RAN Working Group 1 #20 **R1-01-0484**
Busan, Korea
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Agenda:	**8.2**
Source:	**Golden Bridge Technology**
Title:	**Efficient Web-browsing and Interactive Packet Data Services Using CPCH/DSCH**
Document for	**Information**

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1. Introduction

GBT has studied various alternatives for efficient packet data services in WCDMA systems. Most packet data services are characterized by bursty, non-uniform data packet trains, which cannot efficiently be served by constant bit rate, circuit style bearer channels. CPCH affords an efficient means to transfer bursty data in the uplink. FACH and DSCH provide an efficient means to transfer bursty data in the downlink direction. FACH is suited for signaling messages and short downlink bursts, while DSCH in the packet mode is more for medium and large-sized downlink packets. The CPCH/FACH combination is addressed in other papers. This combination is well suited for uplink-only transfers, and interactive applications where the down link packets are short [less than a few hundred bytes]. Downlink-only streaming applications can be supported by CPCH/DSCH, RACH/DSCH or DCH/DCH+DSCH. All three methods are viable, however, if streaming is for non-real time applications and QoS requires using TCP or other end-to-end reliable delivery mechanisms, then use of CPCH/DSCH or RACH/DSCH provides significant capacity gain. Thus, CPCH/DSCH may be used together in 3GPP systems to provide the most efficient means to deliver asymmetric interactive downlink intensive packet data services, while uplink intensive traffic is best served by CPCH/FACH.

In this paper, we focus and expand on the use of CPCH/DSCH operation for web browsing applications. The utility analysis of the mechanism for downlink Multimedia Messaging applications is similar to that for web browsing.

2. Background on DSCH in downlink

For wireless data services, UTRAN maintains the connection to the wired server for the wireless client who is connected to the Radio Access Network (RAN). For downlink data packets, a UTRAN MAC-d instance for each connected UE, buffers all downlink data arriving from the server in the wired Internet connected via the Core Network (CN) to be finally sent to the UE client. All downlink packets received from the CN are processed through the RLC layer and sent to the MAC layer for transport as MAC SDUs. MAC processes the MAC SDUSs and produces MAC PDUs for transmission to the PHY. The MAC PDUs are sent from the MAC-d entity in the SRNC to the MAC-C/sh entity in the CRNC where they are buffered until downlink PHY resources are scheduled to deliver the buffered packets. For effective downlink transport of bursty packet data connections, UTRAN will assign PDSCH downlink resources to transport the MAC-c/sh PDUs to the UE. PDSCH resources can be scheduled to transport all of the MAC PDUs contiguously in a single PDSCH segment. To efficiently use the radio resources, UTRAN will keep the UE in Cell-PCH state. When a set of MAC PDUs is available for downlink transport the UTRAN will send the appropriate RRC messages to send the PDUs to the UE via PDSCH.

After the MAC PDUs are buffered and ready for RAN transport, the UTRAN will page the target UE to receive a Physical Channel Reconfiguration message via the FACH. The UE will receive the FACH Physical Channel Reconfiguration and will configure to the DCH/DCH&DSCH channels indicated in the RRC message. When the DCH is stable, the CRNC will schedule transmission of all the buffered MAC PDUs in a contiguous segment of PDSCH. RRC is aware of the CRNC buffer size for the PDSCH transmissions and schedules another Physical Channel Reconfiguration to release the DCH/PDSCH resources as soon as the buffered PDUs are transmitted. In this way the DCH/DCH&PDSCH resources are assigned only for the period needed to transmit the buffered MAC PDUs. There is no need to hold the DCH channel longer than the period needed for PDSCH transmission. The RRC may then use the DCH and PDSCH resources for other UEs using data services.

3. Background on DCH, RACH and CPCH operation in uplink

For the uplink, DCH is not a resource efficient means of transmitting bursty uplink data. UTRAN has three options to allocate resources for uplink transmission: RACH, CPCH, or DCH. As a default, RACH resources may be allocated by UTRAN. RACH is able to transmit very small PDUs effectively to UTRAN. RACH capacity is limited to 9 bytes (spreading factor SF 256) at cell edge to 75 bytes (SF 32) when the UE is close to the BS. Sequential RACHs may be used to transport more PDUs than a single RACH may carry, however the RACH access procedure must be executed for each RACH access and the subsequent delay is significant. UTRAN sets a threshold measurement of traffic volume in the UE to send a measurement report to UTRAN when traffic volume in the UE uplink buffers exceeds the capacity of 2 RACHs. That would be the load at which it would make sense to utilize a higher capacity channel to transmit the buffered uplink data. If the measurement report is triggered, UTRAN may assign CPCH or DCH resources to empty the uplink buffer.

