TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) ***TSGR2#3(99) 212***
Yokohama 13th to 16th April 1999

Agenda Item: 7.11

Source: Alcatel

Title: Associated Control Channel and soft handover issues related to 'Dynamic Resource Allocation Control (DRAC) of uplink DCH'

Document for: Decision

---

1 Introduction

Alcatel proposes, at the last RAN WG2 meeting, the DPAC (Dynamic Packet Admission Control) procedure for controlling packet transmission on UL (see 'MAC multiplexing on uplink for packet users', Alcatel, Tdoc RAN WG2 122/99.
). The principle was agreed in terms of functionality as resource arbitration for up-link DCH at CRNC level, obtained by the broadcast information sent by RRC.
This document addresses some concerns regarding the Dynamic Resource Allocation Control procedure on uplink DCH, which are the associated control channels on DL on one hand and Soft Ho control on other hand. A description of the proposed arbitration procedure has been recalled with some minor changes in comparison with 'MAC multiplexing on uplink for packet users', Alcatel, Tdoc RAN WG2 122/99..

2 Dynamic Resource Allocation Control procedure on UL DCH

The procedure consists in regularly broadcasting some information in order to control the transmission of all uplink DCH users that can be controlled dynamically. This permits to achieve a decentralised multiplexing of uplink DCH with a limited signalling overhead on downlink. This procedure aims at keeping a statistical control of the network load, considering the statistical nature of interference in a CDMA system, the sharing of radio resources among cells and also with RT users, and the inherent processing delays between changes in cell load and adaptation of resources allocation in C-RNC. However, for an efficient control of the network through this procedure, it should be mandatory for all UEs supporting high bit rate NRT services (packet services).

Some parameters have to be signalled to all UEs only once, either on BCCH or in the RAB establishment message. They should not need being updated very often by the UTRAN.

- Transmission time validity $T_{validity}$, which indicates the time duration for which an access for transmission of data is granted. It may be set by the UTRAN in relation with the activity statistics of real time services, in order to maintain priority for those users.
- T_{retry}, which indicates, in case the resource has not been granted, the time duration before retrying to access the resource.
- T_{out}, which indicates the maximum silent period duration before releasing the resource. This parameter may be merged with the Fkp-b parameter defined in the 'Transmission stop and resumption control' procedure defined in RAN/WG1 S1.14 document.

Some parameters need to be broadcast at each frame, for an efficient control of the network load:

- Transmission probability p_{tr}, which indicates the probability for a mobile to be allowed to transmit. It may be computed according to the actual network load, and should be regularly updated.
- Minimum spreading factor SF_{min} which indicates the maximum user bit rate allowed for the Transmission period $T_{validity}$. It may be set according to the actual number of active users and to the total bit rate allocated to packet users. It should then be updated according to the activity of all users. The UE has then to derive a suitable subset of TFS, according to this SF_{min} in order not to use a lower spreading factor.

On the UE side, when data has to be transmitted on uplink, the UE makes a DCH allocation request on RACH. Following the normal RAB establishment procedure, a DCH has to be allocated with a specific field indicating that this DCH is dynamically controlled. Once the DCH has been allocated together with a Transport Format Set TFS, $T_{validity}$, T_{retry}, T_{out}, the UE listens to the packet information broadcast to get recent updates of parameters, as described in Figure 1.

UE does not need to continuously listen to the broadcast information related to the DRAC procedure. In fact, p_{tr} needs to be updated, from the UE side, every $T_{validity}$ period. Moreover, since the dynamic part of the Transport Format (which define the data rate for a given transport channel) can only be changed every Transmission Time Interval, updating the TFS-subset on a shorter period basis than a Transmission Time Interval is impossible. Setting the $T_{validity}$ period as an entire multiple of the TTI of all the DCH allows the UE to listen to broadcast information only every $T_{validity}$ frames.

The UE selects a subset of TFS according to the minimum allowed spreading factor SF_{min} and to its capabilities and needs. The user bit rate may indeed be limited by transmitter power or the UE may only have a small amount of data to transmit, thus not requiring the minimum allowed SF_{min}. Then the UE picks a random number between 0 and 1, and is allowed to transmit if this number is below p_{tr}.

If transmission is allowed, it is granted for $T_{validity}$. If transmission has not been granted, a DPCCH is continuously active until the UE tries again after a period of T_{retry}. When no more data has to be sent, the UE keeps its DPCCH (Dedicated Physical Control Channel) for a given period T_{out}, and then releases the DCH if no data has to be transmitted by the end.

