GSM and GPRS System Information

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Summary

All GSM base stations continuously pass on information about their current system configuration and other information needed by mobile phones before they are allowed to access the network.
This information is organized in various SYSTEM INFORMATION words containing specific parameters.
Types 1 to 4 are transmitted within the BCCH (Broadcast Control Channel). Types 5 and 6 are only transmitted during an established individual radio link in a downlink direction within a multiplexed service channel called SACCH (Slow Associated Control Channel).
Due to the introduction of new services in the GSM network there are now new system information words, which need to be broadcast over the BCCH or, in the case of GPRS, these may be broadcast over a PBCCH. This description focuses on all of the parameters of these new System Information Fields.
To transfer one system information word, four bursts are needed. In a BCCH, these four bursts are available within one 51-multiframe. In a SACCH, one system information word is spread over four 26-multiframes. If a PBCCH or PACCH is used, the information is spread over 4 Normal Bursts too, with all of them belonging to a so-called Radio Block, or RLC/MAC block.
The GSM System Information in this chapter is to be considered a reiteration of information, with the most important information in this section being the GPRS related system information that describes these new packet switched services.

System Information Type 1

Information elements:
- Cell channel description
- RACH control parameters
- SI 1 Rest Octets information element contains the position about the NCH

System Information Type 2

Information elements:
- Neighbour cells description
- PLMN permitted
- RACH control parameters

System Information Type 3

Information elements:
- Cell identity
- Location area identification
- Control channel description
- Cell options
- Cell selection parameters

- RACH control parameters
- SI 3 rest octets indicating the existence of GPRS services

System Information Type 4

Information elements:
- Location area identification
- Cell selection parameters
- RACH control parameters

System Information Type 5

Information elements:
- Neighbour cells description

System Information Type 6

Information elements:
- Cell identity
- Location area identification
- Cell options (chapter 3.2)
- PLMN permitted

System Information Type 7

This message is sent by the network on the BCCH giving information about cell reselection parameters that are to be used in that cell.
Information elements:
- SI 7 Rest Octets

System Information Type 8

This message is sent by the network on the BCCH giving information about cell reselection parameters to be used in that cell.
Information elements:
SI 8 Rest Octets

System Information Type 9

This message is sent by the network on the BCCH to all mobile stations within the cell giving some, but not necessarily all, information on the scheduling of information on the BCCH.
Information elements:

RACH Control Parameters
SI 9 Rest Octets

System information Type 13

This message is sent on the BCCH if indicated in at least one of the SYSTEM INFORMATION TYPE 3, 4, 7 or 8 messages. The message is sent by the network to provide GPRS information in the cell.
A mobile station not supporting GPRS shall treat this message as an unknown message type.
Information elements:

- SI 13 Rest Octets

System information type 16

This message is sent on the BCCH if indicated in the SYSTEM INFORMATION TYPE 3 message. The message is sent by the network giving information about cell selection and reselection parameters to be used in that cell.
Information elements:

SI 16 Rest Octets

System information type 17

This message is sent on the BCCH if indicated in the SYSTEM INFORMATION TYPE 3 message. The message is sent by the network giving information about cell selection and reselection parameters to be used in that cell.
Information elements:

SI 17 Rest Octets

Content of Information Elements

Cell Channel Description

Length: 17 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	0	0	0	1	0
		cell channel description IEI						
octet 2	CA-No		0 spare	0 spare	ARFCN 124	ARFCN 123	ARFCN 122	ARFCN 121
octet 3	ARFCN 120	ARFCN 119	ARFCN 118	ARFCN 117	ARFCN 116	ARFCN 115	ARFCN 114	ARFCN 113
octet 17	ARFCN 008	ARFCN 007	ARFCN 006	ARFCN 005	ARFCN 004	ARFCN 003	ARFCN 002	ARFCN 001

CA - No: number of frequency band (0 in GSM)
ARFCN xxx: 0 this channel is not used in this cell
1 this channel is used in this cell

This field forms a bitmap pattern that indicates which of the corresponding channel numbers has been allocated to that radio cell. There is also a possibility to indicate the allocated frequency channel numbers by using some bits as BCD, binary coded decimal field, which will be interpreted as a decimal value. This list starts with a 10-bit field showing the highest decimal value, and the following fields are given in a relative path derived from this number. For further information about the structure of this field, we refer to GSM Spec. 04.08.

Cell Options

Length: 2 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	0	1	0	1	1
		cell options IEI						
octet 2	0 spare	PWRC	DTX		RADIO-LINK-TIMEOUT			

PWRC: power control
- 0 power control is not used
- 1 power control is used

DTX: DTX indicator
- 0 0 MS are allowed to use DTX
- 0 1 MS must use DTX
- 1 0 MS must not use DTX

This field allows Discontinuous Transmission, and the MS may not transmit some bursts if the voice activity detector indicates no speech. This can be used to reduce the MS power consumption.

RADIO-LINK-TIMEOUT
- 0 0 0 0 = 4
- 0 0 0 1 = 8
- 0 0 1 0 = 12

- 1 1 1 0 = 60
- 1 1 1 1 = 64

This field can be regarded as an emergency indicator to terminate a call. If the MS receives a corrupted SACCH-block (transmitted over four 26-Multiframes), the counter, initialised with the RADIO-LINK-TIMEOUT field, will be reduced by one each time until it reaches 0. If the MS receives a correct SACCH block, the counter will be increased by two. This generates a so-called positive algorithm, which is limited by the maximum value given by RADIO-LINK-TIMEOUT.

Cell Selection Parameters

Length: 3 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	0	1	1	0	0
		cell selection parameters IEI						
octet 2	CELL-RESELECT-HYSTERESIS		MS-TXPWR-MAX-CCH					
octet 3	0 spare	0 spare	RXLV-ACCESS-MIN					

CELL-RESELECT-HYSTERESIS:

0 0 0 =	0 dB
0 0 1 =	2 dB
0 1 0 =	4 dB
0 1 1 =	6 dB
1 0 0 =	8 dB
1 0 1 =	10 dB
1 1 0 =	12 dB
1 1 1 =	14 dB

Used to calculate the C2 criterion for cell reselection.

MS-TXPWR-MAX-CCH: range 0 to 31
The maximum MS output power used for the first radio access to that BTS.

RXLV-ACCESS-MIN: range 0 to 63
The minimum RF-level which can be received by the MS, so that that particular BTS can be considered as a possible, selectable radio cell.

Control Channel Description

Length: 4 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	0	1	0	0	0
		control channel description IEI						
octet 2	0 spare	ATT	BS-AG-BLKS-RES			CCCH-CONF		
octet 3	0 spare	0 spare	0 spare	0 spare	0 spare	BS-PA-MFRMS		
octet 4	T 3212 time-out value							

ATT: IMSI ATTACH/DETACH procedure
0 not allowed
1 must be performed

BS-AG-BLKS-RES:
Number of AGCH blocks

CCCH-CONF configuration of CCCH
0 0 0 = 1 physical channel reserved for CCCH not combined with SDCCH
0 0 1 = 1 physical channel reserved for CCCH combined with SDCCH
0 1 0 = 2 physical channels reserved for CCCH not combined with SDCCH
1 0 0 = 3 physical channel reserved for CCCH not combined with SDCCH
1 1 0 = 4 physical channel reserved for CCCH not combined with SDCCH

BS-PA-MFRMS
Number of multiframe periods belonging to the same paging group for pagings to MS.
0 0 0 = 2
0 0 1 = 3
0 1 0 = 4
. . .
1 1 1 = 9

T 3212 timeout value: range 0 to 255
T3212 defines the time in decihours (6 minutes) after which an MS has to perform a periodic location update. For T3212 = 0 the MS does not execute a periodic update.

Neighbour Cells Description

Length: 17 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1 neighbour cells description IEI	1	1	0	1	0	0
octet 2	BA-NO		0 spare	BA-IND	ARFCN 124	ARFCN 123	ARFCN 122	ARFCN 121
octet 3	ARFCN 120	ARFCN 119	ARFCN 118	ARFCN 117	ARFCN 116	ARFCN 115	ARFCN 114	ARFCN 113
octet 17	ARFCN 008	ARFCN 007	ARFCN 006	ARFCN 005	ARFCN 004	ARFCN 003	ARFCN 002	ARFCN 001

BA-NO: BCCH allocation number
(set to 0 in GSM)
BA-IND: BA sequence indication
Range 0 and 1
ARFCN xxx: 0 channel belongs to BA
ARFCN xxx: 1 channel does not belong to BA

BCD numbers, as explained in the cell description information element or in the GSM Spec can also indicate the neighbour cell description. 04.08.

PLMN permitted

Length: 2 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	1	0	1	1	0
		PLMN permitted IEI						
octet 2	NCC permitted							

NCC permitted: Used NCCs of this network

For instance:

NCC permitted = 0 0 1 0 1 0 0 0 means:
used are: NCC = 4 and NCC = 6

RACH Control Parameters

Length: 4 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	1	1	1	1	0	0	0
		RACH control parameters IEI						
octet 2	Max Retrans		Tx-integer				CELL BARR ACCESS	RE
octet 3	AC C15	AC C14	AC C13	AC C12	AC C11	EC C10	AC C09	AC C08
octet 4	AC C07	AC C06	AC C05	AC C04	AC C03	AC C02	AC C01	AC C00

Max Retrans: maximum number of access attempts

0 0 = 1 attempt
0 1 = 2 attempts
1 0 = 4 attempts
1 1 = 7 attempts

Tx-integer: number of time slots to spread access attempts

0 0 0 0 = 3 timeslots spread
0 0 0 1 = 4 timeslots spread

division: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 20, 25, 32, 50

CELL-BAR-ACCESS: barring options indicator cell

0 = cell is not blocked
1 = cell is blocked for access

RE: call re-establishment

0 = call re-establishment is allowed in this cell
1 = call re-establishment is not allowed

EC: emergency call

0 = emergency call is allowed in this cell
1 = emergency call is only allowed for MS of access control class 11 to 15

AC Cn: access control classes n = 0, 1, 2, . . . ,8 ,9 , 11 ,12, 13, 14, 15

If switched to "1", members of the indicated AC class are not allowed to access the network.

Cell Identity

Length: 3 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	0	0	1	0	0	0	1
					cell identity IEI			
octet 2	CI value							
octet 3	CI value (continued)							

CI value: numerical value of cell identity (hexadecimal)

Location Area Identification

Length: 6 octets

bit No.	8	7	6	5	4	3	2	1
octet 1	0	0	0	1	0	0	1	1
	location area identification IEI							
octet 2	MCC digit 2				MCC digit 1			
octet 3	1	1	1	1	MCC digit 3			
octet 4	MNC digit 2				MNC digit 1			
octet 5	LAC							
octet 6	LAC (continued)							

MCC: Mobile Country Code
International standardized

MNC: Mobile Network Code
Specified by national authorities to distinguish between several network operators

LAC: Location Area Code
Determined by network operator

Cell Reselection Process, C1 and C2 criteria

Some of the parameters broadcast in the system information fields indicate some parameters that are used to calculate the C1 and C2 criteria. These criteria are used by the MS to reselect a radio cell in GSM idle mode, or in GPRS standby state if there are no additional C31 or C32 criteria defined. As a reminder, the formulae of these 2 criteria are:

C1(n) = RXLEV(n) – RXLEV_ACCESS_MIN(n) –
MAX[0, (MS_TX_PWR_MAX_CCCH – P)]

Where,

RXLEV(n) = actual measured RF – level from the radio cell n
P = maximum transmitting power of the MS
RXLEV_ACCESS_MIN(n) = minimum level for access to that radio cell
MS_TX_PWR_MAX_CCCH = allowed output power for the MS on that cell

The C1 value is calculated for every radio cell indicated in the neighbouring cell description list. The first criterion that must be valid; that is, the MS selects a cell with C1(n) > 0. The MS will reselect that radio cell with the highest C1 value.

C2(n) = C1(n) + CELL_RESELECT_OFFSET –
[TEMPORARY_OFFSET * H(PENALTY_TIME – T)]

Where:

CELL_RESELECT_OFFSET = fixed offset value from the considered BTS
TEMPORARY_OFFSET = temporary offset value from the considered BTS
PENALTY_TIME = Delay time, or waiting time
H(x) = 0 for x ≤0
1 for x > 0

System Information 3 Rest Octets Information Field:

CBQ, CELL_BAR_QUALIFY (1 bit field)

The network to control mobile station cell selection and reselection uses CELL_BAR_QUALIFY. It shows if the priority of this cell in the cell reselection process is normal or low.

CELL_RESELECT_OFFSET (6 bit field)

CELL_RESELECT_OFFSET is a value used by the mobile station to apply a positive or negative offset to the value of C2, describing the cell reselection process. This is a general valid parameter to apply such an offset value, but this offset can be an enhancement or a reduction of the cell class.

TEMPORARY_OFFSET (3 bit field)

The TEMPORARY_OFFSET is used by the mobile station as part of its calculation of C2 for the cell reselection process. It is used to apply a negative offset to C2 for the duration of PENALTY_TIME. In comparison to the CELL_RESELECT_OFFSET value,

this parameter is only valid as a negative offset and only in the case of duration of the penalty time, i.e. the reaction or hysteresis time for the C2 parameter calculation.

PENALTY_TIME (5 bit field)

The PENALTY_TIME defines the length of time for which TEMPORARY_OFFSET is active. With this value the cell reselect hysteresis can be achieved.

WHERE (3 bit field)

If the **WHERE** field is not contained in the information element, this indicates that BCCH scheduling information is not sent in SYSTEM INFORMATION TYPE 9 on the BCCH. If the **WHERE** field is contained in the information element, this indicates that BCCH scheduling information is sent in SYSTEM INFORMATION TYPE 9 on the BCCH. This also indicates that SYSTEM INFORMATION TYPE 9 messages are sent in the blocks of the BCCH norm for which ((FN DIV 51) mod (8) = 4 AND (((FN DIV 51) DIV 8) mod (n+1))= 0), where n is the value encoded in binary in **WHERE**.

