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Contents

Foreword

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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1 Scope

The present document captures the agreements of the different techniques for 3.84 Mcps TDD Enhanced Uplink, namely the support of Node-B controlled rate scheduling, Node-B controlled physical resource scheduling, hybrid ARQ, higher order modulation and intra-frame code hopping, with regards to the overall support of UTRA TDD Enhanced Uplink for the 3.84Mcps mode.

The technical objective of this work item is the introduction of Enhanced Uplink functionality in UTRA 3.84 Mcps TDD, to improve uplink performance for background, interactive and streaming-based traffic.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[<seq>] <doctype> <#>[([up to and including]{yyyy[-mm]|V<a[.b[.c]]>}[onwards])]: "<Title>".

[1] 3GPP TR 25.804 (V6.0.0): "Feasibility Study on Uplink Enhancements for UTRA TDD".

[2] 3GPP TR 30.301: "RAN WG2 Stage 2 Decisions".

[3] 3GPP TS 25.222 “Multiplexing and Channel Coding (TDD)” (v6.2.0)

[4] 3GPP TS 25.223 “Spreading and Modulation (TDD)” (v6.0.0)

[5] 3GPP TS 25.331 “RRC Protocol Specification”

[6] 3GPP TS 25.225 “Physical Layer Measurements (TDD)”

[7] 3GPP TS 25.221 “Physical Channels and Mapping of Transport Channels onto Physical Channels (TDD)”

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

Serving E-DCH cell: Cell from which the UE receives Absolute Grants from the Node-B scheduler. A UE has one Serving E-DCH cell.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CCTrCH	Coded Composite Transport Channel
CFN	Current Frame Number
CRRI	Code Resource Related Information
E-AGCH	E-DCH Absolute Grant Channel
ECSN	E-AGCH Cyclic Sequence Number
E-DCH	Enhanced uplink Dedicated Channel
E-HICH	E-DCH HARQ Acknowledgement Indicator Channel
E-PUCH	E-DCH Physical Uplink Channel
E-RNTI	E-DCH Radio Network Temporary Identifier
E-RUCCH	E-DCH Random access Uplink Control Channel
E-TFC	E-DCH Transport Format Combination
E-TFCI	E-DCH Transport Format Combination Indicator
E-UCCH	E-DCH Uplink Control Channel
FFS	For Further Study
HARQ	Hybrid ARQ
HCSN	HS-SCCH Cyclic Sequence Number
HS-DSCH	High Speed Downlink Shared Channel
HS-SCCH	High-Speed Shared Control Channel
MAC	Medium Access Control
OVSF	Orthogonal Variable Spreading Factor
P-CCPCH	Primary Common Control Physical Channel
PRACH	Physical Random Access Channel
PRRI	Power Resource Related Information
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RACH	Random Access Channel
RDI	Resource Duration Indicator
RNC	Radio Network Controller
RRC	Radio Resource Control
RRM	Radio Resource Management
RSCP	Received Signal Code Power
RSN	Retransmission Sequence Number
RV	Redundancy Version
TDD	Time Division Duplex
TPC	Transmitter Power Control
TRRI	Timeslot Resource Related Information
TTI	Transmission Time Interval
UE	User Equipment
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 Introduction

In TSG RAN plenary meeting #27, a work item for 3.84 Mcps TDD Enhanced Uplink was initiated, based upon the findings of the study item "Feasibility Study on Uplink Enhancements for UTRA TDD". The aim of the study was to look at the feasibility of enhancing uplink operation and performance by several techniques in order to efficiently support services such as web browsing, video clips, multimedia messaging and other IP based applications. The RAN study showed that various techniques such as Node-B controlled rate scheduling, Node-B controlled physical resource scheduling, higher-order modulation, intra-frame code hopping and a hybrid ARQ layer in the Node-B, can enhance the uplink packet transfer performance significantly compared to Release-99/Rel-4/Rel-5. The study item findings are captured in [1].

The technical objective of this work item is the introduction of Enhanced Uplink functionality in UTRA TDD 3.84Mcps, to improve the performance of the uplink for background, interactive and streaming-based traffic. The improvements should take into account backwards compatibility aspects.

For the physical layer, the 3.84 Mcps TDD Enhanced Uplink specification work includes:

- Physical and Transport Channel mapping
- Multiplexing and Channel Coding
- Physical Layer procedures
- Physical layer measurements
- UE physical layer capabilities

5 Basic Physical Layer Structure

5.1 CCTrCH and Transport Channel Structure

Enhanced uplink data is carried on a new dedicated transport channel, the E-DCH.

There is at most one CCTrCH of E-DCH type per UE and only one E-DCH per CCTrCH of E-DCH type. The E-DCH supports one MAC-e transport block per E-DCH TTI. A 10 ms TTI is supported by the E-DCH.

Some components of the MAC-e uplink signalling for enhanced uplink are carried on new Node-B-terminated channels termed E-DCH Uplink Control Channels. Two types of uplink control channel are defined:

E-UCCH (E-DCH Uplink Control Channel): E-UCCH information is transmitted on one or more timeslots of the E-DCH TTI and is multiplexed together with E-DCH onto the set of allocated E-PUCH. E-UCCH is multiplexed with the E-DCH data using physical layer indicator fields.

E-RUCCH (E-DCH Random Access Uplink Control Channel): One E-RUCCH may be mapped to random access physical resources

The information carried by E-UCCH and E-RUCCH is self-contained within a single timeslot. Multiple instances of the same E-UCCH information may be transmitted within an E-DCH TTI depending on the configuration by higher layers.

5.2 Overall Physical Channel Structure

The E-DCH transport channel, and one E-UCCH, are mapped to one or more Enhanced Uplink Physical Channels (E-PUCH).

E-PUCH physical resources are allocated under the control of a scheduling entity in Node-B MAC-e. A maximum of 1 E-PUCH may be transmitted by a UE within a timeslot. When E-PUCH is transmitted, it shall be the only physical channel transmitted in that timeslot.

E-RUCCH is mapped to the same random access physical resources as defined by UTRAN for PRACH.

6 Hybrid ARQ Scheme

6.1 HARQ Scheme for TDD Enhanced Uplink

6.1.1 General

A parallel stop-and-wait HARQ protocol is employed supporting incremental redundancy.

6.1.2 Timing Aspects

Transmission resources (timeslots/codes/power) are allocated by the Node-B scheduler by means of E-AGCH. The E-DCH transmission is acknowledged by a subsequent E-HICH using a synchronous timing relationship.

An overview of the general HARQ scheme is shown in figure 6.1.2.1.

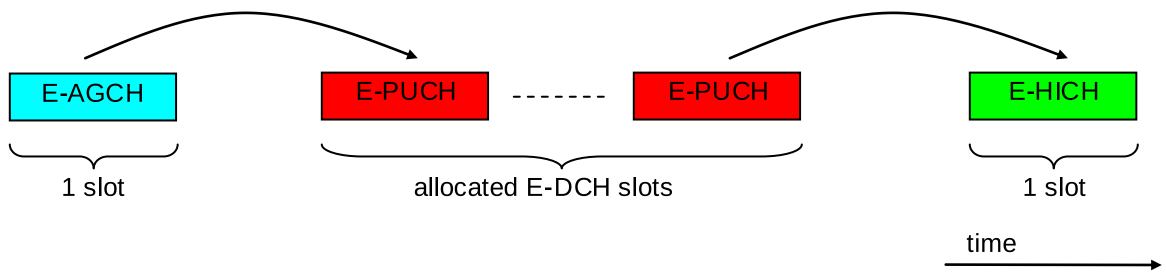

Figure 6.1.2.1 – HARQ scheme

A minimum number of slots is required between the start of the E-AGCH and the start of the first active slot of the subsequent E-DCH transmission to allow for UE processing. This interval is denoted $n_{E\text{-}AGCH}$ and is equal to 6 slots (see figure 6.1.2.2). Upon receiving an E-AGCH, the UE shall assume that the transmission resources indicated are the first instances of those resources (timeslots/codes) existing after a time instant corresponding to the start of the E-AGCH timeslot plus 6 slots.