The SF is automatically derived by the L1, according to the uplink rate matching function, from the TBS of the dynamically controlled DCH and eventually from TBS of DCH multiplexed on the same DPDCH.

The C-RNC informs the Node B about the SF_{min} that may be used on dynamically controlled DCH at each frame, allowing then the Node B receiver to configure according to the current SF used on each frame. The Node B may then be able to de-spread the signal closer to the actual SF being used, thus reducing buffering.

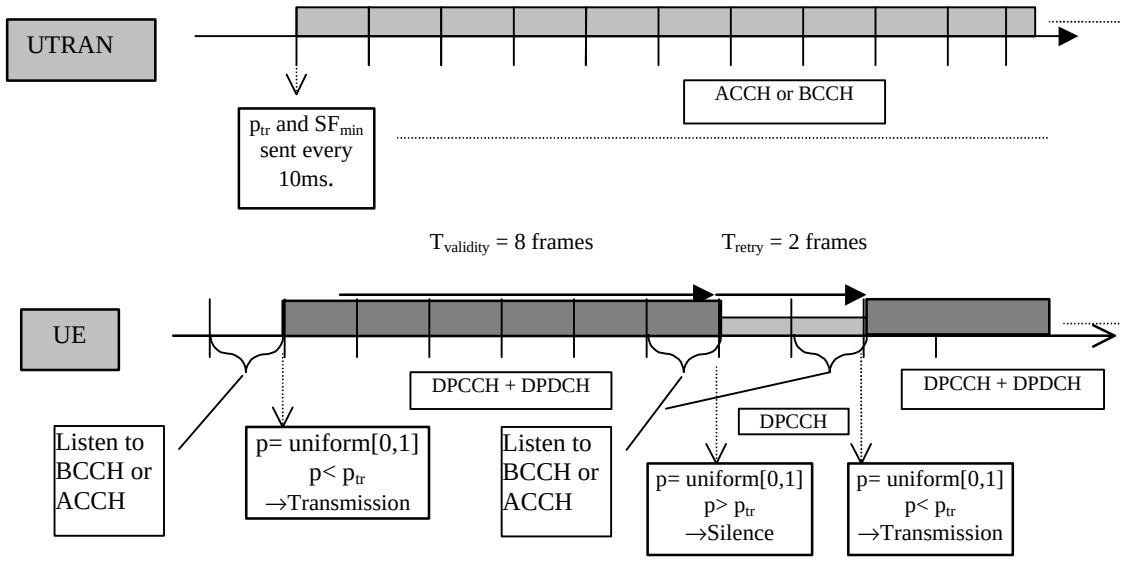

Figure 1: typical DRAC sequence

The procedure for stopping and resuming DPCCH transmission should be done according to the 'Transmission stop and resumption control' procedure defined in RAN/WG1 S1.14 document. The control of this procedure by the higher layers is however not very clear at this stage. It is pointed out that this procedure should not be applied between two transmission periods, when transmission right has not been granted ($p>p_{tr}$). Indeed, in this case, the DPCCH is maintained until transmission right is granted.

3 Selection of a transport channel on downlink for the broadcast of control information

An associated control channel on DL is required to broadcast information related to resource arbitration, and to provide closed loop power control on UL. Two transport channels could be used: BCCH or ACCH (DSCH Control Channel). The selection of the transport channel has to be made according to the availability of the ACCH and to the capability of the UE in terms of multi-code reception. Two cases are considered:

- ACCH is not available: BCCH is used for the broadcast of control information. TPC bits are then sent on DL DCH, provided a DL DCH has already been allocated. In that case, UE has two codes to listen to on DL. Configuration on DL is: DCH (TPC)+ BCCH (P_{tr} + SF_{min})

- ACCH is available: ACCH is used for the broadcast of control information. TPC bits could be sent either on ACCH or on DL DCH (provided a DL DCH has already been allocated). UE has then one (no DL DCH) or two codes to listen to. Configurations on DL are:

    - DCH (TPC) + ACCH (P_{tr} + SF_{min})

    - ACCH only (TPC + P_{tr} + SF_{min}).

    - A third configuration might need to be considered in case UE would be required to also listen to BCCH during transmission for other purposes. This has however not been identified yet. UE would then have three codes to listen to: DCH (TPC) + ACCH (P_{tr} + SF_{min}) + BCCH.

A parameter in the BCCH will indicate on which transport channel the information is broadcast.

4 Soft Handover control on DCH on UL.

Soft Handover on the uplink DCH may be used with the concept described above, but UE needs to listen to broadcast packet information from several cells, which means on several physical channels. Considering this and the configurations described above, two types of control during soft handover are defined.