CPCH may be assigned instead of RACH to provide higher capacity uplink transport. A single CPCH access may transport up to 9216 bytes of data at the cell edge (64 frames at SF 16) or up to 36,864 bytes near the BS (64 frames at SF 4). For a single access, CPCH can carry 64 times more data than a RACH at the highest spreading factor, and 490 times more data than a RACH at the lowest spreading factor. When CPCH resources are assigned to a UE, UTRAN sets a threshold measurement of traffic volume in the UE to send a measurement report to UTRAN when traffic volume in the UE uplink buffers exceeds the capacity of 2-10 CPCHs.

CPCH or RACH may be assigned by UTRAN as default channels in the uplink without using uplink resources until they are needed for transmission of uplink data. Consecutive RACH or CPCH accesses may be used until the uplink buffers are emptied. In the uplink, DCH is different in that dedicated resources in the uplink must be allocated by UTRAN without complete knowledge about the amount of data to be transmitted in the uplink. For this reason an inactivity timer is used in the uplink to determine when the uplink buffers are emptied. UTRAN will measure the time period in the uplink during which there is no uplink data transmission. When this period exceeds the inactivity timer setting, UTRAN will reconfigure the UE to use a common channel, the RACH or CPCH.

4. Use of CPCH/DSCH for web browsing application

CPCH and DSCH can be used alternately for DL and UL data packets for web browsing. If UL packets are presented at the UE during a PDSCH DL reception, the DCH UL channel may be used for uplink data transmission. By using PDSCH resources only during actual DL transmission and by using CPCH resources only during UL transmission, data packets are sent and received with maximum efficiency. The example provided below shows how this is accomplished. UTRAN uses DL buffer traffic volume measurements to determine when to assign DSCH resources. UTRAN RNC uses a Physical Channel Reconfiguration message to assign DCH/DCH&DSCH channels to UE when the DL buffer has data to send to the UE. This Physical Channel Reconfiguration transitions the connected UE from Cell-FACH or Cell-PCH state to Cell-DCH state during the DSCH DL transmission. UTRAN then schedules another Physical Channel Reconfiguration to coincide with the last frame of DL data on DSCH. This second Physical Channel Reconfiguration will reassign CPCH/FACH resources to the UE and will transition the UE back to Cell-FACH state.

It is expected that UTRAN will keep the UE in Cell-FACH state for only a short period of time, waiting for additional UL or DL data transmissions. In order to conserve battery life at the UE, the UTRAN will transition the UE to Cell-PCH state after an inactivity timer for Cell-FACH state has expired. This timer may be in the 20-60 second range.