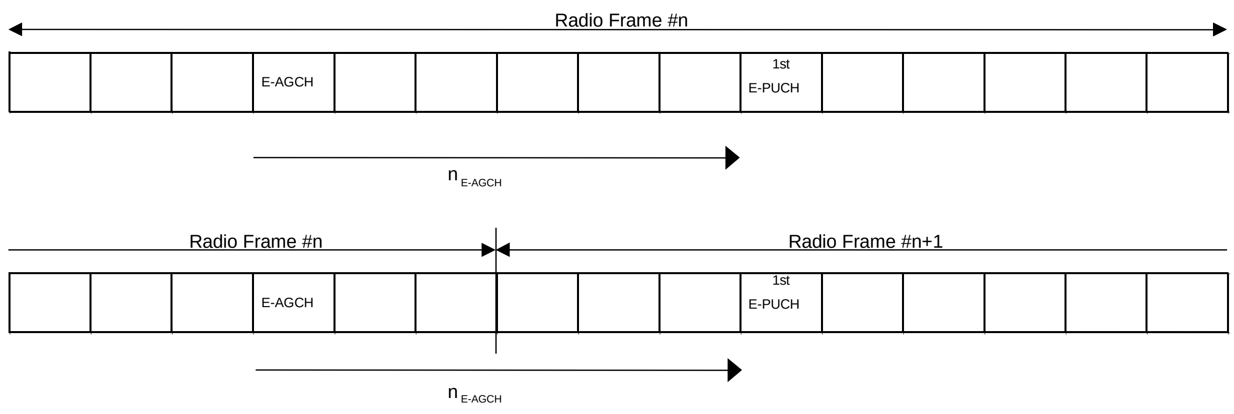

Figure 6.1.2.2 – minimum timing relationship between E-AGCH and E-DCH transmission

A minimum number of slots is also required between the start of the last active slot of the E-DCH TTI and the start of the transmission of the ACK/NACK on E-HICH. This interval is denoted $n_{E\text{-}HICH}$ and is configurable by higher layers within the range [4] to [44] timeslots. Following transmission of an E-DCH TTI, the UE shall assume that the transmission will be acknowledged in the first instance of the E-HICH channelisation code after a time instant corresponding to the start of the last E-DCH timeslot plus n_{E-HICH} slots. Examples of variable n_{E-HICH} are shown in figure 6.1.2.3.

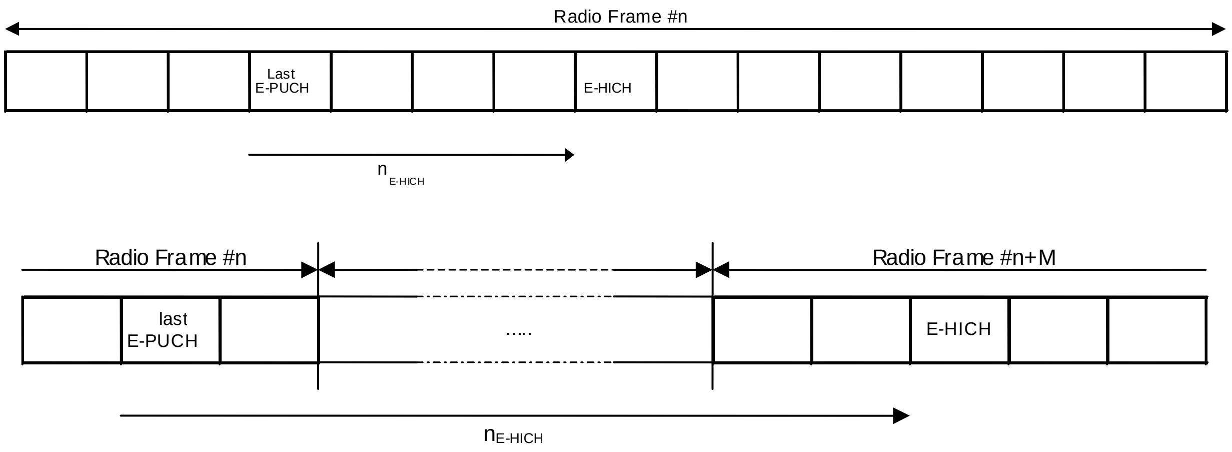

Figure 6.1.2.3 – examples of variable n_{E-HICH}

6.2 Signalling Information Required for the Support of HARQ

E-UCCH is used to carry uplink signaling required for HARQ. The E-UCCH contains the following HARQ-related parameters:

- HARQ process ID (2 bits)
- Retransmission Sequence Number (RSN) – (2 bits)

HARQ-related parameters which are configured by higher layers include:

- n_{E-HICH} in slots (see section 6.1.2)
- The number of HARQ processes (up to 4)

6.2.1 Retransmission Sequence Number

To indicate the redundancy version (RV) of each HARQ transmission and to assist the Node B soft buffer management a two bit retransmission sequence number (RSN) is signalled from the UE to the Node B. The value of RSN is set by higher layers depending on the transmission number (n) for the associated HARQ process, according to table 6.2.1.1 below. Thus, the RSN sequence for a given HARQ process follows the pattern 0,1,2,3,2,3,2,3,…

Table 6.2.1.1: RSN value for the initial transmission and for retransmissions

Transmission Number (n)	RSN value
0 (initial transmission)	0
1	1
2	2
≥3	2+(n mod 2)

The used RV is explicitly linked to the transmitted RSN and as such the Node-B is always able to determine the correct RV if the E-UCCH is correctly decoded.

In addition to being associated with the value of RSN, the redundancy version (RV) of the E-DCH transmission is also associated with the coding rate of the E-DCH transmission according to table 6.2.1.2 below.

Table 6.2.1.2: Relation between RSN and E-DCH RV index

RSN	Coding Rate <1/2	½ ≤ Coding Rate
	E-DCH RV Index	E-DCH RV Index
0	0	0
1	2	3
2	0	2
3	2	1

7 Support for Node B Controlled Uplink Scheduling

7.1 Overview

The UE receives grants controlling the E-DCH resources available to it from the serving cell only. Each serving cell scheduler is responsible for ensuring that the inter-cell interference created by UE's under its control is within acceptable limits set by the network (RNC). In order to assist with this control of inter-cell interference, the UE is responsible for performing serving-cell and neighbour-cell path loss measurements and for reporting these (or a combined metric) to the serving cell scheduler. In the case that E-DCH transmission resources are available, this information is embedded with the higher layer E-DCH data. In the case that E-DCH transmission resources are not available, the information is carried via the associated random access uplink control channel (E-RUCCH).

The network may update the allowable inter-cell interference level granted to each scheduler based upon Node-B measurements of the current uplink load or according to other network-determined factors.

7.2 Support for Node-B Controlled Rate and Physical Resource Scheduling

The UE can receive absolute grants of E-DCH resource, consisting of multiple bits per time interval.

The physical channel used to convey grants to the UE is termed the Enhanced Uplink Absolute Grant Channel (E-AGCH). A single E-AGCH shall be capable of transmitting one complete grant to a UE (ie: transmission of a grant is achieved in one timeslot).

The grant consists of:

- A power grant component (this is used to distribute available system interference resources amongst contending UE's)
- A physical channel grant component (this is used to distribute E-PUCH timeslot and code resources amongst contending UE's)

The grants need not be transmitted in every time interval and are solely determined by the MAC-e scheduling function.

The minimum duration over which a grant applies is equal to one E-DCH TTI. Variable length grants are supported by means of the optional resource duration indicator on E-AGCH (see section 7.3.1.4).

The UE is informed by higher layer signalling on which physical resource (i.e: OVSF code and timeslot) grants to that UE will be transmitted. The network may configure multiple UEs to monitor the same physical resource.

There is only a single cell responsible for E-DCH scheduling, the serving E-DCH cell. The UE shall be capable of receiving one absolute grant from the serving E-DCH cell per time interval.

7.3 Signalling Information Required for the Support of the Scheduling

Scheduler grant information is signalled on the downlink to the UE on the E-AGCH (see sections 8.2.1 and 9.2.1).

Some components of the information to assist with the scheduling process are signalled on the uplink from the UE, either embedded within the E-DCH or via E-RUCCH (see section 7.1). To enable the control of uplink inter-cell interference via scheduling, this signalling shall include information derived by the UE from its measurements of the serving-cell and neighbour-cell path losses. The information is transmitted to the serving cell scheduler within the E-DCH itself or within E-RUCCH.

7.3.1 E-AGCH

The E-AGCH carries information to the UE in support of Node-B scheduling as described in the following sub-clauses.

7.3.1.1 Power Grant

The power grant component of the E-AGCH is referred to as “PRRI” (Power Resource Related Information) and specifies the maximum allowed E-PUCH power per resource unit relative to $P_{e\text{-}base}$ in the UE (see section 11.1.1). PRRI has a granularity of 1dB and is represented by 5 bits.

7.3.1.2 Physical Resource Grant

The granted physical resources are denoted by means of a code and a timeslot component.

