TSG-RAN Meeting #27 Tokyo, Japan, 09-11 March 2005

RP-050073 Agenda item 8.3.5

Source: TSG-RAN WG2

Title: CRs to 25.304 on Cell Reselection (HCS and non-HCS)

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc-2nd-Level	Workitem
25.304	128	1	Rel-5	Reselection procedures (1235)	F	5.7.0	5.8.0	R2-050734	TEI5
25.304	129	1	Rel-6	Reselection procedures (1235)	Α	6.4.0	6.5.0	R2-050735	TEI5
25.304	130	1	Rel-5	RSCP Thresholds	F	5.7.0	5.8.0	R2-050738	TEI5
25.304	131	1	Rel-6	RSCP Thresholds	Α	6.4.0	6.5.0	R2-050739	TEI5
25.304	132	2	Rel-6	High-mobility measurement rules	Α	6.4.0	6.5.0	R2-050745	TEI5
25.304	138	1	Rel-5	High-mobility measurement rules	F	5.7.0	5.8.0	R2-050744	TEI5
25.304	135	1	Rel-5	Intra frequency measurement rules for HCS	F	5.7.0	5.8.0	R2-050742	TEI5
25.304	139	1	Rel-6	Intra frequency measurement rules for HCS	Α	6.4.0	6.5.0	R2-050743	TEI5

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		СН	ANGE	REQ	UES	Γ		С	R-Form-v7.1	
*	25.304	CR 12	8	жrev	1 **	Current vers	sion:	5.7.0	#	
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Proposed change aff	fects: \	JICC apps	. #	MEX	Radio /	Access Netwo	rk	Core Ne	twork	
Title: 第 1	Reselection	on proced	ures (1235)						
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Reason for change:	b) 7 s s r k	hat TS 25. CELL_FACE The current sections of several time never spece	304 contracts. CH. t mixing of the specifies in offling ifically additionally add	reselection leading to the discussion leadin	measure on rules ads to ur ions beto a contri), document Rement requires and measurer aclarity. This had been several bution. Therefeneral correct	ments ment ru as bee compa fore, it	in 25.133 ules in dif en highligl unies altho would be	for ferent nted ough	
Summary of change:	CELL It is a resel Idle, Impa UEs UEs Impl	It is clarified that the power saving options are only valid for Idle, URA_PCH, CELL_PCH states (i.e. the specification is also aligned with 25.133). It is also clarified thesemeasurement rules are also taken into account in the reselection procedures (e.g. Ssearchinter, is a threshold used for reselection Idle, URA_PCH, CELL_PCH and CELL_FACH states) Impact Analysis: UEs that do not behave according to the proposed CR will require modification. UEs that already behave according to the CR do not require modifications. Implementation of this CR by a R99/Rel-4 UE, will not cause backwards compatibility issues.								
Consequences if not approved:						or CELL_FAC				

it may increase the possibility of entering OOS under fast-fading conditions. Furthermore, it was seen this would not allow any extra power saving option

for the UE because the S-CCPCH must be continuously received. The specification will also remain not aligned to 25.133.

b) Measurement rules and reselection criteria will remain mixed in the specification and therefore unclear, leading to uncertain UE behaviour.

Clauses affected:	第 5.2.6.1.1, 5.2.6.1.2, 5.2.6.1.4
Other specs affected:	Y N X Other core specifications Test specifications O&M Specifications
Other comments:	ж

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked \(\mathbb{H} \) contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

The measurement rules below apply in Idle, URA_PCH, CELL_PCH states. In CELL_FACH state the UE is required to perform measurements on all intra-frequency, inter-frequency and inter-RAT cells listed in system information according to requirements specified in [10]. In Idle, URA_PCH, CELL_PCH and CELL_FACH state the UE shall only consider those cells the UE is mandated to measure according to the measurement rules below as measured cells in the cell reselection criteria (section 5.2.6.1.4).

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx, and apply the following rules.
 - 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements. If $Sx <= S_{intrasearch}$, perform intra-frequency measurements. If $S_{intrasearch}$ is not sent for serving cell, perform intra-frequency measurements.
 - If Sx > S_{intersearch}, UE may choose to not perform inter-frequency measurements. Inter frequency measurements that may have been performed shall not be considered in the cell-reselection criteria. If Sx <= S_{intersearch}, perform inter-frequency measurements. If S_{intersearch}, is not sent for serving cell, perform inter-frequency measurements.
 - 3. If Sx > Ssearch_{RAT m}, UE may choose to not perform measurements on cells of RAT "m". Inter RAT measurements that may have been performed shall not be considered in the cell reselection criteria. If Sx <= Ssearch_{RAT m}, perform measurements on cells of RAT "m". If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit.SearchRATm} is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

The measurement rules below apply in Idle, URA PCH, CELL PCH states. In CELL FACH state the UE is required to perform measurements on all intra-frequency, inter-frequency and inter-RAT cells listed in system information according to requirements specified in [10]. In Idle, URA_PCH, CELL_PCH and CELL_FACH state the UE shall only consider those cells the UE is mandated to measure according to the measurement rules below as measured cells in the cell reselection criteria (section 5.2.6.1.4).

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and interfrequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF $(Srxlev_s \le Ssearch_{HCS})$ or $(if FDD and S_x \le S_{intersearch})$ THEN

measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.

ELSE

IF $(S_x > S_{intrasearch})$ THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if S_{intrasearch} or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

IF the UE is <u>not</u> measuring all cells according to the intra-frequency and inter-frequency threshold based measurement rules above THEN

— prioritise reselection of intra frequency and inter-frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

-ELSE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re selection of intra frequency and inter frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period $T_{CrmaxHyst}$:
 - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s
$$\leq$$
 S_{HCS,RATm}) or (if FDD and S_{qual} \leq S_{SearchRATm}) THEN

UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{limit,SearchRATm})$$
 THEN

UE may choose to not measure neighbouring cells in RAT "m". Inter RAT measurements that may have been performed shall not be considered in the cell reselectrion criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

- 2. Inter-RAT measurement rules for fast-moving UEs
 - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall
 - IF the UE is <u>not</u> measuring <u>all</u> neighbouring cells of RAT "m" according to the inter-RAT threshold based measurement rules above THEN
 - prioritise re selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level..

-ELSE

- measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
- prioritise re selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
- END IF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR} , UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period $T_{CrmaxHyst}$
 - revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

5.2.6.1.4 Cell Reselection Criteria

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s}$$
 - $Qhcs_s$
$$H_n = Q_{meas,n}$$
 - $Qhcs_n - TO_n * L_n$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$\begin{split} R_s &= Q_{meas,s} + Qhyst_s \\ R_n &= Q_{meas,n} - Qoffset_{s,n} - TO_n * (1 - L_n) \end{split}$$

where:

$$TO_n = TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n)$$

$$L_n = 0 \qquad \text{if } HCS_PRIO_n = HCS_PRIO_s$$

$$L_n = 1 \qquad \text{if } HCS_PRIO_n <> HCS_PRIO_s$$

$$W(x) = 0 \qquad \text{for } x < 0$$

$$W(x) = 1 \qquad \text{for } x >= 0$$

 $TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

TEMP_OFFSET_n and PENALTY_TIME_n are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

if HCS_PRIO_n <> HCS_PRIO_s and

$$Q_{meas}$$
, $n > Qhcs_n$

Or

- if HCS_PRIO_n = HCS_PRIO_s and
 - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

- for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset2_{s,n}$$

- for all other serving and neighbour cells:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

 T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

S _n	Cell Selection value of the neighbouring cell, (dB)
Q _{meas}	Quality value. The quality value of the received signal derived from the averaged CPICH
	Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells
	and from the averaged received signal level for GSM cells. The averaging of these
	measurement quantities are performed as specified in [10] and [11]. For FDD cells, the
	measurement that is used to derive the quality value is set by the
	Cell_selection_and_reselection_quality_measure information element.

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

The cell selection criterion S used for cell reselection is fulfilled when:

for FDD cells: Srxlev > 0 AND Squal > 0

for TDD cells: Srxlev > 0

for GSM cells: Srxlev > 0

Where:

 $Squal = Q_{qualmeas} - Qqualmin$

 $Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

Squal	Cell Selection quality value (dB)
	Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
Q _{qualmeas}	Measured cell quality value. The quality of the received signal expressed in CPICH E_c/N_0 (dB) for FDD cells. CPICH E_c/N_0 shall be averaged as specified in [10].
	Applicable only for FDD cells.
Q _{rxlevmeas}	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm),
	P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as
	specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received
	signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH - P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in
	system information) (dBm)
P_MAX	Maximum RF output power of the UE (dBm)

If HCS is not used in the serving cell the UE shall perform ranking of all cells that fulfil the criterion S, among:

- all measured cells (see subclause 5.2.6.1.1).