GPRS Indicator

The **GPRS Indicator** contains the RA COLOUR field and the SI13_POSITION field. If the GPRS Indicator is contained in the information element, it indicates that GPRS is supported in the cell.

RA COLOUR (3 bit field)

If the mobile station receives different values of the RA COLOUR field in a different cell, the mobile station shall interpret the cell reselection information as if the two cells belong to different routeing areas. The routeing area in GPRS is the equivalent to the location area defined in GSM, but it defines a smaller cell area. From this value the MS can react much faster, and send a routeing area update message to the network.

SI13_POSITION (1 bit field)

The SI13 POSITION field indicates the minimum procedure for where the SYSTEM INFORMATION TYPE 13 message is sent on BCCH:

0 SYSTEM INFORMATION TYPE 13 message is sent on BCCH Norm;

1 SYSTEM INFORMATION TYPE 13 message is sent on BCCH Ext.

The description of BCCH Norm and Ext can be found in the paragraph about Sys Info 9.

System Information 4 Rest Octets Information Field:

CBQ, CELL_BAR_QUALIFY, CELL_RESELECT_OFFSET, TEMPORARY_OFFSET and PENALTY_TIME are already described in SI 3 Rest Octet field.

POWER OFFSET is used only by DCS 1800 Class 3 MSs to add a power offset to the value of MS_TXPWR_MAX_CCH used for its random access attempts. The MS also uses it in its calculation of C1 and C2 parameters.

The **GPRS Indicator** containing the RA COLOUR field and the SI13_POSITION field is already described in the SI 3 Rest Octet Field.

Break Indicator

The Break Indicator indicates if parameters, in addition to those in SI 4 rest octets, are sent in SI7 and SI8.

PRIO_THR (3 bit field)

The PRIO_THR field is a signal threshold used by the mobile station and its purpose is to determine whether prioritised cell reselection should apply, but this only works if the LSA is supported. The calculation will then be done as follows:

The signal strength threshold criterion parameter C4 is used to determine whether prioritised LSA cell reselection shall apply, and it is defined by:

C4 = A - PRIO_THR , where A is given by RXLEV – RX_LEV_ACCESS_MIN

Values for PRIO_THR are: 0 = 0 dB, 1 = 6 dB, 2 = 12 dB, 3 = 18 dB, 4 = 24 dB, 5 = 30 dB, 6 = 36 dB, 7 = ∞ dB

LSA_OFFSET, Localised Service Area (3 bit field)

The LSA_OFFSET field applies an offset for LSA reselection between cells with the same LSA priorities. Below is a more detailed description of LSA and its services.

MCC and MNC (24 bit field)

If the escaped PLMN is broadcast in SI3 and SI4, the cell is used for SoLSA exclusive access and the MCC and MNC fields are included. For all purposes, the MS will then use the MCC and MNC values received in the LSA Parameters instead of the ones received in the Location Area information element in SI3 and 4; for example when deriving the PLMN Identity, the Location Area Identity and the Cell Global Identity broadcast by the cell.

Cell Identity (16 bit field)

The purpose of the Cell Identity is to identify a cell within a location area.

LSA_ID, Localised Service Area_Identity (24 bit field)

The purpose of the LSA_ID field is to identify an LSA.

Short LSA_ID (10 bit field)

The purpose of the Short LSA_ID field is to identify an LSA. The LSA ID defined by the Short LSA_ID is an LSA_ID, which is only valid from bit 1 up to bit 10.

Localised Service Area, LSA:

The localised service area concept gives the operator the basis to offer subscribers different services (e.g. tariffs or access rights) depending on the (cell based) location of the subscriber.
A localised service area consists of a cell or a number of cells within a PLMN.
Cells that are part of different localised service areas may have overlapping coverage areas.
The cells constituting a localised service area may not necessarily provide continuous coverage.

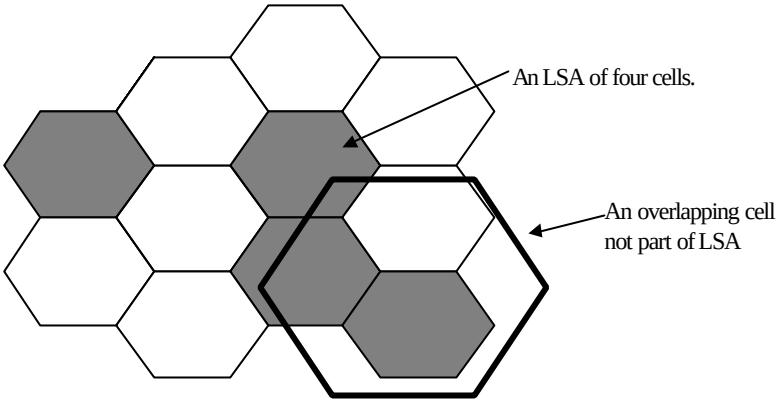


Figure: Localised Service Area

Subscribed to LSA**:** The set of LSAs which the user has subscribed to.

Valid LSA**:** An LSA which the user has subscribed to and means that his MS can receive service.

Current LSA: The LSA where an MS is receiving service.

LSA Priority: Priority of subscriber's LSAs. When the user has several valid LSAs, the current LSA can be selected by prioritising LSAs when they are overlapping.

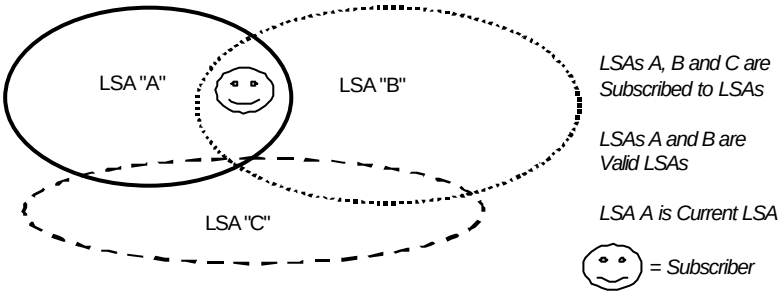


Figure: Localised Service Areas

LSA only access: The LSA user is allowed to access PLMN within his permitted LSAs. The LSA user is not allowed to receive and/or make a call from outside the LSA area.

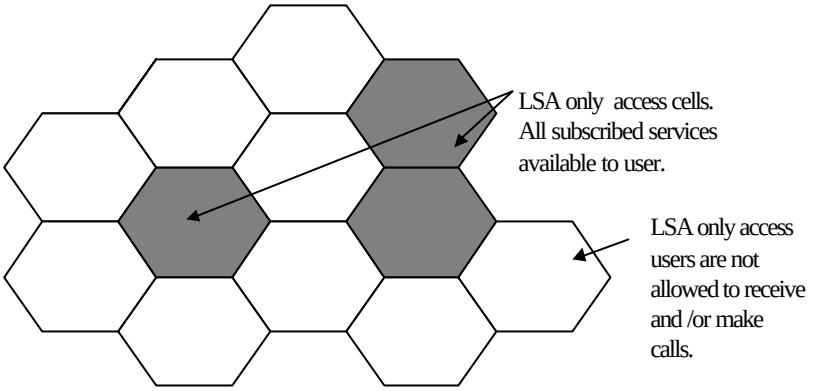


Figure: LSA only access

Exclusive Access: Access to exclusive access cells is restricted to specified LSA subscribers.

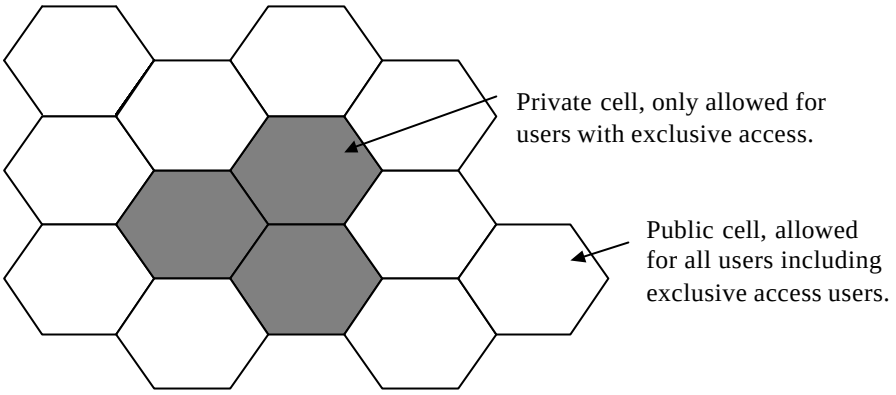


Figure: Exclusive Access

Preferential Access: The LSA user has priority over non-LSA users when accessing the resources of LSA cells.

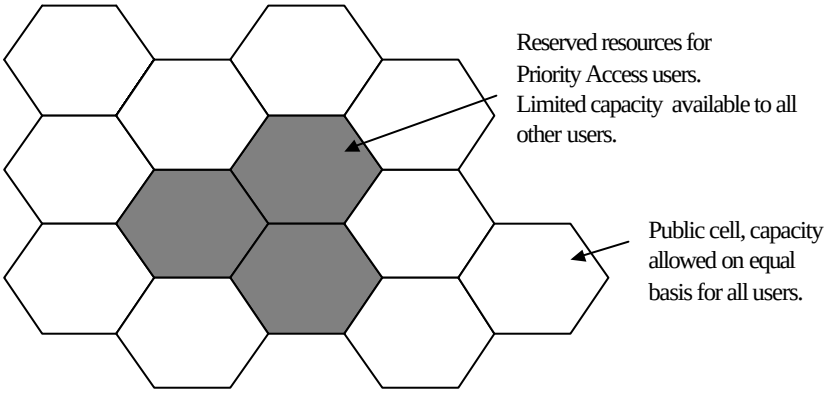


Figure: Preferential Access

System Information 7 Rest Octets Information Field:

The *SI 7 Rest Octets* information element includes parameters that are used by the mobile station for cell selection and reselection purposes. It may also include the POWER OFFSET parameter used by a DCS 1800 Class 3 MS.
The *SI 7 Rest Octets* information element is coded as the *SI 4 Rest Octets*. Its content is already described in the SI 4 Rest Octet description.

System Information 8 Rest Octets Information Field:

The *SI 8 Rest Octets* information element includes parameters that are used by the mobile station for cell selection and reselection purposes. It may also include the POWER OFFSET parameter used by a DCS 1800 Class 3 MS.
The *SI 8 Rest Octets* information element is coded as the *SI 4 Rest Octets*. Its content is already described in the SI 4 Rest Octet description.

System Information 9 Rest Octets Information Field:

The *SI 9 Rest Octets Information Field* indicates one or more information types given in Info_Type_x, together with their positions. Here, a position specifies at which relative position P (specified in relative_position) modulus a position modulus M (specified in modulus) messages of the given information type are sent, on the BCCH norm or BCCH ext as indicated in bcch_type. To be precise, messages of the given information type are sent in the multiframes for which ((frame number) DIV 51) mod (M)) = P.
If the position modulus M equals 0, the information type is not sent.

Info_type_4 (4 bits)

This field contains a binary encoded non-negative integer value assigned to a type of information sent on the BCCH. All values indicate unknown and unnecessary information and are reserved for future use.

Info_type_5 (5 bits)

This field contains a binary encoded non-negative integer value assigned to a type of information sent on the BCCH. All valid values are given by:

0 0000	System Information type 1
0 0001	System Information type 2
0 0010	System Information type 2bis
0 0011	System Information type 2ter
0 0100	System Information type 3
0 0101	System Information type 4
0 0110	System Information type 7
0 0111	System Information type 8
0 1000	System Information type 9
0 1001	System Information type 13
0 1011	System Information type 16

0 1100 System Information type 17

Info_type_6 (6 bits)

This field contains a binary encoded non-negative integer number assigned to a type of information sent on the BCCH. All values indicate unknown, unnecessary information and are reserved for future use. I.e., for the moment, this field contains no valid information about scheduling system information type messages.

Modulus (4 bits)

This field encodes the position modulus according to the following encoding method. Let N be the integer encoded in binary in the modulus field; the position modulus is then defined as follows:

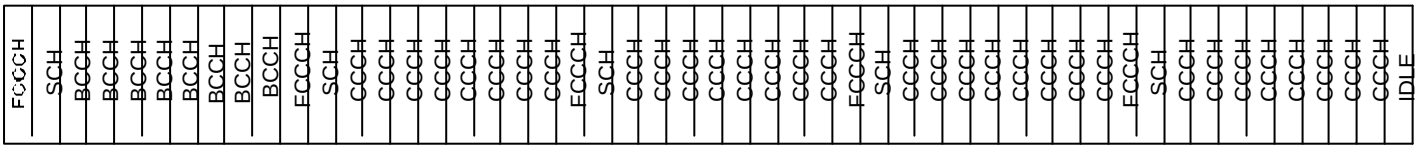
If N=0, the position modulus is 0,
If N>0, the position modulus is $2^{N+1.}$

Relative position (0 bits if the non-negative integer n contained in the modulus field is 0 n+1 bits, if the non-negative integer N encoded in the modulus field is > 0).
This field contains the N+1 bit binary encoding of a non-negative integer number < 2^{N+1}.

BCCH_type (1 bit)

0 BCCH norm, i.e. BCCH information is broadcast on Frame Number 2 – 5 within the 51 multiframe

1 BCCH extended, i.e. additional BCCH information is also broadcast on Frame Number 6 – 9 within one 51 multiframe.



BCCH normal BCCH extended

TDMA frame mapping for FCCH + SCH + BCCH + CCCH

System Information 13 Rest Octets Information Field:

The *SI 13 Rest Octets* information element is used to transmit the relevant GPRS information to MS's supporting GPRS services.

BCCH_CHANGE_MARK (3 bit field)

This field indicates the status of the information on BCCH. The value of this field may be changed when information on BCCH is changed.