7.3.1.2.1 Code Resource

The code component of the physical resource grant “CRRI” (Code Resource Related Information) indicates which node on the OVSF code tree has been allocated and is represented by 5 bits. The mapping between the allocated OVSF and the enumerated node 0…30 on the OVSF code tree is as given in table 7.3.1.2.1.1 below, in which channelisation code “*i*” with spreading factor “*Q*” is denoted as $C_i^{(Q)}$:

Table 7.3.1.2.1.1 – Channelisation code to CRRI mapping

<table>
<tr><td rowspan="16">$C_1^{(1)}$ [0]</td><td rowspan="8">$C_1^{(2)}$ [1]</td><td rowspan="4">$C_1^{(4)}$ [3]</td><td rowspan="2">$C_1^{(8)}$ [7]</td><td>$C_1^{(16)}$ [15]</td></tr>
<tr><td>$C_2^{(16)}$ [16]</td></tr>
<tr><td rowspan="2">$C_2^{(8)}$ [8]</td><td>$C_3^{(16)}$ [17]</td></tr>
<tr><td>$C_4^{(16)}$ [18]</td></tr>
<tr><td rowspan="4">$C_2^{(4)}$ [4]</td><td rowspan="2">$C_3^{(8)}$ [9]</td><td>$C_5^{(16)}$ [19]</td></tr>
<tr><td>$C_6^{(16)}$ [20]</td></tr>
<tr><td rowspan="2">$C_4^{(8)}$ [10]</td><td>$C_7^{(16)}$ [21]</td></tr>
<tr><td>$C_8^{(16)}$ [22]</td></tr>
<tr><td rowspan="8">$C_2^{(2)}$ [2]</td><td rowspan="4">$C_3^{(4)}$ [5]</td><td rowspan="2">$C_5^{(8)}$ [11]</td><td>$C_9^{(16)}$ [23]</td></tr>
<tr><td>$C_{10}^{(16)}$ [24]</td></tr>
<tr><td rowspan="2">$C_6^{(8)}$ [12]</td><td>$C_{11}^{(16)}$ [25]</td></tr>
<tr><td>$C_{12}^{(16)}$ [26]</td></tr>
<tr><td rowspan="4">$C_4^{(4)}$ [6]</td><td rowspan="2">$C_7^{(8)}$ [13]</td><td>$C_{13}^{(16)}$ [27]</td></tr>
<tr><td>$C_{14}^{(16)}$ [28]</td></tr>
<tr><td rowspan="2">$C_8^{(8)}$ [14]</td><td>$C_{15}^{(16)}$ [29]</td></tr>
<tr><td>$C_{16}^{(16)}$ [30]</td></tr>
</table>

7.3.1.2.2 Timeslot Resource

The timeslot component of the physical resource grant “TRRI” (Timeslot Resource Related Information) is a bitmap of length n_{TRRI} indicating which of the timeslots configured for E-DCH use by higher layers have been allocated. The length of the TRRI field (n_{TRRI}) is configurable by higher layers on a per-cell basis up to a maximum of 12 bits.

7.3.1.3 E-RNTI

Each E-AGCH carries a user-specific identifier (the E-RNTI) to facilitate user addressing via this shared channel. The E-RNTI is 16 bits and is allocated by higher layers.

7.3.1.4 Resource Duration Indicator

Optionally, UTRAN may configure, on a per-cell basis the presence of a resource duration indicator (RDI) field on E-AGCH. If configured as present in a cell, 3 bits are used to indicate the number and spacing of TTI's allocated by a single grant. The mapping of the 3 bit field to the number of TTIs granted and their inter-TTI spacing is defined by higher layers.

8 Physical Channel Structure

8.1 Physical Channel Structure for Uplink Data Transmission and Uplink Control Signalling

The E-PUCH is a new physical channel on which the CCTrCH of E-DCH type shall be mapped. The E-PUCH burst carries E-DCH data and may or may not also carry control signalling (E-UCCH) depending on the configuration by higher layers although at least one E-PUCH in the E-DCH TTI shall carry E-UCCH. TPC shall always accompany E-UCCH. In a timeslot when E-UCCH is not transmitted, TPC is not transmitted.

The E-UCCH comprises two parts, E-UCCH part 1 and E-UCCH part 2.

E-UCCH part 1:

- is of length 32 physical channel bits
- is mapped to the TFCI field of the E-PUCH (16 bits either side of the midamble)
- is spread at SF=16 using the channelisation code in the branch with the highest code numbering of the allowed OVSF sub tree
- uses QPSK modulation

E-UCCH part 2:

- is of length 32 physical channel bits
- is spread using the same spreading factor as the data payloads
- uses the same modulation as the data payloads

Figures 8.1.1 and 8.1.2 show the E-PUCH data burst with and without the E-UCCH/TPC fields.

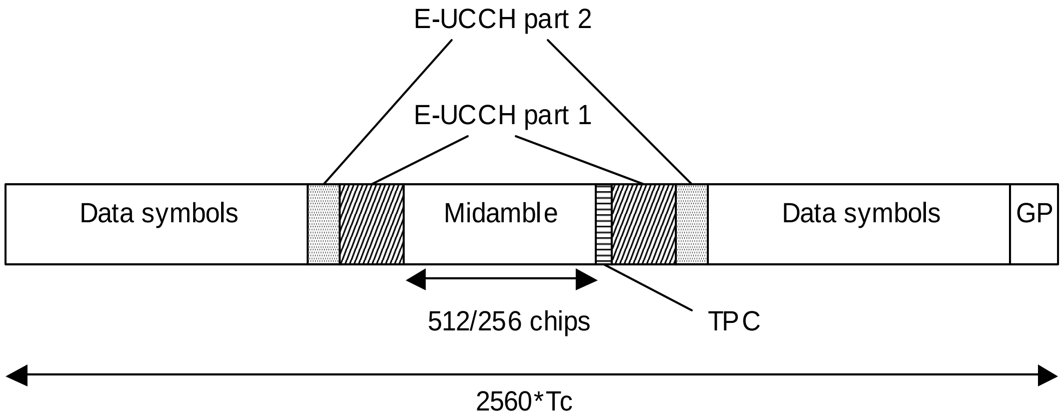

Figure 8.1.1: Location of E-UCCH part 1, E-UCCH part 2 and TPC in the E-PUCH data burst

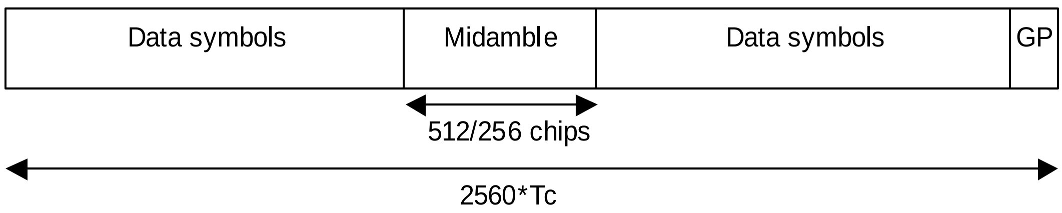

Figure 8.1.2: E-PUCH data burst without E-UCCH/TPC

The E-PUCH supports the following physical layer characteristics:

- Payload spreading factors 16, 8, 4, 2, and 1
- TDD burst types 1 (512-chip midamble) and 2 (256-chip midamble)
- Transmission of E-UCCH part 1 (E-TFCI)
- Transmission of E-UCCH part 2
- Transmission of TPC - Note: this is used for E-AGCH power control purposes
- Guard period of 96 chips
- Support for timing advance

Default and UE-specific midamble allocation schemes may be applied to E-PUCH.

8.2 Physical Channel Structure for Downlink Control Signalling

8.2.1 Enhanced Uplink Absolute Grant Channel (E-AGCH)

The E-AGCH is a new downlink physical channel on which grant information is conveyed to the UE. The E-AGCH uses the same general burst structure as for existing downlink physical channels with the exception that support for a TPC field is included (TPC is not present on existing downlink physical channels for 3.84Mcps TDD).

Figure 8.2.1.1 shows the generic burst structure for E-AGCH.