If HCS is used in the serving cell the UE shall perform ranking of all cells that fulfil the S-criterion S among

- 1. when in low-mobility (see subclause 5.2.6.1.2),
 - all <u>measured</u> cells, that have the highest HCS_PRIO among those cells that fulfil the criterion H >= 0. Note that this rule is not valid when UE high mobility is detected (see subclause 5.2.6.1.2).
 - all <u>measured</u> cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.

2. when in high-mobility (see subclause 5.2.6.1.2),

- all measured cells.

If HCS is used in the serving cell and UE high-mobility has been detected, prioritise re-selection of intra-frequency, inter-frequency and RAT "m" neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on the same HCS priority level as the serving cell, and prioritise neighbouring cells having the same HCS priority as the serving cell before neighbouring cells having higher HCS priority level than the serving cell.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11] for FDD, TDD and GSM cells, respectively.

The offset Qoffset1_{s,n} is used for Qoffset_{s,n} to calculate R_n , the hysteresis Qhyst1_s is used for Qhyst_s to calculate R_s . For UE in RRC connected mode states CELL_PCH or URA_PCH the hysteresis Qhyst_s takes the value Qhyst1_{s,PCH} to calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhyst_s takes the value Qhyst1_{s,FACH} to calculate R_s , if provided in SIB4 [see 4].

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n . If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n . The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values of the FDD cells. The offset Qoffset2_{s,n} is used for Qoffset_{s,n} to calculate R_n , the hysteresis Qhyst2_s is used for Qhyst_s to calculate R_s . For UE in RRC connected mode states CELL_PCH or URA_PCH the hysteresis Qhyst_s takes the value Qhyst2_{s,PCH} to calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhyst_s takes the value Qhyst2_{s,FACH} to calculate R_s , if provided in SIB4 [see 4]. If the usage of HCS is indicated in system information, TEMP_OFFSET2_n is used to calculate TO_n. If it is indicated in system information that HCS is not used, TEMP_OFFSET_n is not applied when calculating R_n . Following this second ranking, the UE shall perform cell reselection to the best ranked FDD cell.

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval Treselection. For UE in RRC connected mode states CELL_PCH or URA_PCH the interval Treselection_{s,PCH} applies, if provided in SIB4 [see 4], while for UE in RRC connected mode state CELL_FACH the interval Treselection_{s,FACH} applies, if provided in SIB4 [see 4]. For hierarchical cell structures when high mobility state has not been detected, if according to the HCS rules the serving cell is not ranked then all the ranked cells are considered to be better ranked than the serving cell.
- more than 1 second has elapsed since the UE camped on the current serving cell.

5.2.6.1.5 Cell reselection parameters in system information broadcasts

The selection of values for network controlled parameters can be optimised by means of different methods. Examples of methods are described in [6]. Cell reselection parameters are broadcast in system information and are read in the serving cell as follows:

Qoffset1_{s.n}

This specifies the offset between the two cells. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qoffset2_{s,n}

This specifies the offset between the two cells. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

Qhyst1_s

This specifies the hysteresis value (Qhyst). It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qhyst1_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst1_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst2_s

This specifies the hysteresis value (Qhyst). It is used for FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No.

Qhyst2_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, Qhyst2_s shall be used.

Qhyst2_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, Qhyst2_s shall be used.

HCS_PRIO_s, HCS_PRIO_n

This specifies the HCS priority level (0-7) for serving cell and neighbouring cells.

HCS priority level 0 means lowest priority and HCS priority level 7 means highest priority.

Qhcs_s, Qhcs_n

This specifies the quality threshold levels for applying prioritised hierarchical cell re-selection.

Qqualmin

This specifies the minimum required quality level in the cell in dB. It is not applicable for TDD cells or GSM cells.

Qrxlevmin

This specifies the minimum required RX level in the cell in dBm.

PENALTY_TIME_n

This specifies the time duration for which the TEMPORARY_OFFSET_n is applied for a neighbouring cell.

TEMPORARY_OFFSET1_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME_n. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

TEMPORARY_OFFSET2_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME_n. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

T_{CRmax}

This specifies the duration for evaluating allowed amount of cell reselection(s).

N_{CR}

This specifies the maximum number of cell reselections.

T_{CRmaxHvst}

This specifies the additional time period before the UE can revert to low-mobility measurements.

Treselection_s

This specifies the cell reselection timer value.

Treselection_{s,PCH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode states CELL_PCH and URA PCH if provided in SIB4, otherwise Treselection_s shall be used.

Treselection_{s,FACH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode state CELL_FACH if provided in SIB4, otherwise Treselection, shall be used.

Ssearch_{HCS}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell.

Ssearch_{RAT 1} - Ssearch_{RAT k}

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{HCS,RATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

Sintrasearch

This specifies the threshold (in dB) for intra frequency measurements and for the HCS measurement rules.

Sintersearch

This specifies the threshold (in dB) for inter-frequency measurements and for the HCS measurement rules.

S_{limit,SearchRATm}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold (in dB) in the serving UTRA cell above which the UE may choose to not perform any inter-RAT measurements in RAT "m".

5.2.6.2 GSM case

The cell reselection procedure in GSM, including reselection from GSM to UTRA, is specified in [1].

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	CHANGE	REQUEST	CR-Form-v7.1
光 2 .	5.304 CR 129	жrev <mark>1</mark> ж	Current version: 6.4.0
For <u>HELP</u> on using	g this form, see bottom of this	s page or look at the	e pop-up text over the 光 symbols.
Proposed change affe	ects: UICC appsЖ	ME X Radio Ac	ccess Network Core Network
Title: 第 R	eselection procedures (1235	5)	
Source: # R.	AN WG2		
Work item code:	EI5		<i>Date:</i>
Def	te <u>one</u> of the following categories F (correction) A (corresponds to a correction B (addition of feature), C (functional modification of the dilute) tailed explanations of the above found in 3GPP TR 21.900.	on in an earlier release, feature)	Release: # Rel-6 Use one of the following releases: Ph2 (GSM Phase 2) Ph3 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) Rel-4 (Release 4) Rel-5 (Release 5) Rel-6 (Release 6) Rel-7 (Release 7)
Reason for change: \$	光 a) During the RAN2 Me	eting #43 (Prague)	document R2-041462 highlighted
Reason for change: #	that TS 25.304 contra CELL_FACH. b) The current mixing of sections of the specif several times in offlin never specifically add	f reselection rules ar fication leads to uncluded discussions between direction in a contribution	nent requirements in 25.133 for and measurement rules in different larity. This has been highlighted een several companies although ation. Therefore, it would be neral correction to be able to clarify
Summary of change: \$	CELL_PCH states (i.e. the lt is also clarified these managements of the lt is also clarified these managements (i.e. the lt is also clarified these managements (i.e. the lt is also clarified these managements). It is also clarified the lt is also clarified the seminated the lt is also clarified the lt is also clar	ne specification is also easurement rules are e.g. Ssearchinter, is PCH and CELL_FAC eccording to the propaccording to the CR	e also taken into account in the a threshold used for reselection in
Consequences if anot approved:	reselecting to a non-cit may increase the p	optimum cell and car ossibility of entering	CELL_FACH may result in the UE use significant UL interference, and-OOS under fast-fading conditions. allow any extra power saving option

for the UE because the S-CCPCH must be continuously received. The specification will also remain not aligned to 25.133.

 Measurement rules and reselection criteria will remain mixed in the specification and therefore unclear, leading to uncertain UE behaviour.

Clauses affected:	第 5.2.6.1.1, 5.2.6.1.2, 5.2.6.1.4
Other specs affected:	Y N X Other core specifications Test specifications O&M Specifications
Other comments:	x

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked \(\mathbb{H} \) contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

The measurement rules below apply in Idle, URA_PCH, CELL_PCH states. In CELL_FACH state the UE is required to perform measurements on all intra-frequency, inter-frequency and inter-RAT cells listed in system information according to requirements specified in [10]. In Idle, URA_PCH, CELL_PCH and CELL_FACH state the UE shall only consider those cells the UE is mandated to measure according to the measurement rules below as measured cells in the cell reselection criteria (section 5.2.6.1.4).

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx, and apply the following rules.
 - 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements. If $Sx <= S_{intrasearch}$, perform intra-frequency measurements. If $S_{intrasearch}$ is not sent for serving cell, perform intra-frequency measurements.
 - If Sx > S_{intersearch}, UE may choose to not perform inter-frequency measurements. Inter frequency measurements that may have been performed shall not be considered in the cell-reselection criteria. If Sx <= S_{intersearch}, perform inter-frequency measurements.
 If S_{intersearch}, is not sent for serving cell, perform inter-frequency measurements.
 - 3. If Sx > Ssearch_{RAT m}, UE may choose to not perform measurements on cells of RAT "m". Inter RAT measurements that may have been performed shall not be considered in the cell reselection criteria. If Sx <= Ssearch_{RAT m}, perform measurements on cells of RAT "m". If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit.SearchRATm} is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

The measurement rules below apply in Idle, URA PCH, CELL PCH states. In CELL FACH state the UE is required to perform measurements on all intra-frequency, inter-frequency and inter-RAT cells listed in system information according to requirements specified in [10]. In Idle, URA_PCH, CELL_PCH and CELL_FACH state the UE shall only consider those cells the UE is mandated to measure according to the measurement rules below as measured cells in the cell reselection criteria (section 5.2.6.1.4).

