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Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 5: Radio interface physical layer specifications;
Sub-part 2: Multiplexing and Multiple Access;
Stage 2 Service Description;
GMR-1 05.002

Reference

DTS/SES-001-05002

Keywords

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IPRs:

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

IPR Owner: Ericsson Mobile Communications (UK) Limited
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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Hughes Network Systems		US	Pending	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES modify the contents of the present document, it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

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- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 5, sub-part 2 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Part 4: "Radio interface protocol specifications";

Part 5: "Radio interface physical layer specifications";

Sub-part 1: "Physical Layer on the Radio Path: General Description; GMR-1 05.001";

Sub-part 2: "Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 05.002";

Sub-part 3: "Channel Coding; GMR-1 05.003";

Sub-part 4: "Modulation; GMR-1 05.004";

Sub-part 5: "Radio Transmission and Reception; GMR-1 05.005";

Sub-part 6: "Radio Subsystem Link Control; GMR-1 05.008";

Sub-part 7: "Radio Subsystem Synchronization; GMR-1 05.010";

Part 6: "Speech coding specifications";

Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where:

- xx.0yy (z = 0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.
- xx.2yy (z = 2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.
- n denotes the first (n = 1) or second (n = 2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist, the corresponding GSM specification may or may not apply. The applicability of the GSM specifications is defined in GMR-1 01.201 [2].

1 Scope

The present document defines the structure of the physical channels for the radio subsystem in the GMR-1 Mobile Satellite System. It describes the GMR-1 concept of logical channels and the timing concepts of TDMA frames, timeslots, and bursts. It defines the relationship between logical and physical channels, and defines the logical channels in terms of size, structure and timing relationships.

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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] GMR-1 01.004 (ETSI TS 101 376-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMR-1 01.004".

[2] GMR-1 01.201 (ETSI TS 101 376-1-2): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 Family; GMR-1 01.201".

[3] GMR-1 03.022 (ETSI TS 101 376-3-10): "GEO-Mobile Radio Interface Specifications; Part 3: Network specifications; Sub-part 10: Functions related to Mobile Earth station (MES) in idle mode; GMR-1 03.022".

[4] GMR-1 04.003 (ETSI TS 101 376-4-3): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 3: Channel Structures and Access Capabilities; GMR-1 04.003".

[5] GMR-1 04.006 (ETSI TS 101 376-4-6): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 6: Mobile earth Station-Gateway Station Interface Data Link Layer Specifications; GMR-1 04.006".

[6] GMR-1 04.008 (ETSI TS 101 376-4-8): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 8: Mobile Radio Interface Layer 3 Specifications; GMR-1 04.008".

[7] GMR-1 05.003 (ETSI TS 101 376-5-3): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-1 05.003".

[8] GMR-1 05.004 (ETSI TS 101 376-5-4): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 4: Modulation; GMR-1 05.004".

[9] GMR-1 05.005 (ETSI TS 101 376-5-5): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMR-1 05.005".

[10] GMR-1 05.008 (ETSI TS 101 376-5-6): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 05.008".

[11] GMR-1 05.010 (ETSI TS 101 376-5-7): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 7: Radio Subsystem Synchronization; GMR-1 05.010".

3 Definitions and abbreviations

For the purposes of the present document, the definitions and the abbreviations given in GMR-1 01.004 [1] apply.

4 General

The radio subsystem is required to support a certain number of logical channels that can be separated into two overall categories as defined in GMR-1 04.003 [4]:

- the traffic channels (TCHs);
- the control channels (CCHs).

The present document is structured as follows:

- clause 5 gives more information about the logical channels;
- clause 6 describes the physical resource available to the radio subsystem;
- clause 7 describes the bursts used to implement the physical channels;
- clause 8 specifies how the logical channels will be mapped onto the physical channels.

Figure 4.1 depicts this process.

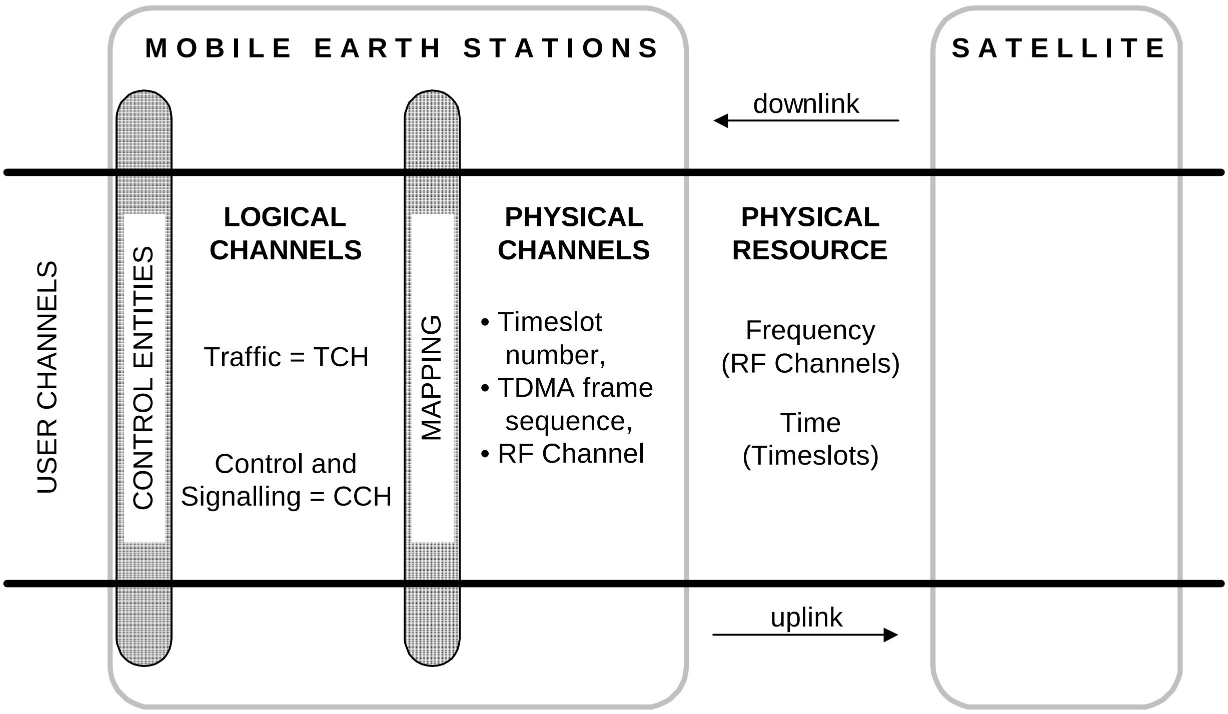

Figure 4.1: Mapping of logical channels onto physical channels, based on the physical resource

5 Logical channels

5.1 General

This clause describes the logical channels that are supported by the GMR-1 Air Interface.

5.2 Traffic channels

5.2.1 General

TCHs are intended to carry either encoded speech or user data. Three general types of traffic channels are defined:

1) TCH3: this channel carries information (not including guard time, unique word, or power control bits) at a gross rate of 5,20 kbps.

2) TCH6: this channel carries information (not including guard time, unique word, or power control bits) at a gross rate of 10,75 kbps.

3) TCH9: this channel carries information (not including guard time, unique word, or power control bits) at a gross rate of 16,45 kbps.

All traffic channels are bidirectional.

The types of traffic channels capable of speech and user data are identified in the following clauses.

5.2.2 Speech traffic channels

The following traffic channel is defined to carry encoded speech:

- Traffic CHannel for speech (TCH3).

5.2.3 Data traffic channels

The following traffic channels are defined to carry user data:

- Traffic CHannel for 4,8 kbps user data (TCH6).
- Traffic CHannel for 9,6 kbps user data (TCH9).

5.2.4 Summary of traffic channel characteristics

Table 5.1 summarizes the characteristics of traffic channels.

Table 5.1: Summary of traffic channel characteristics

Channel Type	User Information Capability	Gross Data Transmission Rate
TCH3	Encoded speech	5,85 kbps
TCH6	User data: 4,8 kbps Fax: 2,4 or 4,8 kbps	11,70 kbps
TCH9	User data: 9,6 kbps Fax: 2,4; 4,8 or 9,6 kbps	17,55 kbps

5.3 Control channels

5.3.1 General

Control channels are intended to carry signalling or synchronization data. Three categories of control channels are defined: broadcast, common, and dedicated. Specific channels within these categories are defined in the following clauses.

5.3.2 Broadcast channels

5.3.2.1 Frequency correction channel (FCCH)

The FCCH carries information for frequency correction of the mobile earth station (MES). This frequency correction is only required for operation of the radio subsystem.

The FCCH is also used for system information cycle synchronization of the MES.

The FCCH is downlink only.

5.3.2.2 GPS broadcast control channel (GBCH)

The GBCH carries global positioning system (GPS) time information and GPS satellite ephemeris information, as described in GMR-1 03.022 [3], to the MESs.

(The PCH may also contain almanac data, as described in GMR-1 04.008 [6]).

The GBCH is downlink only.

5.3.2.3 Broadcast control channel (BCCH)

The BCCH broadcasts system information to the MESs, and is downlink only. The BCCH system information parameters are listed in GMR-1 04.008 [6], and subsets of these parameters are described in detail in various CAI documents. Those described in the present document are introduced as needed in later clauses, and are summarized in clause 10.

5.3.3 Common control channel (CCCH)

The CCH includes the following common control-type channels:

1) The Paging CHannel (PCH): downlink only, used to page MESs.

2) The Random Access CHannel (RACH): uplink only, used to request the allocation of a SDCCH or TCH.

3) The Access Grant CHannel (AGCH): downlink only, used to allocate a Standalone Dedicated Control CHannel (SDCCH) or a TCH directly.

4) The Basic Alerting CHannel (BACH): downlink only, used to alert MESs.

5) The Common Idle CHannel (CICH): downlink only, used by MESs for calibration measurements.

5.3.4 Dedicated control channels

The dedicated control channels indicate resources dedicated to an MES or a particular set of connections. The dedicated control channels are all bidirectional except for the Terminal-to-terminal Associated Control CHannel (TACCH), which is downlink only.