In a first option, the UE evaluates the 'primary cell' as for the SSDT and reacts to broadcast control information from this primary cell only. To help the control of transmission into the C-RNC, the UE is requested to indicate its primary cell as for SSDT. The UE should react to TPC commands sent by all cells. This option could happen when a DCH is already allocated on DL in both cells, providing TPC bits for UL DCH, and when UE only listens to the associated control channel from the primary cell. As the cell with the lowest pathloss is not necessarily the cell with the highest cell load, it may lead to potential overload situation in the secondary cell. In this case, the bit rate of this dynamically controlled DCH might need to be limited. In Figure 2, soft handover is already applied on DL DCH, providing TPC bits for UL DCH. But only one control channel, from the primary cell, is listened by the UE, at least every $T_{validity}$ period.

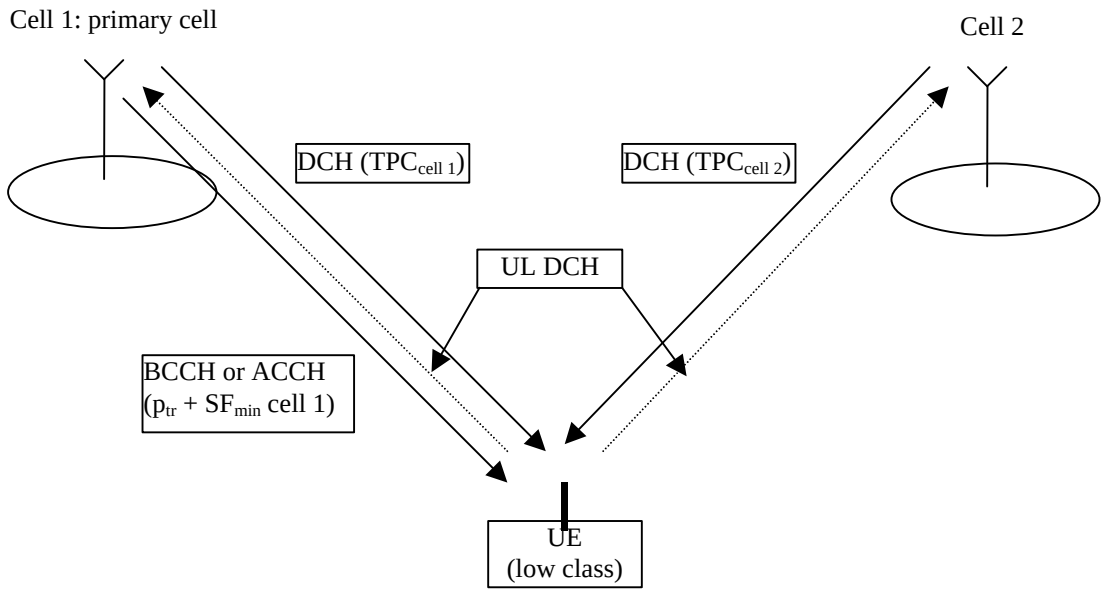

Figure 2: control from 'primary cell'

In a second option, the UE listens to the broadcast information from all the cells involved in the soft handover. In that case, resource arbitration, at the UE side, is managed in the same way as the closed loop power control. The lowest ratio p_{tr} / SF_{min} will be taken into account every $T_{validity}$ period. In **Figure 3**, soft handover is applied on DL DCH, providing TPC bits for UL DCH. UE has to listen to two other channels (BCCH or ACCH) every $T_{validity}$ period at least, in order to get control information from both cells. Alternatively, the UE may also get TPC bits on downlink from the ACCH of

each cell. In this case, only one code has to be listened in each cell of the Active Set (see Figure 4). This option may be used when the DSCH is used for downlink transmission.