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and interfrequency measurements, the UE shall:

use HCS priority₁ as the HCS priority broadcast in the system information and apply the following rule:

IF an MBMS PL is used THEN

- If the UE is in HCS low mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority₁ + HCS_OFF_{mbms}.
- If the UE is in HCS high mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority₁.
- for serving cell and neighbour cells not belonging to the MBMS PL, set the HCS priority = HCS priority₁.

IF an MBMS PL is not used THEN

For serving cell and all neighbour cells set HCS priority = HCS priority₁

Then apply this to the following:

1. For intra-frequency and inter-frequency threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s \leq Ssearch_{HCS}) or (if FDD and S_x \leq S_{intersearch}) THEN

measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{intrasearch})$$
 THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if S_{intrasearch} or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

IF the UE is <u>not</u> measuring all cells according to the intra-frequency and inter-frequency threshold based measurement rules above THEN

prioritise reselection of intra frequency and inter frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

FISE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}:
 - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s \leq S_{HCS,RATm}) or (if FDD and S_{qual} \leq S_{SearchRATm}) THEN

UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

ELSE

IF $(S_x > S_{limit, SearchRATm})$ THEN

UE may choose to not measure neighbouring cells in RAT "m". Inter RAT measurements that may have been performed shall not be considered in the cell reselectrion criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

- 2. Inter-RAT measurement rules for fast-moving UEs
 - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR}, high-mobility has been detected. In this high-mobility state, UE shall
 - IF the UE is <u>not</u> measuring <u>all</u> neighbouring cells of RAT "m" according to the inter-RAT threshold based measurement rules above THEN
 - prioritise re-selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving
 cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having
 the same HCS priority before neighbouring cells having higher HCS priority level..

ELSE

- measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
- prioritise re selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
- END IF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}
 - revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

5.2.6.1.4 Cell Reselection Criteria

[This subclause will need material on the MBMS offset, expected as part of the FLC changes.]

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s}$$
 - $Qhcs_s$
$$H_n = Q_{meas,n}$$
 - $Qhcs_n - TO_n * L_n$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$R_s = Q_{meas,s} + Qhyst_s + Qoffmbms$$

$$R_n = Q_{meas,n} - Qoffset_{s,n} + Qoffmbms - TO_n * (1 - L_n)$$

where:

the signalled value Qoffmbms is only applied to those cells (serving or neighbouring) belonging to the MBMS PL where:

$$TO_n = TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n)$$

$$L_n = 0 \qquad \text{if } HCS_PRIO_n = HCS_PRIO_s$$

$$L_n = 1 \qquad \text{if } HCS_PRIO_n <> HCS_PRIO_s$$

$$W(x) = 0 \qquad \text{for } x < 0$$

$$W(x) = 1 \qquad \text{for } x >= 0$$

 $TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

TEMP_OFFSET_n and PENALTY_TIME_n are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

if HCS_PRIO_n <> HCS_PRIO_s and

$$Q_{meas,n} > Qhcs_n$$

Or

- if $HCS_PRIO_n = HCS_PRIO_s$ and
 - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

- for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset2_{s,n}$$

- for all other serving and neighbour cells:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

 T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

S _n	Cell Selection value of the neighbouring cell, (dB)
Q _{meas}	Quality value. The quality value of the received signal derived from the averaged CPICH
	Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells
	and from the averaged received signal level for GSM cells. The averaging of these
	measurement quantities are performed as specified in [10] and [11]. For FDD cells, the
	measurement that is used to derive the quality value is set by the
	Cell_selection_and_reselection_quality_measure information element.

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

The cell selection criterion S used for cell reselection is fulfilled when:

for FDD cells: Srxlev > 0 AND Squal > 0 for TDD cells: Srxlev > 0

for GSM cells: Srxlev > 0

Where:

$$Squal = Q_{qualmeas} - Qqualmin$$

$$Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$$

Squal	Cell Selection quality value (dB)
	Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
Q _{qualmeas}	Measured cell quality value. The quality of the received signal expressed in CPICH E _C /N ₀
	(dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10].
	Applicable only for FDD cells.
Q _{rxlevmeas}	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm),
	P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as
	specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received
	signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH - P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in
	system information) (dBm)
P_MAX	Maximum RF output power of the UE (dBm)

If HCS is not used in the serving cell the UE shall perform ranking of all cells that fulfil the criterion S, among:

- all measured cells (see subclause 5.2.6.1.1).

If HCS is used in the serving cell the UE shall perform ranking of all cells that fulfil the S-criterion S among

- 1. when in low-mobility (see subclause 5.2.6.1.2),
 - all <u>measured</u> cells, that have the highest HCS_PRIO among those cells that fulfil the criterion H >= 0. Note that this rule is not valid when UE high mobility is detected (see subclause 5.2.6.1.2).
 - all <u>measured</u> cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.
- 2. when in high-mobility (see subclause 5.2.6.1.2),
 - all measured cells.

If HCS is used in the serving cell and UE high-mobility has been detected, prioritise re-selection of intra-frequency, inter-frequency and RAT "m" neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on the same HCS priority level as the serving cell, and prioritise neighbouring cells having the same HCS priority as the serving cell before neighbouring cells having higher HCS priority level than the serving cell.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11] for FDD, TDD and GSM cells, respectively.

The offset Qoffset1_{s,n} is used for Qoffset_{s,n} to calculate R_n , the hysteresis Qhyst1_s is used for Qhyst_s to calculate R_s . For UE in RRC connected mode states CELL_PCH or URA_PCH the hysteresis Qhyst_s takes the value Qhyst1_{s,PCH} to calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhyst_s takes the value Qhyst1_{s,FACH} to calculate R_s , if provided in SIB4 [see 4].

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n . If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n . The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values of the FDD cells. The offset $Q_{neas,n}$ is used for $Q_{neas,n}$ to calculate $Q_{neas,n}$ in For UE in RRC connected mode state $Q_{neas,n}$ takes the value $Q_{neas,n}$ to calculate $Q_{neas,n}$ in For UE in RRC connected mode state $Q_{neas,n}$ takes the value $Q_{neas,n}$ to calculate $Q_{neas,n}$ in For UE in RRC connected mode state $Q_{neas,n}$ takes the value $Q_{neas,n}$ to calculate $Q_{neas,n}$ in For UE in RRC connected mode state $Q_{neas,n}$ takes the value $Q_{neas,n}$ to calculate $Q_{neas,n}$ in For UE in RRC connected mode state $Q_{neas,n}$ takes the value $Q_{neas,n}$ to calculate $Q_{neas,n}$ and calcu

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval Treselection. For UE in RRC connected mode states CELL_PCH or URA_PCH the interval Treselection_{s,PCH} applies, if provided in SIB4 [see 4], while for UE in RRC connected mode state CELL_FACH the interval Treselection_{s,FACH} applies, if provided in SIB4 [see 4]. For hierarchical cell structures when high mobility state has not been detected, if according to the HCS rules the serving cell is not ranked then all the ranked cells are considered to be better ranked than the serving cell.
- more than 1 second has elapsed since the UE camped on the current serving cell.

3GPP TSG-RAN-WG2 Meeting #46 Phoenix, USA, 14-18 February 2005

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Reason for change:
A problem with the current reselection rules was highlighted in R2-042446 where the current thresholds for cell quality are only based on Ec/No measurements, as stated in section 5.2.6.1.1-25.304 - "use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules". The suitability of a neighbouring cell is still ensured by Squal and Srxlev levels.

Summary of change: ₩

 $S_{\text{searchHCS}}$ is used in the measurement rules when HCS is not used, such the UE will perform measurements if $S_{\text{rxlev}} <= S_{\text{searchHCS}}$.

Impact Analysis:

All UEs will require modifications.

Optimal parameterisation of system information Ssearchinter and Ssearchrat parameters, for UEs that have implemented this CR may slightly degrade legacy UEs reselection performance. This is the reason why pre-Rel5 implementation was allowed and is inline with the *mirror* RSCP threshold addition already present in the GERAN specifications.

Implementation of this CR by a R99/Rel-4 UE, will not cause backwards compatibility issues.

Consequences if not approved:

The UE may experience good downlink coverage and perform reselection to a cell. However, although the uplink coverage may satisfy the suitability criterion Srxlev, it may not be sufficient to provide adequate service. For example, currently there is no threshold that triggers the UE to measure GSM cells if the uplink coverage is suitable but does not ensure service.