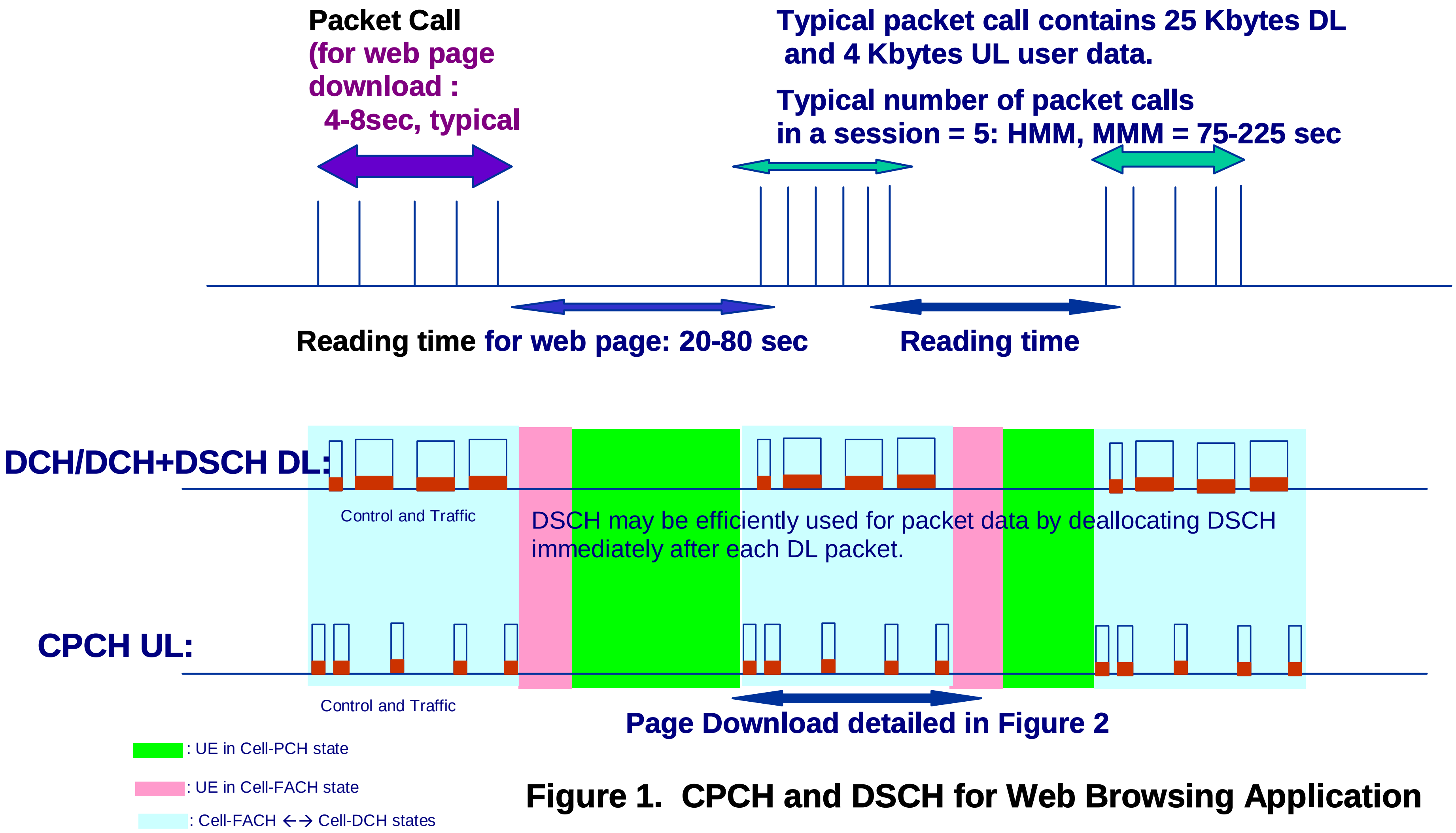

Figure 1. CPCH and DSCH for Web Browsing Application

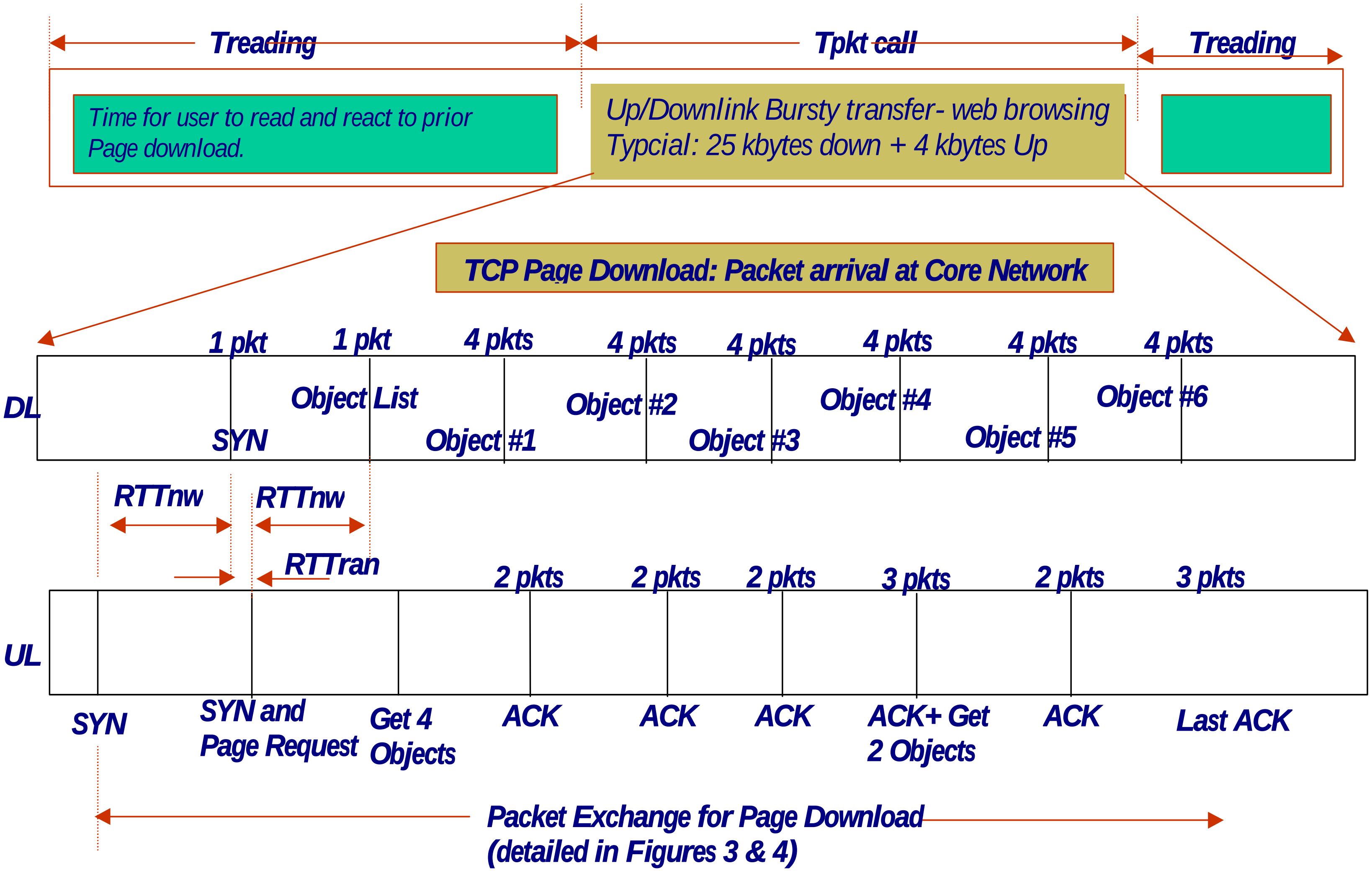

Figure 2: Page Download Packet Exchange

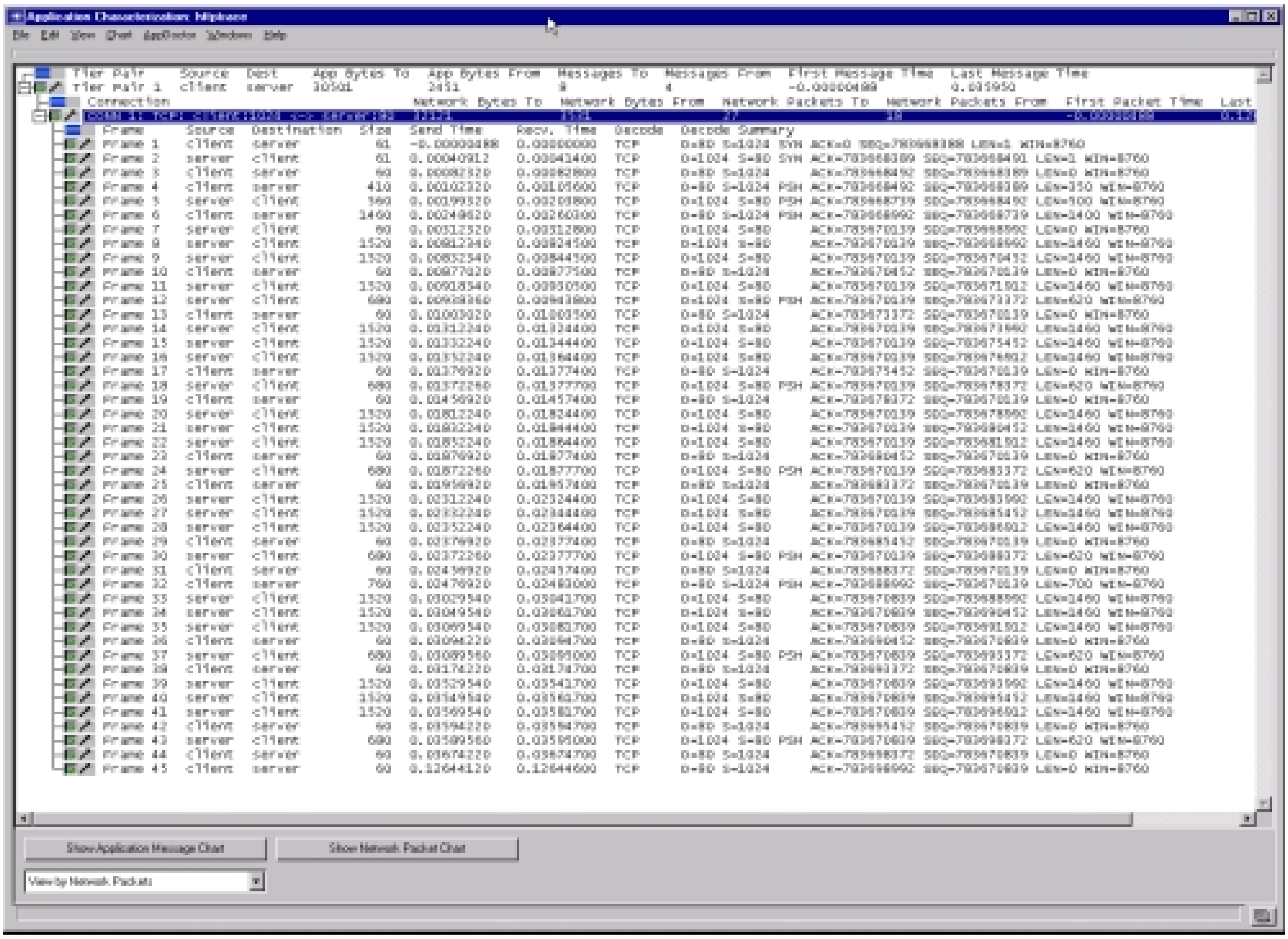

FIGURE 3. Opnet Trace of Typical Page Download

Figure 3 shows a trace for a typical page download from the OPNET simulation tool. This figure shows an example of a web page download. The example shows the client requesting a page, receiving the page description (6 objects), requesting 4 objects, receiving 4 objects, requesting the last 2 objects and receiving the last 2 objects to complete the page download.

