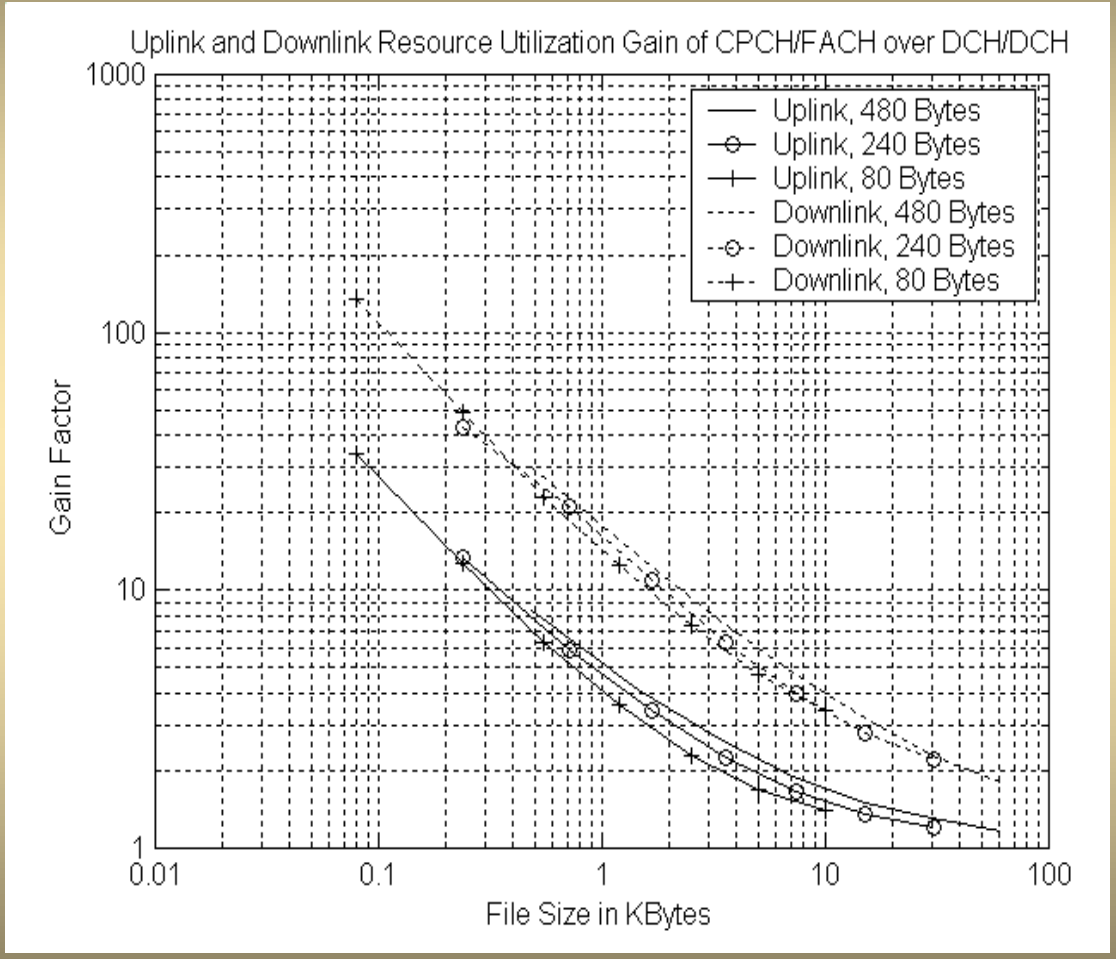


Spectrum efficiency gain of CPCH/FACH over DCH/ DCH for unidirectional uplink transfer



Throughput Improvement Ratio

CPCH/FACH vs DCH/DCH+DSCH and DCH/DCH



CPCH/FACH versus DCH/DCH+DSCH and DCH/DCH: Capacity Gain in both directions

Applications	Uplink Usage	Uplink Packet size per user (Bytes)	Downlink Usage	Downlink Packet size per user (Bytes)	n, m	File sizes (kbytes)
E-mail	80%	240	40%	240	2,3	7.2
Web-browsing	10%	80	50%	480	4,15	7.2(up) 1.35(down)
FTP	10%	480	10%	480	7,127	61

Table 4: Traffic model.

Capacity CPCH/FACH vs DCH/DCH+DSCH

Uplink Direction:

CPCH capacity = 26 xDCH

Downlink Direction:

FACH capacity = 3.5 x DSCH+DCH

Resource Utilization Gain: CPCH/FACH vs DCH/DCH+DSCH

UL Gain CPCH vs. DCH:	**Gain range of 1.2-34**
DL Gain FACH versus DSCH+DCH:	**Gain range of 2-134**