Clauses affected:	第 5.2.6.1.1
	YN
Other specs	X Other core specifications
affected:	X Test specifications
	X O&M Specifications
Other comments:	# A related proposal was already accepted in GERAN last year (with R99 solution)

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5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.
- 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements. If $Sx <= S_{intrasearch}$, perform intra-frequency measurements.

If S_{intrasearch}, is not sent for serving cell, perform intra-frequency measurements.

- 2. If Sx > S_{intersearch}, and Srxlev > S_{searchHCS} if S_{searchHCS} is signalled, UE may choose to not perform interfrequency measurements. Inter-frequency measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le S_{intersearch}$, or $Srxlev \le S_{searchHCS}$ if $S_{searchHCS}$ is signalled, perform inter-frequency measurements. If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.
- 3. If Sx > Ssearch_{RAT ms} and Srxlev > S_{HCS,RATm} if S_{HCS,RATm} is signalled, UE may choose to not perform measurements on cells of RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le Ssearch_{RAT \, m}$, or $Srxlev \le S_{HCS,RATm}$ if $S_{HCS,RATm}$ is signalled, perform measurements on cells of RAT "m".

If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit,SearchRATm} is sent for serving cell, UE shall ignore it.

NOTE: The presence of S_{searchHCS} and S_{HCS,RATm} thresholds in system information are used to avoid introducing new parameters to system information and their presence does not imply that HCS is used.

****** next changed section *******

5.2.6.1.5 Cell reselection parameters in system information broadcasts



Ssearch_{HCS}

This threshold is used in the measurement rules for cell re-selection when HCS is used. When HCS is used, I it specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell. When HCS is not used, it specifies the limit for Srxlev in the serving cell below which the UE ranks interfrequency neighbouring cells of the serving cell.

Ssearch_{RAT 1} - Ssearch_{RAT k}

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

S_{HCS,RATm}

This threshold is used in the measurement rules for cell re-selection when HCS is used. When HCS is used, I it specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules. When HCS is not used, it specifies the limit for Srxlev in the serving cell below which the UE ranks inter-RAT neighbouring cells of the serving cell.

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Phoenix, USA, 14-18 February 2005																	
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for Sx and apply the following rules". The suitability of a neighbouring cell is still ensured by Squal and Srxlev levels.

Summary of change: ₩

S_{searchHCS} is used in the measurement rules when HCS is not used, such the UE will perform measurements if $S_{rxlev} \ll S_{searchHCS}$.

Impact Analysis:

All UEs will require modifications.

Optimal parameterisation of system information Ssearchinter and Ssearchrat parameters, for UEs that have implemented this CR may slightly degrade legacy UEs reselection performance. This is the reason why pre-Rel5 implementation was allowed and is inline with the mirror RSCP threshold addition already present in the GERAN specifications.

Implementation of this CR by a R99/Rel-4 UE, will not cause backwards compatibility issues.

Consequences if not approved:

The UE may experience good downlink coverage and perform reselection to a cell. However, although the uplink coverage may satisfy the suitability criterion Srxlev, it may not be sufficient to provide adequate service. For example, currently there is no threshold that triggers the UE to measure GSM cells if the uplink coverage is suitable but does not ensure service.

Clauses affected:	第 5.2.6.1.1
	YN
Other specs	米 X Other core specifications
affected:	X Test specifications
	X O&M Specifications
Other comments:	# A related proposal was already accepted in GERAN last year (with R99 solution)

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked # contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.
- 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements. If $Sx <= S_{intrasearch}$, perform intra-frequency measurements.

If S_{intrasearch}, is not sent for serving cell, perform intra-frequency measurements.

- 2. If Sx > S_{intersearch}, and Srxlev > S_{searchHCS} if S_{searchHCS} is signalled, UE may choose to not perform interfrequency measurements. Inter-frequency measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le S_{intersearch}$, or $Srxlev \le S_{searchHCS}$ if $S_{searchHCS}$ is signalled, perform inter-frequency measurements. If $S_{intersearch}$, is not sent for serving cell, perform inter-frequency measurements.
- 3. If Sx > Ssearch_{RAT ms} and Srxlev > S_{HCS,RATm} if S_{HCS,RATm} is signalled, UE may choose to not perform measurements on cells of RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le Ssearch_{RAT \, m}$, or $Srxlev \le S_{HCS,RATm}$ if $S_{HCS,RATm}$ is signalled, perform measurements on cells of RAT "m".

If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit,SearchRATm} is sent for serving cell, UE shall ignore it.

NOTE: The presence of S_{searchHCS} and S_{HCS,RATm} thresholds in system information are used to avoid introducing new parameters to system information and their presence does not imply that HCS is used.

****** next changed section *******

5.2.6.1.5 Cell reselection parameters in system information broadcasts



Ssearch_{HCS}

This threshold is used in the measurement rules for cell re-selection when HCS is used. When HCS is used, I it specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell. When HCS is not used, it specifies the limit for Srxlev in the serving cell below which the UE ranks interfrequency neighbouring cells of the serving cell.

Ssearch_{RAT 1} - Ssearch_{RAT k}

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

S_{HCS,RATm}

This threshold is used in the measurement rules for cell re-selection when HCS is used. When HCS is used, I it specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules. When HCS is not used, it specifies the limit for Srxlev in the serving cell below which the UE ranks inter-RAT neighbouring cells of the serving cell.

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issues

Consequences if

not approved:

Implementation of this CR by a R99/Rel-4 UE will not cause compatibility

measure sufficient cells when the serving cell quality is low. This could lead to

A UE may not apply threshold based rules in HCS high-mobility and may not

fast-moving UEs reselecting to non-suitable cells.

Clauses affected:	Ħ	5	.6.2	.1.2		
Other specs affected:	æ	Y	N X X	Other core specifications Test specifications O&M Specifications	¥	
Other comments:	\mathbb{H}					

How to create CRs using this form:

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- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and interfrequency measurements, the UE shall:

use HCS priority₁ as the HCS priority broadcast in the system information and apply the following rule:

IF an MBMS PL is used THEN

- If the UE is in HCS low mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority₁ + HCS_OFF_{mbms}.
- If the UE is in HCS high mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority₁.
- for serving cell and neighbour cells not belonging to the MBMS PL, set the HCS priority = HCS priority₁.

IF an MBMS PL is not used THEN

For serving cell and all neighbour cells set HCS priority = HCS priority₁

Then apply this to the following:

For intra-frequency and inter-frequency threshold based measurement rules for UEs not in high-mobility
use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF $(Srxlev_s \le Ssearch_{HCS})$ or $(if FDD and S_x \le S_{intersearch})$ THEN

measure on all intra-frequency and inter-frequency cells. Fast moving UEs may also use this rule.

ELSE

IF $(S_x > S_{intrasearch})$ THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell-unless measurement rules for fast moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell-unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if S_{intrasearch} or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

- IF the UE is measuring all cells according to the intra frequency and inter-frequency threshold based measurement rules above THEN
- IF ($Srxlev_s \le Ssearch_{HCS}$) or (if FDD and $S_x \le S_{intersearch}$), or $S_{searchHCS}$ or $S_{intersearch}$ (in FDD) are not sent for the serving cell THEN

measure on all intra-frequency and inter-frequency cells.

- prioritise reselection of intra-frequency and inter-frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

ELSE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}:
 - revert to measurements according to the threshold based measurement rulesexit high-mobility.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules for UEs not in high-mobility

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF
$$(Srxlev_s \le S_{HCS,RATm})$$
 or $(if FDD and S_{qual} \le S_{SearchRATm})$ THEN

UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

ELSE

```
IF (S_x > S_{limit, SearchRATm}) THEN
```

UE may choose to not measure neighbouring cells in RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell-unless measurement rules for fast moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

- 2. Inter-RAT measurement rules for fast-moving UEs
 - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall
 - IF $(Srxlev_s \le S_{HCS,RATm})$ or $(if FDD \text{ and } S_{qual} \le S_{SearchRATm})$, or $S_{HCS,RATm}$ or $S_{SearchRATm}$ are not sent for the serving cell THEN
 - UE shall measure on all inter-RATm cells.
 - IF the UE is measuring neighbouring cells of RAT "m" according to the inter RAT threshold based measurement rules above THEN

- prioritise re-selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

- ELSE

- measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
- prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
- ENDIF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR} , UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}
 - revert to measure according to the threshold based measurement rulesexit high-mobility.

< snip >

5.2.6.1.5 Cell reselection parameters in system information broadcasts

< snip >

 $T_{CRmaxHvst}$

This specifies the additional time period before the UE can revert exit to low high-mobility measurements.

3GPP TSG-RAN-WG2 Meeting #46 Phoenix, USA, 14-18 February 2005

₩ F

Use <u>one</u> of the following categories:

C (functional modification of feature)

Detailed explanations of the above categories can

B (addition of feature),

D (editorial modification)

be found in 3GPP TR 21.900.