1) Slow TCH6-Associated Control CHannel (SACCH6).
2) Slow TCH9-Associated Control CHannel (SACCH9).
3) Fast TCH3-Associated Control CHannel (FACCH3).
4) Fast TCH6-Associated Control CHannel (FACCH6).
5) Fast TCH9 Associated Control CHannel (FACCH9).
6) Standalone Dedicated Control CHannel (SDCCH/4).
7) Terminal-to-terminal Associated Control CHannel (TACCH/2). This channel can be shared among a subset of terminal-to-terminal calls and is not necessarily dedicated to a single terminal-to-terminal call.

5.3.5 Cell broadcast channel

The Cell Broadcast CHannel (CBCH) is downlink only and used to broadcast Short Message Service Cell Broadcast (SMSCB) information to MESs on a per-spot beam basis.

6 The physical resource

6.1 General

The physical resource available to the radio subsystem is an allocation of part of the radio spectrum. This resource is partitioned both in frequency and time. Frequency is partitioned into radio frequency channels as defined in GMR-1 05.005 [9]. Time is partitioned by timeslots and TDMA frames as defined in clause 6.3 of the present document.

6.2 Radio frequency channels

6.2.1 Spot beam allocation

GMR-1 05.005 [9] partitions the radio frequency spectrum available to the Air Interface into radio frequency channels and assigns a channel number to each channel. Each spot beam is allocated a subset of these channels; this process is defined as the beam allocation. One or more radio frequency channels of the beam allocation, known as BCCH carriers, carry information that includes BCCH information.

6.2.2 Downlink and uplink

The downlink comprises radio frequency channels used in the satellite-to-MES direction, and the uplink comprises radio frequency channels used in the MES-to-satellite direction.

6.3 Timeslots and TDMA frames

6.3.1 General

A timeslot has a duration of 5/3 msec. Twenty-four timeslots form a TDMA frame, 40 msec in duration.

At the satellite, the TDMA frames on all of the radio frequencies in the downlink of each spot beam will be aligned. The same also applies to the uplink.

At the MES, the start of a TDMA frame on the uplink is delayed by a variable amount from the start of the TDMA frame on the downlink. This delay is variable to allow for signal propagation delay. The process of adjusting this delay is detailed in GMR-1 05.010 [11].

6.3.2 Timeslot number

The timeslots within a TDMA frame will be numbered from 0 to 23, and a particular timeslot will be referred to by its Timeslot Number (TN).

6.3.3 TDMA frame number

TDMA frames will be numbered by a Frame Number (FN). The frame number will be cyclic and have a range of 0 to $FN\_MAX = (16 \times 4 \times 4\,896) - 1 = 313{,}343$ as defined in GMR-1 05.010 [11]. The frame number will be incremented at the end of each TDMA frame. The complete cycle of TDMA frame numbers from 0 to FN_MAX is defined as a hyperframe. The need for a hyperframe arises from the requirements of the encryption process, which uses FN as an input parameter.

Other combinations of frames include:

- **Multiframes.** A multiframe consists of 16 TDMA frames. Multiframes are aligned so that the FN of the first frame in a multiframe, modulo 16, is always 0.
- **Superframes.** A superframe consists of four multiframes. Superframes are aligned so that the FN of the first frame in a superframe, modulo 64, is always 0.
- **System information cycle.** The system information cycle has the same duration as a superframe. However, the first frame of the system information cycle is delayed an integer number of frames (0-15) from the start of a superframe. (The actual delay is intentionally varied from spot beam to spot beam to reduce the satellite's peak power requirements.) The FCCH and BCCH are used to achieve system information cycle synchronization at the MES.

See figure 6.1.

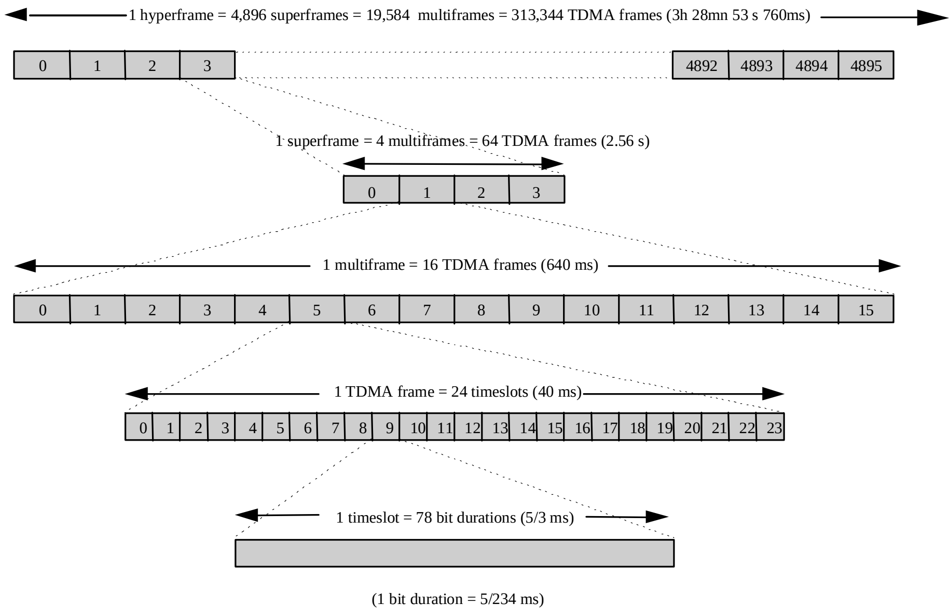

Figure 6.1: Timeframe structures and timeslots

7 Bursts

7.1 General

A physical channel uses time division multiplexing and is defined as a sequence of timeslots on a single Radio Frequency (RF) channel. The transmissions within these timeslots are known as bursts.

A burst is a single unit of transmission on the radio path defined in terms of RF channel, RF power profile, and modulation symbols. Bursts are sent in a defined time and frequency window where the time window is defined by a range of contiguous timeslot numbers and the frequency window is defined by the carrier number. Therefore, a burst represents the physical content of one or more contiguous timeslots.

7.2 Timing

7.2.1 Half-symbol period

The fundamental unit of burst timing is the half-symbol period. A timeslot consists of 78 half-symbol periods, each of 5/234 msec duration. A particular half-symbol period within a burst is referenced by a half-symbol number (HSN), with the first half-symbol period numbered 0. In the following clauses, the transmission timing of a burst is defined in terms of half-symbol numbers. The half symbol with the lowest half-symbol number is transmitted first.

7.2.2 Useful duration

Different types of bursts exist in the system. One characteristic of a burst is its useful duration. The useful duration of a burst is defined as beginning with HSN5. The present document defines bursts with useful durations of 146, 224, 458, 614, and 692 half-symbol periods, based on total durations of 2, 3, 6, 8, and 9 timeslots.

7.2.3 Guard period

The period between the useful durations of successive bursts is termed the guard period. Each burst has a guard period with a duration of five half-symbol periods before its useful duration, and a similar guard period with a duration of five half-symbol periods after its useful duration, which has the effect of centering a burst's useful duration within its timeslot(s).

7.3 Multiple unique word patterns in bursts

Many bursts contain a pattern of bits known as a unique word pattern, used to resolve phase ambiguities inherent in the modulation. The NT3, NT6, and NT9 bursts, described later, allow multiple patterns for the unique word to distinguish bursts that contain signalling (FACCH) from those that contain user information (speech/data). The SDCCH bursts use multiple unique word patterns to identify a subchannel associated with each SDCCH burst. Additional details concerning SDCCH subchannels use of multiple unique word patterns are in clause 8.5.4.

7.4 Types of bursts

The following clauses describe each of the types of bursts in alphabetical order.

7.4.1 BACH burst

The BACH burst format, which occupies two timeslots, is modulated with BACH 6PSK modulation and contains the information shown in table 7.1.

Table 7.1: BACH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–148	144	BACH sequence S_j
149–150	2	Idle bits
151–155	5	Guard period in half symbols

The BACH sequence Sj is specified in GMR-1 05.004 [8].

7.4.2 BCCH burst

The BCCH burst, which occupies six timeslots, contains the information shown in table 7.2.

Table 7.2: BCCH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–78	22	Extended unique word
79–238	160	Encoded bits e52 to e211
239–244	6	Extended unique word
245–394	150	Encoded bits e212 to e361
395–400	6	Extended unique word
401–462	62	Encoded bits e362 to e423
463–467	5	Guard period in half symbols

The 34-bit unique word pattern for the BCCH burst is shown in table 7.3.

Table 7.3: BCCH burst unique word definition

Unique Word Bits (HSN57 …HSN78, HSN239…HSN244, HSN395…HSN400)
(00-11-11-00-00-00-11-00-11-11-11-11-11-00-11-11-00)

7.4.3 CICH burst

Each Common Idle CHannel (CICH) burst occupies three timeslots and has the format shown in table 7.4.

Table 7.4: CICH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–228	224	Idle; no transmission
229–233	5	Guard period in half symbols

7.4.4 DC2 burst

The two-slot downlink control (DC2) burst contains the information shown in table 7.5.

Table 7.5: DC2 burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–70	14	Unique word
71–150	80	Encoded bits e52 to e131
151–155	5	Guard period in half symbols

The 14-bit unique word pattern for the two-slot downlink control burst is:

(HSN57, HSN58 …HSN70) = (00-01-11-10-00-10-00).

7.4.5 DC6 burst

The six-slot downlink control (DC6) burst contains the information shown in table 7.6.

Table 7.6: DC6 burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–70	14	Unique word
71–238	168	Encoded bits e52 to e219
239–244	6	Unique word
245–394	150	Encoded bits e220 to e369
395–400	6	Unique word
401–462	62	Encoded bits e370 to e431
463–467	5	Guard period in half symbols

The 26-bit unique word pattern for the six-slot downlink control burst is:

(HSN57, HSN58 …HSN70, HSN239, … HSN244, HSN395, …HSN400) =
(00-00-00-11-11-00-11-00-10-00-10-01-01)

7.4.6 DKABs bursts

The dual keep-alive bursts (DKABs) burst for three-slot traffic channels (TCH3) use π/4 differential binary phase-shift keying (DBPSK) modulation. Therefore, two half-symbols only transfer one bit of information. The DKABs bursts contain the information shown in table 7.7.