SI_CHANGE_FIELD (4 bit field)

This field is the binary representation of the information that was changed at the last indication in BCCH_CHANGE_MARK.

0 Update of *unspecified* SI message or SI messages;
1 Update of SI1 message;
2 Update of SI2, SI2 bis or SI2 ter message;
3 Update of SI3, SI4, SI7 or SI8 message;
4 Update of SI9 message;

All other values shall be interpreted as 'update of unknown SI message type'.

SI13_CHANGE_MARK (2 bit field)

This field is the binary representation of the SI change mark identifying the GPRS Mobile Allocation provided in SI13 and PSI13 messages. Range: 0 to 3.

GPRS Mobile Allocation (information element)

The GPRS Mobile Allocation information element defines a set of radio frequency channels and a hopping sequence number (HSN), which may be allocated to a mobile station to define its channel configuration.
This information element may refer to a reference frequency list or a set of reference frequency lists defined in the PSI2 information. In case there is no such reference included in this information element, it refers to the cell allocation (CA) defined for the cell. The cell allocation is contained in the PSI2 information if PBCCH is present in the cell, or in the SI1 information. There are two alternative ways to encode the GPRS mobile allocation; using the MA_BITMAP or using the ARFCN index list.

HSN (6 bit field)

This field is the binary representation of the hopping sequence number. Range: 0 to 63.

RFL number list (construction)

This construction is a list specifying the referenced set of reference frequency lists for this information element. If the list is not included, this information element refers to the cell allocation defined for the cell and is given in SI1 or PSI2.

MA_BITMAP (variable length, 1 to 64 bit, field)

This field is a bitmap representing the radio frequency channels belonging to the GPRS mobile allocation. The number of bit positions in MA_BITMAP shall equal the length of RFL. Each bit position is coded:

0 the corresponding radio frequency channel does not belong to the GPRS mobile allocation;

1 the corresponding radio frequency channel belongs to the GPRS mobile allocation.

ARFCN index list (construction)

This construction is a list representing a set of radio frequency channels that are to be excluded from the definition of the GPRS mobile allocation. The GPRS mobile allocation consists of the radio frequency channels included in the referenced set of reference frequency lists or the referenced cell allocation, except those represented by the ARFCN index list. If the list is not included, this information element defines a GPRS mobile allocation consisting of all radio frequency channels included in the referenced set of reference frequency lists or the referenced cell allocation, without exception.

RFL_NUMBER (4 bit field)

This field is the binary reference to a reference frequency list provided in PSI2. Range 0 to 15.

ARFCN_INDEX (6 bit field)

This field is the binary reference to radio frequency channels in the referenced set of reference frequency lists or the referenced cell allocation. Range: 0 to NFñ1

This information element is the representation of the GPRS mobile allocation provided in SI13 and PSI13 messages. It is identified by MA_NUMBER = 14 when referenced from a packet assignment message. When used in SI13 or PSI13 messages, this information element refers to the cell allocation defined for the cell in SI1 or PSI2.

RAC (8 bit field)

This field is the binary representation of the Routing Area Code.

SPGC_CCCH_SUP (1 bit field)

This field indicates the support of the parameter SPLIT_PG_CYCLE on CCCH from the network side:

0 SPLIT_PG_CYCLE is not supported on CCCH in this cell;
1 SPLIT_PG_CYCLE is supported on CCCH in this cell.

In GPRS there is an additional option to split the paging cells into either CCCH or PCCCH and into a PG_CYCLE, corresponding to the Paging Group which is known in GSM. In the past, this paging group in GSM was used to support DRX mode in the MS, i.e. there was no need for continuous receiving on the MS side. The parameter BS_PA_MFRMS separated the MS into different paging groups. In GPRS there is now the possibility of using the same principle as known in GSM, or using another similar procedure. For that procedure, in the GPRS attached message, the MS gets a value for SPLIT_PG_CYCLE. Due to this value, the MS can calculate either a PCCCH_GROUP factor, indicating in which Paging Block on the PCCCH it is paged, or it can calculate a Paging_group factor corresponding to the CCCH.

PRIORITY_ACCESS_THR, (3bit):

0 0 0 packet access is not allowed in the cell;
0 0 1 spare, shall be interpreted as '000' (packet access not allowed);
0 1 0 spare, shall be interpreted as '000' (packet access not allowed);
0 1 1 packet access is allowed for priority level 1;
1 0 0 packet access is allowed for priority level 1 to 2;

1 0 1 packet access is allowed for priority level 1 to 3;
1 1 0 packet access is allowed for priority level 1 to 4;
1 1 1 spare, shall be interpreted as '110' (packet access allowed).

NETWORK_CONTROL_ORDER field, (2 bit)

0 0 NC0: MS controlled cell reselection, no measurement reporting.
0 1 NC1: MS controlled cell reselection, MS sends measurement reports.
1 0 NC2: Network controlled cell reselection, MS sends measurement reports.
1 1 Reserved for future use, interpreted as NC0 by mobile station.

PSI1_REPEAT_PERIOD (4 bit field), Packet System Information Type 1

This field is the representation of the PSI1 repeat period. The field is coded according to the following table:

0000 PSI1 repeat period = 1 multiframe
0001 PSI1 repeat period = 2 multiframes
:
1111 PSI1 repeat period = 16 multiframes

GPRS Power Control Parameters struct

In GPRS, the MS TX-Power is controlled in a more modified manner than with GSM. The following diagram gives the formula needed to calculate the MS output power.

MS power output is calculated with the formula:

$$P_{CH} = \min(\Gamma_0 - \Gamma_{CH} - \alpha * (C + 48), PMAX)$$

Γ_0 = 39dBm for GSM 900 / 400 / 850
36 dBm for GSM 1800 / 1900

Γ_{CH} = MS specific parameter, sent in RLC control message, valid per Timeslot, 5 bit value, step of 2 dB from 0..62 dB

α = system parameter on System Information, 4 bit value, from 0.0 .. 1.0 in 10 steps

PMAX = maximum allowed power in that cell

C = received signal level at MS (= RX_{LEV})

P_{CH} is used on each individual PDCH !

Figure: Formula needed to calculate MS TX output power.

In GPRS, the MS output power can be derived in two ways. One way is the more classical way, like GSM with the Power Control Levels (PCL), where the network orders a fixed power from the MS. This is the first part of the formula.

In GPRS there is no longer an associated active control channel like the SACCH that reports periodically the measurement report to the network. This kind of signalling is sent „on demand“, either when requested from the network, or within a time interval. However, it is also possible that there is no measurement reported from the MS to the network. There is then the trouble of combining the power output of the MS with the receiving power level to allow a more dynamic power control loop. The influence of this is taken into consideration by the weight factor Alpha, which ranges from 0.0 up to 1.0 in steps of 0.1.

The **ALPHA** field (4 bit) is the binary representation of the parameter α for MS power output control in units of 0.1:

The **T_AVG_W** field (5 bit) is the binary representation of the parameter T_{AVG_W} for MS power output control:

The **T_AVG_T** field (5 bit) is the binary representation of the parameter T_{AVG_T} for MS power output control:

The **PC_MEAS_CHAN** field (bit) indicates the type of channel that is used for downlink measurements for power control:

`0` BCCH;

`1` PDCH.

Deriving the received power level, i.e. the C value in the above formula:

- Packet idle mode

In packet idle mode, the MS measures periodically the received signal level of the PCCCH. However, if the PCCCH does not exist, the received signal level of the BCCH will be measured, or, for COMPACT, the CPCCCH or CPBCCH, CFCCH, and CSCH will be measured. The MS measures the received signal level of each paging block monitored by the MS according to its current DRX mode and its paging group.
The normal C value for each radio block is calculated:

$$C_{block\ n} = SS_{block\ n} + Pb$$

where

$SS_{block\ n}$ is the mean of the received signal level of the four normal bursts that make up the block.

Pb is the BTS power output reduction (relative to the power output used on BCCH) used on the channel which performs the measurements.

Finally, the $C_{block\ n}$ values are filtered with a running average filter:

$$C_n = (1-a) * C_{n-1} + a * C_{block\ n},$$

where a is the left behind factor:

$a = 1/MIN(n, MAX(5, T_{AVG\_W}*N_{DRX}))$.

N_{DRX} = the average number of monitored blocks per multiframe, according to the current DRX mode and its paging group.

T_{AVG_W} is broadcast on PBCCH or on BCCH.

n is the iteration index. The filter is restarted with n=1 for the first sample every time a new cell is selected. Otherwise, when entering packet idle mode, the filter shall continue from the n and C_n values obtained during packet transfer mode. The filter shall also continue from its previous state if N_{DRX} is changed.

- Packet transfer mode

In packet transfer mode, the MS uses the same received signal level measurements as made for cell reselection on the BCCH carrier of the serving cell. The measurements are filtered with a running average filter:

$$C_n = (1-b) * C_{n-1} + b * SS_n,$$

where

SS_n is the received signal level of the measurement samples.

b is the forgetting factor:

$b = 1/(6*T_{AVG\_T})$.

n is the iteration index. When entering packet transfer mode, the filter shall continue from the n and C_n values obtained during packet idle mode.

The **N_AVG_I** field (4 bit) is the binary representation of the parameter N_{AVG_I} for MS power output control.

INT_MEAS_CHANNEL_LIST_AVAIL (1 bit field)
Indicates if the optional PSI4 message is broadcast. If broadcast, the PSI4 contains the channel list for interference measurements (INT_MEAS_CHANNEL_LIST).
0 PSI4 message not broadcast
1 PSI4 message broadcast

Derivation of Channel Quality Report

During idle frames of the multiframe when the serving cell is not transmitting, the channel quality is measured as the interference signal level. No measurements are taken on the BCCH carrier of the serving cell, since the BTS transmits with constant output power on this carrier.

- Packet transfer mode

In packet transfer mode, the MS measures the interference signal level on the same carrier as the assigned PDCHs. The MS makes these measurements during the search frames and PTCCH frames, which are not required for BSIC decoding or the timing advance procedure.
Interference measurement timeslots have lower priority than real receiver or transmit timeslots, and if these conflict the interference measurement timeslots are not compulsory.
For each channel, every measurement $SS_{CH,n}$ shall consist of the minimum of the two signal level samples from one search frame and one PTCCH frame. These two measurements should be spaced as closely as possible, but it is not required that they are contiguous.
The measured interference is averaged in a running average filter:

$$\gamma_{CH,n} = (1-d) * \gamma_{CH,n-1} + d * SS_{CH,n}, \gamma_{CH,0} = 0$$

where d is the forgetting factor:

$d = 1/MIN(n, N_{AVG\_I})$.

n is the iteration index.

The filter shall be restarted with n=1 for the first sample every time a new cell is selected. For each channel, the MS performs at least N_{AVG_I} (rounded to the nearest integer) measurements of $SS_{CH,n}$, before valid γ_{CH} values can be determined.

PBCCH Description struct

The PBCCH description struct provides the channel description for the PBCCH. An ARFCN (non-hopping radio frequency channel) or a MAIO (hopping radio frequency channel) field may specify the frequency description for the PBCCH. In the case of the hopping radio frequency channel, the PBCCH uses the GPRS mobile allocation specified in this message. If none of the ARFCN or MAIO fields are present, the PBCCH uses the BCCH carrier.

Pb (4 bit field)

The Pb parameter is a power reduction value used by the BTS on PBCCH blocks, relative to the output power used on BCCH. The field is coded according to the following table:

Bit 4 3 2 1	
0 0 0 0	Pb = 0 dB
0 0 0 1	Pb = -2 dB
0 0 1 0	Pb = -4 dB
: :	
1 1 1 1	Pb = -30 dB

The **TSC** field (3 bit) is the binary representation of the training sequence code used for PBCCH and PCCCHs. Range: 0 to 7.

The **TN** field (3 bit) is the binary representation of the timeslot number for the PBCCH and the corresponding PCCCH. Range: 0 to 7.

The **ARFCN** field (10 bit) is the binary representation of the absolute RF channel number.

The **MAIO** field (6 bit) is the binary representation of the mobile allocation index offset.

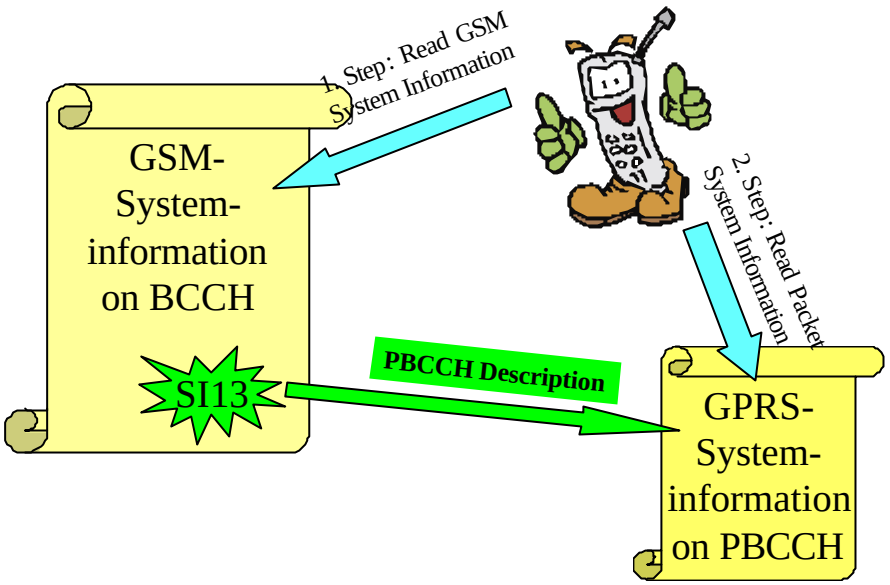


Figure: Signalling Information Procedure

GPRS Cell Options

The *GPRS Cell Options* information element is used to control a set of cell options related to GPRS.