A (corresponds to a correction in an earlier release)

F (correction)

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Title:	Ж	Intra- and inter-f	requency mea	asurement	rules	for H	ICS			
Source:	Ж	RAN WG2								
Work item co	de: #	TFI5					Date: %	Feb/2005		

Reason for change: ₩

Category:

CPICH Ec/No is a good measure of downlink quality and CPICH RSCP is a good measure of uplink quality. These measures are thus complementing each other and are both necessary to define the quality of a cell.

Release: 第 Rel-5

Ph2

R96

R97

R98

R99

Rel-4

Rel-5

Rel-6

Rel-7

Use one of the following releases:

(GSM Phase 2)

(Release 1996)

(Release 1997)

(Release 1998)

(Release 1999)

(Release 4)

(Release 5)

(Release 6)

(Release 7)

If HCS is used, both CPICH Ec/No thresholds and a CPICH RSCP thresholds are defined, but here the same threshold values are used both for inter and intra frequency cells. To avoid strong interference from RACH attempts towards a cell, which is not the best intra frequency cell available, the intra frequency thresholds are set to a high values if used. As a consequence the threshold functionality can't be used for inter frequency either.

Inter-RAT cell reselections should work for a release 99 UE when using HCS, and RAN4 has specified a test case for it in release 5.

Summary of change: # When HCS is used and Sintrasearch is not sent for the serving cell but

SsearchHCS and Sintersearch (in FDD) are sent, the UE is mandated to meassure on:

- All intra-frequency neighbouring cells, and
- if (Srxlev > SsearchHCS) and (Sx > Sintersearch): all inter-frequency cells, which have higher HCS priority level than the serving cell, otherwise all inter-frequency cells.

The change is only for non-high-mobility.

Impact Analysis:

System information parameterisation optimised for UEs compliant to this CR will eliminate inter-frequency power saving options for legacy UEs. Since Sintrasearch is required to be set to a very high value if sent, power saving will only be performed for low priority inter-frequency cells. Hence, if there are no low priority cells there is no impact.

Implementation of this CR by a R99/Rel-4 UE will not cause any compatibility issues.

Consequences if not approved:

The threshold functionality cannot be used for inter-frequency cell reselection (for neighbouring inter-frequency cells of equal HCS priority) without creating strong interference peaks and congestion for intra-frequency cells.

Clauses affected:	第 5.2.6.1.2						
Other specs affected:	Y N X Other core specifications Test specifications O&M Specifications						
Other comments:	★ Ranking rules are specified in CR128.						

How to create CRs using this form:

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- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.
- 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements.
 - If $Sx \le S_{intrasearch}$, perform intra-frequency measurements.
 - If S_{intrasearch} is not sent for serving cell, perform intra-frequency measurements.
- 2. If $Sx > S_{intersearch}$, UE may choose to not perform inter-frequency measurements. Inter-frequency measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le S_{intersearch}$, perform inter-frequency measurements.
 - If S_{intersearch}, is not sent for serving cell, perform inter-frequency measurements.
- 3. If Sx > Ssearch_{RAT m}, UE may choose to not perform measurements on cells of RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx \le Ssearch_{RAT m}$, perform measurements on cells of RAT "m".
 - If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit,SearchRATm} is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and inter-frequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF
$$(Srxlev_s \le Ssearch_{HCS})$$
 or $(if FDD and S_x \le S_{intersearch})$ THEN

measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{intrasearch})$$
 THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

IF (S_{intrasearch} is not sent for the serving cell) THEN

measure on all intra-frequency cells. Fast-moving UEs may also use this rule.

measure on all inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if S_{intrasearch} or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

IF the UE is measuring all cells according to the intra-frequency and inter-frequency threshold based measurement rules above THEN

- prioritise reselection of intra-frequency and inter-frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

ELSE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR} , UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period $T_{CrmaxHyst}$:
 - revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

$$IF \ (Srxlev_s <= S_{HCS,RATm}) \ or \ (if \ FDD \ and \ S_{qual} <= S_{SearchRATm}) \ THEN$$

UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{limit,SearchRATm})$$
 THEN

UE may choose to not measure neighbouring cells in RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselectrion criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

2. Inter-RAT measurement rules for fast-moving UEs

- If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall
- IF the UE is measuring neighbouring cells of RAT "m" according to the inter-RAT threshold based measurement rules above THEN
 - prioritise re-selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level..

- ELSE

- measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
- prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
- END IF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}
 - revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

5.2.6.1.4 Cell Reselection Criteria

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s}$$
 - $Qhcs_s$
$$H_n = Q_{meas,n}$$
 - $Qhcs_n - TO_n * L_n$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$\begin{split} R_s &= Q_{meas,s} + Qhyst_s \\ R_n &= Q_{meas,n} - Qoffset_{s,n} - TO_n * (1 - L_n) \end{split}$$

where:

$$TO_n = TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n)$$

$$L_n = 0 \qquad \text{if } HCS_PRIO_n = HCS_PRIO_s$$

$$L_n = 1 \qquad \text{if } HCS_PRIO_n <> HCS_PRIO_s$$

$$W(x) = 0 \qquad \text{for } x < 0$$

$$W(x) = 1 \qquad \text{for } x >= 0$$

 $TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

TEMP_OFFSET_n and PENALTY_TIME_n are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

if HCS_PRIO_n <> HCS_PRIO_s and

$$Q_{meas}$$
, $n > Qhcs_n$

Or

- if HCS_PRIO_n = HCS_PRIO_s and
 - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

- for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset2_{s,n}$$

- for all other serving and neighbour cells:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

 T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

S _n	Cell Selection value of the neighbouring cell, (dB)
Q _{meas}	Quality value. The quality value of the received signal derived from the averaged CPICH
	Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells
	and from the averaged received signal level for GSM cells. The averaging of these
	measurement quantities are performed as specified in [10] and [11]. For FDD cells, the
	measurement that is used to derive the quality value is set by the
	Cell_selection_and_reselection_quality_measure information element.

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

The cell selection criterion S used for cell reselection is fulfilled when:

for FDD cells: Srxlev > 0 AND Squal > 0

for TDD cells: Srxlev > 0

for GSM cells: Srxlev > 0

Where:

 $Squal = Q_{qualmeas} - Qqualmin$

 $Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$

Squal	Cell Selection quality value (dB)
	Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
Q _{qualmeas}	Measured cell quality value. The quality of the received signal expressed in CPICH E_c/N_0 (dB) for FDD cells. CPICH E_c/N_0 shall be averaged as specified in [10].
	Applicable only for FDD cells.
Qrxlevmeas	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm),
	P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as
	specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received
	signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH - P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in
	system information) (dBm)
P_MAX	Maximum RF output power of the UE (dBm)

The UE shall perform ranking of all cells that fulfil the S criterion among

- all cells that have the highest HCS_PRIO among those cells that fulfil the criterion $H \ge 0$. Note that this rule is not valid when UE high-mobility is detected (see subclause 5.2.6.1.2).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11] for FDD, TDD and GSM cells, respectively.

The offset Qoffset $1_{s,n}$ is used for Qoffset $1_{s,n}$ to calculate $1_{s,n}$ to Connected mode states CELL_PCH or URA_PCH the hysteresis $1_{s,n}$ takes the value $1_{s,n}$ to

calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhysts takes the value Qhyst1_{s,FACH} to calculate R_s , if provided in SIB4 [see 4].

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n . If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n . The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values of the FDD cells. The offset $Q_{neas,n}$ is used for $Q_{neas,n}$ to calculate $Q_{neas,n}$ in $Q_{neas,n}$ and $Q_{neas,n}$ and calculate $Q_{neas,n}$ is used for $Q_{neas,n}$ to calculate $Q_{neas,n}$ in $Q_{neas,n}$ and calculate $Q_{neas,n}$ is used to calculate $Q_{neas,n}$ to $Q_{neas,n}$ and calculate $Q_{neas,n}$ and calculating $Q_{neas,n}$ and calculat

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval Treselection. For UE in RRC connected mode states CELL_PCH or URA_PCH the interval Treselection_{s,PCH} applies, if provided in SIB4 [see 4], while for UE in RRC connected mode state CELL_FACH the interval Treselection_{s,FACH} applies, if provided in SIB4 [see 4]. For hierarchical cell structures when high mobility state has not been detected, if according to the HCS rules the serving cell is not ranked then all the ranked cells are considered to be better ranked than the serving cell.
- more than 1 second has elapsed since the UE camped on the current serving cell.

5.2.6.1.5 Cell reselection parameters in system information broadcasts

The selection of values for network controlled parameters can be optimised by means of different methods. Examples of methods are described in [6]. Cell reselection parameters are broadcast in system information and are read in the serving cell as follows:

Qoffset1_{s,n}

This specifies the offset between the two cells. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qoffset2_{s,n}

This specifies the offset between the two cells. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

Qhyst1_s

This specifies the hysteresis value (Qhyst). It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qhyst1_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst1_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst2s

This specifies the hysteresis value (Qhyst). It is used for FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No.