Table 7.7: DKABs burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–(4 + p)	p	Idle bits to start position of first KAB (see note)
(5 + p)–(6 + p)	2	Differential start bit
(7 + p)–(14 + p)	8	Encoded bits e0 to e3
(15 + p)–(122 + p)	108	KAB burst separation
(123 + p)–(124 + p)	2	Differential start bit
(125 + p)–(132 + p)	8	Encoded bits e4 to e7
(133 + p)–228	96 – p	Idle bits to the end of timeslot assignment
229–233	5	Guard period in half symbols
NOTE: p shall be even, from 2 to 42 inclusive or from 64 to 94 inclusive. Also, the value of p is set at call initialization as part of the assignment command. See GMR-1 04.008 [6] for details.		

Figure 7.1 gives a time-scaled example of a DKABs burst for the case of p = 40.

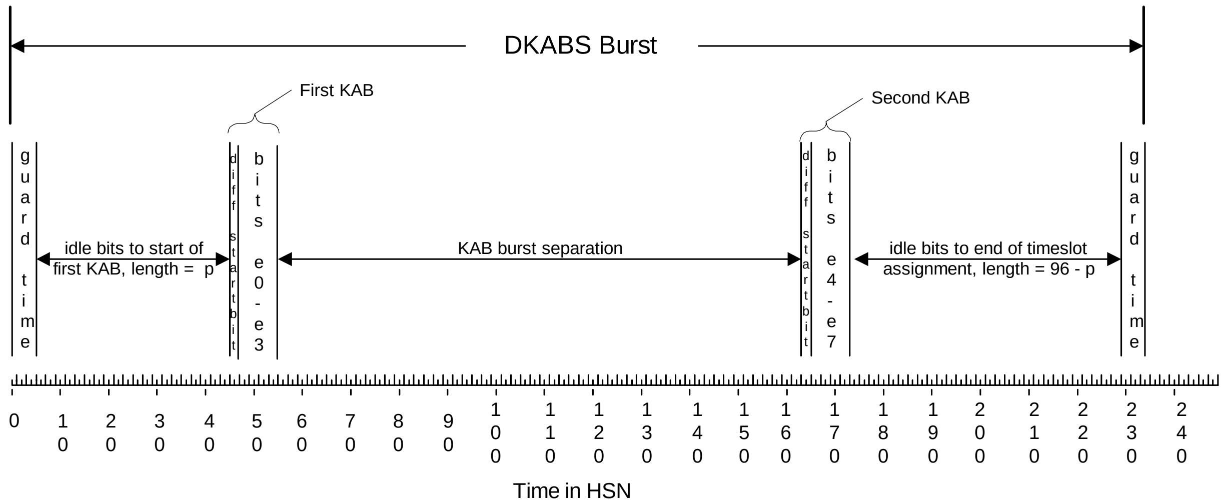

Figure 7.1: DKABs burst contents vs. time, for p = 40

7.4.7 FCCH burst

Each FCCH burst occupies three timeslots and has the format shown in table 7.8.

Table 7.8: FCCH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–228	224	Chirp modulation
229–233	5	Guard period in half symbols

For additional details concerning the modulation of the FCCH bursts, see GMR-1 05.004 [8].

7.4.8 NT3 burst

The three-slot normal traffic (NT3) burst is modulated via π/4 CQPSK for encoded speech but via π/4 coherent binary phase-shift keying (CBPSK) for FACCH. For additional details concerning the modulation of the NT3 bursts, see GMR-1 05.004 [8].

The definitions of the NT3 bursts for encoded speech and FACCH are explained separately in the following clauses.

7.4.8.1 NT3 burst for encoded speech

Because the NT3 burst for encoded speech is modulated via π/4-CQPSK, each half-symbol encodes 1 bit, as shown in table 7.9.

Table 7.9: NT3 burst for encoded-speech definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–68	12	Unique word
69–228	160	Encoded bits e52 to e211
229–233	5	Guard period in half symbols

The 12-bit unique word pattern is shown in table 7.10.

Table 7.10: NT3 burst for encoded-speech unique word definition

Unique Word Bits (HSN57, HSN58 …HSN68)
(00-10-10-01-11-10)

7.4.8.2 NT3 burst for FACCH

Because the NT3 burst for FACCH is modulated via π/4-CBPSK, each symbol encodes 1 bit, as shown in table 7.11.

Table 7.11: NT3 burst for FACCH definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e25
57–72	16	Unique word
73–228	156	Encoded bits e26 to e103
229–233	5	Guard period in half symbols

where the NT3 burst for FACCH has one of two 8-bit unique word patterns that are shown in table 7.12.

Table 7.12: NT3 burst for FACCH unique word

FACCH3 Identifier Type	Unique Word Bits (HSN57, HSN58 …HSN72)
0	(1 – 0 – 1 – 0 – 1 – 0 – 1 – 0)
1	(1 – 1 – 0 – 0 – 1 – 0 – 0 – 1)

The usage of these Unique Word patterns is as follows. Each FACCH message to be sent over TCH3 results in a group of four NT3 bursts for FACCH, as described in GMR-1 05.003 [7]. (The transmission of certain FACCH groups may be stopped before all four bursts are sent, in accord with FACCH preemption procedures contained in GMR-1 04.006 [5]). All four of the bursts of a FACCH group shall contain the same Unique Word pattern.

For the first FACCH group on a TCH3, the Unique Word pattern shall be that corresponding to FACCH3 Identifier Type 0. In order to help distinguish consecutive groups, the Unique Word pattern used by each successive group shall be different from the one used by the previous group.

More formally, where the groups of NT3 bursts for FACCH on a TCH3 are numbered starting from 0, the FACCH3 Identifier Type corresponding to Nth FACCH group shall be:

FACCH3 Identifier Type = (***N*** mod 2).

7.4.9 NT6 burst

The six-slot normal traffic (NT6) burst contains the information shown in table 7.13.

Table 7.13: NT6 burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–68	12	Unique word
69–238	170	Encoded bits e52 to e221
239–244	6	Unique word
245–394	150	Encoded bits e222 to e371
395–400	6	Unique word
401–462	62	Encoded bits e372 to e433
463–467	5	Guard period in half symbols

where two 24-bit unique word patterns are defined for the six-slot normal traffic burst, as shown in table 7.14.

Table 7.14: NT6 unique word definition

Unique Word Pattern	Unique Word Bits (HSN57, HSN58 …HSN68, HSN239 … HSN244, HSN395, …, HSN400)
1 (FACCH)	(00-11-11-10-11-10---00-01-00---11-10-00)
2 (User Data)	(00-00-00-11-11-00---01-10-00---11-01-10)

Each TCH6 message is transmitted over three NT6 bursts (see GMR-1 05.003 [7] for details). All the TCH6 bursts shall have the User Data Unique Word pattern.

Each FACCH6 message is transmitted over one NT6 burst on TCH6 by stealing the bursts. All the FACCH6 bursts shall have the FACCH Unique Word pattern.

7.4.10 NT9 burst

The nine-slot normal traffic (NT9) burst contains the information shown in table 7.15.

Table 7.15: NT9 burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e51
57–68	12	Unique word
69–238	170	Encoded bits e52 to e221
239–244	6	Unique word
245 –394	150	Encoded bits e222 to e371
395–400	6	Unique word
401–550	150	Encoded bits e372 to e521
551–556	6	Unique word
557–696	140	Encoded bits e522 to e661
697–701	5	Guard period in half symbols

where two 30-bit unique word patterns are defined for the nine-slot normal traffic burst, as shown in table 7.16.

Table 7.16: NT9 unique word definition

Unique Word Pattern	Unique Word Bits (HSN57, HSN58 …HSN68, HSN239 … HSN244, HSN395… HSN400, HSN551,…HSN556)
1 (FACCH)	(00-11-11-10-11-10---01-11-11---00-01-00---11-10-00)
2 (User Data)	(00-00-00-11-11-00---00-11-00---01-10-00---11-01-10)

Each TCH9 message is transmitted over three NT9 bursts (see GMR-1 05.003 [7] for details). All the TCH9 bursts shall have the User Data Unique Word pattern.

Each FACCH9 message is transmitted over one NT9 burst on TCH9 by stealing the bursts. All FACCH9 bursts shall have the FACCH Unique Word pattern.

7.4.11 RACH burst

The RACH burst has a total duration of nine timeslots and uses $\pi/4$ CQPSK modulation, as shown in table 7.17.

Table 7.17: RACH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–156	152	Encoded bits e0 to e151
157–190	34	Unique word
191–254	64	Encoded bits e152 to e215
255–318	64	CW (coded as all 1 bits)
319–382	64	Encoded bits e216 to e279
383–446	64	CW (coded as all 1 bits)
447–510	64	Encoded bits e280 to e343
511–544	34	Unique word
545–694	150	Encoded bits e343 to e493
695–696	2	Dummy (coded as 00)
697–701	5	Guard period in half symbols

The 68-bit unique word pattern for the random access burst consists of two identical 34-bit patterns:

(HSN156, HSN157 … HSN190) = (HSN511, HSN512 … HSN544) =

(00-11-11-00-00-00-11-00-11-11-11-11-11-00-11-11-00)

7.4.12 SDCCH burst

The six-slot SDCCH burst is modulated with π/4 CBPSK. Therefore, two half-symbols only transfer 1 bit of information. Each SDCCH burst contains the information shown in table 7.18.

Table 7.18: SDCCH burst definition

HSN	Length of Field in Half Symbols	Contents of Field
0–4	5	Guard period in half symbols
5–56	52	Encoded bits e0 to e25
57–70	14	Unique word
71–230	160	Encoded bits e26 to e105
231–244	14	Unique word
245–394	150	Encoded bits e106 to e180
395–408	14	Unique word
409–462	54	Encoded bits e181 to e207
463–467	5	Guard period in half symbols

The 21-bit unique word patterns for the SDCCH burst are shown in table 7.19.