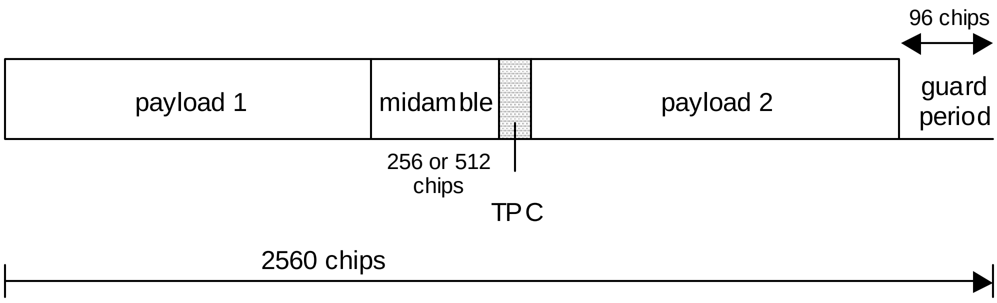

Figure 8.2.1.1 – E-AGCH Burst Structure

The E-AGCH supports the following physical layer characteristics:

- Payload spreading factor 16
- TDD burst types 1 (512-chip midamble) and 2 (256-chip midamble)
- Transmission of TPC (always present)
- Guard period of 96 chips

The E-AGCH does not support transmission of TFCI.

As for other downlink physical channels, E-AGCH may use default, UE-specific or common midamble allocation.

Two new slot formats are required to support E-AGCH. These are listed in table 8.2.1.1.

Table 8.2.1.1

Slot Format #	Spreading Factor	Midamble length (chips)	$N_{TFCI\ code\ word}$ (bits)	N_{TPC} (bits)	Bits/slot	$N_{Data/Slot}$ (bits)	$N_{data/data\ field (1)}$ (bits)	$N_{data/data\ field (2)}$ (bits)
20	16	512	0	2	244	242	122	120
21	16	256	0	2	276	274	138	136

8.2.2 HARQ Acknowledgement Indicator Channel (E-HICH)

The E-DCH HARQ Acknowledgement indicator channel (E-HICH) is characterised as a SF=16 downlink physical channel in conjunction with a particular signature sequence carrying the uplink E-DCH Hybrid-ARQ Acknowledgement (HARQ-ACK) indicator. Figure 8.2.2.1 illustrates the structure of the E-HICH.

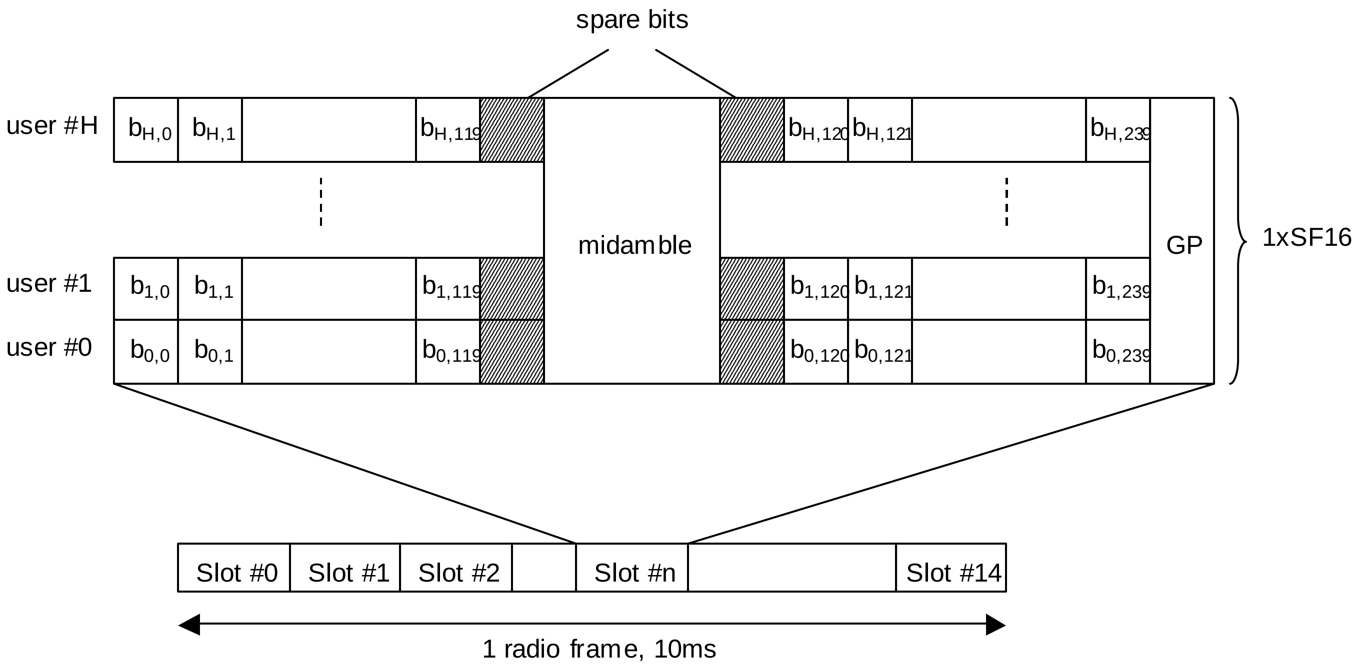

Figure 8.2.2.1 – E-HICH Structure

A single channelisation code may carry one or multiple HARQ acknowledgement indicators, one for each of *H* E-HICH users *(note: the upper limit on H is 240 but H will typically be far less – of the order of 10)*. Each acknowledgement indicator is transmitted within a single timeslot using a signature sequence of 240 bits (b_0, b_1, … , b_{239}). Each E-HICH also contains *U* spare bit locations, where *U=4* for burst type 1 and *U=36* for burst type 2. The spare bit values are undefined (note however that the peak power may be reduced in the portion of the burst occupied by the spare bits if they are not set to the same sequence for each E-HICH user).

The power of each E-HICH may be set independently by the Node-B. As for other physical channels, the power in the midamble field is equal to the composite mean power in the payload areas of the burst.

The acknowledgement indicator for an E-DCH transmission in TTI "N" is carried by the E-HICH in TTI "N+T_A" where T_A is determined according to the value of $n_{E\text{-}HICH}$ (see section 6.1.2). The E-HICH is thus synchronously related to those E-DCH transmissions for which it carries acknowledgement information.

9 Multiplexing, Channel Coding and Interleaving

9.1 Coding and Multiplexing for Uplink Data

Figure 9.1.1 shows the processing structure for the E-DCH transport channel mapped onto a separate CCTrCH. Data arrives to the coding unit in form of a maximum of one transport block once every transmission time interval (TTI). A 10ms TTI is used for E-DCH. The following coding steps for E-DCH can be identified:

- append CRC (length 24) to each transport block
- code block segmentation
- channel coding (1/3 rate turbo coding shall be employed)
- hybrid ARQ

- bit scrambling
- interleaving for E-DCH
- constellation re-arrangement for 16QAM
- mapping to physical channels

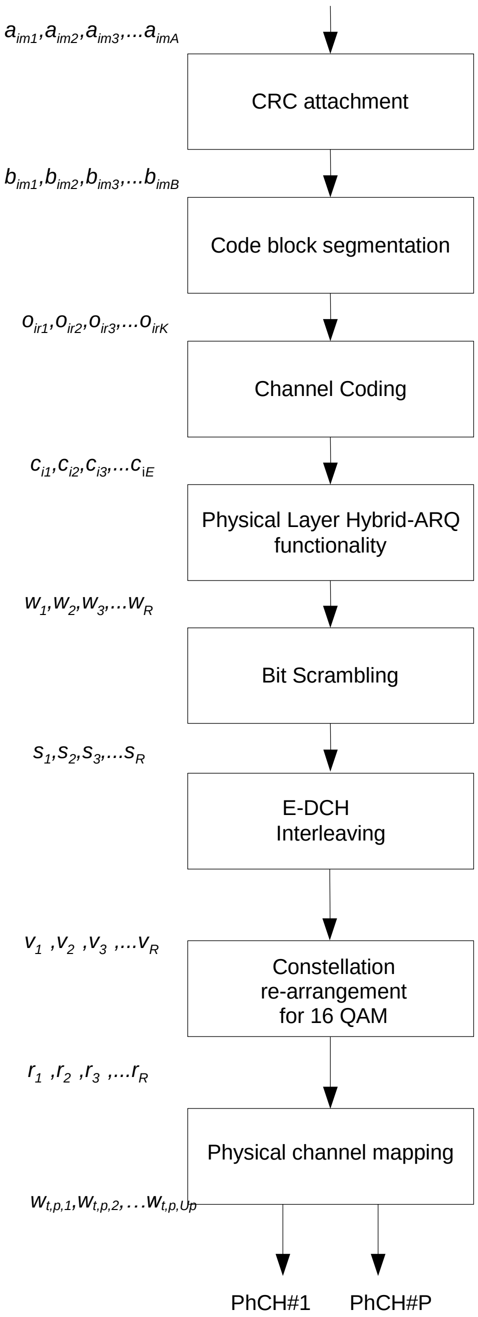

Figure 9.1.1. Coding chain for E-DCH

Many of the processing functions of figure 9.1.1 for the E-DCH follow the same general principles as those employed for HS-DSCH for TDD due to the similar use of QPSK and 16-QAM modulation along with 1/3 rate turbo coding in both cases. Full details are described in the following sub-clauses.