Qhyst2_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, Qhyst2_s shall be used.

Qhyst2_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, Qhyst2_s shall be used.

HCS_PRIO_s, HCS_PRIO_n

This specifies the HCS priority level (0-7) for serving cell and neighbouring cells.

HCS priority level 0 means lowest priority and HCS priority level 7 means highest priority.

Qhcs_s, Qhcs_n

This specifies the quality threshold levels for applying prioritised hierarchical cell re-selection.

Qqualmin

This specifies the minimum required quality level in the cell in dB. It is not applicable for TDD cells or GSM cells.

Orxlevmin

This specifies the minimum required RX level in the cell in dBm.

$PENALTY_TIME_n$

This specifies the time duration for which the TEMPORARY_OFFSET_n is applied for a neighbouring cell.

TEMPORARY_OFFSET1_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME $_n$. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

TEMPORARY_OFFSET2_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME_n. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

TCPmar

This specifies the duration for evaluating allowed amount of cell reselection(s).

NCR

This specifies the maximum number of cell reselections.

T_{CRmaxHyst}

This specifies the additional time period before the UE can revert to low-mobility measurements.

Treselection_s

This specifies the cell reselection timer value.

Treselection_{s,PCH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode states CELL_PCH and URA_PCH if provided in SIB4, otherwise Treselection_s shall be used.

Treselection_{s,FACH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode state CELL_FACH if provided in SIB4, otherwise Treselection, shall be used.

Ssearch_{HCS}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell.

Ssearch_{RAT 1} - Ssearch_{RAT k}

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{HCS,RATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

Sintrasearch

This specifies the threshold (in dB) for intra frequency measurements and for the HCS measurement rules.

Sintersearch

This specifies the threshold (in dB) for inter-frequency measurements and for the HCS measurement rules.

S_{limit,SearchRATm}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold (in dB) in the serving UTRA cell above which the UE may choose to not perform any inter-RAT measurements in RAT "m".

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whilst others will continuously perform measurements.

It would be beneficial to clarify some of the threshold based rules, to guaranteed that a UE using these will perform the necessary minimum measurements depending on the quality of the cell – i.e. if the serving cell quality if low, the UE will always perform all measurements when in high-mobility.

2. There is an incorrect usage of terminology (i.e. "low-mobility" in the T_{CRmaxHyst} definition).

Summary of change: ₩

- 1. The HCS measurement rules are clarified to ensure UEs in high-mobility will measure all cells when the quality of the serving cell is below a certain threshold. The measurement rules for HCS were split into high/low mobility.
- 2. The terminology was corrected.

Impact Analysis:

UEs not implementing the CR will require modifications. This CR does not have impact to UTRAN implementations.

Implementation of this CR by a R99/Rel-4 UE will not cause compatibility issues

Consequences if not approved:

A UE may not apply threshold based rules in HCS high-mobility and may not measure sufficient cells when the serving cell quality is low. This could lead to fast-moving UEs reselecting to non-suitable cells.

Clauses affected:	H	5	.6.2	.1.2		
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How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and interfrequency measurements, the UE shall:

1. For intra-frequency and inter-frequency threshold based measurement rules for UEs not in high-mobility

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s \leq Ssearch_{HCS}) or (if FDD and S_x \leq S_{intersearch}) THEN

measure on all intra-frequency and inter-frequency cells. Fast moving UEs may also use this rule.

ELSE

IF $(S_x > S_{intrasearch})$ THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell-unless measurement rules for fast moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell-unless measurement rules for fast moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if S_{intrasearch} or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

- IF the UE is measuring all cells according to the intra frequency and inter-frequency threshold based measurement rules above THEN
- IF (Srxlev_s <= Ssearch_{HCS}) or (if FDD and S_x <= S_{intersearch}), or S_{searchHCS} or S_{intersearch} (in FDD) are not sent for the serving cell THEN

measure on all intra-frequency and inter-frequency cells.

- prioritise reselection of intra-frequency and inter-frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

ELSE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHvs}:

- revert to measurements according to the threshold based measurement rules exit high-mobility.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules for UEs not in high-mobility

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s
$$\leq$$
 S_{HCS,RATm}) or (if FDD and S_{qual} \leq S_{SearchRATm}) THEN

UE shall measure on all inter-RATm cells. Fast moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{limit, SearchRATm})$$
 THEN

UE may choose to not measure neighbouring cells in RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell-unless measurement rules for fast moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

- 2. Inter-RAT measurement rules for fast-moving UEs
 - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall
 - <u>IF (Srxlev_s <= S_{HCS,RATm}) or (if FDD and S_{qual} <= S_{SearchRATm}), or S_{HCS,RATm} or S_{SearchRATm} are not sent for the serving cell THEN</u>
 - UE shall measure on all inter-RATm cells.
 - IF the UE is measuring neighbouring cells of RAT "m" according to the inter RAT threshold based measurement rules above THEN
 - prioritise re-selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving
 cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having
 the same HCS priority before neighbouring cells having higher HCS priority level.
 - ELSE
 - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
 - prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
 - ENDIF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period T_{CrmaxHyst}
 - revert to measure according to the threshold based measurement rulesexit high-mobility.

< snip >

5.2.6.1.5 Cell reselection parameters in system information broadcasts

< snip >

 $T_{CRmaxHyst}$

This specifies the additional time period before the UE can revert exit to low high-mobility measurements.

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Detailed explanations of the above categories can

be found in 3GPP TR 21.900.

Reason for change:

CPICH Ec/No is a good measure of downlink quality and CPICH RSCP is a good measure of uplink quality. These measures are thus complementing each other and are both necessary to define the quality of a cell.

Rel-4

Rel-5

Rel-6

Rel-7

(Release 4)

(Release 5)

(Release 6)

(Release 7)

If HCS is used, both CPICH Ec/No thresholds and a CPICH RSCP thresholds are defined, but here the same threshold values are used both for inter and intra frequency cells. To avoid strong interference from RACH attempts towards a cell, which is not the best intra frequency cell available, the intra frequency thresholds are set to a high values if used. As a consequence the threshold functionality can't be used for inter frequency either.

Inter-RAT cell reselections should work for a release 99 UE when using HCS, and RAN4 has specified a test case for it in release 5.

Summary of change: # When HCS is used and Sintrasearch is not sent for the serving cell but

SsearchHCS and Sintersearch (in FDD) are sent, the UE is mandated to meassure on:

- All intra-frequency neighbouring cells, and
- if (Srxlev > SsearchHCS) and (Sx > Sintersearch): all inter-frequency cells, which have higher HCS priority level than the serving cell, otherwise all interfrequency cells.

The change is only for non-high-mobility.

Impact Analysis:

System information parameterisation optimised for UEs compliant to this CR will eliminate inter-frequency power saving options for legacy UEs. Since Sintrasearch is required to be set to a very high value if sent, power saving will only be performed for low priority inter-frequency cells. Hence, if there are no low priority cells there is no impact.

Implementation of this CR by a R99/Rel-4 UE will not cause any compatibility issues.

Consequences if not approved:

The threshold functionality cannot be used for inter-frequency cell reselection (for neighbouring inter-frequency cells of equal HCS priority) without creating strong interference peaks and congestion for intra-frequency cells.

Clauses affected:	第 5.2.6.1.2				
Other specs affected:	Y N X Other core specifications Test specifications O&M Specifications				
Other comments:	★ Ranking rules are specified in CR128.				

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- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

5.2.6 Cell Reselection Evaluation Process

5.2.6.1 UTRA case

The cell reselection process is specified in the following sub-clauses:

5.2.6.1.0 Use of MBMS PL

In the cell reselection process, an MBMS PL shall only be applicable while the UE is receiving an MBMS session from one or more of the ongoing activated MBMS services for which this PL is indicated.

5.2.6.1.1 Measurement rules for cell re-selection when HCS is not used

If the system information broadcast in the serving cell indicates that HCS is not used, then for intra-frequency and inter-frequency measurements and inter-RAT measurements, the UE shall:

- use Squal for FDD cells and Srxlev for TDD for Sx and apply the following rules.
- 1. If $Sx > S_{intrasearch}$, UE may choose to not perform intra-frequency measurements.
 - If $Sx \le S_{intrasearch}$, perform intra-frequency measurements.
 - If S_{intrasearch}, is not sent for serving cell, perform intra-frequency measurements.
- 2. If Sx > S_{intersearch} and MBMS PL has not been indicated, UE may choose to not perform inter-frequency measurements. Inter-frequency measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx > S_{intersearch}$ and MBMS PL has been indicated and the serving cell belongs to the MBMS PL, UE may choose to not perform inter-frequency measurements. Inter-frequency measurements that may have been performed shall not be considered in the cell-reselection criteria.
 - If $Sx > S_{intersearch}$, MBMS PL has been indicated and the serving cell does not belong to the MBMS PL, UE shall at least perform inter-frequency measurements on the MBMS PL.
 - If $Sx \le S_{intersearch}$, perform inter-frequency measurements.
 - If S_{intersearch}, is not sent for serving cell, perform inter-frequency measurements.
- 3. If Sx > Ssearch_{RAT m}, UE may choose to not perform measurements on cells of RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria. If Sx <= Ssearch_{RAT m}, perform measurements on cells of RAT "m". If Ssearch_{RAT m}, is not sent for serving cell, perform measurements on cells of RAT "m".