Table 7.19: SDCCH burst unique word definition

SDCCH Type	Unique Word Bits (HSN57, …HSN70, HSN231 … HSN244, HSN395, …, HSN408)
0	(0-1-0-1-0-1-0---1-0-1-0-1-0-1---0-1-0-1-0-1-1)
1	(0-0-1-1-0-0-1---1-0-0-1-1-0-0---1-1-0-0-1-1-1)
2	(0-0-0-0-1-1-1---1-0-0-0-0-1-1---1-1-0-0-0-0-1)
3	(0-1-1-0-1-0-0---1-0-1-1-0-1-0---0-1-0-1-1-0-1)

The SDCCH Type, listed in the first column of table 7.19, corresponds directly to an SDCCH subchannel. The use of SDCCH unique word patterns to identify subchannels is described later, in clause 8.5.4.2.

8 Logical-physical channel mapping

8.1 General

This clause describes the parameters needed to describe the mapping of logical channels onto physical channels. Only certain combinations of channels are allowed as defined in GMR-1 04.003 [4]. The complete definition of a particular channel consists of a description in the frequency domain and a description in the time domain. These are described in more detail in the following clauses.

8.1.1 Frequency-domain description

Radio-frequency channel allocation is performed on a per-spot beam basis, and the radio-frequency channel allocation of a logical channel depends on the channel's type:

- The radio frequency channel allocation of a common channel is either a downlink or an uplink radio frequency channel of a given spot beam.
- The radio frequency channel allocation of a dedicated channel consists of both a downlink and an uplink radio frequency channel within a given spot beam.

8.1.2 Time-domain description

8.1.2.1 Physical channels

The Air Interface allows multiple physical channels to share the same radio-frequency channel of a given spot beam using a TDMA scheme. Therefore, each physical channel is characterized by a sequence of timeslots on a radio-frequency channel. Once a physical channel has been allocated timeslots in a TDMA frame, it maintains the same timeslot numbers (relative to the start of the TDMA frame) in all subsequent TDMA frames, for the duration of the physical channel allocation. The uplink and downlink timeslot numbers assigned to a physical channel need not be the same.

Uplink and downlink physical channel timeslot assignments can cross TDMA frame boundaries. An example of a physical channel timeslot assignment that crosses a TDMA-frame boundary would be a PC6 that extends from timeslots numbered 21, 22, and 23 of frame N into timeslots numbered 0, 1, and 2 of frame N+1.

8.1.2.2 Logical channels

The Air Interface allows for the possibility, in specified cases, of multiple logical channels sharing a physical channel. This may be done by partitioning a physical channel's timeslots both by timeslot number relative to the start of the TDMA frame and by TDMA frame sequence. Therefore, characterization of a logical channel requires the definition of a frame sequence in addition to a sequence of timeslots on a physical channel.

One type of frame sequencing (known as a simple paired-frame sequence) assigns pairs of frames to subchannels. Thus, the pair of frames with FN = 0 and 1 would be assigned to subchannel 0, the pair of frames with FN = 2 and 3 would be assigned to subchannel 1, and so on. Another type of frame sequencing is based on the system information cycle. Frame sequencing is presented in more detail in clause 8.5.

8.2 Physical channel (PC) types and names

By convention, the distinguishing characteristics of physical channel types are captured in their names. Physical channel names start with the letters PC (physical channel) followed by the number of contiguous timeslots used per TDMA frame. In the case of a unidirectional channel, a suffix is added designating the channel's direction, "u" for uplink or "d" for downlink.

Six types of physical channels are used, as follows:

- PC2d, a physical channel with a length of two timeslots for downlink only;
- PC6d, a physical channel with a length of six timeslots for use only by the downlink;
- PC12u, a physical channel with a length of 12 timeslots for use only by the uplink;
- PC3, a physical channel with a length of three timeslots;
- PC6, a physical channel with a length of six timeslots;
- PC9, a physical channel with a length of nine timeslots.

8.3 Logical channel parameters

Table 8.1 summarizes the main parameters of logical channels.

Table 8.1: Summary of logical channel parameters

Channel Designation	Direction	Burst Type	Modulation Type	Timeslots per Burst	Frame Assignment
TCH3 TCH6 TCH9	U&D U&D U&D	NT3 NT6 NT9	π/4-CQPSK π/4-CQPSK π/4-CQPSK	3 6 9	All All All
FACCH3 FACCH6 FACCH9	U&D U&D U&D	NT3 NT6 NT9	π/4-CBPSK π/4-CQPSK π/4-CQPSK	3 6 9	All All All
SACCH6 SACCH9	U&D U&D	NT6 NT9	π/4-CQPSK π/4-CQPSK	6 9	All (note 1) All (note 1)
—	U&D	DKABs	π/4-DBPSK	3	All
SDCCH/4	U&D	SDCCH	π/4-CBPSK	6	U: Every fourth frame pair D: Statistically multi-plexed frame pairs
CBCH	D	DC6	π/4-CQPSK	6	Configured frame pairs
FCCH	D	FCCH	Dual Chirp	3	See sys. Info. Cycle
CICH	D	CICH	N/A	3	See sys. Info. Cycle
BACH BCCH PCH AGCH	D D D D	BACH BCCH DC6 DC6	BACH 6PSK π/4-CQPSK π/4-CQPSK π/4-CQPSK	2 6 6 6	See sys. Info. Cycle See sys. Info. Cycle See sys. Info. Cycle See sys. Info. Cycle
GBCH	D	DC2	π/4-CQPSK	2	All
RACH	U	RACH	π/4-CQPSK	9 (note 2)	All
TACCH/2	D	DC2	π/4-CQPSK	2	Every second frame
NOTE 1: SACCH information is interleaved across 20 frames. In both the uplink and downlink directions, the SACCH blocks correspond to FN modulo 20. NOTE 2: See GMR-1 05.010 [11] for RACH timeslot assignments.					

8.4 Permitted channel configurations

There are only a few permitted ways in which logical channels can populate physical channels, as shown in table 8.2.

Table 8.2: Permitted channel configurations

Config. Number	Physical Channel Type	Logical Channel Configuration
1.	PC2d	TACCH/2. This channel configuration is also known as a TTCH.
2.	PC2d	GBCH.
3.	PC6d	FCCH + CICH + BCCH + CCCH (PCH + BACH + AGCH). This channel configuration is also known as a BCCH/CCCH.
4.	PC6d	CCCH (PCH + BACH + AGCH). This channel configuration is also known as a “normal CCCH".
5.	PC6d	CCCH (AGCH). This channel configuration is also known as an AGCH/CCCH.
6.	PC12u	RACH.
7.	PC3	TCH3 + FACCH3.
8.	PC6	TCH6 + FACCH6 + SACCH.
9.	PC6	SDCCH/4.
10.	PC6	CBCH.
11.	PC6	SDCCH/4 + CBCH.
12.	PC9	TCH9 + FACCH9 + SACCH.

8.5 Logical channel frame sequencing concepts

The logical channels that use frame sequencing to share a physical channel do so by one of five means:

1) **Simple frame sequence:** just selecting every $\boldsymbol{m}^{th}$ frame.

2) **Simple paired frame sequence:** just selecting every $\boldsymbol{m}^{th}$ frame pair.

3) **Configured paired frame sequence:** selecting frame pairs based on system information sent via BCCH.

4) **Statistically multiplexed paired frame sequence:** frame pairs are dynamically allocated from a pool of available frame pairs.

5) **System information cycle sequence:** using a frame sequence referenced to the system information cycle.

Each of these methods is described in more detail in the following clauses.

8.5.1 Simple frame sequence

A logical channel using a simple frame sequence just chooses every mth frame. More formally, for all frames used by a simple frame-sequence logical channel, FN modulo ***m*** is congruent.

The only example of a simple frame sequence logical channel is TACCH/2.

The number "2" after the slash ("/") is the modulus m.

8.5.1.1 Simple frame sequence subchannels

A physical channel may contain up to m simple frame-sequence logical channels, known as subchannels. These may be distinguished by the remainder r of FN divided by m and identified by a suffix consisting of a dash followed by r. Thus, for example, a PC2d (TTCH) can contain two TACCH/2 subchannels:

- TACCH/2-0 – with bursts from frames such that FN mod 2 = 0;
- TACCH/2-1 – with bursts from frames such that FN mod 2 = 1.

The simple frame-sequenced channels have a two-burst block structure. For details of the block structure and its frame alignment, see GMR-1 05.003 [7].

8.5.2 Simple paired-frame sequence

A logical channel using a simple paired-frame sequence just chooses every mth frame pair. More formally, for all frames used by a simple paired-frame-sequence logical channel, (FN div 2) modulo m is congruent.

The only example of a simple paired-frame sequence logical channel is SDCCH/4, in the uplink direction only, because the SDCCH/4 downlink uses a statistically multiplexed paired-frame sequence.

The number "4" after the slash ("/") is the modulus m.

8.5.2.1 Simple paired-frame sequence subchannels

A physical channel may contain up to m simple paired-frame-sequence logical channels, known as subchannels. These may be distinguished by the remainder r of (FN div 2) divided by m and identified by a suffix consisting of a dash followed by r. For example, a PC6 uplink could contain four simple paired-frame sequence SDCCH/4 subchannels:

- SDCCH/4-0 – with bursts from frames such that (FN div 2) mod 4 = 0;
- SDCCH/4-1 – with bursts from frames such that (FN div 2) mod 4 = 1;
- SDCCH/4-2 – with bursts from frames such that (FN div 2) mod 4 = 2;
- SDCCH/4-3 – with bursts from frames such that (FN div 2) mod 4 = 3.

The SDCCH/4 channels have a two–burst block structure. For details of the block structure and its frame alignment, see GMR-1 05.003 [7].

8.5.3 Configured paired-frame sequence

A logical channel using a configured paired-frame sequence chooses frame pairs based on system information sent via BCCH.

- The only configured paired-frame sequence logical channel is CBCH.

8.5.3.1 CBCH configuration

SA_CBCH_CONFIG is the (4-bit) parameter that indicates the configured frame pairs of CBCH.

If SA_CBCH_CONFIG is considered to be a bit field with bit number 0 as the least significant bit, then a frame is used for CBCH if and only if:

Bit number [(FN div 2) mod 4] of SA_CBCH_CONFIG = 1, where

- "div" represents Integer Division
- "mod" represents Modulo

This is further illustrated in table 8.3.