Figure 4 and Table 1 (Annex A) provide a packet-by-packet detailed view of this OPNET trace from the Radio Interface perspective. Table 1 lists packet and packet components for a typical page download. 28 individual packets are listed in Table 1. The OPNET trace in Figure 3 lists only the application level packets presented at the core network interface to the wired Internet. Table 1 includes these as DTCH (user traffic) packet components. Table 1 (Annex A) also includes the Radio Access Network (RAN) control and signaling packet components. Figure 4 visually shows the packet components as they are multiplexed into complete packets and transmitted on the Radio Interface by Layer 1 & 2.

Prior to beginning this sequence listed in Table 1, the UE has established an RRC connection for an interactive service. The connection uses RLC in UM mode and establishes an Internet connection for use by the UE. TCP/IP protocol is used for web browsing and error detection and packet retransmission are handled by application layers. UE is in Cell-FACH state to begin this sequence.

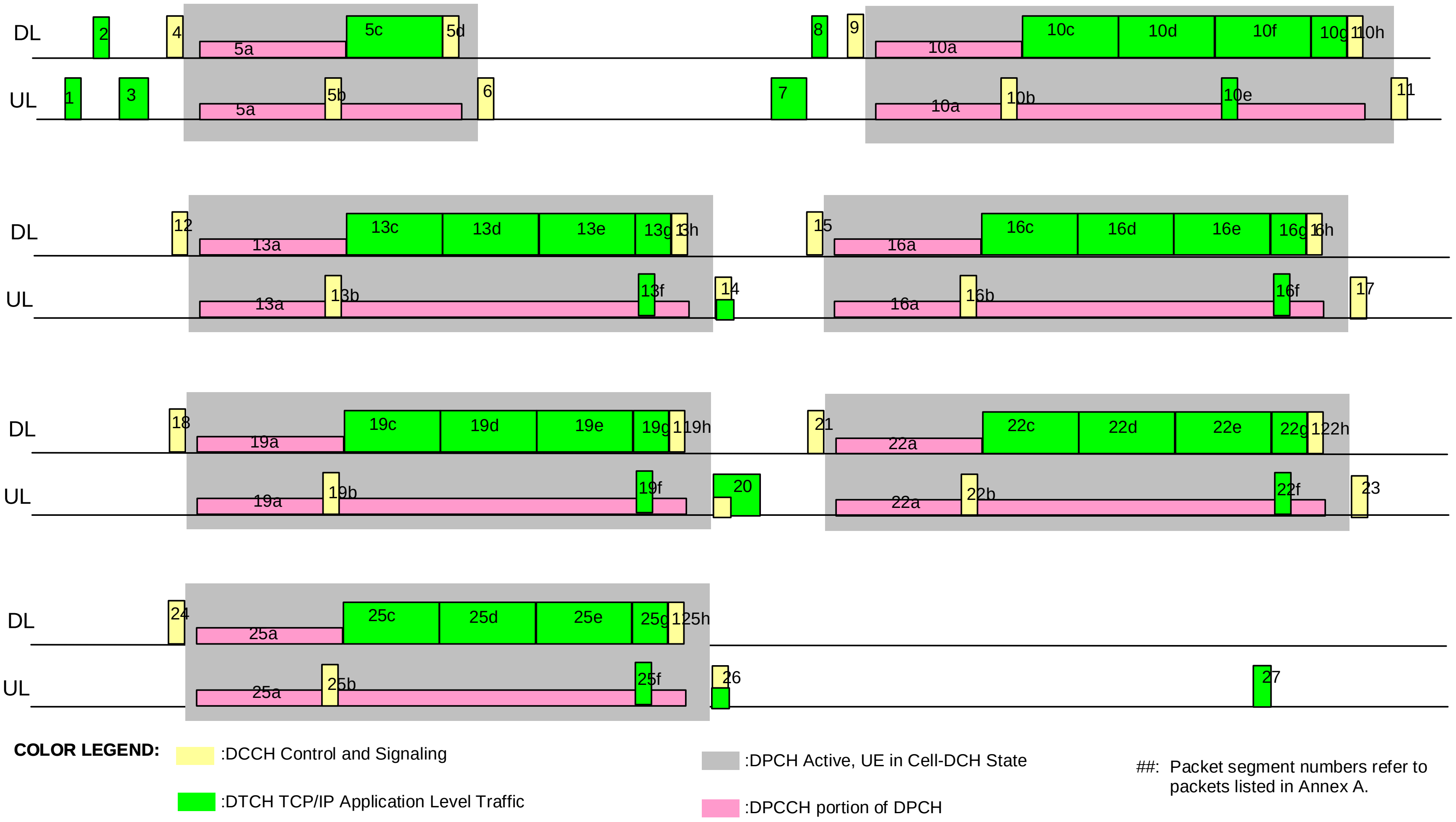

Figure 4. Packet by Packet Radio Interface View of Web Page Download

5. CPCH/DSCH operation at the cell border

5.1 Cell re-selection for CPCH/DSCH

Using this CPCH/DSCH approach for web browsing may also occur across multiple cells for mobile UEs. In the mobility case, movement from cell to cell may occur while the UE is in Cell-FACH state or in Cell-DCH state. If a normal cell reselection takes place while the UE is in Cell-FACH state, the UE performs a Cell Update procedure to inform the UTRAN of the new primary cell. If the System Information for CPCH is different in the new cell as compared to the CPCH information in the old cell, then UTRAN would include the new CPCH Set Info IE in the Cell Update Confirm message to the UE. In this way the UE may continue to access CPCH without delay immediately after cell reselection.