If HCS is not used and if S_{limit,SearchRATm} is sent for serving cell, UE shall ignore it.

5.2.6.1.2 Measurement rules for cell re-selection when HCS is used

If the system information broadcast in the serving cell indicates that HCS is used, then for intra-frequency and interfrequency measurements, the UE shall:

use HCS priority₁ as the HCS priority broadcast in the system information and apply the following rule:

IF an MBMS PL is used THEN

- If the UE is in HCS low mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority $_1$ + HCS_OFF_{mbms}.
- If the UE is in HCS high mobility state, for serving cell and neighbour cells belonging to the MBMS PL set the HCS priority = HCS priority₁.
- for serving cell and neighbour cells not belonging to the MBMS PL, set the HCS priority = HCS priority₁.

IF an MBMS PL is not used THEN

For serving cell and all neighbour cells set HCS priority = HCS priority₁

Then apply this to the following:

1. For intra-frequency and inter-frequency threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s \leq Ssearch_{HCS}) or (if FDD and S_x \leq S_{intersearch}) THEN

measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{intrasearch})$$
 THEN

measure on all intra-frequency and inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ELSE

measure on all intra-frequency and inter-frequency cells, which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

IF (S_{intrasearch} is not sent for the serving cell) THEN

measure on all intra-frequency cells. Fast-moving UEs may also use this rule.

measure on all inter-frequency cells, which have higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $\frac{S_{intrasearch}}{S_{intrasearch}}$ or $S_{intersearch}$ (in FDD) are not sent for the serving cell, UE shall:

- measure on all intra-frequency and inter-frequency cells. Fast-moving UEs may also use this rule.
- 2. For intra-frequency and inter-frequency measurement rules for fast-moving UEs:

If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall

IF the UE is measuring all cells according to the intra-frequency and inter-frequency threshold based measurement rules above THEN

- prioritise reselection of intra-frequency and inter-frequency neighbouring cells having lower HCS priority level than the serving cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having the same HCS priority before neighbouring cells having higher HCS priority level.

ELSE

- measure intra-frequency and inter-frequency neighbouring cells, which have equal or lower HCS priority than serving cell.
- prioritise re-selection of intra-frequency and inter-frequency neighbouring cells on lower HCS priority level than the serving cell before neighbouring cells on same HCS priority level.

ENDIF

When the number of cell reselections during time period T_{CRmax} no longer exceeds N_{CR}, UE shall

- continue these measurements during time period T_{CrmaxHvst}
- if the criteria for entering high mobility is not detected during time period $T_{CrmaxHyst}$:

- revert to measurements according to the threshold based measurement rules.

When serving cell belongs to a hierarchical cell structure, the UE shall follow these rules for Inter-RAT measurements:

1. Inter-RAT threshold-based measurement rules

use Squal for FDD cells and Srxlev for TDD cells for Sx and apply the following rules.

IF (Srxlev_s
$$\leq$$
 S_{HCS,RATm}) or (if FDD and S_{qual} \leq S_{SearchRATm}) THEN

UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

ELSE

IF
$$(S_x > S_{limit, SearchRATm})$$
 THEN

UE may choose to not measure neighbouring cells in RAT "m". Inter-RAT measurements that may have been performed shall not be considered in the cell-reselection criteria.

ELSE

UE shall measure on all neighbouring cells in RAT "m", which have equal or higher HCS priority level than the serving cell unless measurement rules for fast-moving UEs are triggered

ENDIF

ENDIF

If HCS is used and if $S_{HCS,RATm}$ is not sent for the serving cell, UE shall measure on all inter-RATm cells. Fast-moving UEs may also use this rule.

- 2. Inter-RAT measurement rules for fast-moving UEs
 - If the number of cell reselections during time period T_{CRmax} exceeds N_{CR} , high-mobility has been detected. In this high-mobility state, UE shall
 - IF the UE is measuring neighbouring cells of RAT "m" according to the inter-RAT threshold based measurement rules above THEN
 - prioritise re-selection of neighbouring cells in RAT "m" having lower HCS priority level than the serving
 cell before neighbouring cells having the same HCS priority level and prioritise neighbouring cells having
 the same HCS priority before neighbouring cells having higher HCS priority level.
 - ELSE
 - measure the neighbouring cells in RAT "m", which have an equal or lower HCS priority than the serving cell
 - prioritise re-selection of neighbouring cells in RAT "m" on lower HCS priority level than the serving cell before neighbouring cells in RAT "m" on same HCS priority level.
 - ENDIF

When the number of cell reselections during time interval T_{CRmax} no longer exceeds N_{CR} , UE shall

- continue these measurements during time period T_{CrmaxHyst}
- if the criteria for entering high mobility is not detected during time period $T_{CrmaxHyst}$
 - revert to measure according to the threshold-based measurement rules.

5.2.6.1.3 Highest ranked cells with access restrictions

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in subclause 5.2.6.1.4, the UE shall check if the access is restricted according to the rules in subclause 5.3.1.1.

If that cell and other cells have to be excluded from the candidate list, as stated in subclause 5.3.1.1, the UE shall not consider these as candidates for cell reselection. This limitation is removed when the highest ranked cell changes.

5.2.6.1.4 Cell Reselection Criteria

[This subclause will need material on the MBMS offset, expected as part of the FLC changes.]

The following cell re-selection criteria are used for intra-frequency cells, inter-frequency cells and inter-RAT cells:

The quality level threshold criterion H for hierarchical cell structures is used to determine whether prioritised ranking according to hierarchical cell re-selection rules shall apply, and is defined by:

$$H_s = Q_{meas,s}$$
 - $Qhcs_s$
$$H_n = Q_{meas,n}$$
 - $Qhcs_n - TO_n * L_n$

If it is indicated in system information that HCS is not used, the quality level threshold criterion H is not applied.

The cell-ranking criterion R is defined by:

$$R_s = Q_{meas,s} + Qhyst_s + Qoffmbms$$

$$R_n = Q_{meas,n} - Qoffset_{s,n} + Qoffmbms - TO_n * (1 - L_n)$$

where:

the signalled value Qoffmbms is only applied to those cells (serving or neighbouring) belonging to the MBMS PL where:

$$\begin{split} TO_n &= TEMP_OFFSET_n * W(PENALTY_TIME_n - T_n) \\ L_n &= 0 & \text{if } HCS_PRIO_n = HCS_PRIO_s \\ L_n &= 1 & \text{if } HCS_PRIO_n <> HCS_PRIO_s \\ \\ W(x) &= 0 & \text{for } x < 0 \\ W(x) &= 1 & \text{for } x >= 0 \end{split}$$

 $TEMP_OFFSET_n$ applies an offset to the H and R criteria for the duration of $PENALTY_TIME_n$ after a timer T_n has started for that neighbouring cell.

TEMP_OFFSET_n and PENALTY_TIME_n are only applicable if the usage of HCS is indicated in system information.

The timer T_n is implemented for each neighbouring cell. T_n shall be started from zero when one of the following conditions becomes true:

- if HCS_PRIO_n <> HCS_PRIO_s and

$$Q_{meas}, n > Qhcs_n$$

Or

- if HCS_PRIO_n = HCS_PRIO_s and
 - for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH RSCP in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

- for serving FDD and neighbour FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No in the serving cell, and:

$$Q_{meas,n} > Q_{meas,s} + Qoffset2_{s,n}$$

- for all other serving and neighbour cells:

$$Q_{meas,n} > Q_{meas,s} + Qoffset1_{s,n}$$

 T_n for the associated neighbour cell shall be stopped as soon as any of the above conditions are no longer fulfilled. Any value calculated for TO_n is valid only if the associated timer T_n is still running else TO_n shall be set to zero.

At cell-reselection, a timer T_n is stopped only if the corresponding cell is not a neighbour cell of the new serving cell, or if the criteria given above for starting timer T_n for the corresponding cell is no longer fulfilled with the parameters of the new serving cell. On cell re-selection, timer T_n shall be continued to be run for the corresponding cells but the criteria given above shall be evaluated with parameters broadcast in the new serving cell if the corresponding cells are neighbours of the new serving cell.

Sn	Cell Selection value of the neighbouring cell, (dB)
Q _{meas}	Quality value. The quality value of the received signal derived from the averaged CPICH
	Ec/No or CPICH RSCP for FDD cells, from the averaged P-CCPCH RSCP for TDD cells
	and from the averaged received signal level for GSM cells. The averaging of these
	measurement quantities are performed as specified in [10] and [11]. For FDD cells, the
	measurement that is used to derive the quality value is set by the
	Cell_selection_and_reselection_quality_measure information element.