Table 8.3: Interpretation of the SA_CBCH_CONFIG parameter

SA_CBCH_CONFIG	Frames used for CBCH
0000	None
0001	All frames such that (FN div 2) mod 4 = 0
0010	All frames such that (FN div 2) mod 4 = 1
0011	All frames such that (FN div 2) mod 4 = {0 or 1}
0100	All frames such that (FN div 2) mod 4 = 2
0101	All frames such that (FN div 2) mod 4 = {0 or 2}
0110	All frames such that (FN div 2) mod 4 = {1 or 2}
0111	All frames such that (FN div 2) mod 4 = {0, 1, or 2}
1000	All frames such that (FN div 2) mod 4 = 3
1001	All frames such that (FN div 2) mod 4 = {0 or 3}
1010	All frames such that (FN div 2) mod 4 = {1 or 3}
1011	All frames such that (FN div 2) mod 4 = {0, 1 or 3}
1100	All frames such that (FN div 2) mod 4 = {2 or 3}
1101	All frames such that (FN div 2) mod 4 = {0, 2 or 3}
1110	All frames such that (FN div 2) mod 4 = {1, 2 or 3}
1111	All frames

The SA_CBCH_CONFIG parameter has the effect of configuring the bit rate of CBCH. If the number of bits set in SA_CBCH_CONFIG is b, then CBCH is able to use ($25 \times b$) percent of the frames. (When $b = 2$, CBCH has a bit rate equivalent to GSM CBCH. Other values of b allow for configurable bit rates higher or lower than the GSM standard.)

8.5.4 Statistically multiplexed paired-frame sequence

A logical channel using a statistically multiplexed paired-frame sequence dynamically selects frame pairs from a pool of potential frame pairs. The bursts of the frame pairs contain information identifying the associated logical channel.

The only example of a statistically multiplexed paired-frame sequence logical channel is the downlink of a SDCCH/4. (The SDCCH/4 uplink uses a simple paired-frame sequence.)

8.5.4.1 Pool size

The size of the pool of potential frame pairs depends on the usage of the specific PC6 containing the SDCCH. All of the simple-paired-frame frame pairs of the SDCCH's PC6 downlink, except those in use for CBCH, are part of the pool of potential frame pairs.

8.5.4.2 Statistically multiplexed paired-frame sequence subchannels

A PC6 can contain up to four SDCCH subchannels. The SDCCH downlink uses Unique Word patterns in bursts to identify the subchannel associated with a frame pair.

Table 7.19 shows four distinctive SDCCH burst Unique Word definitions, each identified by a SDCCH type. Both bursts of a SDCCH downlink frame pair shall contain Unique Words with the same pattern.

The SDCCH type of the Unique Words directly corresponds with the SDCCH subchannel, for instance:

- UW SDCCH type 0 corresponds to SDCCH subchannel 0;
- UW SDCCH type 1 corresponds to SDCCH subchannel 1;
- UW SDCCH type 2 corresponds to SDCCH subchannel 2;
- UW SDCCH type 3 corresponds to SDCCH subchannel 3.

For consistency in the notation, these subchannels are referred to as:

- SDCCH/4-0;
- SDCCH/4-1;
- SDCCH/4-2;
- SDCCH/4-3.

In the uplink direction, SDCCH bursts shall also use the UW with a SDCCH type corresponding to the subchannel.

8.5.4.3 Example using SDCCH

Figure 8.1 gives an example of SDCCH multiplexed on a PC6. In this example, two SDCCH subchannels, SDCCH/4-0 and SDCCH/4-3, share the PC6 with CBCH, configured with SA_CBCH_CONFIG = 0010. The horizontal lines represent frames. Consecutive frames with the same value of (FN div 2) mod 4 form frame pairs.

The uplink, shown on the left of the dashed line, uses simple paired-frame sequencing. The uplink subchannels associated with the frame pairs can always be identified by (FN div 2) mod 4. (By convention, the SDCCH type of the Unique Words in the bursts of each uplink frame pair also corresponds with the subchannel, although this is not required by simple frame pairing.)

For the downlink, CBCH uses a configured paired-frame sequence, and occupies all frame pairs such that (FN div 2) mod 4 = 1. CBCH is further contrasted with SDCCH/4 later, in clause 9.9.

All other downlink frame pairs form the shared pool of potential frame pairs for SDCCH. Even though only two SDCCH subchannels have been allocated, three out of four frame pairs are in the potential pool for downlink SDCCH. The SDCCH/4 downlink subchannels of the pooled frame pairs are only identified by the SDCCH type of the Unique Words of the bursts in each frame pair, and not by (FN div 2) mod 4.

When multiple SDCCH downlink subchannels are simultaneously ready for transmission, the method used by the GS to schedule the SDCCH subchannels (such as first-in first-out, priority based, etc.) is not specified in the CAI.

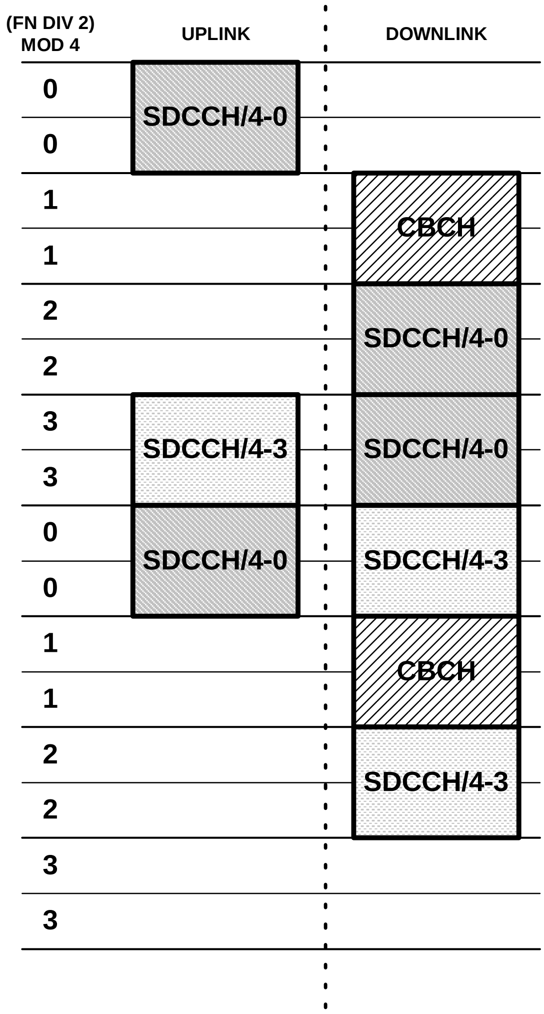

Figure 8.1: An SDCCH multiplexed in a PC6d

In figure 8.1, each of the frame-pair rectangles consists of two bursts occurring in two separate frames.

There is only one CBCH per logical cell, even though it can have variable throughput. Therefore, the CBCH frame pairs as shown do ***not*** use the subchannel suffix notation of "/4-1", since this subchannel notation might confuse some into thinking that there could be multiple CBCH per logical cell.

The SDCCH bursts use a double block structure, and CBCH bursts use a single block structure, as described in GMR-1 05.003 [7]. For the SDCCH, each frame pair corresponds to the double block structure of GMR-1 05.003 [7]. But, the two bursts of each CBCH frame pair are not related by block structure.

8.5.5 System information cycle sequencing

Some logical channels, such as those that share a BCCH/CCCH, use a repetitive frame sequence based on the system information cycle. Since the system information cycle has the same duration as a superframe, each system information cycle consists of 64 TDMA frames.

A timeslot used for a system-information-cycle-sequenced logical channel can be identified by a combination of a system-information-relative frame number (SIRFN) and a physical-channel-relative timeslot number (PCRTN), represented by an ordered pair:

(SIRFN, PCRTN).

SIRFN and PCRTN are explained in more detail in the following clauses.

The sequence of timeslots used for a burst is represented by an ordered triple:

(SIRFN, PCRTN, LOBITS),

where (SIRFN, PCRTN) is the first timeslot in the burst, and LOBITS is the length of the burst in timeslots. Thus, the triple (1, 0, 6) is a shorthand notation for (1, 0) + (1, 1) + … + (1, 5).

8.5.5.1 Physical-channel-relative timeslot number (PCRTN)

A PCRTN ranges from 0 to N-1, where N is the number of timeslots in the physical channel per TDMA frame. For instance, a PC6d would have PCRTN ranging from 0 to 5. Table 8.4 gives an example of the PCRTN for a PC6d that starts at TN 4.

Table 8.4: PCRTN for a PC6d starting at TN 4

	← TDMA FRAME = 24 TIMESLOTS →																							
TN:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PCRTN:					0	1	2	3	4	5														

In this table, the numbers from 0 to 23 in the shaded area represent the 24 timeslots of a TDMA frame. The double-outlined lighter portion represents the six timeslots of a PC6d within the larger TDMA frame. The PC6d starts at TN = 4. Relative to the start of the physical channel, however, TN 4 is the same as PCRTN 0.

8.5.5.2 System-information-relative frame number (SIRFN)

The start of a system information cycle is delayed from the start of a superframe by a number of frames (SA_SIRFN_DELAY) ranging from 0 to 15, which is constant for a beam. Frame numbers relative to the start of the system information cycle (SIRFN) are defined as (FN – SA_SIRFN_DELAY) mod 64, and range from 0 to 63. Table 8.5 shows a sample of SIRFN for a system information cycle that is delayed three TDMA frames from superframe timing.

Table 8.5: SIRFN for SA_SIRFN_DELAY = 3

FN (Hyperframe Relative)	Superframe-Relative Frame Number	SIRFN for SA_SIRFN_DELAY = 3
60	60	57
61	61	58
62	62	59
63	63	60
64	0	61
65	1	62
66	2	63
67	3	0
68	4	1
69	5	2

8.5.5.3 Graphical representation of system information cycle timeslots

By convention timeslots are represented as columns, and TDMA frames are represented as rows in tables that describe frame sequencing relative to the system information cycle. Only the timeslots occupied by the physical channel under discussion are shown. Because this would result in a tall narrow table, it is also conventional to break the table into four 16 TDMA clauses arranged side by side. An example of this tabular representation is shown as table 8.6.