9.1.1 CRC attachment

CRC attachment for the E-DCH transport channel shall be performed according to the general method described in section 4.2.1 of TS 25.222 with the following specific parameters:

- The CRC length shall always be L_i = 24 bits.

9.1.2 Code block segmentation

Code block segmentation for the E-DCH transport channel shall be performed according to the general method described in 4.2.2 of TS 25.222 with the following specific parameters:

- Maximum number of transport block is 1.
- The bits $b_{im1}, b_{im2}, b_{im3},\ldots b_{imBi}$ input to the block are mapped to the bits x_{i1}, x_{i2}, x_{i3},…x_{iXi} directly. It follows that $X_i = B_i$. Note that the bits x referenced here refer only to the internals of the code block segmentation function. The output bits from the code block segmentation function are o_{ir1}, o_{ir2}, o_{ir3},…o_{irK}.
- The value of Z = 5114 for turbo coding shall be used

9.1.3 Channel coding

Channel coding for the E-DCH transport channel shall be performed according to the general method described in section 4.2.3 of TS 25.222 with the following specific parameters:

- There is a maximum of one transport block, i=1
- The rate 1/3 turbo coding shall be used.

9.1.4 Physical layer HARQ functionality and rate matching

The hybrid ARQ functionality matches the number of bits at the output of the channel coder to the total number of bits of the E-PUCH set to which the E-DCH transport channel is mapped. The hybrid ARQ functionality is controlled by the redundancy version (RV) parameters.

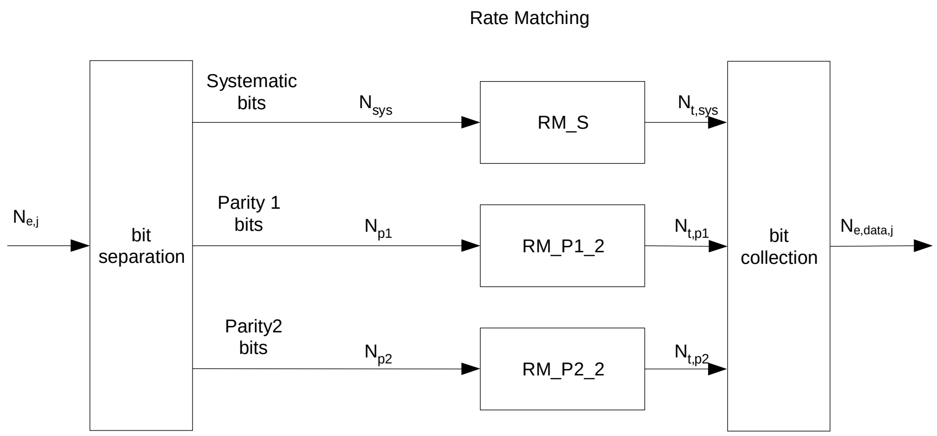

Figure 9.1.4.1: E-DCH hybrid ARQ functionality

9.1.4.1 Determination of SF, modulation and number of physical channels

The SF, modulation type and number of E-PUCHs in the E-PUCH set is determined by higher layers. These correspond to a value of $N_{e,data,j}$.

9.1.4.2 HARQ bit separation

The HARQ bit separation function is performed in the same way as bit separation for turbo encoded TrCHs with puncturing as described in section 4.2.7.2.1 of TS 25.222.

9.1.4.3 HARQ Rate Matching Stage

The hybrid ARQ rate matching for the E-DCH transport channel is performed in accordance with the general method described in section 4.2.7.3 of TS 25.222 with the following specific parameters.

The parameters of the rate matching stage depend on the value of the RV parameters *s* and *r*. The *s* and *r* combinations corresponding to each RV allowed for the E-DCH are listed in table 9.1.4.3.1 below.

Table 9.1.4.3.1: RV for E-DCH

E-DCH RV Index	*s*	*r*
0	1	0
1	0	0
2	1	1
3	0	1

The parameter e_{plus}, e_{minus} and e_{ini} are calculated with the general method described in section 4.5.4.3 of TS 25.222. The following parameters are used as input:

$N_{sys} = N_{p1} = N_{p2} = N_{e,j}/3$

$N_{data} = N_{e,data,j}$

$r_{max} = 2$ (for both QPSK and 16-QAM)

9.1.4.4 HARQ bit collection

HARQ bit collection for E-DCH is performed according to the general method described for HS-DSCH in subclause 4.5.4.4 of TS 25.222.

9.1.5 Bit scrambling

The bit scrambling for E-DCH is performed in accordance with the general method described in subclause 4.2.9 of TS 25.222.

9.1.6 Interleaving for E-DCH

Interlevaing for E-DCH is performed in accordance with the general method described for HS-DSCH in subclause 4.5.6 of TS 25.222.

9.1.7 Constellation re-arrangement for 16 QAM

In the case of 16-QAM, constellation rearrangement is performed in accordance with the general method described for HS-DSCH in subclause 4.5.7 of TS 25.222. For QPSK this function is transparent.

The constellation version parameter *b* is associated with the E-DCH RV index as shown in table 9.1.7.1 below.

Table 9.1.7.1: Mapping of RV to constellation rearrangement parameter *b* for E-DCH

E-DCH RV Index	*b*
0	0
1	1
2	2
3	3

9.1.8 Physical channel mapping for E-DCH

The bits input to the physical channel mapping are denoted by $r_1, r_2, ..., r_R$, where $R= N_{e,data,j}$ and is the number of physical channel data bits to be transmitted in the current TTI on the set of E-PUCHs. These bits are mapped to the physical channel bits, $\{w_{t,k} : t = 1, 2, ..., T;$ and $k = 1, 2, ..., U_t\}$, where t is the timeslot index, T is the number of timeslots in the allocation message, k is the physical channel bit index and U_t is the number of bits in the E-PUCH physical channel in timeslot t. The timeslot index, t, increases with increasing timeslot number and the physical channel bit index, k, increases with increasing physical channel bit position in time.

The bits $r_1, r_2, ..., r_R$ shall be mapped to the physical channel bits $w_{t,k}$ according to the following rule :

$w_{1,k} = r_k$ for $k = 1, 2, ..., U_1$

$w_{2,k} = r_{k+U_1}$ for $k = 1, 2, ..., U_2$

…

$w_{T,k} = r_{k+\sum_{t=1}^{T-1} U_t}$ for $k = 1, 2, ..., U_T$

9.2 Coding and Multiplexing for Downlink Signalling

9.2.1 E-AGCH

The E-AGCH carries the following fields multiplexed* into w bits $x_{ag,1}, x_{ag,2}, \ldots x_{ag,w}$.

- PRRI (5 bits)
- CRRI (5 bits)
- TRRI (n_{TRRI} bits) [Note: n_{TRRI} is configured by higher layers]
- RDI (3 bits if present) – [Note: presence of RDI is configured by higher layers]
- ECSN (3 bits) - (see 11.1.3)

Figure 9.2.1.1 illustrates the overall coding chain for the E-AGCH.