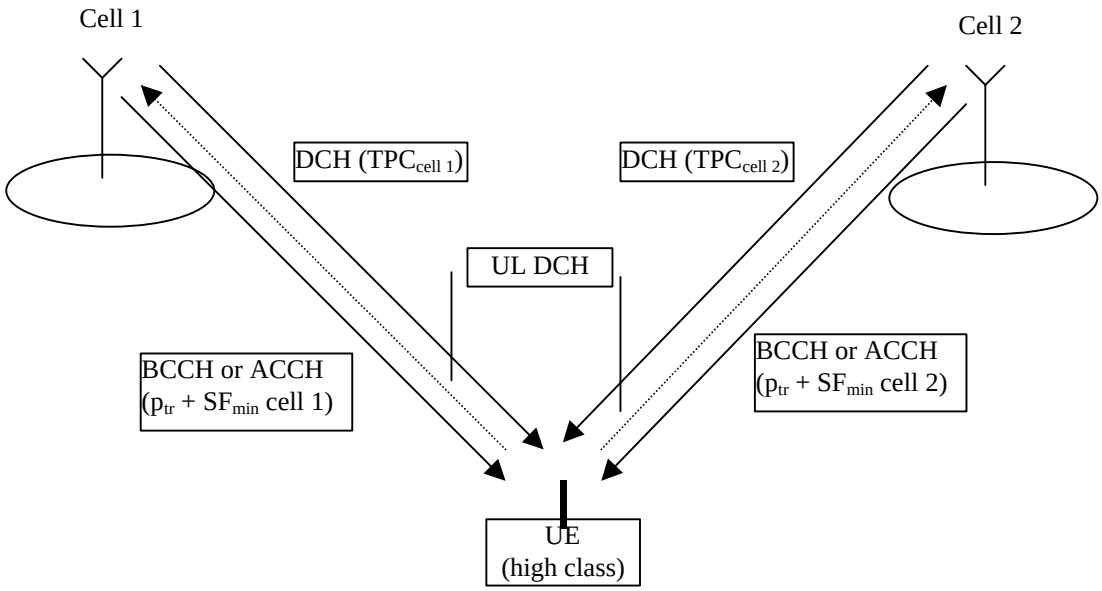

Figure 3: control from both cells

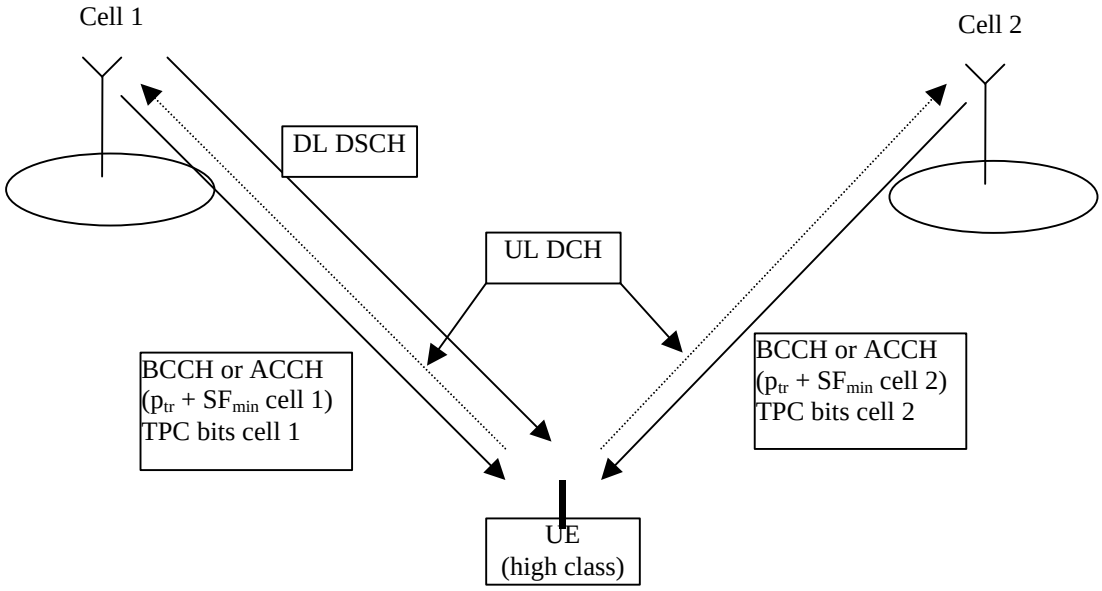

Figure 4 : Control from both cells with TPC bits on the ACCH

It is proposed to implement both options, according to UE class. If the class of the mobile is too restrictive (UE is not able to listen to several associated control channels), the first option will be used. Otherwise, if its class allows this UE to listen to several associated control channels, the second option will be applied. To improve DRAC according to the class of the mobiles in soft handover, specific values of p_{tr} and SF_{min} will be broadcast for each class, high class mobiles being allowed to transmit with higher bit rate.

5 Conclusion

This document addresses concerns related to the DRAC procedure and proposes solutions for the broadcast of control information and for a control during soft handover. Other contributions present the detailed RRC and MAC procedures required by the DRAC, for inclusion in the WG2 specifications.

6 References

[1] ‘MAC multiplexing on uplink for packet users’, Alcatel, Tdoc RAN WG2 122/99.