Because all of the frames shown are on the same physical channel, they all use the same RF channel. Also, timeslots that graphically appear adjacent but are in different TDMA frames, such as (0,5) and (1,0), are actually separated by 18 timeslots, because a complete TDMA frame has 24 timeslots instead of just the six shown.

Table 8.6: System information cycle timeslots graphical representation

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
0						
1					X	
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
16						
17						
18						
19			Y	Y		
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
48						
49						
50						
51						
52						
53	Z	Z	Z	Z	Z	Z
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						

In table 8.6, some timeslots have been arbitrarily labelled "X", "Y", and "Z" to illustrate the ordered pair and ordered triple notation. The timeslot labelled "X" is at (1,4). There is a burst labelled "Y" at (19,2,2) and a burst labelled "Z" at (53,0,6).

8.6 Mapping of logical channels to BCCH/CCCH

The logical channels mapped to a BCCH/CCCH are of three types:

- **Fixed reserved-slot logical channels:** those that always have bursts that are transmitted in a BCCH/CCCH in a fixed position relative to the system information cycle. The fixed-reserved-slot logical channels are FCCH, CICH, and BCCH.
- **Optional reserved-slot logical channels:** those that can optionally have timeslots reserved for their use based on BCCH parameters. However, even if such timeslots are reserved, an optional reserved-slot logical channel does not need to generate a burst unless information needs to be transmitted. The optional-reserved-slot logical channels are PCH and BACH.
- **Unreserved-slot logical channels:** those that can use any of the otherwise unused PC6d frames. The only unreserved-slot logical channel is AGCH.

Each of these types of logical channels is described in turn in the following clauses.

8.6.1 Fixed reserved-slot logical channels

FCCH, CICH, and BCCH are the three fixed logical channels. They are always transmitted in a BCCH/CCCH.

The FCCH, CICH, and BCCH logical channels are described separately in the following clauses.

8.6.1.1 FCCH

Each system information cycle has eight FCCH bursts.

The FCCH burst positions are at:

(0, 0, 3), (16, 0, 3), (32, 0, 3), (48, 0, 3),
(8, 0, 3), (24, 0, 3), (40, 0, 3), (56, 0, 3).

8.6.1.2 CICH

Each system information cycle has eight CICH bursts.

The CICH burst positions are at:

(0, 3, 3), (16, 3, 3), (32, 3, 3), (48, 3, 3),
(8, 3, 3), (24, 3, 3), (40, 3, 3), (56, 3, 3).

8.6.1.3 BCCH

Each system information cycle contains eight BCCH bursts, as shown in table 8.7. Each BCCH burst contains a message as explained in GMR-1 05.003 [7]. The BCCH bursts occur at the following ordered triples:

(2, 0, 6), (18, 0, 6), (34, 0, 6), (50, 0, 6),
(10, 0, 6), (26, 0, 6), (42, 0, 6), (58, 0, 6).

Table 8.7: Fixed bursts in BCCH/CCCH

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
0	FCCH			CICH		
1						
2	BCCH					
3						
4						
5						
6						
7						
8	FCCH			CICH		
9						
10	BCCH					
11						
12						
13						
14						
15						
16	FCCH			CICH		
17						
18	BCCH					
19						
20						
21						
22						
23						
24	FCCH			CICH		
25						
26	BCCH					
27						
28						
29						
30						
31						
32	FCCH			CICH		
33						
34	BCCH					
35						
36						
37						
38						
39						
40	FCCH			CICH		
41						
42	BCCH					
43						
44						
45						
46						
47						
48	FCCH			CICH		
49						
50	BCCH					
51						
52						
53						
54						
55						
56	FCCH			CICH		
57						
58	BCCH					
59						
60						
61						
62						
63						

8.6.2 Optional reserved-slot logical channels

PCH and BACH are the two types of reserved logical channels. They are called "reserved" because they can send bursts only on timeslots that have been reserved for their use. However, just because the timeslots have been reserved does not mean that a burst shall be transmitted. Optional-reserved-slot logical channels employ DTX as described in GMR-1 05.008 [10], so bursts on these logical channels are only sent when information needs to be transmitted.

The unit of reserving timeslots is a *group* of bursts. For PCH, two groups are identified as PCH0 and PCH1. For BACH, eight groups are identified as BACH0 … BACH7. Table 8.8 shows the reserved logical channel groups in a BCCH/CCCH.

Table 8.8: Reserved logical channel bursts in a BCCH/CCCH

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
0	FCCH			CICH		
1	BACH 0		BACH 0		BACH 0	
2	BCCH					
3	BACH 4		BACH 4		BACH 4	
4	PCH0					
5	BACH 0		BACH 0		BACH 0	
6	BACH 1		BACH 1		BACH 1	
7	BACH 5		BACH 5		BACH 5	
8	FCCH			CICH		
9	BACH 2		BACH 2		BACH 2	
10	BCCH					
11	BACH 6		BACH 6		BACH 6	
12	PCH1					
13	BACH 7		BACH 7		BACH 7	
14	BACH 3		BACH 3		BACH 3	
15	BACH 4		BACH 4		BACH 4	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
16	FCCH			CICH		
17	BACH 0		BACH 0		BACH 0	
18	BCCH					
19	BACH 4		BACH 4		BACH 4	
20	PCH0					
21	BACH 1		BACH 1		BACH 1	
22	BACH 1		BACH 1		BACH 1	
23	BACH 5		BACH 5		BACH 5	
24	FCCH			CICH		
25	BACH 2		BACH 2		BACH 2	
26	BCCH					
27	BACH 6		BACH 6		BACH 6	
28	PCH1					
29	BACH 7		BACH 7		BACH 7	
30	BACH 3		BACH 3		BACH 3	
31	BACH 5		BACH 5		BACH 5	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
32	FCCH			CICH		
33	BACH 0		BACH 0		BACH 0	
34	BCCH					
35	BACH 4		BACH 4		BACH 4	
36	PCH0					
37	BACH 2		BACH 2		BACH 2	
38	BACH 1		BACH 1		BACH 1	
39	BACH 5		BACH 5		BACH 5	
40	FCCH			CICH		
41	BACH 2		BACH 2		BACH 2	
42	BCCH					
43	BACH 6		BACH 6		BACH 6	
44	PCH1					
45	BACH 7		BACH 7		BACH 7	
46	BACH 3		BACH 3		BACH 3	
47	BACH 6		BACH 6		BACH 6	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
48	FCCH			CICH		
49	BACH 0		BACH 0		BACH 0	
50	BCCH					
51	BACH 4		BACH 4		BACH 4	
52	PCH0					
53	BACH 3		BACH 3		BACH 3	
54	BACH 1		BACH 1		BACH 1	
55	BACH 5		BACH 5		BACH 5	
56	FCCH			CICH		
57	BACH 2		BACH 2		BACH 2	
58	BCCH					
59	BACH 6		BACH 6		BACH 6	
60	PCH1					
61	BACH 7		BACH 7		BACH 7	
62	BACH 3		BACH 3		BACH 3	
63	BACH 7		BACH 7		BACH 7	

A group also delimits subsets of bursts that are of interest only to subsets of MESs. Details of the assignment of groups to MESs are presented later, in clause 9.7.

The PCH and BACH logical channels are described separately in the following clauses.

8.6.2.1 PCH

The potential PCH bursts of every BCCH/CCCH and normal CCCHs are organized into two paging groups, identified as PCH0 and PCH1. A PCH message is not transmitted if there are no pages for any MESs in a paging group. Every BCCH/CCCH and normal CCCH reserves the timeslots of at least one of these paging groups for PCH bursts, based on the value of the BCCH parameter SA_PCH_CONFIG, as follows in table 8.9.

Table 8.9: Paging groups reserved by SA_PCH_CONFIG

SA_PCH_CONFIG Value	Reserved Paging Groups
01	PCH0
10	PCH1
11	PCH0 and PCH1

Reserving the PCH0 paging group allows the following four ordered triples to be used for PCH bursts:

(4, 0, 6), (20, 0, 6), (36, 0, 6), and (52, 0, 6).

Reserving the PCH1 paging group allows the following four ordered triples to be used for PCH bursts:

(12, 0, 6), (28, 0, 6), (44, 0, 6), and (60, 0, 6).

Assignment of MESs to paging groups is described later, in clause 9.7.2.

8.6.2.2 BACH

Similar to PCH, the potential BACH bursts of every BCCH/CCCH are organized into eight alerting groups, identified as BACH0 … BACH7. Whether or not the bursts corresponding to an alerting group are reserved for BACH bursts depends on the (bit-mapped) value of the BCCH parameter SA_BACH_CONFIG as follows in table 8.10.

Table 8.10: Alerting groups reserved by SA_BACH_CONFIG value

SA_BACH_CONFIG Value	Reserved Alerting Groups
00000000	None
00000001	BACH0
00000010	BACH1
00000011	BACH0 and BACH1
00000100	BACH2
…	(and so on)
11111111	BACH0, BACH1, BACH2, BACH3, BACH4, BACH5, BACH6, and BACH7

Even if a BACH group is reserved via SA_BACH_CONFIG, a burst will not be sent if there are no alerts for any MESs in that alerting group. The assignment of MESs to alerting groups is described later, in clause 9.7.3. The bursts that correspond to the eight alerting groups in BCCH/CCCH are shown in table 8.11.