If UTRAN decides to perform a hard handover of the UE while it is in Cell-DCH state and is receiving DSCH, UTRAN would sent a Physical Channel Reconfiguration message to indicate the new primary cell (new Primary CPICH Info IE). If the System Information for CPCH were different in the new cell as compared to the CPCH information in the old cell, then UTRAN would include the new CPCH Set Info IE in the Physical Channel Reconfiguration message to the UE. In this way the UE may continue to access CPCH in the new cell after transition back to Cell-FACH state. Table 2 (Annex B) shows an example of hard handover during web page download; handover items are highlighted in yellow.

If upon transition to Cell-FACH state, the UE selects a different cell than the one used as target cell in the hard handover, the UE would signal this to the UTRAN by including a Cell Update procedure within the Physical Channel Reconfiguration procedure. Again, if the System Information for CPCH is different in the newly selected cell as compared to the CPCH information in the target cell used for the hard handover, then UTRAN would include the new CPCH Set Info IE in the Cell Update Confirm message to the UE. In this way the UE may continue to access CPCH without delay immediately after cell reselection.

The same handover procedure described above for hard handover would apply equally to the soft handover case in which the DCH used as part of the DCH/DCH+DSCH configuration could be maintained in soft handover.

5.2 CPCH cell re-selection and adjacent cell interference

In the boundary region between cells, the CPCH transmit power and resulting co-cell interference may be limited by using the Transport Format Combination Control feature of RRC. TFC Control permits the UTRAN to limit UEs use of the assigned CPCH Transport Format Set to a subset of the TFS broadcast in the System information. The TFS subset may be a subset, which is limited to transmit data rates below the maximum data rate in the broadcast TFS (SF greater than the minimum in the broadcast TFS). By using TFC Control in this way, UTRAN may limit the transmit power of a CPCH UE near a cell edge. The normal intra.frequency measurements are used by UTRAN to obtain from the UE relative CPICH RSCP levels for the primary and all neighbor cells. Using these measurement results, UTRAN may determine when a UE is near a cell edge and then may use TFC Control to limit the UE CPCH transmit power. Table 3 (Annex C) shows an example of TFC Control to limit transmit power while using CPCH/DSCH during web page download. TFC Control items are highlighted in yellow.

6. Conclusions

GBT has studied use of various 3GPP radio channels for web browsing and other packet data services. This paper presents a web-browsing example using CPCH/DSCH combination to minimize use of radio resources for this application. In addition, existing techniques to provide mobility (cell reselection, hard handover and soft handover for associated DPCH) are described as they apply to CPCH/DSCH. Finally, in order to limit UE transmit power when in a cell edge region, an example of TFC Control is presented for CPCH/DSCH. These examples demonstrate that the current Release 99 standard can fully support CPCH and DSCH used in combination in a real world, multi-cellular system for packet data services. Understanding these examples is important because GBT's simulations and analysis support the conclusion that CPCH/DSCH is the most efficient and most practical means for an operator to provide downlink intensive interactive packet data services in 3G WCDMA systems.

Annex A

TABLE 1. Packet by Packet Description of Web Page Download

Numbers listed below refer to packet segment numbers as shown in Figure 4.

******Page Request Upload*****

1. UL DTCH:CPCH: TCP connection open request from client (SYN) (61 bytes)
2. DL DTCH:FACH: TCP connection opened indication from server (SYN) (61 bytes)
3. UL DTCH:CPCH:
   - 3a.SYN ACK from client completing three-way handshake (60 bytes)
   - 3b. Client sends HTTP get message (350 bytes for the page + 60 byte header (TCP + IP Ethernet)) with a "PUSH" indicating that the file is complete—TCP sends file up to the application layer (total 470 bytes)

*****Page Object Contents (6 objects) Download*****

4. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
5. UL/DL DCH/DCH+DSCH
   - 5a. Power Control Preamble (PCP) for DCH initialization
   - 5b. UL DCCH:DCH: PhyChanReconfigComplete
   - 5c. DL DTCH:DSCH: HTTP page (500 bytes + 60 bytes) returned from server (with PUSH)
   - 5d. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
6. UL DCCH:CPCH: PhyChanReconfigComplete