Typical example

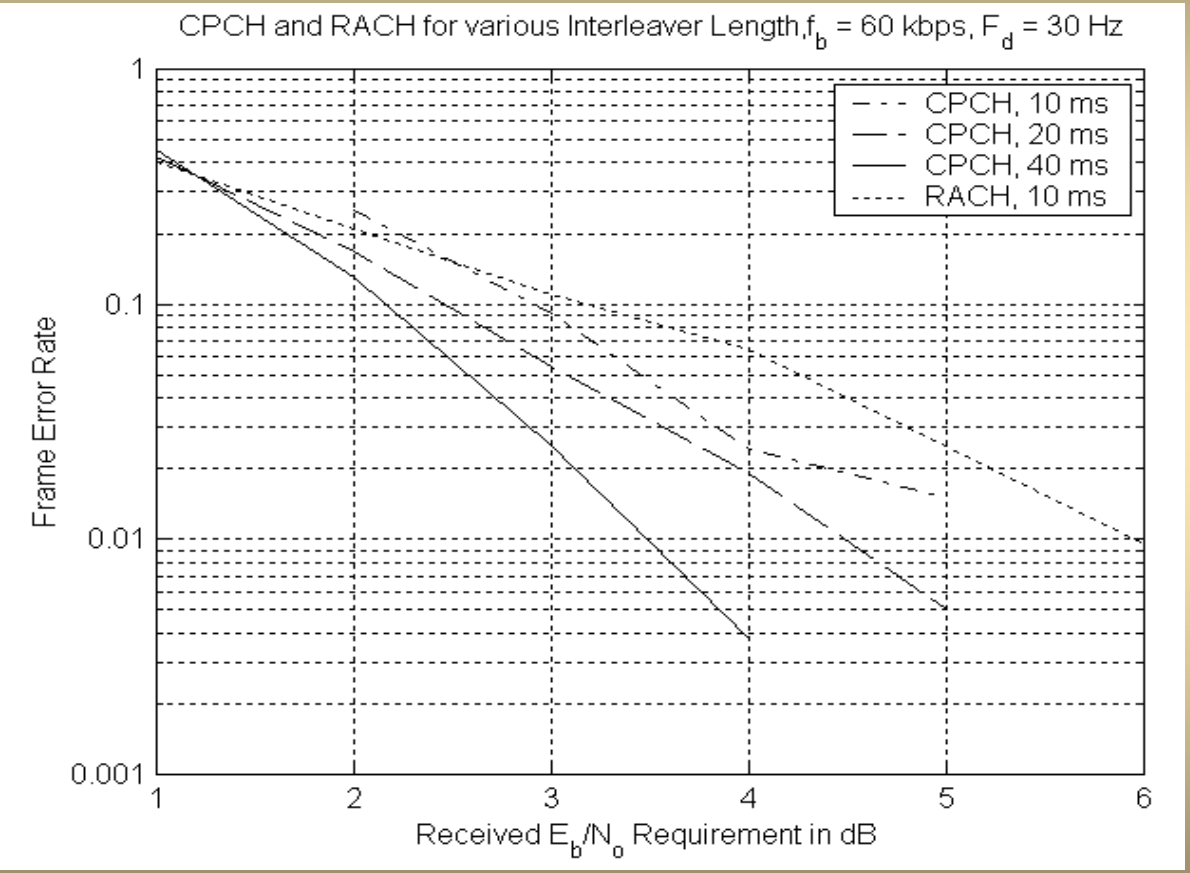
Overall CPCH/FACH gain over DCH/DCH+DSCH