Table 8.11: Bursts corresponding to alerting groups in BCCH/CCCH

Alerting Group	Bursts
BACH0	(1, 0, 2), (1, 2, 2), (1, 4, 2), (5, 0, 2), (5, 2, 2), (5, 4, 2), (17, 0, 2), (17, 2, 2), (17, 4, 2), (33, 0, 2), (33, 2, 2), (33, 4, 2), (49, 0, 2), (49, 2, 2), (49, 4, 2)
BACH1	(6, 0, 2), (6, 2, 2), (6, 4, 2), (21, 0, 2), (21, 2, 2), (21, 4, 2), (22, 0, 2), (22, 2, 2), (22, 4, 2), (38, 0, 2), (38, 2, 2), (38, 4, 2), (54, 0, 2), (54, 2, 2), (54, 4, 2)
BACH2	(9, 0, 2), (9, 2, 2), (9, 4, 2), (25, 0, 2), (25, 2, 2), (25, 4, 2), (37, 0, 2), (37, 2, 2), (37, 4, 2), (41, 0, 2), (41, 2, 2), (41, 4, 2), (57, 0, 2), (57, 2, 2), (57, 4, 2)
BACH3	(14, 0, 2), (14, 2, 2), (14, 4, 2), (30, 0, 2), (30, 2, 2), (30, 4, 2), (46, 02, 2), (46, 24, 2), (46, 46, 2), (53, 02, 2), (53, 24, 2), (53, 46, 2), (62, 0, 2), (62, 2, 2), (62, 4, 2)
BACH4	(3, 0, 2), (3, 2, 2), (3, 4 ,2), (15, 0, 2), (15, 2, 2), (15, 4, 2), (19, 0, 2), (19, 2, 2), (19, 4, 2), (35, 0, 2), (35, 2, 2), (35, 4, 2), (51, 0, 2), (51, 2, 2), (51, 4, 2)
BACH5	(7, 0, 2), (7, 2, 2), (7, 4 ,2), (23, 0, 2), (23, 2, 2), (23, 4, 2), (31, 0, 2), (31, 2, 2), (31, 4, 2), (39, 0, 2), (39, 2, 2), (39, 4, 2), (55, 0, 2), (55, 2, 2), (55, 4, 2)
BACH6	(11, 0, 2), (11, 2, 2), (11, 4 ,2), (27, 0, 2), (27, 2, 2), (27, 4, 2), (43, 0, 2), (43, 2, 2), (43, 4, 2), (47, 0, 2), (47, 2, 2), (47, 4, 2), (59, 0, 2), (59, 2, 2), (59, 4, 2)
BACH7	(13, 0, 2), (13, 2, 2), (13, 4 ,2), (29, 0, 2), (29, 2, 2), (29, 4, 2), (45, 0, 2), (45, 2, 2), (45, 4, 2), (61, 0, 2), (61, 2, 2), (61, 4, 2), (63, 0, 2), (63, 2, 2), (63, 4, 2)

Each BACH message consists of 15 bursts, as described in GMR-1 05.004 [8]. The 15 BACH bursts that comprise a message all belong to the same BACH group, and all occur during the same SI cycle, in the sequence specified in table 8.11.

8.6.3 Unreserved-slot logical channels

The only type of unreserved-slot logical channel is AGCH.

AGCH can use any of the PC6d frames that are unreserved due to the PCH or BACH channel configuration parameters in BCCH.

AGCH can also use any of the PC6d frames that are optionally reserved, if the optionally-reserved-timeslot logical channel has no information to send in that frame.

8.7 Mapping of logical channels to normal CCCH

The logical channels mapped to a normal CCCH are similar to those mapped to a BCCH/CCCH with the following exceptions:

1) There are no fixed reserved-slot logical channels in a normal CCCH, so a normal CCCH never includes FCCH or BCCH.

2) The slots that would have been reserved for FCCH, CICH, and BCCH in a BCCH/CCCH are not usable by AGCH in a normal CCCH.

The reserved logical channels of a normal CCCH are shown in table 8.12.

Table 8.12: Reserved logical channel bursts in a normal CCCH

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
0						
1	BACH 0		BACH 0		BACH 0	
2						
3	BACH 4		BACH 4		BACH 4	
4	PCH0					
5	BACH 0		BACH 0		BACH 0	
6	BACH 1		BACH 1		BACH 1	
7	BACH 5		BACH 5		BACH 5	
8						
9	BACH 2		BACH 2		BACH 2	
10						
11	BACH 6		BACH 6		BACH 6	
12	PCH1					
13	BACH 7		BACH 7		BACH 7	
14	BACH 3		BACH 3		BACH 3	
15	BACH 4		BACH 4		BACH 4	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
16						
17	BACH 0		BACH 0		BACH 0	
18						
19	BACH 4		BACH 4		BACH 4	
20	PCH0					
21	BACH 1		BACH 1		BACH 1	
22	BACH 1		BACH 1		BACH 1	
23	BACH 5		BACH 5		BACH 5	
24						
25	BACH 2		BACH 2		BACH 2	
26						
27	BACH 6		BACH 6		BACH 6	
28	PCH1					
29	BACH 7		BACH 7		BACH 7	
30	BACH 3		BACH 3		BACH 3	
31	BACH 5		BACH 5		BACH 5	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
32						
33	BACH 0		BACH 0		BACH 0	
34						
35	BACH 4		BACH 4		BACH 4	
36	PCH0					
37	BACH 2		BACH 2		BACH 2	
38	BACH 1		BACH 1		BACH 1	
39	BACH 5		BACH 5		BACH 5	
40						
41	BACH 2		BACH 2		BACH 2	
42						
43	BACH 6		BACH 6		BACH 6	
44	PCH1					
45	BACH 7		BACH 7		BACH 7	
46	BACH 3		BACH 3		BACH 3	
47	BACH 6		BACH 6		BACH 6	

SIRFN	PC6d PCRTN					
	0	1	2	3	4	5
48						
49	BACH 0		BACH 0		BACH 0	
50						
51	BACH 4		BACH 4		BACH 4	
52	PCH0					
53	BACH 3		BACH 3		BACH 3	
54	BACH 1		BACH 1		BACH 1	
55	BACH 5		BACH 5		BACH 5	
56						
57	BACH 2		BACH 2		BACH 2	
58						
59	BACH 6		BACH 6		BACH 6	
60	PCH1					
61	BACH 7		BACH 7		BACH 7	
62	BACH 3		BACH 3		BACH 3	
63	BACH 7		BACH 7		BACH 7	

9 Operation of channels

This clause describes various aspects of channel operation related to channel assignments and multiple access.

9.1 PC6d and PC12u pairing

A number of PC6d may be required in a spot beam to support the amount of paging or alerting traffic in that spot beam. One BCCH/CCCH is always assigned in every spot beam on the BCCH carrier.

Every PC6d shall be assigned in combination with a PC12u (RACH) physical channel. This PC12u shall be assigned on the duplex paired uplink radio frequency channel described in GMR-1 05.005 [9]. In other words, the number of PC12u's (RACH) is equal to the number of normal CCCHs, plus the number of AGCH/CCCHs, plus 1 (for the BCCH/CCCH), and each RACH's radio-frequency channel number is derived algorithmically from the corresponding CCCH's radio-frequency channel number.

The PC12u shall start in the return link timeslots specified by the parameter RACH_TS_OFFSET, broadcast in the BCCH. This relationship is shown by example in figure 9.1, where the value of RACH_TS_OFFSET can range from 0 to 23. The starting timeslot of the PC12u is equal to the starting timeslot of the corresponding PC6d plus RACH_TS_OFFSET, modulo 24.

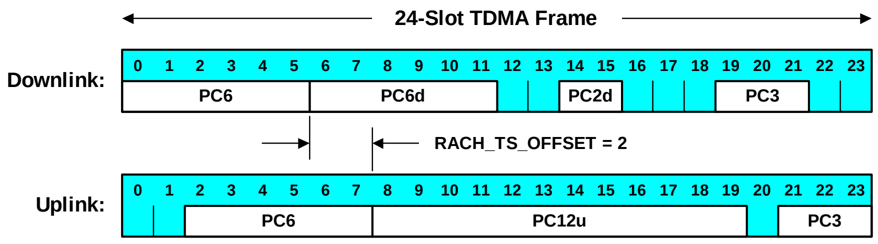

Figure 9.1: A RACH_TS_OFFSET example

A number of RACHs may be required in a spot beam to support the amount of random access traffic in that spot beam. Additional PC12u physical channels required to support the RACH messages shall be paired on the forward link with PC6d physical channels on which the entire CCCH or only the AGCH may be mapped.

9.2 Bidirectional channel timeslot assignments

Bidirectional physical channels need not have the same timeslot assignments for the downlink and uplink. Normally, the offset between paired downlink and uplink timeslot assignments for traffic channels is equal to RACH_TS_OFFSET.

9.3 GBCH

One PC2d of type (2) of clause 8.4 may be assigned in every spot beam on the BCCH carrier. This PC2d, used for GBCH, starts eight timeslots after the start of the PC6d used for the BCCH/CCCH. Therefore, the starting timeslot of the PC2d used for GBCH is always equal to (SA_BCCH_STN + 8) mod 24.

9.4 DKABs

The DKABs' bursts do not form a channel. They are just used on TCH3 during periods of speech inactivity. For additional details on the use of DKABs bursts, see GMR-1 04.008 [6].

9.5 FCCH and CICH

The FCCH and the BCCH on a BCCH carrier are used by the MESs for initial synchronization and spot beam selection.

The CICH on a BCCH carrier may be used by the MESs for calibration measurements, for instance, as part of spot beam selection.

9.6 TACCH/2

When an MES is engaged in a terminal-to-terminal call, it is assigned a TACCH/2 channel to monitor for signalling messages from the network. The TACCH/2 assignment is made at the time of the traffic channel assignment.

A number of TACCH/2s may be required to support the amount of terminal-to-terminal traffic in a spot beam. These may be broadcast on any RF channel, and need not be paired with either an uplink channel assignment or with another TACCH/2 in a TTCH.

9.7 MES monitoring of paging and alerting groups

MESs are only required to monitor their own paging group on their assigned CCCH. Likewise, MESs are only required to monitor their own alerting group on their assigned CCCH. The following clauses describe how to determine the CCCH, paging group, and alerting group assigned to an MES.

9.7.1 Determination of assigned CCCH

To determine the CCCH that the MES should monitor for paging and alerting, the MES computes an index (known as CCCH_INDEX) into the CCCH tables (known as SA_CCCH_LIST) carried by the BCCH. A CCCH_INDEX of 0 indicates that the first CCCH described in the SA_CCCH_LIST is the assigned CCCH, a CCCH_INDEX of 1 means that the second CCCH described in the SA_CCCH_LIST is the assigned CCCH, and so on.