NMO (2 bit field)

This field is the binary representation of the Network Mode of Operation.

Bit 2 1	
0 0	Network Mode of Operation I
0 1	Network Mode of Operation II
1 0	Network Mode of Operation III
1 1	Reserved.

Three network operation modes are defined:

Network operation mode I: the network sends a CS paging message for a GPRS-attached MS, either on the same channel as the GPRS paging channel (i.e., the packet paging channel or the CCCH paging channel), or on a GPRS traffic channel. This means that the MS only needs to monitor one paging channel, and it receives CS paging messages on the packet data channel when it has been assigned a packet data channel.

Network operation mode II: the network sends a CS paging message for a GPRS-attached MS on the CCCH paging channel, and this channel is also used for GPRS paging. Not only does this mean that the MS only needs to monitor the CCCH paging channel, but that CS paging also continues on this paging channel even if the MS has been assigned a packet data channel.

Network operation mode III: the network sends a CS paging message for a GPRS-attached MS on the CCCH paging channel, and sends a GPRS paging message on either the packet paging channel (if allocated in the cell) or on the CCCH paging channel. This means that an MS wanting to receive pages for both circuit-switched and packet-switched services monitors

both paging channels if the packet paging channel is allocated in the cell. The network performs no paging co-ordination.

The following table summarizes the different Network Operation Modes

Mode	Circuit Paging Channel	GPRS Paging Channel	Paging co-ordination
I	Packet Paging Channel	Packet Paging Channel	Yes
	CCCH Paging Channel	CCCH Paging Channel	
	Packet Data Channel	Not Applicable	
II	CCCH Paging Channel	CCCH Paging Channel	No
III	CCCH Paging Channel	Packet Paging Channel	No
	CCCH Paging Channel	CCCH Paging Channel	

When the Gs interface is present, all MSC-originated paging of GPRS-attached MSs travel via the SGSN, thus allowing network co-ordination of paging. Paging co-ordination is made by the SGSN based on the IMSI, and is provided no matter whether the MS is in STANDBY or in READY state. The network operates in mode I.
When the Gs interface is not present, all MSC-originated paging of GPRS-attached MSs travel via the A interface, and the co-ordination of paging cannot be performed. The network shall then either:

- operate in mode II, meaning that the packet common control channel is not allocated in the cell; or
- operate in mode III, meaning that the packet common control channel is used for GPRS paging when the packet paging channel is allocated in the cell.

The network operation mode (mode I, II, or III) shall be indicated as system information to MSs. When accurately operated, the mode of operation should be the same in each cell of a routeing area.
Based on the mode of operation provided by the network, the MS can then choose, according to its capabilities, whether to attach to GPRS services, to non-GPRS services, or to both.

T3168 (3 bit field)

This field is the binary representation of the timeout value of timer T3168. Range: 0 to 7. The timeout value is given as the binary value plus one, in units of 500 milliseconds. This timer is used on the mobile station side to define when to stop waiting for a Packet Uplink Assignment message after sending a Packet Resource request message.

T3192 (3 bit field)

This timer is used on the mobile station side when the mobile station has received all of the RLC data blocks. When the timer T3192 expires, the mobile station releases the resources associated with the TBF (e.g. TFI) and begins to monitor its paging channel. This field is the binary representation of the timeout value of timer T3192. Range: 0 to 7. The timeout value is given in the following table. In the case of 0 msec, the timer is

not started and the mobile station follows such release procedures, that it receives RLC/MAC blocks containing its TFI field until the Final Block Indicator, FBI, is set.

Bit 3 2 1	
0 0 0	500 msec
0 0 1	1000 msec
0 1 0	1500 msec
0 1 1	0 msec
1 0 0	80 msec
1 0 1	120 msec
1 1 0	160 msec
1 1 1	200 msec

DRX_TIMER_MAX (3 bit field)

This field is the binary representation of the parameter DRX_TIMER_MAX. Range: 0 to 7. The parameter value is given as two taken to the power of the binary value minus one ($2^{(bv - 1)}$), in seconds. The binary value zero indicates the parameter value zero (i.e., the parameter takes the values: 0, 1 s, 2 s, 4 s, .. 64 s.)

After Packet Transfer Mode, the MS enters the Packet Idle Mode and listens to the CCCH or PCCCH. After a waiting period, calculated out of the DRX_TIMER_MAX value, the MS enters the DRX mode, i.e. paging calls are only transmitted in longer time intervals.

ACCESS_BURST_TYPE (1 bit field)

The ACCESS_BURST_TYPE field indicates if 8 or 11 bit access bursts shall be used on PRACH, PTCCH/U and in the PACKET CONTROL ACKNOWLEDGEMENT message, when the format is four access bursts. The field is coded according to the following table:

0 8 bit access burst shall be used
1 11 bit access burst shall be used

CONTROL_ACK_TYPE (1 bit field)

This field is the binary representation of the default format of the PACKET CONTROL ACKNOWLEDGMENT message:

0 default format is four access bursts
1 default format is RLC/MAC control block.

BS_CV_MAX (4 bit field), Base Station Countdown Value Max

This field is the binary representation of the parameter BS_CV_MAX. Range: 0 to 15. The value BS_CV_MAX=0 is interpreted as value BS_CV_MAX=1 for the calculation of T3198, T3200 and N3104 max values.

These timers allow the calculation of the countdown value field in the RLC/MAC block, indicating in the end, the acceptance of a negative acknowledgement or the discard of an RLC/MAC block when there are erroneous retransmissions.

PAN_DEC (3 bit field), Packet Ack/Nacknowledge Decrement

This field is the binary representation of the parameter PAN_DEC. Range: 0 to 7.

PAN_INC (3 bit field), Packet Ack/Nacknowledge Increment

This field is the binary representation of the parameter PAN_INC. Range: 0 to 7.

PAN_MAX (3 bit field), Packet Ack/Nacknowledge Maximum

This field defines the maximum value allowed for the counter N3102.

Bit 3 2 1	
0 0 0	maximum value allowed for counter N3102 is 4
0 0 1	maximum value allowed for counter N3102 is 8
. . .	
1 1 1	maximum value allowed for counter N3102 is 32

At each cell reselection, the mobile station sets the counter N3102 to the value defined by the optional broadcast parameter PAN_MAX. Whenever the mobile station receives a Packet Ack/Nack that allows the advancement of V(S), the send state flag, the mobile station increments N3102 by the broadcast value PAN_INC. However, N3102 shall never exceed the value PAN_MAX. Each time T3182 expires, i.e. the waiting time until an acknowledgement has been received, the mobile station shall reduce N3102 by the broadcast value PAN_DEC. When N3102 $\leq$ 0 is reached, the mobile station performs an abnormal release with cell reselection.

EGPRS_PACKET_CHANNEL_REQUEST (1 bit field)

0 EGPRS capable MSs use the EGPRS PACKET CHANNEL REQUEST message for uplink TBF establishment on the PRACH if there is a PBCCH in the cell or on the RACH when there is no PBCCH in the cell.

1 EGPRS capable MSs use two phase access with the PACKET CHANNEL REQUEST message on the PRACH for uplink TBF establishment if there is a PBCCH in the cell. EGPRS capable MSs use two phase access with the CHANNEL REQUEST message on the RACH when there is no PBCCH in the cell.

BEP_PERIOD (4 bit field)

This field contains the bit error probability (BEP) filter averaging period. This BEP is an estimation of the bit error rate, which is transmitted in a faster control loop to the network in order to get a faster impression about the radio link quality on the air interface.

PFC_FEATURE_MODE (1 bit field)

0 The network does not support packet flow context procedures.

1 The network supports packet flow context procedures.

Packet Flow Context describes additional parameters used on the air interface together with packet data flow, e.g. priority level or receiver window size.

System Information 16 Rest Octets Information Field:

PRIO_THR (3 bit field)

Already described in System Information 13.

LSA_OFFSET (3 bit field), Localised Service Area Offset

The LSA_OFFSET field applies an offset for LSA reselection between cells with the same LSA priorities.

MCC and MNC (24 bit field)

If the escape PLMN is broadcast in SI3 and SI4, the cell is used for SoLSA exclusive access and the MCC and MNC fields are included. The MS shall then use the MCC and MNC values received in the LSA Parameters instead of the ones received in the Location Area information element in SI3 and 4.

LSA_ID (24 bit field)

The purpose of the LSA_ID field is to identify an LSA.

Short LSA_ID (10 bit field)

The purpose of the Short LSA_ID field is to identify an LSA. The LSA ID defined by the Short LSA_ID is an LSA_ID with only 9 bit length, instead of 24.

System Information 17 Rest Octets Information Field:

The *SI 17 Rest Octets* information element includes parameters that are used by the mobile station for cell selection and reselection purposes.

The *SI 17 Rest Octets* information element is coded as the *SI 16 Rest Octets*. Its contents have already been described.

Packet System Information Messages on PBCCH

The existence of the PBCCH is optional. If it does exist, then its position is indicated in the PBCCCH struct message on the System Information 13. The PBCCH comprises the length of 4 Normal Bursts, corresponding to one Radio Block. It is broadcast on Block B0 within the 52 multiframe structure.
PBCCH is used to give additional information to GPRS MS due to the transmission of Packet System Information messages.

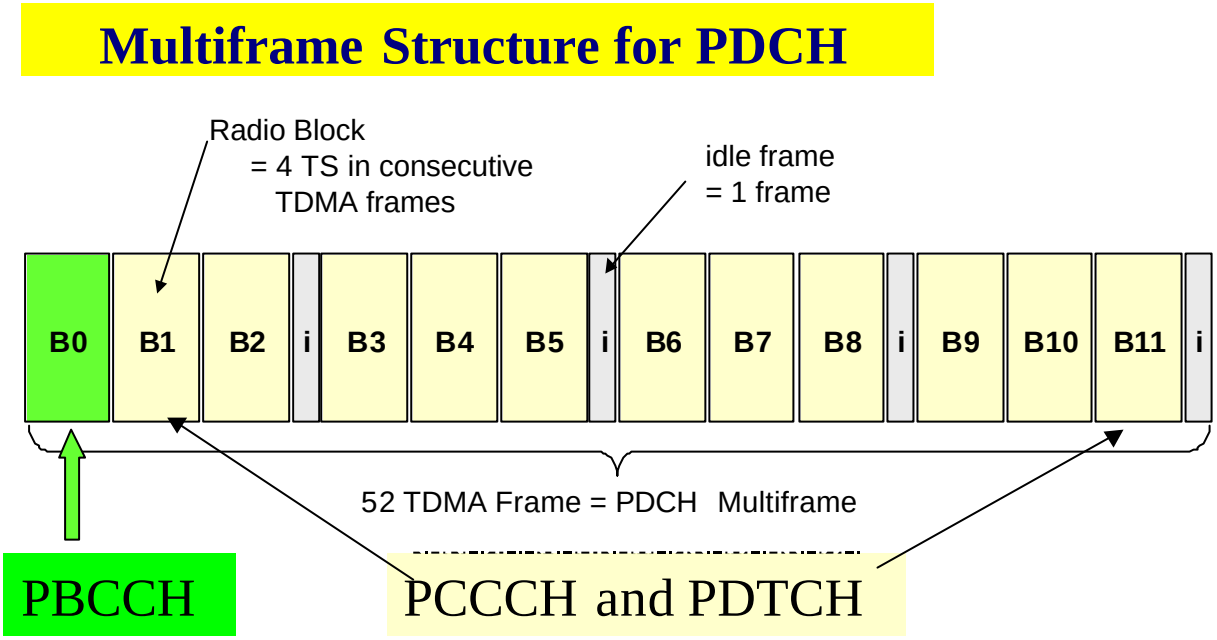


Figure: Position of the PBCCH within a 52-multiframe

In order to facilitate the MS operation, the network is required to transmit certain types of Packet System Information (PSI) messages in specific multiframes and PBCCH blocks within the multiframes. The occurrence of the PSI1 message is defined by TC = (FN DIV 52) mod PSI1_REPEAT_PERIOD. PSI1_REPEAT_PERIOD (range 1 - 16) is indicated in the SI13 message on BCCH, in the PSI 1 message on PBCCH and, if present, in the Neighbour Cell parameters in PSI3 and PSI3bis messages sent on the serving cell PBCCH.

Packet System Information Type 1

This message is sent by the network on the PBCCH or PACCH giving information for Cell selection, for control of the PRACH, and for a description of the control channel(s) and optional global power control parameters.

GPRS Cell Options

This information element is defined in the description of SI13.

Global Power Control Parameters

This information element is defined in the description of SI13.

MEASUREMENT ORDER (1 bit field)

If set = 0, the MEASUREMENT ORDER field indicates that the mobile station is in control of the cell reselection in both packet idle mode and packet transfer mode and it also indicates that the mobile station will not send any measurement reports to the network. It also indicates that the Optional PSI5 message is not broadcast. If set = 1 the mobile station sends measurement reports for cell reselection and/or for extended measurements to the network. Further cell reselection and measurement details are included in the PSI5 message.

PAGE_MODE (2 bit field)

This field describes the type of page mode used, i.e. either normal paging, extended paging, paging reorganization or the same as before from the previous page mode. Usually the MS will only listen to the blocks of the PCH which contain paging calls to MS belonging to a certain paging group. Extended paging means that MSs not belonging to that paging group can also be paged in a block on the PCH.

PBCCH_CHANGE_MARK (3 bit field)

The PBCCH_CHANGE_MARK field is a 3 bit counter increased by one every time information is changed in one or more of the broadcast PSI-Info messages on the PBCCH (n>2).

PSI_CHANGE_FIELD (4 bit field)

The PSI_CHANGE_FIELD is a 4 bit value reflecting which PSI message or group of instantiated PSI messages were most recently updated when the PBCCH_CHANGE_MARK was last incremented. If more than one PSI message or group of instantiated PSI messages were changed at the same time, the PSI_CHANGE_FIELD indicates unspecified updates. Range 0 to 15. A bitmap structure gives a hint about which PSI was updated.