X 16

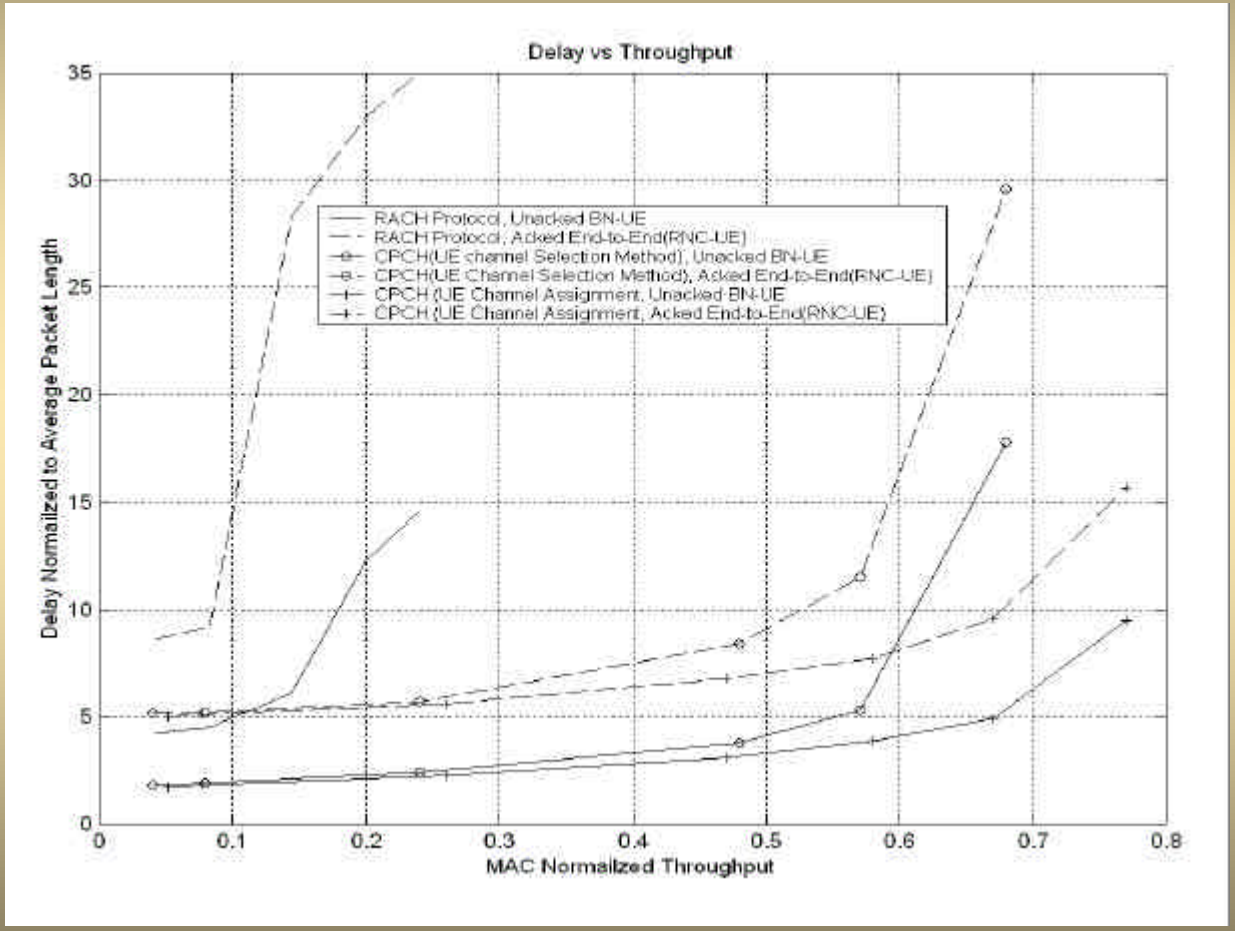
Recommendations 1-2

1. Fast de-allocation of DSCH
2. Improvement of the OLPC-FACH

RACH/FACH versus CPCH/FACH Capacity Comparison



Throughput delay performance of CPCH and RACH



Recommendation 3

3. Introduction of CR on RACH to improve throughput, reduce collisions and reduce UE power consumption

Table 1: ASIC Power Consumption

Mode of Operation	Power Consumption
Full Duplex	80 mA
Idle (Rx+Buffer)	40 mA
Sleep Mode	1.25 mA

Table 2: RF segment Power Consumption

Mode of Operation	Power Consumption
Full Duplex	56 mA (Rx) + 80 mA (minimum TX)+ 240 mA (TX PA)
Idle	56 mA (Rx)
Sleep Mode	2.5 mA

Table 3: LCD Display Power Consumption

Terminal Type	Power Consumption
Cell Phone	150 ?A
Smart Phone	600 ?A-1.2 mA
PDA/Passive	1 mA-2 mA
PDA/Active	13.3 mA

Terminal Power Consumption Ratio: Packet Mode vs. Circuit Mode

A: Activity factor	$I_{average\text{-}circuit\text{-}DCH}$ I_{LCD} = 2 mA	$I_{average\text{-}packet\text{-}CPCH}$ I_{LCD} = 2 mA	**Gain Ratio**	$I_{average\text{-}circuit\text{-}DCH}$ I_{LCD} = 13.3 mA	$I_{average\text{-}packett\text{-}CPCH}$ I_{LCD} = 13.3 mA	**Gain Ratio**
1%	10.27 mA	6.27 mA	**1.7**	21.27 mA	17.26 mA	**1.23**
5%	28.3 mA	8.31 mA	**3.4**	39.4 mA	19.3 mA	**2**
10%	50.9 mA	10.9 mA	**4.7**	62 mA	22.25 mA	**2.8**
20%	99.2 mA	16 mA	**6.2**	107.2 mA	26.8 mA	**4**
25%	119 mA	18.55 mA	**6.4**	130 mA	29.55 mA	**4.4**

Conclusions on Power Consumption

1. Gain Ratio of 2-6.4 (1-25% activity factor)
2. Gain Ratio of 4-6 (A=20% and 2-13 mA LCD display)

Recommendation 4-5

4. Use of DCH/DCH in uplink bursty packet data transfer leads to excessive interference and UE power consumption. Since fast de-allocation is not practical, avoid using DCH/DCH for this purpose.

5. Use of dedicated control in uplink and downlink for downlink packet transfer in circuit mode is extremely costly from capacity and UE power consumption perspective. This recommendation is related to the future E-DSCH design and the uplink/downlink signaling associated with that channel.

Summary of recommendations

1. Fast de-allocation of DSCH
2. Improvement of OLPC on FACH
3. Introduce CR on RACH
4. Avoid DCH/DCH for transfer of uplink bursty packet data
5. Avoid circuit mode (continuous dedicated uplink and downlink) in the future HSPD design.