*****Request Upload for first 4 objects*****

7. UL DTCH:CPCH: Client sends 4 HTTP gets (350 bytes/object) with PUSH
8. DL DTCH:FACH: Server sends ACK

*****1st Object Download*****

9. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
10. UL/DL DCH/DCH+DSCH
    - 10a. Power Control Preamble (PCP) for DCH initialization
    - 10b. UL DCCH:DCH: PhyChanReconfigComplete
    - 10c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 1st object after server processing delay to read objects.
    - 10d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
    - 10e. UL DTCH:DCH: Client sends ACK
    - 10f. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
    - 10g. DL DTCH:DSCH: Server sends last TCP segment for 1st object (620 + 60) with PUSH
    - 10h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH

11a. UL DCCH:CPCH: PhyChanReconfigComplete

11b. UL DTCH:CPCH: Client sends ACK

*****2nd Object Download*****

12. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
13. UL/DL DCH/DCH+DSCH
    - 13a. Power Control Preamble (PCP) for DCH initialization
    - 13b. UL DCCH:DCH: PhyChanReconfigComplete
    - 13c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 2nd object after server processing delay for object ack.
    - 13d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
    - 13e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
    - 13f. UL DTCH:DCH: Client sends ACK

13g. DL DTCH:DSCH: Server sends last TCP segment for 2nd object (620 + 60) with PUSH
13h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
14a. UL DCCH:CPCH: PhyChanReconfigComplete
14b. UL DTCH:CPCH: Client sends ACK
*****3rd Object Download*****
15. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
16. UL/DL DCH/DCH+DSCH
16a. Power Control Preamble (PCP) for DCH initialization
16b. UL DCCH:DCH: PhyChanReconfigComplete
16c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 3rd object after server processing delay for object ack.
16d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
16e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
16f. UL DTCH:DCH: Client sends ACK
16g. DL DTCH:DSCH: Server sends last TCP segment for 3rd object (620 + 60) with PUSH
16h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
17a. UL DCCH:CPCH: PhyChanReconfigComplete
17b. UL DTCH:CPCH: Client sends ACK
*****4th Object Download*****
18. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
19. UL/DL DCH/DCH+DSCH
19a. Power Control Preamble (PCP) for DCH initialization
19b. UL DCCH:DCH: PhyChanReconfigComplete
19c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 4th object after server processing delay for object ack.
19d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
19e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
19f. UL DTCH:DCH: Client sends ACK
19g. DL DTCH:DSCH: Server sends last TCP segment for 4th object (620 + 60) with PUSH
19h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
20a. UL DCCH:CPCH: PhyChanReconfigComplete
20b. UL DTCH:CPCH: Client sends ACK
*****Request Upload for final 2 objects*****
20c. UL DTCH:CPCH: Client sends 2 HTTP gets (350 bytes/object) with PUSH
*****5th Object Download*****
21. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
22. UL/DL DCH/DCH+DSCH
22a. Power Control Preamble (PCP) for DCH initialization
22b. UL DCCH:DCH: PhyChanReconfigComplete
22c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 5th object after server processing delay for object ack.
22d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
22e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
22f. UL DTCH:DCH: Client sends ACK
22g. DL DTCH:DSCH: Server sends last TCP segment for 5th object (620 + 60) with PUSH
22h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
23a. UL DCCH:CPCH: PhyChanReconfigComplete
23b. UL DTCH:CPCH: Client sends ACK
*****6th Object Download*****

24. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
25. UL/DL DCH/DCH+DSCH
   25a. Power Control Preamble (PCP) for DCH initialization
   25b. UL DCCH:DCH: PhyChanReconfigComplete
   25c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 6th object after server processing delay for object ack.
   25d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   25e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   25f. UL DTCH:DCH: Client sends ACK
   25g. DL DTCH:DSCH: Server sends last TCP segment for 6th object (620 + 60) with PUSH
   25h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
26a. UL DCCH:CPCH: PhyChanReconfigComplete
26b. UL DTCH:CPCH: Client sends ACK
*****Acknowledge Page Complete*****
27. UL DTCH:CPCH: Client sends ACK

Annex B

TABLE 2. Packet by Packet Description of Hard Handover during Web Page Download

Numbers listed below refer to packet segment numbers as shown in Figure 4.

******Page Request Upload*****

1. UL DTCH:CPCH: TCP connection open request from client (SYN) (61 bytes)
2. DL DTCH:FACH: TCP connection opened indication from server (SYN) (61 bytes)
3. UL DTCH:CPCH:
   3a.SYN ACK from client completing three-way handshake (60 bytes)
   3b. Client sends HTTP get message (350 bytes for the page + 60 byte header (TCP + IP Ethernet)) with a "PUSH" indicating that the file is complete—TCP sends file up to the application layer (total 470 bytes)

*****Page Object Contents (6 objects) Download*****

4. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
5. UL/DL DCH/DCH+DSCH
   5a. Power Control Preamble (PCP) for DCH initialization
   5b. UL DCCH:DCH: PhyChanReconfigComplete
   5c. DL DTCH:DSCH: HTTP page (500 bytes + 60 bytes) returned from server (with PUSH)
   5d. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
6. UL DCCH:CPCH: PhyChanReconfigComplete