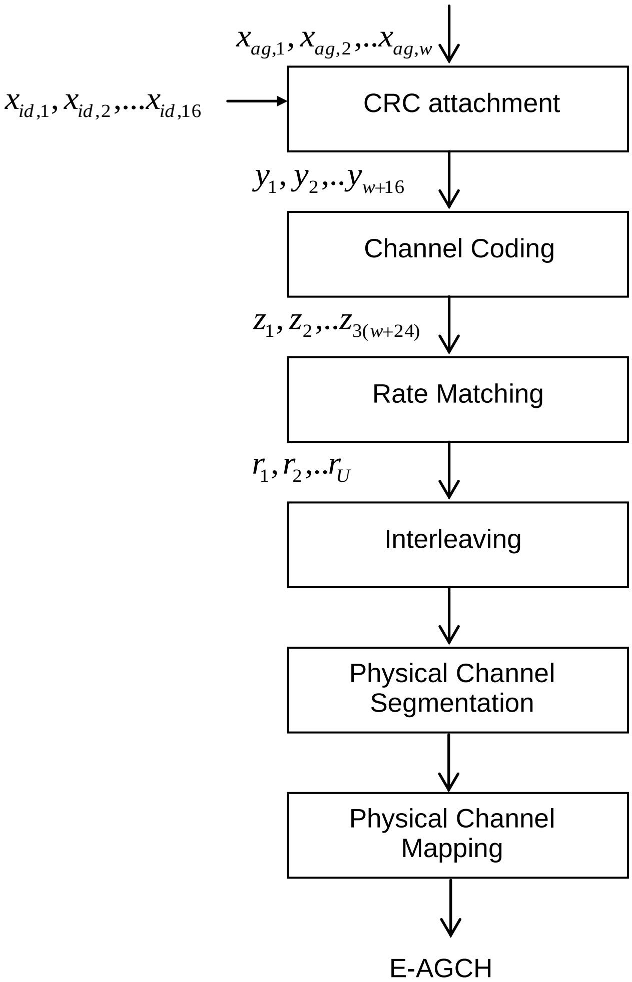

Figure 9.2.1.1 – TrCH processing of E-AGCH

9.2.1.1 Field Multiplexing

The PRRI, CRRI, TRRI, RDI (if present) and ECSN are concatenated before being applied to the remainder of the E-AGCH transport channel processing function. The output of the field multiplexing function is the sequence of bits $x_{ag,1}, x_{ag,2}, \ldots x_{ag,w}$

9.2.1.2 CRC attachment

The E-RNTI ($x_{id,1}, x_{id,2}, ..., x_{id,16}$) is the E-DCH Radio Network Identifier defined in [5]. It is mapped such that $x_{id,1}$ corresponds to the MSB.

From the sequence of bits $x_{ag,1}, x_{ag,2}, ..., x_{ag,w}$ a 16 bit CRC is calculated according to section 4.2.1.1 of [3]. This gives the sequence of bits $c_1, c_2, ..., c_{16}$ where:

$$c_k = p_{im(17-k)} \qquad k=1,2,\ldots,16$$

This sequence of bits is then masked with $x_{id,1}, x_{id,2}, ..., x_{id,16}$ and appended to the sequence of bits $x_{ag,1}, x_{ag,2}, ..., x_{ag,w}$ to form the sequence of bits $y_1, y_2, ..., y_{w+16}$ where

$y_i = x_{ag,i} \qquad i=1,2, ...,w$

$y_i = (c_{i-w} + x_{id,i-w}) \bmod 2 \qquad i=w+1, ..., w+16$

9.2.1.3 Channel Coding

1/3 rate convolutional channel coding is applied to the sequence $z_1, z_2, \ldots, z_{44}$ in accordance with section 4.2.3.1 of [3], resulting in the sequence of bits $z_1, z_2, \ldots, z_{3x(w+24)}$.

9.2.1.4 Rate Matching

Rate matching is applied to the input sequence $z_1, z_2, \ldots, z_{3x(w+24)}$ *to* obtain the output sequence $r_1, r_2, \ldots, r_U$, where U = 242 for burst type 1 and U = 274 for burst type 2.

9.2.1.5 Interleaving

Interleaving is performed as per section 4.2.11.1 of [3] (frame-related 2nd interleaving).

9.2.1.6 Physical Channel Segmentation

Physical channel segmentation is performed as per section 4.2.10 of [3]. Note that physical channel segmentation is transparent when only one physical channel exists (as is the case for E-AGCH).

9.2.1.7 Physical Channel Mapping

Physical channel mapping is performed as per section 4.2.12 of [3].

9.2.2 E-HICH

The value of a binary HARQ acknowledgement indicator for user *h* is denoted "a_h" and may assume the value 0 or 1. The value of the indicator is mapped as shown in table 9.2.2.1.

Table 9.2.2.1 – Mapping of HARQ acknowledgement indicator

Command	HARQ acknowledgement indicator value (a_h)
NACK	0
ACK	1

Construction of the binary signature sequence $b_{h,0}, b_{h,1}, \ldots, b_{h,239}$ for the h^{th} acknowledgement indicator is achieved via a serialised binary spreading process using two orthogonal sequences as shown in figure 9.2.2.1.

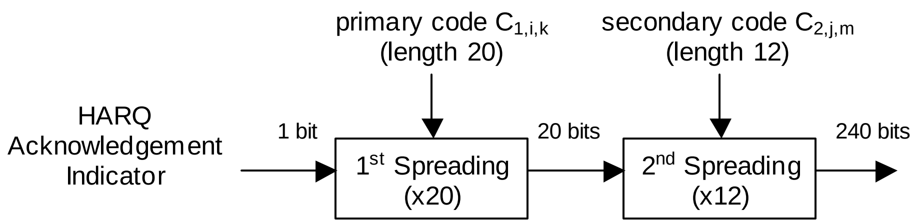

Figure 9.2.2.1

The first orthogonal sequence set ($C_{1,i,k}$) is given by table 9.2.2.2 and the second orthogonal sequence set ($C_{2,j,m}$) is given by table 9.2.2.3.

Table 9.2.2.2 – Primary E-HICH Sequences

k	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
$C_{1,0,k}$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
$C_{1,1,k}$	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1
$C_{1,2,k}$	1	0	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	0
$C_{1,3,k}$	1	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	0	0
$C_{1,4,k}$	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1
$C_{1,5,k}$	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1
$C_{1,6,k}$	1	0	0	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	0
$C_{1,7,k}$	1	0	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0
$C_{1,8,k}$	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0	0
$C_{1,9,k}$	1	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0
$C_{1,10,k}$	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1
$C_{1,11,k}$	1	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0
$C_{1,12,k}$	1	0	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1
$C_{1,13,k}$	1	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0
$C_{1,14,k}$	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1
$C_{1,15,k}$	1	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1
$C_{1,16,k}$	1	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1	1
$C_{1,17,k}$	1	0	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1	1	1
$C_{1,18,k}$	1	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0
$C_{1,19,k}$	1	1	0	0	1	1	0	0	0	0	1	0	1	0	1	1	1	1	0	0

Table 9.2.2.3 – Secondary E-HICH Sequences

m	0	1	2	3	4	5	6	7	8	9	10	11
$C_{2,0,m}$	1	1	1	1	1	1	1	1	1	1	1	1
$C_{2,1,m}$	1	0	1	0	1	1	1	0	0	0	1	0
$C_{2,2,m}$	0	1	1	0	1	0	0	0	1	1	1	0
$C_{2,3,m}$	1	1	0	0	1	0	1	1	1	0	0	0
$C_{2,4,m}$	1	0	1	0	0	1	0	1	1	1	0	0
$C_{2,5,m}$	0	1	1	0	1	1	0	1	0	0	0	1
$C_{2,6,m}$	0	1	1	1	0	1	1	0	1	0	0	0
$C_{2,7,m}$	0	0	1	1	1	0	1	1	0	1	0	0
$C_{2,8,m}$	1	1	1	0	0	0	1	0	0	1	0	1
$C_{2,9,m}$	0	0	0	0	1	1	1	0	1	1	0	1
$C_{2,10,m}$	0	1	0	0	0	1	1	1	0	1	1	0
$C_{2,11,m}$	1	1	0	1	1	1	0	0	0	1	0	0

A HARQ acknowledgement indicator is synchronously linked with the E-DCH TTI transmission to which it relates. There is thus a one-to-one association between an E-DCH TTI transmission and its respective HARQ acknowledgment indicator. An allocation resource tag ID "r" (*r = 0,1,2,…239*) is calculated for the E-DCH resource allocation associated with the HARQ acknowledgement indicator.

$$r = 16(t_0 - 1) + (q_0 - 1)\frac{16}{Q_0}$$

- where:
    - o t_0 is the bit position ($1 \ldots n_{TRRI}$) of the first active timeslot in the timeslot resource related information bitmap where bit position 1 corresponds to the lowest-numbered timeslot
    - o q_0 is the lowest-numbered channelisation code index allocated in timeslot t_0 ($1,2,3,\ldots Q_0$)

- Q_0 is the spreading factor of the lowest-numbered channelisation code index allocated in timeslot t_0

The binary sequences selected for the first ($C_{1,i,k}$) and second ($C_{2,j,m}$) spreading operations are derived as a function of r.

$$i = \left\lfloor \frac{r}{12} \right\rfloor$$

$$j = r \bmod 12$$

The output of the first spreading stage is equal to $s_{1,k} = a_h \oplus C_{1,i,k}$, where $k=0,1,2,....19$.