PSI1_REPEAT_PERIOD (4 bit field)

The PSI1_REPEAT_PERIOD field indicates the PSI1 repeat period (see GSM 05.02). The field is coded according to the following table:

Bit 4 3 2 1	
0 0 0 0	PSI1 repeat period = 1
0 0 0 1	PSI1 repeat period = 2
. . .	
1 1 1 1	PSI1 repeat period = 16

PSI_COUNT_LR (6 bit field)

The PSI_COUNT_LR field is a 6 bit value indicating the number of different Packet System Information messages that are mapped onto the PBCCH with a low repetition rate. On PBCCH, the network divides the PSI into 2 groups with different repetition rates; one group with a high repetition rate and the other with a low one.

PSI_COUNT_HR (4 bit field)

The PSI_COUNT_HR is a 4 bit value indicating the number of different Packet System Information messages that are mapped onto the PBCCH with a high repetition rate. The value does not include PSI1, but can include any selected message and all

examples of that message. If PSI_COUNT_HR is not included in PSI1, the default value of PSI_COUNT_HR = 0.

PCCCH Organization Parameters

This information element consists of the following parameters:

BS_PCC_REL (1 bit field), Base Station Packet Control Channel Release
The BS_PCC_REL field indicates that if set = 1, then the last PDCH carrying PCCCH and PBCCH will be released shortly. As soon as this information has been received, all mobile stations on PCCCH will then return to CCCH and will then obey the information sent on BCCH. If the field is set = 0, no channel release is pending.

BS_PBCCH_BLKS (2 bit field)
The BS_PBCCH_BLKS field indicates the number of blocks allocated to the PBCCH in the multiframe. The numbering starts with block 0, which is always the carrier of the PBCCH if this physical channel is normally a PBCCH-carrier.

BS_PAG_BLKS_RES (4 bit field)
The BS_PAG_BLKS_RES field indicates the number of blocks on each PDCH carrying the PCCCH per multiframe where neither packet paging nor PBCCH should appear. Therefore this number corresponds to the number of blocks reserved for PAGCH, PDTCH and PACCH.

BS_PRACH_BLKS (4 bit field)
The BS_PRACH_BLKS field indicates the number of blocks reserved in a fixed way to the PRACH channel on any PDCH carrying PCCCH.

PRACH Control Parameters

The purpose of the PRACH Control Parameters information element is to provide parameters used to control the PRACH utilization. It consists of the fields:

TX_INT (4 bit field)
Number of slots to spread transmission of the random access burst.

S (4 bit field)
S is a parameter used for calculation of the minimum number of slots between two successive channel request messages

MAX_RETRANS (2 bit field for each Radio Priority 1..4)
Indicates for each Radio Priority level 1 to 4 the maximum number of retransmissions allowed. Radio Priority 1 represents the highest priority. The field is coded with two bits per Radio Priority level according to the following table where the first two bits refer to Radio Priority 1, the second two bits to Radio Priority 2, etc.:

Bit 2 1	
0 0	1 retransmission allowed
0 1	2 retransmissions allowed
1 0	4 retransmissions allowed

1 1 7 retransmissions allowed

PERSISTENCE_LEVEL (4 bit field for each Radio Priority 1..4)

The PERSISTENCE_LEVEL field indicates the values of the access persistence level P(i) for each Radio Priority i (i = 1..4) where Radio Priority 1 represents the highest Radio Priority of an LLC PDU to be transmitted.

bits 4 3 2 1	
0 0 0 0	persistence level 0
0 0 0 1	persistence level 1
0 0 1 0	persistence level 2
0 0 1 1	persistence level 3
0 1.0.0	persistence level 4
: : :	
1 1 1 0	persistence level 14
1 1 1 1	persistence level 16

ACC_CONTR_CLASS (16 bit field)

Access Control Class N (bit 1-16) (see octet 3 and 4 of the RACH Control Parameters IE in GSM) . For a mobile station with Access Control Class =N, access is not barred if the Access Control Class N bit is coded with a '0'; N = 0, 1,....9,11,...,15. Bit 11= the EC bit is the Emergency Call Allowed.

Bits:	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Class N:	15	14	13	12	11	EC	9	8	7	6	5	4	3	2	1	0

PSI_STATUS_IND (1 bit field):

0 The network does not support the PACKET PSI STATUS message;
1 The network supports the PACKET PSI STATUS message.

MSCR, MSC Release (1 bit field):

0 The MSC is Release '98 or older
1 The MSC is Release '99 onwards

SGSNR, SGSN Release (1 bit field)

0 The SGSN is Release '98 or older
1 The SGSN is Release '99 onwards

Packet System Information Type 2

This message is sent by the network on PBCCH and PACCH, giving information about reference frequency lists, cell allocation, GPRS mobile allocations and PCCCH descriptions being used in the cell.
PSI2 also contains Non-GPRS cell options that are applicable for non-packet access.

PAGE_MODE (2 bit field); already described in PSI 1.

PSI2_CHANGE_MARK (2 bit field)

This field is the binary representation of the PSI *change mark* parameter identifying a consistent set of PSI2 messages. The PSI change mark messages indicate a change of the content in the PSI in order to enable the MS to camp on that PBCCH or on the BCCH.

PSI2_INDEX (3 bit field) and **PSI2_COUNT** (3 bit field)

These fields are the binary representation of the PSI *index* and the PSI *count* parameters associated with the PSI2 message. It is necessary to separate the PSI into groups with high and low repetition rates.

Cell Identification

This information element describes the cell identity, consisting of LAC, RAC and Cell Identity values.

Non GPRS Cell Options

This field contains some GSM parameters that are necessary for the paging of CS connections and cell reselection.

Reference Frequency Lists (construction)

This construction is the representation of the reference frequency lists provided when there is a PSI2 message. An RFL_NUMBER field preceding each reference frequency list (RFL) identifies the RFL. This list is used as a base for neighbourhood measurements or mobile allocation.

Cell Allocations (construction)

This construction is a representation of the cell allocation (CA) defined for the cell. The set of radio frequency channels contained in the referenced RFLs in this construction defines the cell allocation.

GPRS Mobile Allocations (construction)

This construction is the representation of the GPRS mobile allocations provided when there is a PSI2 message. An MA_NUMBER field preceding each GPRS mobile allocation identifies the GPRS mobile allocation. The receiver disregards a GPRS mobile allocation provided in this message that is identified by MA_NUMBER = 14 or 15.

PCCCH Description (construction)

This construction is a representation of the timeslots carrying PCCCH in the cell and their frequency configurations. The preceding training sequence code (TSC) is used for each timeslot carrying PCCCH.

The number of timeslots carrying PCCCH in the cell is denoted by KC. This is also the implicit value of the parameter BS_PCC_CHANS. The range for KC is 1 to 16 if PBCCH and PCCCH are present in the cell. (KC = 0, if PBCCH is not present in the cell.)

RFL_NUMBER (4 bit field)

This field is the binary identification of an RFL provided in this message or the binary reference to such. Range: 0 to 15.

RFL contents (variable length octet string)

This variable length octet string is the representation of a set of radio frequency channels defining an RFL provided in the PSI2 message. The encoding of the octet string is defined by the *value part* of the type 4 information element *Frequency List.*

MA_NUMBER (4 bit field)

This field is the binary identification of a GPRS Mobile Allocation provided in this message or the binary reference to such. Range: 0 to 15.

GPRS Mobile Allocation (information element)

The *GPRS Mobile Allocation* information element consists of:

HSN (6 bit field)

This field is the binary representation of the hopping sequence number.

RFL number list (construction)

This construction is a list specifying the referenced set of reference frequency lists for this information element. If the list is not included, this information element refers to the cell allocation defined for the cell. NF denotes the number of radio frequency channels included in the referenced set of reference frequency lists or the referenced cell allocation (excluding any duplication of radio frequency channels). The radio frequency channels shall be arranged by the receiver of this information element in the order of ascending ARFCN, except for ARFCN = 0, if it is included, which is put last. Each radio frequency channel shall then be assigned an ARFCN_INDEX value, ranging from zero for the first radio frequency channel, to NFñ1 for the last radio frequency channel in the ordered set.

MA_BITMAP (variable length, 1 to 64 bit, field)

This field is a bitmap representing the radio frequency channels belonging to the GPRS mobile allocation. The number of bit positions in MA_BITMAP shall equal NF. The first bit position in MA_BITMAP corresponds to ARFCN_INDEX = NFñ1, and the last position corresponds to ARFCN_INDEX = 0. Each bit position is coded:

0 the corresponding radio frequency channel does not belong to the GPRS mobile allocation;

1 the corresponding radio frequency channel belongs to the GPRS mobile allocation.

ARFCN index list (construction)

This construction is a list representing a set of radio frequency channels to be excluded from the GPRS mobile allocation definition. The GPRS mobile allocation is defined as consisting of the radio frequency channels included in the referenced set of reference

frequency lists or the referenced cell allocation, except for those represented by the ARFCN index list. If the list is not included, this information element defines a GPRS mobile allocation consisting of all radio frequency channels included in the referenced set of reference frequency lists or the referenced cell allocation, without any exceptions.

RFL_NUMBER (4 bit field)
This field is the binary reference to a reference frequency list provided in PSI2. Range 0 to 15.

ARFCN_INDEX (6 bit field)
This field is the binary reference to a radio frequency channel in the referenced set of reference frequency lists or the referenced cell allocation. Range: 0 to NFñ1

TSC (3 bit field)
This field is the binary representation of the training sequence code. Range: 0 to 7.

ARFCN (10 bit field)
This field is the binary representation of the absolute radio frequency channel number (ARFCN). Range 0 to 1023.

MAIO (6 bit field)
This field is the binary representation of the mobile allocation index offset (MAIO).

PCCCH_TIMESLOT (8 bit field)
This field indicates which timeslots are assigned as PCCCH. This field is coded as TIMESLOT_ALLOCATION information element.

Large Cell Operation (LARGE_CELL_OP)
If this bit is set to one, the cell is in large cell operation mode, which is used in EGPRS.
0 This cell is a nominal size cell
1 This cell is a large cell

NIB_CPBCCH_0 (4 bit field)
This field is the binary representation of the number of radio blocks that remain idle in time group 0 for blocks associated with CPBCCH and CPCCCH. If this information element is not present, the value 0 is used.

NIB_CCCH_1, NIB_CCCH_2, NIB_CCCH_3
This is defined exactly as NIB_CCCH_0, except when applied to time groups 1, 2, and 3 respectively.

N_CCCH_NH (4 bit field)
This field is the binary representation of the amount of non-hopping blocks on control channels. Range 1 to 11.

Reference Frequency Lists in PSI2

A Reference Frequency Lists construction may be included in every PSI2 message. The presence of reference frequency lists (RFLs) is optional. RFLs will be provided as required in order to decode the GPRS mobile and cell allocations.

Cell Allocation in PSI2

A Cell Allocation construction will not be included in more than one PSI2 message within the consistent set of PSI2 messages. The presence of a Cell Allocation construction is optional. It shall be provided as required for the decoding of GPRS mobile allocations and for the support of GPRS mobile stations, which may access the network in dedicated, group receive and group transmit modes.

GPRS Mobile Allocation in PSI2

A GPRS Mobile Allocations construction may be included in every PSI2 message. The presence of GPRS mobile allocations is optional. The GPRS mobile allocations will be provided as required for determining the frequency configuration of PDCHs.

PCCCH Description

A PCCCH Description construction shall be included in only one instance of the PSI2 message within the consistent set of PSI2 messages.

Packet System Information Type 3

This message is sent by the network on the PBCCH or PACCH giving information about the BCCH allocation (BA_GPRS) in the neighbouring cells and cell selection parameters for serving cells and non-serving cells. This message shall not be segmented across more than one RLC/MAC control block .

PAGE_MODE (2 bit field)
This field describes which type of page mode is used, i.e. either normal paging, extended paging, paging reorganization or the same as before from the previous page mode.

PSI3_CHANGE_MARK (2 bit field)
The PSI3 change mark field is changed each time information has been updated in any of the PSI3 or PSI3 bis messages. A new value indicates that the mobile station shall re-read the information from the PSI3 and all PSI3 bis messages. Range: 0-3.

PSI3_BIS_COUNT (4 bit field)
This field is coded as the binary representation of the PSI3 bis index (in the PSI3 bis message) for the last (highest indexed) individual PSI3 bis message.
Range: 0-15.

Serving Cell Parameters:

CELL_BAR_ACCESS_2 (1 bit field)
This field combines the CELL_BAR_ACCESS and CELL_BAR_QUALIFY parameters and indicates the status for cell reselection.
0 Status for cell reselection is set to *normal*;
1 Status for cell reselection is set to *barred*.

EXC_ACC (1 bit field)
EXC_ACC is used by the network to prevent mobiles that do not have exclusive access rights to camp on the cell. The coding of EXC_ ACC is as follows:
0 The cell is not used for SoLSA exclusive access.
1 The cell is used for SoLSA exclusive access.

GPRS_RXLEV_ACCESS_MIN (6 bit field)
The GPRS_RXLEV_ACCESS_MIN field is coded as the binary representation of the 'RXLEV_ACCESS_MIN' defined in GSM. It is the minimum received level at the mobile station required for access to the system.

GPRS_MS_TXPWR_MAX_CCH (5 bit field)
The GPRS_MS_TXPWR_MAX_CCH field is coded as the binary representation of the 'power control level', with PCL in GSM corresponding to the maximum TX power level a mobile station may use when accessing a packet control channel. This value has the similar function to the GSM MS_TXPWR_MAX_CCCH parameter.

HCS struct, Hierarchical Cell Structure

If the HCS struct is omitted for the serving cell, HCS is not used and the HCS parameters for the other cells are neglected i.e. the HCS signal strength threshold is set to infinity for all cells. Otherwise PRIORITY_CLASS and HCS_THR are defined.
Hierarchical Cell Structure is used by the network to influence a mobile station's cell reselection process, in the way that all cells are classified into so-called priority classes.