*****Request Upload for first 4 objects*****

7. UL DTCH:CPCH: Client sends 4 HTTP gets (350 bytes/object) with PUSH
8. DL DTCH:FACH: Server sends ACK

*****1st Object Download*****

9. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
10. UL/DL DCH/DCH+DSCH
   10a. Power Control Preamble (PCP) for DCH initialization
   10b. UL DCCH:DCH: PhyChanReconfigComplete
   10c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 1st object after server processing delay to read objects.
   10d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   10e. UL DTCH:DCH: Client sends ACK
   10f. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   10g. DL DTCH:DSCH: Server sends last TCP segment for 1st object (620 + 60) with PUSH
   10h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH

11a. UL DCCH:CPCH: PhyChanReconfigComplete
11b. UL DTCH:CPCH: Client sends ACK

*****2nd Object Download*****

12. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
13. UL/DL DCH/DCH+DSCH
   13a. Power Control Preamble (PCP) for DCH initialization
   13b. UL DCCH:DCH: PhyChanReconfigComplete
   13c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 2nd object after server processing delay for object ack.
   13d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   13e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   13f. UL DTCH:DCH: Client sends ACK

13g. DL DTCH:DSCH: Server sends last TCP segment for 2nd object (620 + 60) with PUSH
13h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH in new target cell
**********Hard Handover to new cell*******
14a. UL DCCH:CPCH: PhyChanReconfigComplete in new cell
14b. UL DTCH:CPCH: Client sends ACK
*****3rd Object Download*****

[ALL SUBSEQUENT PACKET SEGMENTS ARE SAME AS THOSE IN ANNEX A.]

Annex C

TABLE 3. Packet by Packet Description of Web Page Download with TFC Control

Numbers listed below refer to packet segment numbers as shown in Figure 4.

******Page Request Upload*****

1. UL DTCH:CPCH: TCP connection open request from client (SYN) (61 bytes)
2. DL DTCH:FACH: TCP connection opened indication from server (SYN) (61 bytes)
3. UL DTCH:CPCH:
   3a.SYN ACK from client completing three-way handshake (60 bytes)
   3b. Client sends HTTP get message (350 bytes for the page + 60 byte header (TCP + IP Ethernet)) with a "PUSH" indicating that the file is complete—TCP sends file up to the application layer (total 470 bytes)

*****Page Object Contents (6 objects) Download*****

4. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
5. UL/DL DCH/DCH+DSCH
   5a. Power Control Preamble (PCP) for DCH initialization
   5b. UL DCCH:DCH: PhyChanReconfigComplete
   5c. DL DTCH:DSCH: HTTP page (500 bytes + 60 bytes) returned from server (with PUSH)
   5d. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
6. UL DCCH:CPCH: PhyChanReconfigComplete

*****Request Upload for first 4 objects*****

7. UL DTCH:CPCH: Client sends 4 HTTP gets (350 bytes/object) with PUSH
8. DL DTCH:FACH: Server sends ACK

*****1st Object Download*****

9. DL DCCH:FACH: PhyChanReconfig to DCH/DCH+DSCH
10. UL/DL DCH/DCH+DSCH
   10a. Power Control Preamble (PCP) for DCH initialization
   10b. UL DCCH:DCH: PhyChanReconfigComplete
   10c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 1st object after server processing delay to read objects.
   10d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   10e. UL DTCH:DCH: Client sends ACK
   10f. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   10g. DL DTCH:DSCH: Server sends last TCP segment for 1st object (620 + 60) with PUSH
   10h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH

11a. UL DCCH:CPCH: PhyChanReconfigComplete
11b. UL DTCH:CPCH: Client sends ACK
11c. UL DCCH:CPCH: UE sends measurement report indicating cell edge condition.

*****2nd Object Download*****

12. DL DCCH:FACH: TransportChanReconfig to DCH/DCH+DSCH using TFC Control
13. UL/DL DCH/DCH+DSCH
   13a. Power Control Preamble (PCP) for DCH initialization
   13b. UL DCCH:DCH: PhyChanReconfigComplete
   13c. DL DTCH:DSCH: Server sends first TCP segment (1460 + 60) for 2nd object after server processing delay for object ack.
   13d. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)
   13e. DL DTCH:DSCH: Server sends next TCP segment (1460 + 60)

13f. UL DTCH:DCH: Client sends ACK
13g. DL DTCH:DSCH: Server sends last TCP segment for 2nd object (620 + 60) with PUSH
13h. DL DCCH:DSCH: PhyChanReconfig to CPCH/FACH
14a. UL DCCH:CPCH: PhyChanReconfigComplete
14b. UL DTCH:CPCH: Client sends ACK
*****3rd Object Download*****

[ALL SUBSEQUENT PACKET SEGMENTS ARE SAME AS THOSE IN ANNEX A.]