The output of the second spreading stage is then given by $s_{2,v} = s_{1,w} \oplus C_{2,j,m}$, where $v=0,1,...,239$ and where $w = \left\lfloor \frac{v}{12} \right\rfloor$ and, $m = v \bmod 12$.

The bit sequence $b_{h,0}, b_{h,1},\ldots,b_{h,239}$ is formed by applying bit scrambling (as per section 4.2.9 of TS 25.222) to the sequence $s_{2,v}$.

The bits $b_{h,0}, b_{h,1},\ldots,b_{h,239}$ are segmented into two halves corresponding to $b_{h,0}\ldots b_{h,119}$ and to $b_{h,120}\ldots b_{h,239}$ and a sequence of U spare bits z_u ($u=0\ldots U-1$) are inserted between the first and second half of the sequence to form:

$$d_h = \{b_{h,0}, b_{h,1}, \ldots, b_{h,119}, z_0, z_1, \ldots z_{U-1}, b_{h,120}, b_{h,121}, \ldots, b_{h,239}\}$$

d_h (of length 244 for burst type 1 and length 276 for burst type 2) is then subject to QPSK modulation and is amplitude-weighted prior to summation with other such sequences corresponding to the other acknowledgement indicators active on the same channelisation code.

Physical channel spreading and scrambling operations are then performed in the usual manner.

9.3 Coding and Multiplexing for Uplink Signalling

9.3.1 E-RUCCH

Processing for E-RUCCH consists of standard 3GPP transport channel processing functions, with the addition of a CRC bit inversion process. This is used to enable the Node-B to distinguish between an E-RUCCH and a PRACH carrying RACH.

The following processing steps are thus defined for E-RUCCH:

- CRC attachment, length 16 (see subclause 4.2.1.1 of [3])
- CRC bit inversion
  - The bits output from CRC attachment are denoted b_{imk}, k=1,2,3, … A_i+L_i.
  - Each parity bit b_{imk} , k=A_i+1,A_i+2, … A_i+L_i is XOR'd with 1 such that its polarity is reversed
- 1/3 rate convolutional coding (see subclause 4.2.3 of [3])
- Rate matching (see subclause 4.2.7 of [3])
- Bit scrambling (see subclause 4.2.9 of [3])
- Frame related 2nd interleaving (see subclause 4.2.11.1 of [3])
- Mapping to physical channels (see subclause 4.2.12.1 of [3])

E-RUCCH supports a TTI of 10ms only.

9.3.2 E-UCCH

The E-UCCH is used to convey the following information:

- The occupied code resources of the selected E-TFC – 0 bits (see note 1)
- The modulation type of the selected E-TFC – 0 bits (see note 1)
- The transport block size of the selected E-TFC – 7 bits
- The retransmission sequence number (RSN) – 2 bits
- The HARQ process ID – 2 bits

Note 1: The occupied code resources and the modulation type are not explicitly signaled, but may be inferred from the transport block size.

E-UCCH is coded in two parts, E-UCCH part 1 and E-UCCH part 2. Both parts of the E-UCCH are transmitted on the E-PUCH.

The following information is explicitly transmitted by means of E-UCCH part 1:

- The transport block size of the selected E-TFC (7 bits)

The following information is transmitted by means of E-UCCH part 2:

- Retransmission sequence number (RSN) (2 bits)

- HARQ process ID (HARQ_ID) (2 bits)

E-UCCH part 1 and E-UCCH part 2 are each separately coded using a (32,10) sub code of the second order Reed Muller code as defined in subclause 4.3.1.1 of [3].

10 Spreading and Modulation

10.1 Modulation

10.1.1 E-PUCH

QPSK and 16-QAM modulation are supported for E-PUCH. The modulation constellations shall be the same as those supported for QPSK and 16-QAM in [4].

10.2 Spreading

10.2.1 E-PUCH

Spreading of the E-PUCH follows the same general procedures as described in [4]. The complex symbols are multiplied by:

- A code specific multiplier (no spreading)

- A channelisation code spreading sequence (OVSF)
- A cell-specific scrambling code sequence

When channelisation code hopping is configured by higher layers, the allocated OVSF code C^{alloc} (CRRI indicated in E-AGCH – see section 7.3.1.2.1) is transformed by the physical layer into a sequence of "effective" allocated OVSF codes $C_{t_i}^{eff}$, one for each active timeslot index "t_i" {t_i = 0 … n_{TRRI}-1}.

In order to calculate the effective allocated code, the UE shall first calculate the timeslot index t_i of each allocated timeslot. The set of n_{TRRI} timeslots configured for E-DCH use is denoted t_{E-DCH} (each element of t_{E-DCH} may assume a value between 0 and 14).

The first element of t_{E-DCH} is associated with t_i = 0, the second element with t_i = 1 and so on. t_i = 0 therefore corresponds to the lowest numbered timeslot configured for E-DCH use and to the first element of the TRRI bitmap.

A hopping index parameter h_i is calculated for each timeslot of the E-DCH TTI in which the UE has been allocated as follows:

$$h_i = (t_i + CFN) \bmod 16$$

The effective allocated OVSF code $C_{t_i}^{eff}$ for timeslot index t_i is then derived from h_i and the code indicated by the corresponding E-AGCH (C^{alloc}) as according to table 10.2.1.1.

C^{alloc}	CRRI	Hop index h_i															
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SF16																	
1	15	1	9	5	13	3	11	7	15	2	10	6	14	4	12	8	16
2	16	2	10	6	14	4	12	8	16	1	9	5	13	3	11	7	15
3	17	3	11	7	15	1	9	5	13	4	12	8	16	2	10	6	14
4	18	4	12	8	16	2	10	6	14	3	11	7	15	1	9	5	13
5	19	5	13	1	9	7	15	3	11	6	14	2	10	8	16	4	12
6	20	6	14	2	10	8	16	4	12	5	13	1	9	7	15	3	11
7	21	7	15	3	11	5	13	1	9	8	16	4	12	6	14	2	10
8	22	8	16	4	12	6	14	2	10	7	15	3	11	5	13	1	9
9	23	9	1	13	5	11	3	15	7	10	2	14	6	12	4	16	8
10	24	10	2	14	6	12	4	16	8	9	1	13	5	11	3	15	7
11	25	11	3	15	7	9	1	13	5	12	4	16	8	10	2	14	6
12	26	12	4	16	8	10	2	14	6	11	3	15	7	9	1	13	5
13	27	13	5	9	1	15	7	11	3	14	6	10	2	16	8	12	4
14	28	14	6	10	2	16	8	12	4	13	5	9	1	15	7	11	3
15	29	15	7	11	3	13	5	9	1	16	8	12	4	14	6	10	2
16	30	16	8	12	4	14	6	10	2	15	7	11	3	13	5	9	1
SF8																	
1	7	1	5	3	7	2	6	4	8	1	5	3	7	2	6	4	8
2	8	2	6	4	8	1	5	3	7	2	6	4	8	1	5	3	7
3	9	3	7	1	5	4	8	2	6	3	7	1	5	4	8	2	6
4	10	4	8	2	6	3	7	1	5	4	8	2	6	3	7	1	5
5	11	5	1	7	3	6	2	8	4	5	1	7	3	6	2	8	4
6	12	6	2	8	4	5	1	7	3	6	2	8	4	5	1	7	3
7	13	7	3	5	1	8	4	6	2	7	3	5	1	8	4	6	2
8	14	8	4	6	2	7	3	5	1	8	4	6	2	7	3	5	1
SF4																	

1	3	1	3	2	4	1	3	2	4	1	3	2	4	1	3	2	4
2	4	2	4	1	3	2	4	1	3	2	4	1	3	2	4	1	3
3	5	3	1	4	2	3	1	4	2	3	1	4	2	3	1	4	2
4	6	4	2	3	1	4	2	3	1	4	2	3	1	4	2	3	1
SF2																	
1	1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
2	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
SF1																	
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

For all subsequent operations, the physical layer shall assume the allocated physical resources to be described by the effective allocated code $C_{t_i}^{eff}$ associated with the current timeslot.