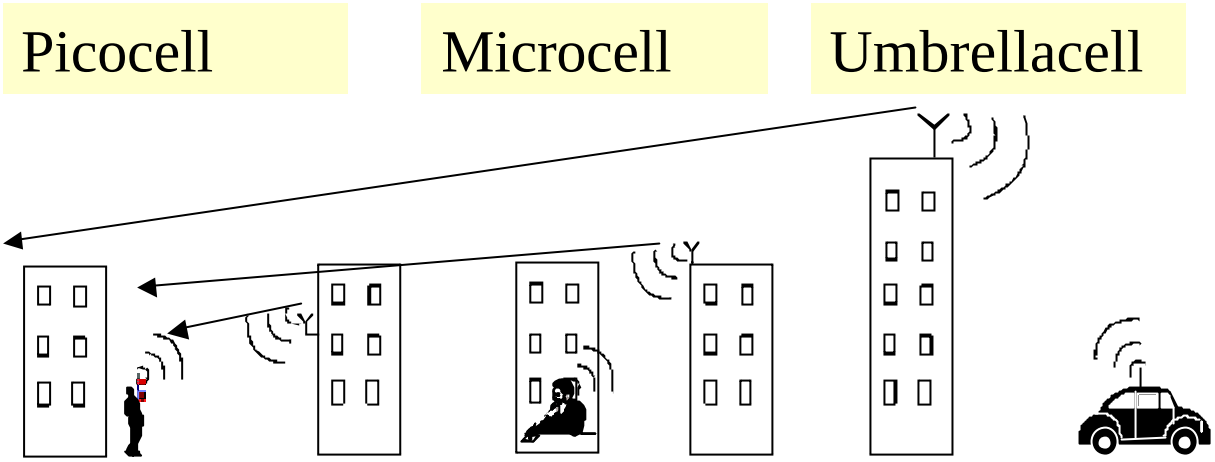


Figure: 3 Dimensions in network planning: Hierarchical Cell Structure

Before detailing all of the parameters linked to HCS, the cell reselection process will first be explained:

Cell Reselection Criteria

Firstly we need to be briefly reminded of the cell reselection process in GSM, i.e. the calculation of the parameters C1 and C2.

The path loss criterion parameter C1 used for cell selection and reselection is defined by:

$$C1 = (A - Max(B , 0))$$

where

A = RLA_C - RXLEV_ACCESS_MIN
B = MS_TXPWR_MAX_CCH – P

RLA_C is the average Rx-level value measured on the circuit switched BCCH carrier, and P is the maximum output power of the mobile station. The other parameters are broadcast in the GSM System Information.

The following cell reselection criteria are used for GPRS, whereby (s) denotes the serving cell, and (n_i) denotes the neighbour cells. Different parameter values may apply for each neighbour cell. One set of parameters is broadcast in each cell.

The path loss criterion parameter C1 is used as a minimum signal level criterion for cell reselection for GPRS in the same way as for the GSM Idle mode. C1 is defined in the same way as the formula above, except that

A = RLA_P - GPRS_RXLEV_ACCESS_MIN
B = GPRS_MS_TXPWR_MAX_CCH - P

The GPRS specific parameters GPRS_RXLEV_ACCESS_MIN and GRS_MS_TXPWR_MAX_CCH for the serving cell and neighbour cells are broadcast on PBCCH of the serving cell. RLA_P is the average RX-level measured on the PBCCH carrier.

The signal level threshold criterion parameter C31 for hierarchical cell structures (HCS) is used to determine whether prioritised hierarchical GPRS and LSA cell reselection should apply and is defined by:

C31(s) = RLA_P(s) - HCS_THR(s) (serving cell)
C31(n) = RLA_P(n) - HCS_THR(n) - TO(n) * L(n) (neighbour cell)

where HCS_THR is the signal threshold for applying HCS GPRS and LSA reselection. HCS_THR is broadcast on PBCCH of the serving cell. TO and L(n) are explained below.

The cell ranking criterion parameter (C32) is used to select cells that have the same priority and is defined by:

C32(s) = C1(s) (serving cell)

C32(n) = C1(n) + GPRS_RESELECT_OFFSET(n) - TO(n) * (1-L(n)) (neighbour cell)

where
GPRS_RESELECT_OFFSET applies an offset and hysteresis value to each cell.

The other parameters are calculated by:

TO(n) = GPRS_TEMPORARY_OFFSET(n) * H(GPRS_PENALTY_TIME(n) - T(n)).

L(n) = 0 if PRIORITY_CLASS(n) = PRIORITY_CLASS(s)
1 if PRIORITY_CLASS(n) ≠ PRIORITY_CLASS(s)

H(x) = 0 for x < 0
1 for x ≥ 0

GPRS_TEMPORARY_OFFSET applies a negative offset to C31/C32 for the duration of GPRS_PENALTY_TIME after the timer T has started for that cell.
T is a timer implemented for each cell in the list of strongest carriers. T starts from zero at the time the cell is placed by the MS on the list of strongest carriers.
GPRS_RESELECT_OFFSET, PRIORITY_CLASS, GPRS_TEMPORARY_OFFSET and GPRS_PENALTY_TIME are broadcast on PBCCH of the serving cell.

We have just explained the cell reselection process, so the parameters for the HCS structure now need to be explained:

PRIORITY_CLASS (3 bit field)
The PRIORITY_CLASS field contains the binary representation of the HCS priority for the cell. This field ranges from 0-7 and identifies the priority class of the cell.

Bit 3 2 1	
0 0 0	Lowest Priority
...	...
1 1 1	Highest Priority

HCS_THR (5 bit field)
The HCS_THR is the HCS signal strength threshold with a range from –110 to -48 dBm

Bit 5 4 3 2 1	
0 0 0 0 0	-110 dBm
0 0 0 0 1	-108 dBm

... ...
1 1 1 1 1 -48 dBm

MULTIBAND_REPORTING (2 bit field)
For a multiband MS, the number of cells for each frequency band supported which are included in the measurement report is indicated by that parameter.
The meaning of different values indicates if the MS should report the six strongest cells irrespective of the band used; if it should report the strongest cells in each of the bands used, excluding the band of the serving cell; or if it should report 2 or 3 cells on the other bands, excluding the band of the serving cell, and use the remaining part to report the 2 – 3 strongest cells of the serving cell band. Range 0-3.

General Cell Selection Parameters

GPRS_CELL_RESELECT_HYSTERESIS (3 bit field)
The GPRS_CELL_RESELECT_HYSTERESIS field indicates the Additional Hysteresis that applies in the Ready state for cells with the same RA. This field is encoded according to the following table:

Bit 3 2 1	
0 0 0	0 dB
0 0 1	2 dB
0 1 0	4 dB
0 1 1	6 dB
1 0 0	8 dB
1 0 1	10 dB
1 1 0	12 dB
1 1 1	14 dB

C31_HYST (1 bit field)
If set to 1, the C31_HYST field indicates that the GPRS_RESELECT_HYSTERESIS is applied to the C31 criterion.

C32_QUAL (1 bit field)
If the parameter C32_QUAL is set, positive GPRS_RESELECT_OFFSET values only apply to the neighbour cell with the highest RLA_P value among the above cells for which C32 is compared with.

RANDOM_ACCESS_RETRY (1 bit field)
If set to 1, the RANDOM_ACCESS_RETRY field indicates that the mobile station is allowed to try to access another available cell, describing the process of abnormal release with cell reselection. If this happens, the mobile station aborts all TBFs that are in progress. If access to another cell is allowed, i.e. if the RANDOM_ACCESS_RETRY bit is set, the mobile station shall perform abnormal cell reselection and initiate the creation of an uplink TBF. The mobile station should not reselect back to the original cell for T_RESEL seconds if another suitable cell is available. The parameters RANDOM_ACCESS_RETRY and T_RESEL (default value 5 s) are broadcast in PSI 3.
If access to another cell is not allowed, i.e. the RANDOM_ACCESS_RETRY bit is not set, or if no neighbour cells are available, the mobile station should go to the CCCH or PCCCH and report an RLC/MAC failure to the higher layer.

T_RESEL (3 bit field)
If the mobile station has performed an abnormal release with cell reselection from this cell, the mobile station is not allowed to reselect this cell for T_RESEL seconds if another cell is available. The default value of T_RESEL is 5 seconds. If the field is omitted from the message, the default value is used by the mobile station.

Bit 3 2 1	
0 0 0	5 seconds
0 0 1	10 seconds
0 1 0	15 seconds
0 1 1	20 seconds
1 0 0	30 seconds
1 0 1	60 seconds
1 1 0	120 seconds
1 1 1	300 seconds

RA_RESELECT_HYSTERESIS (3 bit field)
The RA_RESELECT_HYSTERESIS field indicates in both STANDBY and READY state the additional hysteresis that applies when selecting a cell in a new Routing Area. If this field is not present, the default value is GPRS_CELL_RESELECT_HYSTERESIS. This field is encoded according to the following table:

Bit 3 2 1	
0 0 0	0 dB
0 0 1	2 dB
0 1 0	4 dB
0 1 1	6 dB
1 0 0	8 dB
1 0 1	10 dB
1 1 0	12 dB
1 1 1	14 dB

Neighbour Cell Parameters (BA-GPRS)

The Neighbour Cell Parameters (BA-GPRS) are specified in PSI3 and at least once in PSI3bis. BA(GPRS) is used to specify one or several groups of neighbour cells and their corresponding cell selection parameters. Preferably cells with several common cell selection parameters can be grouped together. If one example of PSI3bis is not sufficient to specify the cell selection parameters of all neighbouring cells, the remaining frequency groups are specified in consecutive examples of PSI3bis. If all information fits within the PSI3 message, one example of PSI3bis is broadcast without any neighbour cell parameters.
Each neighbour cell listed in PSI3 and in one or more instances of PSI3bis is assigned an ascending index used for measurement reports. The first neighbour cell in PSI3 has the lowest index (= 0), and the last neighbour cell in the highest indexed PSI3bis message has the highest index. The total number of neighbour cells in the BA-GPRS will not exceed 32. If a mobile station receives more than 32 cells in the BA-GPRS, only the 32 cells with the lowest indexes shall be considered.

START_FREQUENCY (10 bit field)
The START_FREQUENCY defines the ARFCN for the first carrier in the list (ARFCN(0)).

FREQ_DIFF_LENGTH (3 bit field)
This field is required to calculate the number of bits to be used for the FREQUENCY_DIFF field in the current frequency group.

FREQUENCY_DIFF (1+val(FREQ_DIFF_LENGTH) bit field)
Each FREQUENCY_DIFF parameter field specifies the difference in frequency to the next carrier to be defined. The FREQUENCY_DIFF parameter encodes a non negative integer in binary format (W).
Each frequency following the start frequency (ARFCN(0)) and belonging to the Frequency List struct is then calculated by the formula ARFCN(n) = (ARFCN(n-1) + W(n)) modulus 1024, n=1, . . ., val(NR_OF_REMAINING_CELLS).

Cell Selection parameters

The first field of the Cell Selection struct, *BSIC*, defines the BSIC of the cell and then the fields CELL_BAR_ACCESS_2, ECX_ACC and SAME_RA_AS_SERVING_CELL. Then follow none, some, or all of the fields GPRS_RXLEV_ACCESS_MIN, GPRS_MS_TXPWR_MAX_CCH, GPRS_TEMPORARY_OFFSET, GPRS_PENALTY_TIME, GPRS_RESELECT_OFFSET , HCS params, SI13_PBCCH_LOCATION, PCCH_TYPE and PSI1_REPEAT_PERIOD. If fields are omitted, the values for these parameters are the same as for the preceding cell unless otherwise actually specified for the parameter.

BSIC (6 bit field)
The BSIC field is coded as the 'Base Station Identity Code'.

CELL_BAR_ACCESS_2 (1 bit field)
EXC_ACC (1 bit field)
For a definition, see the Serving Cell parameters.

SAME_RA_AS_SERVING_CELL (1 bit field)
The Same RA As Serving Cell field contains one bit, set to
0 if the cell is in a different Routeing Area from the serving cell, or
1 if the cell is in the same Routeing Area as the serving cell.

GPRS_TEMPORARY_OFFSET (3 bit field)
The GPRS_TEMPORARY_OFFSET field indicates the negative offset to C32 that the mobile station shall use for the duration of GPRS_PENALTY_TIME. It is used by the mobile station as part of its calculation of C32 for the cell reselection process.

Bit	
3 2 1	
0 0 0	0 dB
0 0 1	10 dB
0 1 0	20 dB
0 1 1	30 dB
1 0 0	40 dB
1 0 1	50 dB
1 1 0	60 dB
1 1 1	infinity

GPRS_PENALTY_TIME (5 bit field)

The GPRS_PENALTY_TIME defines the length of time for which GPRS_TEMPORARY_OFFSET is active.

Bit 5 4 3 2 1	
0 0 0 0 0	10 seconds
0 0 0 0 1	20 seconds
. . .	
1 1 1 1 1	320 seconds

GPRS_RESELECT_OFFSET (5 bit field)

GPRS_RESELECT_OFFSET is used by the mobile station to apply a positive or negative offset and a hysteresis to the GPRS cell reselection criteria. The default value is 0 dB. If the field is omitted from the message, the default value shall be used by the mobile station.

Bit 5 4 3 2 1	
0 0 0 0 0	-52 dB
0 0 0 0 1	-48 dB
...	
0 1 0 1 0	-12 dB
0 1 0 1 1	-10 dB
...	
1 0 1 1 0	+12 dB
1 0 1 1 1	+16 dB
...	
1 1 1 1 1	+48 dB

SI13_PBCCH_LOCATION construction

The optional SI13_PBCCH_LOCATION struct may either indicate the position of the SI13 message or a PBCCH position. If not included, SI3 and SI4 in the neighbour cell indicate if the neighbour cell supports GPRS. Thanks to this, the serving cell can indicate to its listening MS's which of the neighbour cells supports GPRS, so as to avoid the MS watching the BCCH carrier of the neighbour cell. This makes it possible for a faster cell reselection process to be executed by the MS itself.