CCCH_INDEX (0 … SA_CCCH_CHANS-1) = ((IMSI mod 1000) mod (SA_CCCH_CHANS × L)) div L

where:

1) L = the larger of:
   a) the number of paging groups reserved on the BCCH/CCCH (= SA_PCH_GROUPS); and
   b) the number of alerting groups reserved on the BCCH/CCCH (= SA_BACH_GROUPS).
2) IMSI = International Mobile Subscriber Identity;
3) SA_CCCH_CHANS = the number of normal CCCHs + 1 that are supported in the spot beam;
4) mod = Modulo;
5) div = Integer division.

For example, if SA_CCCH_CHANS = 4 and L = 2, then the values of CCCH_INDEX computed for the first 16 values of (IMSI mod 1000) would be as shown in table 9.1.

Table 9.1: First 16 values of CCCH_INDEX, for SA_CCCH_CHANS = 4 and L = 2

IMSI Mod 1000	CCCH_INDEX
0	0
1	0
2	1
3	1
4	2
5	2
6	3
7	3
8	0
9	0
10	1
11	1
12	2
13	2
14	3
15	3

9.7.2 Determination of assigned paging group

The MES computes an index for its assigned paging group via the formula:

PAGING_INDEX (0,… N-1) = ((IMSI mod 1000) mod N)

where N is the number of paging groups reserved on one CCCH (= SA_PCH_GROUPS), and IMSI and mod are the same as before.

As there is at least one and at most two paging groups reserved per CCCH, determining the assigned paging group from the paging index reduces to the cases shown in table 9.2.

Table 9.2: Determining assigned paging group

N	SA_PCH_CONFIG	Paging Groups in Assigned CCCH	Paging Index	Assigned Paging Group
1	01	PCH0	0	PCH0
1	10	PCH1	0	PCH1
2	11	PCH0, PCH1	0	PCH0
2	11	PCH0, PCH1	1	PCH1

9.7.3 Determination of alerting group

The MES computes an index for its assigned alerting group via the formula:

ALERTING_INDEX (0, … M-1) = ((IMSI mod 1000) mod M)

where M is the number of alerting groups reserved on one CCCH (= SA_BACH_GROUPS), and IMSI and mod are the same as before.

As there are up to eight alerting groups reserved per CCCH, determining the assigned alerting group from the ALERTING_INDEX and SA_BACH_CONFIG could be done via a table with 256 rows. A few rows of such a table are shown in table 9.3.

Table 9.3: Table for determining assigned alerting group

	Assigned Alerting Group for Alerting Index =							
SA_BACH_CONFIG	0	1	2	3	4	5	6	7
00000000	na	na	na	na	na	na	na	na
00000001	BACH0	na	na	na	na	na	na	na
00000010	BACH1	na	na	na	na	na	na	na
00000011	BACH0	BACH1	na	na	na	na	na	na
00000100	BACH2	na	na	na	na	na	na	na
00000101	BACH0	BACH2	na	na	na	na	na	na
00000110	BACH1	BACH2	na	na	na	na	na	na
00000111	BACH0	BACH1	BACH2	na	na	na	na	na
00001000	BACH3	na	na	na	na	na	na	na
00001001	BACH0	BACH3	na	na	na	na	na	na
00001010	BACH1	BACH3	na	na	na	na	na	na
00001011	BACH0	BACH1	BACH3	na	na	na	na	na
00001100	BACH2	BACH3	na	na	na	na	na	na
00001101	BACH0	BACH2	BACH3	na	na	na	na	na
00001110	BACH1	BACH2	BACH3	na	na	na	na	na
00001111	BACH0	BACH1	BACH2	BACH3	na	na	na	na
…	(and so on)							
11111111	BACH0	BACH1	BACH2	BACH3	BACH4	BACH5	BACH6	BACH7

9.8 MES selection of PC12U

An MES randomly selects a PC12U for RACH as described in GMR-1 04.008 [6].

9.9 SDCCH vs. CBCH

The SDCCH/4 and CBCH use different burst structures but can, if bandwidth requirements permit, share a PC6. SDCCH/4 and CBCH have many important differences:

- The type of information sent over SDCCH/4 is different than that sent over CBCH; SDCCH/4 is used for dedicated control information, but CBCH is used for cell broadcast information.
- SDCCH/4 is assigned on a per-call basis as needed. However, CBCH is configured via system parameters transmitted via BCCH.
- There is at most one CBCH per BCCH, and at most one PC6 that can be used for CBCH per BCCH. However, there can be many SDCCH/4, on many PC6.
- SDCCH/4 is bidirectional, but CBCH is downlink only.
- The CBCH needs to be time orthogonal to the PCH and BCCH, so that idle MESs can read the CBCH without missing pages or missing the BCCH.

The SDCCH/4 downlink uses a statistically multiplexed paired-frame sequence. CBCH uses a configured paired-frame sequence.

9.10 MES monitors paired CCCH for AGCH

An MES monitors the AGCH paired with the PC12u it previously used for RACH transmission, as described in GMR-1 04.008 [6].

9.11 Additional air interface constraints

An MES may assume that the following additional Air Interface constraints are imposed by the GS to ensure compatibility of the Air Interface with single-receiver MESs:

1) All the normal CCCHs and AGCH/CCCHs of a beam use the same timeslots (TN) and the same SIRFN as the BCCH/CCCH of that beam. This constraint keeps PCH and BACH from blocking the FCCH and BCCH.

2) All the AGCH CCCHs of a beam also use the same timeslots and the same SIRFN as the BCCH/CCCH.

3) The CBCH shall not be blocked by any PCH on which the MES may be camped. To prevent blocking, the PCH bursts shall not overlap the CBCH in time, and shall be separated from the CBCH by a minimum of 1,6 msec.

4) The GBCH shall not be blocked by any PCH on which the MES may be camped. To prevent blocking, the PCH shall not overlap its GBCH in time and shall be separated from the GBCH by a minimum of 1,6 msec.

5) For constraints on the timing of GBCH relative to neighboring-beam BCCH, see GMR-1 05.008 [10].

6) The BCCH shall not be blocked by the CBCH. To prevent blocking, the CBCH bursts associated with a BCCH shall not overlap the BCCH in time and shall be separated from the BCCH by a minimum of 1,6 msec.

7) AGCH messages shall not be scheduled to overlap the BCCH and FCCH in time and shall be separated from the BCCH and FCCH by a minimum of 1,6 msec. This allows single-receiver MESs to monitor BCCH or FCCH to remain in synchronization, after sending RACH and waiting to receive AGCH.

10 BCCH parameters

The complete list of BCCH parameters and their coding is described in GMR-1 04.008 [6]. Only a subset of BCCH parameters relevant to the present document is summarized in the following clauses, and certain aspects of the data coding (such as padding bits) have not been described.

10.1 Types of BCCH parameters

The BCCH includes several types of channel parameters, including:

- Information used to obtain synchronization, such as the TN offset of the BCCH or the delay between system information cycle timing and superframe timing.

- Channel meta-information, such as the number of normal CCCHs.

- Information that is beam-configurable, but the same for multiple channels, such as the number of paging groups per CCCH.

- Information specific to one instance of a channel, such as the radio-frequency channel of a normal CCCH.

The following clauses present, in turn, details about BCCH parameters that have been organized according to the above classifications.

10.2 Information used to obtain synchronization

SA_SIRFN_DELAY (4 bits) Delay of the system information cycle relative to superframe timing, in frames. This value ranges from 0-15.

SA_BCCH_STN (5 bits) Starting timeslot number of the BCCH/CCCH. This value ranges from 0-23. All the normal CCCH and AGCH/CCCH in the spot beam also use this same starting timeslot number.

Superframe Number (13 bits) The 13 most significant bits of the FN.

Multiframe number (2 bits) The next two most significant bits of the FN.

MFFN (1 bit) The most significant bit of the Multiframe frame number, equal to (FN mod 16) div 8.

10.3 Channel meta-information

SA_CCCH_CHANS (5 bits) Gives the total number of normal CCCHs + BCCH/CCCHs. The value can range from a minimum of 1 in very low traffic spot beams to a maximum value of 31 in the most highly congested spot beams.

SA_AGCH_CHANS (5 bits) The number of additional AGCH/CCCHs in the spot beam. The value can range from 0-31.

10.4 Beam-configurable multichannel information

SA_PCH_CONFIGjanet (2 bits) Provides a bitmap of configured paging groups, as shown in table 8.10, which is the same for all normal CCCHs and the BCCH/CCCH of a logical cell. SA_PCH_CONFIG may also be used to compute SA_PCH_GROUPS since the number of bits set to one in SA_PCH_CONFIG is equal to SA_PCH_GROUPS.

SA_BACH_CONFIG (8 bits) Provides a bitmap of configured alerting groups, as shown in table 8.11, which is the same for all normal CCCHs and the BCCH/CCCH of a logical cell. SA_BACH_CONFIG may also be used to compute SA_BACH_GROUPS since the number of bits set to one in SA_BACH_CONFIG is equal to SA_BACH_GROUPS.

RACH_TS_OFFSET (5 bits) This parameter specifies the delay from the first timeslot of a PC6d to the first timeslot of the associated PC12u (RACH) in timeslots, as shown in figure 9.1. The value ranges from 0 to 23. See GMR-1 05.010 [11] for additional details concerning RACH timing.

10.5 Information specific to one instance of a channel

SA_CBCH_RF_CH The (11-bit) radio frequency channel of the PC6 used for the CBCH.

SA_CBCH_TS (5 bits) This parameter contains the starting timeslot for the CBCH's PC6 on the CBCH's radio frequency channel. The value ranges from 0-23.

SA_CBCH_CONFIG This (4-bit) parameter provides a bitmap indicating which frame pairs are used for CBCH, as shown in table 8.3.

SA_CCCH_LIST The ARFCN of each CCCH with PCH (that is, either a normal CCCH or a BCCH/CCCH), differentially encoded as described in GMR-1 04.008 [6].

SA_AGCH_LIST The ARFCN of each CCCH without PCH (or AGCH/CCCH), differentially encoded as described in GMR-1 04.008 [6].

History

Document history		
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