Cell reselection parameters broadcast in system information are listed in subclause 5.2.6.1.5.

The cell selection criterion S used for cell reselection is fulfilled when:

for FDD cells:	Srxlev > 0 AND Squal > 0
for TDD cells:	Srxlev > 0
for GSM cells:	Srxlev > 0

Where:

$$Squal = Q_{qualmeas} - Qqualmin \\ Srxlev = Q_{rxlevmeas} - Qrxlevmin - Pcompensation$$

Squal	Cell Selection quality value (dB)
	Applicable only for FDD cells.
Srxlev	Cell Selection RX level value (dB)
Q _{qualmeas}	Measured cell quality value. The quality of the received signal expressed in CPICH E _C /N ₀
	(dB) for FDD cells. CPICH Ec/N0 shall be averaged as specified in [10].
	Applicable only for FDD cells.
Q _{rxlevmeas}	Measured cell RX level value. This is received signal, CPICH RSCP for FDD cells (dBm),
	P-CCPCH RSCP for TDD cells (dBm) and the averaged received signal level as
	specified in [10] for GSM cells (dBm). CPICH RSCP, P-CCPCH RSCP and the received
	signal level for GSM cells shall be averaged as specified in [10] and [11].
Qqualmin	Minimum required quality level in the cell (dB). Applicable only for FDD cells.
Qrxlevmin	Minimum required RX level in the cell (dBm)
Pcompensation	max(UE_TXPWR_MAX_RACH - P_MAX, 0) (dB)
UE_TXPWR_MAX_RACH	Maximum TX power level an UE may use when accessing the cell on RACH (read in
	system information) (dBm)
P_MAX	Maximum RF output power of the UE (dBm)

The UE shall perform ranking of all cells that fulfil the S criterion among

- all cells that have the highest HCS_PRIO among those cells that fulfil the criterion H >= 0. Note that this rule is not valid when UE high-mobility is detected (see subclause 5.2.6.1.2).
- all cells, not considering HCS priority levels, if no cell fulfil the criterion H >= 0. This case is also valid when it is indicated in system information that HCS is not used, that is when serving cell does not belong to a hierarchical cell structure.

The cells shall be ranked according to the R criteria specified above, deriving $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values using CPICH RSCP, P-CCPCH RSCP and the averaged received signal level as specified in [10] and [11] for FDD, TDD and GSM cells, respectively.

The offset Qoffset1_{s,n} is used for Qoffset_{s,n} to calculate R_n , the hysteresis Qhyst1_s is used for Qhyst_s to calculate R_s . For UE in RRC connected mode states CELL_PCH or URA_PCH the hysteresis Qhyst_s takes the value Qhyst1_{s,PCH} to calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhyst_s takes the value Qhyst1_{s,FACH} to calculate R_s , if provided in SIB4 [see 4].

If the usage of HCS is indicated in system information, $TEMP_OFFSET1_n$ is used for $TEMP_OFFSET_n$ to calculate TO_n . If it is indicated in system information that HCS is not used, $TEMP_OFFSET_n$ is not applied when calculating R_n . The best ranked cell is the cell with the highest R value.

If a TDD or GSM cell is ranked as the best cell, then the UE shall perform cell re-selection to that TDD or GSM cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH RSCP, the UE shall perform cell re-selection to that FDD cell.

If an FDD cell is ranked as the best cell and the quality measure for cell selection and re-selection is set to CPICH Ec/No, the UE shall perform a second ranking of the FDD cells according to the R criteria specified above, but using the measurement quantity CPICH Ec/No for deriving the $Q_{meas,n}$ and $Q_{meas,s}$ and calculating the R values of the FDD cells. The offset Qoffset2_{s,n} is used for Qoffset_{s,n} to calculate R_n , the hysteresis Qhyst2_s is used for Qhyst_s to calculate R_s . For UE in RRC connected mode states CELL_PCH or URA_PCH the hysteresis Qhyst_s takes the value Qhyst2_{s,PCH} to calculate R_s , if provided in SIB4 [see 4]. For UE in RRC connected mode state CELL_FACH the hysteresis Qhyst_s takes the value Qhyst2_{s,FACH} to calculate R_s , if provided in SIB4 [see 4]. If the usage of HCS is indicated in system information, TEMP_OFFSET2_n is used to calculate TO_n. If it is indicated in system information that HCS is not used, TEMP_OFFSET_n is not applied when calculating R_n . Following this second ranking, the UE shall perform cell reselection to the best ranked FDD cell.

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better ranked than the serving cell during a time interval Treselection. For UE in RRC connected mode states CELL_PCH or URA_PCH the interval Treselection_{s,PCH} applies, if provided in SIB4 [see 4], while for UE in RRC connected mode state CELL_FACH the interval Treselection_{s,FACH} applies, if provided in SIB4 [see 4]. For hierarchical cell structures when high mobility state has not been detected, if according to the HCS rules the serving cell is not ranked then all the ranked cells are considered to be better ranked than the serving cell.
- more than 1 second has elapsed since the UE camped on the current serving cell.

5.2.6.1.5 Cell reselection parameters in system information broadcasts

The selection of values for network controlled parameters can be optimised by means of different methods. Examples of methods are described in [6]. Cell reselection parameters are broadcast in system information and are read in the serving cell as follows:

Qoffset1_{s,n}

This specifies the offset between the two cells. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qoffset2_{s,n}

This specifies the offset between the two cells. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

Qhyst1s

This specifies the hysteresis value (Qhyst). It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

Qhyst1_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst1_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP. If this parameter is not provided in SIB4, Qhyst1_s shall be used.

Qhyst2s

This specifies the hysteresis value (Qhyst). It is used for FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No.

Qhyst2_{s,PCH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode states CELL_PCH and URA_PCH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, $Qhyst2_s$ shall be used.

Qhyst2_{s,FACH}

This specifies the hysteresis value (Qhyst) to be used in RRC connected mode state CELL_FACH. It is used for FDD cells if the quality measure for cell selection and re-selection is set to CPICH Ec/No. If this parameter is not provided in SIB4, Qhyst2_s shall be used.

HCS_PRIOs, HCS_PRIOn

This specifies the HCS priority level (0-7) for serving cell and neighbouring cells.

HCS priority level 0 means lowest priority and HCS priority level 7 means highest priority.

HCS_OFF_{mbms}

This specifies the offset to the normal HCS priority level that is used for cells belonging to the MBMS PL.

Qhcs_s, Qhcs_n

This specifies the quality threshold levels for applying prioritised hierarchical cell re-selection.

Ooffmbms

This specifies the additional offset added to cells belonging to the MBMS PL.

Qqualmin

This specifies the minimum required quality level in the cell in dB. It is not applicable for TDD cells or GSM cells.

Qrxlevmin

This specifies the minimum required RX level in the cell in dBm.

PENALTY TIME_n

This specifies the time duration for which the TEMPORARY_OFFSET_n is applied for a neighbouring cell.

TEMPORARY_OFFSET1_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME_n. It is used for TDD and GSM cells and for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH RSCP.

TEMPORARY_OFFSET2_n

This specifies the offset applied to the H and R criteria for a neighbouring cell for the duration of PENALTY_TIME_n. It is used for FDD cells in case the quality measure for cell selection and re-selection is set to CPICH Ec/No.

T_{CRmax}

This specifies the duration for evaluating allowed amount of cell reselection(s).

N_{CR}

This specifies the maximum number of cell reselections.

$T_{CRmaxHyst}$

This specifies the additional time period before the UE can revert to low-mobility measurements.

Treselections

This specifies the cell reselection timer value.

Treselection_{s,PCH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode states CELL_PCH and URA_PCH if provided in SIB4, otherwise Treselection_s shall be used.

Treselection_{s,FACH}

This specifies the cell reselection timer value the UE shall use in RRC connected mode state CELL_FACH if provided in SIB4, otherwise Treselection_s shall be used.

Ssearch_{HCS}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the limit for Srxlev in the serving cell below which the UE shall initiate measurements of all neighbouring cells of the serving cell.

Ssearch_{RAT 1} - Ssearch_{RAT k}

This specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

$S_{HCS,RATm}$

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold in the serving cell used in the inter-RAT measurement rules.

Sintrasearch

This specifies the threshold (in dB) for intra frequency measurements and for the HCS measurement rules.

Sintersearch

This specifies the threshold (in dB) for inter-frequency measurements and for the HCS measurement rules.

S_{limit,SearchRATm}

This threshold is used in the measurement rules for cell re-selection when HCS is used. It specifies the RAT specific threshold (in dB) in the serving UTRA cell above which the UE may choose to not perform any inter-RAT measurements in RAT "m".

5.2.6.2 GSM case

The cell reselection procedure in GSM, including reselection from GSM to UTRA, is specified in [1].