SI13_LOCATION (1 bit field)

If present, the SI13_LOCATION field indicates the logical channel where the SYSTEM INFORMATION TYPE 13 is broadcast.

0 SYSTEM INFORMATION TYPE 13 message is sent on BCCH norm
1 SYSTEM INFORMATION TYPE 13 message is sent on BCCH ext

PBCCH_LOCATION (2 bit field)

If present, the PBCCH_LOCATION field indicates the location of the PBCCH on the BCCH carrier.

Bit 2 1	
0 0	PBCCH on TN 1 of BCCH carrier
0 1	PBCCH on TN 2 of BCCH carrier
1 0	PBCCH on TN 3 of BCCH carrier
1 1	PBCCH on TN 4 of BCCH carrier

PSI1_REPEAT_PERIOD (4 bit field)

The PSI1_REPEAT_PERIOD field indicates the PSI repeat period. The field is coded according to the following table:

Bit 4 3 2 1	
0 0 0 0	PSI1 repeat period = 1
0 0 0 1	PSI1 repeat period = 2
...	
1 1 1 1	PSI1 repeat period = 16

LSA Parameters IE

The LSA Parameters IE contain a list of LSA_ID(s) corresponding to the entries in the Neighbour Cell Parameters (BA-GPRS). Some entries in the LSA parameters may be empty. The entries in the LSA Parameters IE are listed in the same order as in the Neighbour Cell Parameters and the number of entries (nr_of_frequencies_or_cells) should be the same. If there are too few entries in the LSA Parameters IE, empty entries are added at the end. If there are too many entries in the LSA parameters, the last are discarded.

LSA_ID (24 bit field)
The purpose of the LSA_ID field is to identify an LSA. The LSA ID value field is coded as follows:

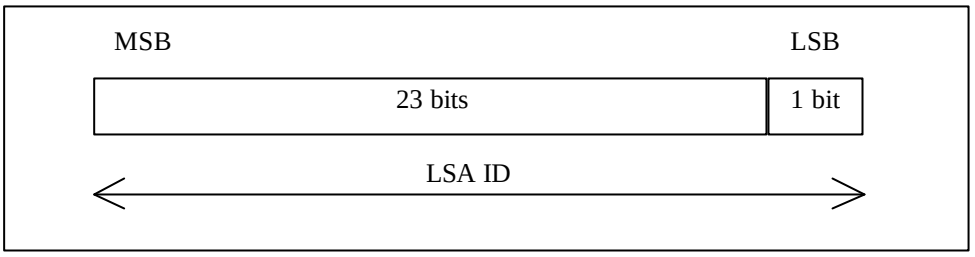


Figure : Structure of LSA ID

LSB = 1 indicates a universal LSA. LSB=0 indicates a network operator‘s accurate LSA. MSB stands for Most Significant Bit.

Short LSA_ID (10 bit field)
The purpose of the Short LSA_ID field is to identify an LSA. The LSA ID defined by the Short LSA_ID is an LSA_ID as given above with bit 0 set to "0", bit 1 to 10 set to the value of the Short LSA_ID field (LSB in bit 1, MSB in bit 10) and bit 11 to 23 set to "0".

TIME_GROUP (2 bit field)
The TIME_GROUP defines which time group the cell belongs to

Bit 2 1	
0 0	Time Group 0
0 1	Time Group 1
1 0	Time Group 2
1 1	Time Group 3

A Time Group is used for EGPRS, i.e. COMPACT, and means that all cells belong to a certain time group. This time group is a rotation of control channels and timeslots for which an MS can measure the signal on its normal measurement windows.

GUAR_CONSTANT_PWR_BLKS (2 bit field)
This field indicates the guaranteed number of constant power blocks in the neighbour cell. These are the blocks that the MS can use to perform neighbour cell measurements. Note that there may be more CPBCCH blocks or paging blocks allowed in the neighbour cell than are indicated in this field, but there will never be less.

Bit 2 1	Blocks at constant power
0 0	4
0 1	5
1 0	6
1 1	12 (i.e. BS_PAG_BLKS_RES = 0 in that cell)

CELL_BAR_QUALIFY_2 (2bits)
This indicator is used by the network to indicate cells that are without voice support and to control mobile station cell selection (by overriding the cell bar indication).

00	Voice supported, Cell Bar indication active
01	Reserved

10 Voice not supported, Cell not barred, norm. cell selection priority
11 Voice not supported, Cell not barred, low cell selection priority

Cell Identification
This information element is the cell identity field that is known from GSM.

Packet System Information Type 3 bis

This message is sent by the network on the PBCCH and PACCH and gives information about the BCCH allocation in the neighbour cells and cell selection parameters for the non-serving cells. This message shall not be segmented across more than one RLC/MAC control block. If not all information fits into one of the PSI3bis messages, the PSI3bis message can be repeated.
Some information elements are already described in previous pages. Therefore, only the parameter‘s names are indicated for the sake of completeness.

PAGE_MODE (2 bit field) See description under PSI3
PSI3_CHANGE_MARK (2 bit field) See description under PSI3.
PSI3_BIS_INDEX (4 bit field)
The PSI3_BIS_INDEX field is used to distinguish individual PSI3 bis messages containing information about different neighbour cells. The field can take the binary representation of the values 0 to n, where n is the index of the last PSI3 bis message. (PSI3 bis count).
PSI3_BIS_COUNT (4 bit field)See description under PSI3.

General rules for handling neighbour cell parameter default values
The first neighbour cell defined in the first PSI3bis case uses the parameter values defined for the last neighbour cell in PSI3 as its default parameter values.
The following neighbour cells in PSI3bis use the parameter values of the previous neighbour cell as their default values.
This principle of referring to the previous cell applies independently of the coding used in PSI3bis (Neighbour cell parameters, Neighbour cell parameters 2 and COMPACT Neighbour Cell Parameters).
This principle also applies when going from PSI3bis instance i over to PSI3bis instance i+1.

Neighbour cell params struct The coding of the Neighbour Cell parameters is described under PSI3.

Neighbour cell params struct 2
This coding may be used if the number of neighbour cells is high and if many cells share common parameter values. The structure contains pointers to the list of sets of actual parameters. The coding of actual parameters that are contained in or referenced by the Neighbour Cell params 2 struct is described in PSI3.

COMPACT Neighbour Cell params struct
The coding of the Neighbour cell parameters is the same as the coding of the Neighbour cell params struct 2, apart from the two additional parameters, TIME_GROUP and GUAR_CONSTANT_PWR_BLKS. The coding of the actual parameters that are contained in or referenced by the COMPACT Neighbour Cell params struct is described in PSI3.

The following parameters (GENERATION, CELL_PARAMS_POINTER, BCC and NCC) are not defined in PSI3:

GENERATION (2 bit field)
This field is used to indicate neighbour information for other Radio Access Technologies. Range 0…3.

00	GSM neighbour
01	3G neighbour
10	Reserved for future use, if received discard the structure.
11	Reserved for future use, if received discard the structure.

CELL_PARAMS_POINTER (2 bit field)
Pointer to the parameter set that is valid for a certain cell group (up to four).

BCC (3 bit field)
BTS Colour Code.

NCC : bit (3).
Network Colour Code. The default value is given by the serving cell.

LSA Parameters IE
The LSA Parameters IE is described under PSI3.

Packet System Information Type 4

This message is optionally sent by the network on the PBCCH and PACCH, and gives information directing the mobile station to make interference measurements. This message will not be segmented across more than one RLC/MAC control block.
The PSI4 message is optional and is only sent if indicated by the Power Control parameter INT_MEAS_CHANNEL_LIST_AVAIL. For more information, please see the description of the Global Power Information Element.
Depending on the size of the list, more than one PSI4 message can be required to broadcast the total list. Therefore, the PSI4 count parameter indicates the last (highest indexed) PSI4 message. The sequence number of each PSI4 message is then indicated by the Message Sequence number parameter.
The PSI4 message contains a list of channels that shall be used by the mobile station for interference measurements in packet idle mode. The channel list is defined as a Channel list struct that contains one or more Channel Group structs. The Channel Group struct can have two alternative coding formats, the MA format or the ARFCN format. The MA format is used for frequency hopping physical channels. A maximum of 32 Channel Group structs may be defined, and of these, a maximum 4 Channel Group structs may be defined in MA format.
Using the MA format, a set of physical channels may be defined. The definition comprises a mobile allocation specified in the PSI2 message and referenced by the MA_NUMBER value, a MAIO value and a TIMESLOT_ALLOCATION bit map.
Using the ARFCN format, a set of non-hopping physical channels may be defined by a ARFCN value, identifying the radio frequency and a TIMESLOT_ALLOCATION bit map.

PSI4_CHANGE_MARK (2 bit field)
The PSI4 change mark field is changed each time information is updated in any of the individual PSI4 messages. A new value indicates that the mobile station will re-read the information from all PSI4 messages. The coding of this field is network dependent. Range: 0 - 3.

PAGE_MODE (2 bit field) This field is described in PSI3.

PSI4_COUNT (3 bit field)
The PSI4 count field is coded as the binary representation of the last (highest indexed) individual PSI4 message. Range: 0 - 7.

PSI4_INDEX (3 bit field)
The PSI4 index field is used to distinguish individual PSI4 messages. The field can take the binary representation of the values 0 to n, where n is the index of the last PSI4 message. (PSI4 count). Range: 0 - 7.

ARFCN (Absolute RF channel number) (10 bit field)
The ARFCN is coded as the binary representation of the absolute RF channel number. Range: 0 to 1023.

MA_NUMBER (4 bit field)
The purpose of the MA_NUMBER field is to refer to a mobile allocation and a corresponding HSN value defined in the PSI2 message for the decoding of a physical channel description. The MA_NUMBER field is binary coded. Range: 0 - 15.

MAIO (Mobile allocation index offset) (6 bit field)
The MAIO field is coded as the binary representation of the mobile allocation index offset as defined in GSM for the description of frequency hopping. Range: 0 to 63.

TIMESLOT_ALLOCATION (8 bit field)
This information field indicates the timeslots assigned for use during the TBF or the timeslots carrying a PCCCH. Bit 8 indicates the status of timeslot 0, bit 7 indicates the status of timeslot 1, etc. At least one timeslot must be assigned.
0 Timeslot is not assigned
1 Timeslot is assigned

Packet System Information Type 5

This optional message is sent by the network on the PBCCH giving information about measurement reporting and network controlled cell reselection. This message shall not be segmented across more than one RLC/MAC control block.
The optional PSI5 message contains broadcast measurement parameters for either the Network Control (NC) measurements containing the NC Measurement Parameters, for extended measurements containing the EXT Measurement Parameters, or for both. It may also contain parameters for Enhanced measurement reporting.
The 'EXT measurement parameters struct' contains the EXT Measurement Order, the EXT parameters and one or more EXT Frequency List structs.

PAGE_MODE (2 bit field) This field is described in PSI3.

PSI5_CHANGE_MARK (2 bit field)
The PSI5_CHANGE_MARK field is changed each time information is updated in any of the individual cases of the PSI5 message. A new value indicates that the mobile station shall re-read the information from all PSI5 messages. Range: 0 to 3. The coding of this field is network dependent.

PSI5_INDEX (3 bit field) and **PSI5_COUNT** (3 bit field)
The purpose of the PSI5_INDEX field and the PSI5_COUNT field is to indicate the number of individual messages within the sequence of PSI5 messages and to assign an index to identify each one of them. The PSI5_INDEX field is binary coded, range: 0 to 7, and provides an index to identify the individual PSI5 message. The PSI5_COUNT field is binary coded, range: 0 to 7, and provides the PSI5_INDEX value for the last (highest indexed) message in the sequence of PSI5 messages.

NETWORK_CONTROL_ORDER (2 bit field)
This parameter indicates the way in which cell reselection is controlled by the network.
The NETWORK_CONTROL_ORDER field is coded according to the following table:

Bit 2 1	
0 0	NC0
0 1	NC1
1 0	NC2
1 1	Reserved

If the NETWORK_CONTROL_ORDER parameter = NC0, then the other parameters in the NC Measurement parameters struct may be omitted. If the NETWORK_CONTROL_ORDER parameter indicates NC1 or NC2 and the other parameters are omitted, the default value for these parameters shall be assumed.

NC_NON_DRX_PERIOD (3 bit field)
This field indicates the minimum time the mobile station stays in non-DRX mode after an NC-measurement report has been sent. The field is coded according to the following table:

Bit 3 2 1	
0 0 0	No non-DRX mode after a measurement report has been sent.
0 0 1	0,24 sec
0 1 0	0,48 sec *(default value)*
0 1 1	0,72 sec
1 0 0	0,96 sec
1 0 1	1,20 sec
1 1 0	1,44 sec
1 1 1	1,92 sec

NC_REPORTING_PERIOD_I (3 bit field)
NC_REPORTING_PERIOD_T (3 bit field)
These fields indicate the time period for cell reselection measurement reporting in packet idle mode (I) and packet transfer mode (T), respectively. The field is coded according to the following table:

Bit 3 2 1	
0 0 0	0.48 sec
0 0 1	0.96 sec
0 1 0	1.92 sec
0 1 1	3.84 sec *(default value for NC_REPORTING_PERIOD_T)*
1 0 0	7.68 sec
1 0 1	15.36 sec
1 1 0	30.72 sec
1 1 1	61.44 sec *(default value for NC_REPORTING_PERIOD_I)*

EXT Measurements
The 'EXT Measurements Parameters' can be repeated in a sequence of PSI5 message instances, where each message instance can contain a sub-list of frequency (ARFCN) parameters. The sub-lists shall be put together into a resulting frequency list in order of ascending PSI5 message instances. Each added frequency position in the resulting frequency list shall then be assigned an ascending index used for measurement reports. If the same frequency is defined more than once in the resulting list, each occurrence will get an index, but measurements will only be performed and reported for the last position added.