The following rules apply in the case of code hopping:

- If higher layers select an E-TFC with a spreading factor greater than the allocated spreading factor, the OVSF code shall always be varied (by the physical layer) along the branch of the OVSF sub-tree with the higher code numbering in accordance with [7]. The root node of the OVSF sub-tree (under which the SF increase may be applied) is the effective allocated OVSF code $C_{t_i}^{eff}$ after the timeslot hop sequence has been applied to the allocated OVSF code C^{alloc} (ie: the root node may change on a per timeslot basis as a function of the hop sequence).
- Under default midamble allocation, the actual transmitted midamble is mapped to the actual transmitted code as per the normal default code/midamble mappings of [7]. "Actual" transmitted code refers to the code transmitted over the air (after the code hopping sequence and autonomous SF selection procedures have been applied by the UE).
- A channelisation code specific multiplier is applied to E-PUCH transmissions. The multiplier is associated with the effective allocated code $C_{t_i}^{eff}$ and remains unchanged in the event that the spreading factor is autonomously increased by the UE (as per existing releases).
- A common scrambling sequence is applied to all E-PUCHs within the frame. The assigned scrambling sequence is a function of the cell ID and on whether the frame number is odd or even, in the same manner as existing releases.

11 Physical Layer Procedures

11.1 Power Control

11.1.1 E-PUCH

The power of the CCTrCH of E-DCH type is set based upon the sum of:

1. An open loop component (similar to that used in R99/4/5/6). This is based upon beacon channel pathloss.
2. A closed-loop TPC component. One TPC bit is signalled to the UE within each E-AGCH. The TPC command is derived by Node-B.
3. Adjustment factors accounting for:
    a. the E-TFC selected by the UE (i.e. beta values)

b. the spreading factor of the physical channel (i.e. gamma values)

A new set of beta factors is adopted to provide the necessary granularity of power adjustment between E-TFC's. Gamma values according to the spreading factor of the physical channel remain as per current specifications.

The transmit power for an E-DCH E-TFC is calculated in the UE as follows:

$$P_{E-DCH} = P_{e-base} + L + \gamma_{SF} + \beta_{E-TFC}$$

… where:

- $P_{E\text{-}DCH}$ is the transmit power of the E-DCH physical channel E-PUCH
- $P_{e\text{-}base}$ is a closed-loop quantity stored in the UE and which is incremented or decremented upon each receipt of a TPC command on E-AGCH. The TPC step size is configured by higher layers.
- L is a pathloss term derived from beacon function physical channels. It may comprise a weighted sum of the instantaneous (L_{PCCPCH}) and filtered (L_0) pathloss measurements as used in existing specifications (see [5])
- γ_{SF} is a gain factor appropriate for the selected spreading factor
- $\beta_{E\text{-}TFC}$ is the gain factor for the selected E-TFC

The UE shall use the calculated power in addition to the granted power offset Δ in order to determine the set of available E-TFC's.

11.1.2 E-RUCCH

E-RUCCH is transmitted using an open-loop power control scheme similar to that used for PRACH.

Following the general procedure of [5] for PRACH, the power of the E-RUCCH is set as follows:

$$P_{E-RUCCH} = L_{PCCPCH} + I_{BTS} + E\_RUCCH\_constant\_value$$

… where:

- L_{PCCPCH} is a pathloss estimate based on beacon function physical channels
- I_{BTS} is the interference value on the E-RUCCH (=PRACH) timeslot signalled in system information
- E-RUCCH constant value is a new parameter signalled via RRC

11.1.3 E-AGCH

The power of E-AGCH is set by the Node-B. The Node-B may use TPC commands from the UE carried on E-DCH transmissions (on the E-PUCH physical channel) to assist with this process.

The E-AGCH includes a 3-bit cyclic sequence number (ECSN field) to assist with outer-loop power control of the E-AGCH (c.f: HCSN on HS-SCCH [3]).

11.1.4 E-HICH

Network based methods are used to power control the acknowledgement indicator on E-HICH.

11.2 Timing Advance

Timing advance is applied to E-PUCH. The Node-B is responsible for making Rx Timing Deviation measurements (as defined in [6]) on the E-PUCH transmissions. These are communicated to the RNC via the appropriate framing protocol. Higher layer (i.e. RRC) signalling is used to update the timing advance value used by the UE.

Timing advance is not applied to E-RUCCH transmissions.

11.3 Channelisation Code Hopping

When channelisation code hopping is configured by higher layers, the allocated OVSF code (i.e. the CRRI indicated in E-AGCH – see section 7.3.1.2.1) is first transformed by the physical layer into a sequence of "effective" allocated OVSF codes (one for each active timeslot of the allocation) before further physical layer processing is performed (see figure 11.3.1). The mapping of CRRI to effective OVSF allocation is a function of the allocated timeslots and of the current CFN. See section 10.2.1 for further details.

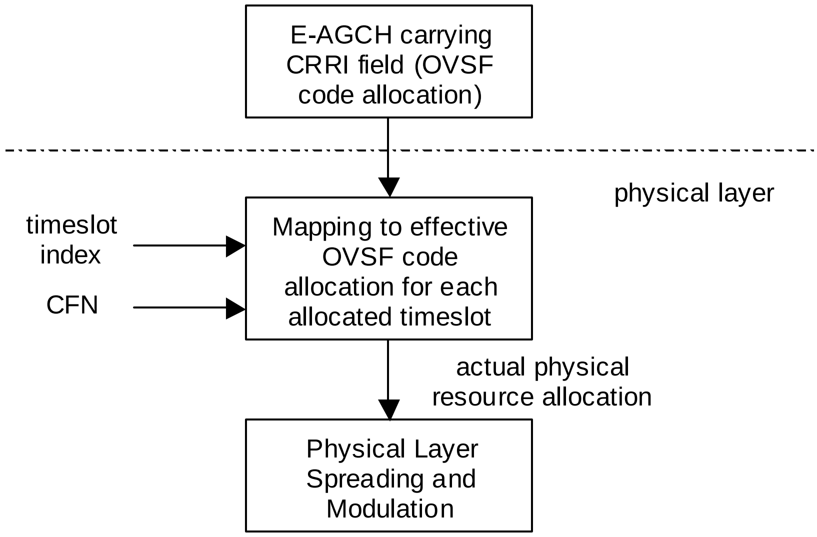

Figure 11.3.1 - physical layer interpretation of OVSF code allocation in the case that code hopping is applied

12 Physical Layer Measurements

The UE shall have the ability to measure the path loss to the serving cell and to neighbour cells. Serving cell path loss measurements are made each radio frame. The number and frequency of the neighbour cell measurements remain FFS. These may need to be increased with respect to that required for neighbour cell RSCP measurements in current releases.

The Node-B shall support measurement of E-DCH interference and/or fractional loading to assist with RRM procedures.

The Node-B shall also support measurement of Rx Timing Deviation for E-PUCH.

13 UE Physical Layer Capabilities

The E-DCH UE categories are defined in TS25.306.

Annex A: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2005-04	RAN1#40 bis				Initial draft presented for discussion		0.0.0
2005-09	RAN1#42				Inclusion of text proposals agreed at RAN1 #41		0.0.1
2005-09	RAN1#42				Raised to v0.1.0 following presentation of v0.0.1 at RAN1#42	0.0.1	0.1.0
2005-10	RAN1#42 bis				Inclusion of text proposals agreed at RAN1 #42	0.1.0	0.1.1
2005-10	RAN1#42 bis				Raised to v0.2.0 following presentation of v0.1.1 at RAN1#42bis	0.1.1	0.2.0
2005-10	RAN1#43				Inclusion of text proposals agreed at RAN1 #42bis	0.2.0	0.2.1
2005-11	RAN1#43				Raised to v0.3.0 following presentation of v0.2.1 at RAN1#43	0.2.1	0.3.0
2006-02	RAN1#44				Inclusion of text proposals agreed at RAN1 #43	0.3.0	0.3.1
2006-02	RAN1#44				Inclusion of text proposal from RAN1#44 and raised to v1.0.0	0.3.1	1.0.0
2006-05	RAN1#45				Inclusion of text proposals agreed at RAN1#44bis	1.0.0	1.0.1
2006-05	RAN1#45				Raised to v1.1.0 following presentation of v1.0.1 at RAN1#45	1.0.1	1.1.0
2006-05	RAN1#45				Version 1.1.1 based upon the changes of R1-061413 with further editorial updates.	1.1.0	1.1.1
2006-05	RAN1#45				Changes in v1.1.1 accepted and raised to v1.2.0	1.1.1	1.2.0
2006-08	RAN1#46				Inclusion of text proposals agreed at RAN1 #46 – including description of E-DCH coding and RSN/RV association	1.2.0	1.2.1
2006-09	RAN1#46				Acceptance of changes in v1.2.1 to produce clean version 2.0.0	1.2.1	2.0.0
29/09/06	RAN_33	RP-060478	-	-	Approved as v7.0.0 to put under change control	2.0.0	7.0.0