EXT_MEASUREMENT_ORDER (2 bit field)
The network may request measurement reports from the MS for other purposes other than cell reselection. This is indicated by the parameter EXT_MEASUREMENT_ORDER. The meaning of the different parameter values is specified as follows:

EM0	The MS shall not perform extended measurements.
EM1	The MS shall send extended measurement reports to the network.
RESET	The MS shall return to the broadcast parameters. Only sent on PCCCH, CPCCCH or PACCH.

The EXT_MEASUREMENT_ORDER field shows the mobile station how to interpret the rest of the extended measurement parameters. This field is coded according to the following table:

Bit 2 1	
0 0	EM0
0 1	EM1
1 0	Reserved.
1 1	Reserved and shall be interpreted as EM0 by the receiver.

If the EXT_MEASUREMENT_ORDER parameter = EM1, the optional parameters in the EM1 struct may be included in at least one instance of the message. If a field is included in more than one instance, the value of the field in the instance with the highest index shall be valid and all others shall be ignored.

NCC_PERMITTED (8 bit field)
This field is a bitmap of NCCs for which the mobile station is permitted to report measurement; this bitmap relates to the NCC part of BSIC.

EXT_REPORTING_TYPE (2 bit field)
The parameter EXT_REPORTING_TYPE indicates one of three different types of reporting:

Type 1: Carriers that are reported if they are among the 6 strongest carriers, regardless of whether BSIC was decoded or not. The measurement report shall contain a received signal level and, if successfully decoded, BSIC.
Type 2: Carriers that are reported if they are among the 6 strongest carriers, if BSIC is successfully decoded, and if they also have an allowed NCC part as indicated by the NCC_PERMITTED. The measurement shall contain received signal level and BSIC.
Type 3: Carriers that are reported without BSIC decoding. The measurement report contains a received signal level. In addition, interference may be reported for one carrier.
This field indicates the type of extended measurement reporting to which the frequencies on the list are subjected. This field is coded according to the following table:

Bit 2 1	
0 0	Type 1 measurement reporting *(default value for EXT_REPORTING_TYPE*
0 1	Type 2 measurement reporting
1 0	Type 3 measurement reporting
1 1	Reserved. In this version of the protocol the mobile station will ignore the entire list contained in this field.

EXT_REPORTING_PERIOD (3 bit field)
The EXT_REPORTING_PERIOD field indicates the time interval between extended measurement reports. This field is coded according to the following table:

Bit 3 2 1	
0 0 0	60 sec
0 0 1	120 sec
0 1 0	240 sec
0 1 1	480 sec
1 0 0	960 sec
1 0 1	1920 sec *(default value for EXT_REPORTING_TYPE*
1 1 0	3840 sec
1 1 1	7680 sec

INT_FREQUENCY (5 bit field)
This optional field indicates the frequency at which the interference measurement is made. This field is an index in the EXT Frequency List. If the field is not included in any instance of the message, no interference measurements will be done. Range 0 to 31.

EXT_FREQUENCY_LIST
Contains the EXT Frequency List description struct. The EXT Frequency Lists description struct may contain multiple EXT frequency list structs. The listing of frequencies is done in the same way as for the cell allocation or neighbour frequency list.

START_FREQUENCY (10 bit field)
The START_FREQUENCY defines the ARFCN for the first carrier in the list (ARFCN(0)).

FREQ_DIFF_LENGTH (3 bit field)
This field is required to calculate the number of bits to be used for the FREQUENCY_DIFF field in the current frequency group.

FREQUENCY_DIFF (1+val(FREQ_DIFF_LENGTH) bit field)
Each FREQUENCY_DIFF parameter field specifies the difference in frequency to the next defined carrier. The FREQUENCY_DIFF parameter encodes a non negative integer in binary format (W). Each frequency following the start frequency (ARFCN(0)) and belonging to the Frequency List struct is then calculated by the formula ARFCN(n) = (ARFCN(n-1) + W(n)) modulus 1024, n=1, . . ., val(NR_OF_FREQUENCIES

Packet System Information Type 6

This optional message is sent by the network on the PBCCH or PACCH to provide broadcast information required by non-GSM networks.

PAGE_MODE (2 bit field)
This field is described in PSI 3

PSI6_CHANGE_MARK (2 bit field)
The PSI6 change mark field is changed each time information has been updated in any of the PSI6 messages. A new value indicates that the mobile station shall re-read the information from the PSI6 message. The coding of this field is network dependent.

PSI6_INDEX (3 bit field) and **PSI6_COUNT** (3 bit field)
The purpose of the PSI6_INDEX field and the PSI6_COUNT field is to indicate the number of individual messages within the sequence of PSI6 messages and to assign an index to identify each one of them. The PSI6_INDEX field is binary coded, range: 0 to 7, and provides an index to identify the individual PSI6 message. The PSI6_COUNT field is binary coded, range: 0 to 7, and provides the PSI6_INDEX value for the last (highest indexed) message in the sequence of PSI6 messages.

NonGSM Protocol Discriminator (3 bit field)
This information element is used to identify the non-GSM network for which a PSI6 message is transmitted and is coded as shown below.

Bit
3 2 1
0 0 1 TIA/EIA-136
All other values are reserved

Reminder: There is a specified way to combine GSM/GPRS networks with the United States Standard IS-136 that leads to the standard EGPRS-classic. For that, GPRS functionality must be included in a non-GSM network or the existence of a IS-136 network must be indicated in a GSM/GPRS network. This is how the two networks know about each other.

NR_OF_CONTAINER_OCTETS (5 bit field)
This field indicates the number of CONTAINER octets that form a specific non-GSM message and is coded as shown below.

Bit
5 4 3 2 1
0 0 0 0 1 1 octet **CONTAINER** length
0 0 0 1 0 2 octets **CONTAINER** length
…. through …
0 1 0 1 1 19 octets **CONTAINER** length
1 1 1 1 1 The remaining portion of the PSI message is used by the associated CONTAINER. The Non-GSM message continues with the next CONTAINER that has the same NonGSM Protocol Discriminator as the current one.

CONTAINER (8 bits)
The concatenation of one or several CONTAINER octets forms the actual contents specific to the non-GSM network, soliciting the transmission of a PSI6 message.

Packet System Information Type 7

This optional message is sent by the network on the PBCCH or PACCH to provide broadcast information required by non-GSM networks.

The PSI7 information elements are equal to the PSI6 elements already defined.

Packet System Information Type 8

This message is sent optionally by the network on the PBCCH and PACCH giving information about Cell Broadcast Channel configuration.

PAGE_MODE (2 bit field)
This field is defined in clause 12.20.

PSI8_INDEX (3 bit field) and **PSI8_COUNT** (3 bit field)
These fields are the binary representation of the PSI *index* and PSI *count* parameters associated with the PSI8 messages.

PSI8_CHANGE_MARK (2 bit field)
The PSI8 change mark field is changed each time information has been updated in the PSI8 message. A new value indicates that the mobile station will re-read the information from the PSI8 message. The coding of this field is network dependent. Range: 0-3.

CBCH Channel Description struct (Cell Broadcast Channel)
The CBCH Channel Description provides the description for the CBCH. If the CBCH Channel Description is not available (either because it is not included in any instance of PSI8 or if no PSI8 is broadcast at all), the mobile station can assume that SMSCB is not active in the cell.

Channel type and TDMA offset (5 bit field)
The indication of an existing CBCH is done by transmitting the CBCH Channel Description struct on the System Information 4 or the Packet System Information 8. Therefore the general channel description structure is used. This structure is given by:

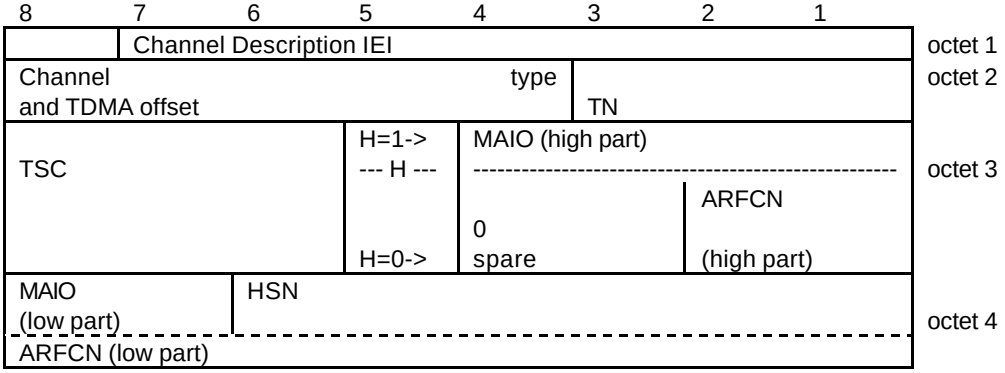


Figure: *Channel Description* information element

The meanings of the parameters are already described, the CBCH existing indication is performed in the channel type parameter, where the channel combination: BCCH+CCCH+SDCCH/4 shows the usage of such an SDCCH/4 channel as CBCH.

TN, Timeslot number(3 bit field)
The TN field is coded as the binary representation of the timeslot number.

Packet System Information 13

This message may be broadcast by the network on the PACCH or on the PCCCH. The message provides the mobile station with GPRS cell specific access-related information. The information in this message will be the same as provided in the SI13 message on BCCH.

Some of these parameters are the same as the System Information 13 message parameters.

PAGE_MODE (2 bit field)
This field describes which type of page mode is used, i.e. either normal paging, extended paging, paging reorganization, or the same as before from the previous page mode.

BCCH_CHANGE_MARK (3 bit field)
This field indicates the status of the information on BCCH. The value of this field shall be changed each time the information on BCCH is changed, except for when the contents of the SI-13 message are changed.

SI_CHANGE_FIELD (4 bit field)
This field is the binary representation of the information that was changed at the last indication in BCCH_CHANGE_MARK. Range 0 to 15:

Bit 4 3 2 1	
0 0 0 0	Update of *unspecified* SI message or SI messages;
0 0 0 1	Update of SI1 message;
0 0 1 0	Update of SI2, SI2 bis or SI2 ter message;
0 0 1 1	Update of SI3, SI4, SI7 or SI8 message;
0 1 0 0	Update of SI9 message;
	All other values shall be interpreted as 'update of unknown SI message type'.

SI13_CHANGE_MARK (2 bit field)
This field is the binary representation of the SI change mark identifying the GPRS Mobile Allocation provided in SI13 and PSI13 messages. Range: 0 to 3.

A consistent set of system information messages is identified by a PSI or SI *change mark* parameter included in each message in the set. All messages within a consistent set shall have the same value as this parameter.
The total number of system information messages of a certain type within a consistent set is indicated by a PSI or SI *count* parameter included in each message in the set. The position of a certain message instance within the consistent set of system information messages is indicated by a PSI or SI *index* parameter.
The PSI or SI *count* parameter shall have the value N–1, where N is the number of instances of the particular message type present in the consistent set. The PSI or SI *index* parameter will have a range from zero to N–1. Different instances of a particular message type in a consistent set will have different values from the PSI or SI *index* parameter.

GPRS Mobile Allocation (information element)

This information element is the representation of the GPRS mobile allocation provided in SI13 and PSI13 messages. It is identified by MA_NUMBER = 14 when referenced from a packet assignment message. When used in the SI13 or PSI13 messages, this information element refers to the cell allocation defined for the cell in SI1 or PSI2.

The parameters of this information element are already described in the System Information 13 chapter.

RAC (8 bit field)
This field is the binary representation of the Routing Area Code.

SPGC_CCCH_SUP (bit field)
This field indicates the support of the parameter SPLIT_PG_CYCLE on CCCH.

PRIORITY_ACCESS_THR field (3 bit)
This parameter identifies a threshold level for a priority order in what concerns the packet access to the network.

NETWORK_CONTROL_ORDER field (2 bit)
Indicates who is controlling the cell reselection process (network or MS) and orders the MS whether to send measurement report messages or not.

GPRS Cell Options (information element)
The *GPRS Cell Option* information element has already been explained in the System Information 13 description.

PSI1_REPEAT_PERIOD (4 bit field)
This field is the representation of the PSI1 repeat period. It indicates in how many multiframes the PSI1 message is retransmitted.

GPRS Power Control Parameters struct

This structure transmits the power control parameters needed from the MS to calculate its TX output power. The formula on how to derive the TX power and a detailed explanation of the parameters is also given in the description of SI13.

ALPHA (4 bit field)
T_AVG_W (5 bit field)
T_AVG_T (5 bit field)
PC_MEAS_CHAN (1 bit field)
N_AVG_I (4 bit field)

PBCCH Description struct

The PBCCH description struct provides the channel description for the PBCCH. The frequency description for the PBCCH may be specified by an ARFCN (non-hopping radio frequency channel) or a MAIO (hopping radio frequency channel) field. In the case of a hopping radio frequency channel, the PBCCH uses the GPRS mobile allocation specified in this message. If none of the ARFCN or MAIO fields are present, the PBCCH uses the BCCH carrier.
The detailed description of these parameters is given in SI13 description.

Pb (4 bit field)
Parameter of the global power control description field.

TSC (3 bit field)
This field is the binary representation of the training sequence code used for PBCCH and PCCCHs. Range: 0 to 7.

TN (3 bit field)
This field is the binary representation of the timeslot number for the PBCCH and the corresponding PCCCH. Range: 0 to 7.

ARFCN (10 bit field)
This field is the binary representation of the absolute RF channel number. Range: 0 to 1023.

MAIO (6 bit field)
This field is the binary representation of the mobile allocation index offset.
Range: 0 to 63.

SGSNR (bit field)
This field indicates the Release of the SGSN: