Archives

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1.6 Cell Selection and Re-Selection

1.6.1 Cell Selection

When a MS is switched on, it tries to contact GSM PLMN that the SIM permits and select a proper cell to extract control channel parameters and other system information. This process is called cell selection.

The priority levels of cells include normal, low, and barred. Low priority level cell is selected when there is no proper normal cell.

A proper cell means:

The cell belongs to the selected network;

The cell is not barred;

The cell is not in the national prohibited roaming location area;

The path loss between MS and BTS is under the limit set by network.

The priority level of a cell is determined by CELL_BAR_QUALIFY (CBQ) and CELL_BAR_ACCESS (CBA).

1.6.2 Cell Selection Process

To perform cell selection and re-selection, MS requires all the frequencies monitored to stay at the unweighted average value of Relev RLA_C.

I. Cell Selection When MS Storing No BCCH Information

MS searches all RF channels (at least 30 channels for 900 M, 40 for 1800 M, and 40 for PSC1900) in the system to obtain the Relev of each RF channel, and calculate the RLA_C based on at least five samples in three to five seconds, and then arrange these levels in descending order to select the proper BCCH. MS selects the cells with normal priority first. If the proper cells have low priority, MS will select the cell with the highest Relev. MS has already decoded and identified all these frequencies by now. If there is no proper cell, MS will keep on searching. It takes a maximum of 0.5 s to synchronize a BCCH TRX and 1.9 s to read the synchronized BCCH TRX data, except that it takes n*1.9s(n>1)to obtain the system information.

II. Cell Selection When MS Storing BCCH Information

If MS stores the BCCH frequency list of the former selected networks, MS will perform measurement sampling procedure (only for the stored BCCH TRX) according to this list. If the cell selection within this list fails, common cell selection will be performed. If all the cells have low priority level, MS will select the cell with the highest Relev. MS has already decoded and identified all these frequencies by now. When a 900 M MS enters the 900/1800 network, MS will probably choose 900 M network and ignore the priority level, because the MS stores all the 900 M frequency information in BCCH frequency list.

III. Cell Selection Criteria

Parameter C1 is the path loss criteria for cell selection, C1 of the service cell must exceed 0, the formula is as follows:

C1= RLA_C - RXLEV_ACCESS_MIN- MAX ((MS_TXPWR_MAX_CCH- P), 0) (2-1)

For DCS 1800 cells:

C1 = RLA_C - RXLEV_ACCESS_MIN- MAX ((MS_TXPWR_MAX_CCH + POWER OFFSET- P), 0)

In the formula:

RLA_C: Average value of Relev

RXLEV_ACCESS_MIN: Minimum Relev that MS allows

MS_TXPWR_MAX_CCH: Maximum transmit power on control channel

P: Maximum transmit power of MS

POWER OFFSET: Power offset related to MS_TXPWR_MAX_CCH used by DCS1800 cells.

1.6.3 Down Link Failure

Downlink failure criteria are based on DSC. When a mobile phone stays in a cell, DSC is initialized to an integer most close to 90/N (N is BS_PA_MFRMS, range value: 2–9). Each time when mobile phone successfully decodes a message on its paging subchannel, DSC increases by 1, but DSC cannot exceed the initial value; when decoding fails, DSC decreases by 4. When DSC<=0, downlink failure occurs. Down signaling link failure will lead to cell re-selection.

1.6.4 Cell Re-Selection Process

In cell re-selection, mobile phone will synchronize and read the information from six BCCH TRXs (in BA list) with strongest signals outside the service area. For multi-frequency mobile phones, the TRXs with strongest signals may be in different frequency bands.

In idle mode, mobile phone monitors all the BCCH TRXs in BA list and averages each Relev from BCCH TRX within 5 s to Max {5, ((5 * N + 6) DIV 7) * BS_PA_MFRMS / 4} s. N is the number of BCCH TRXs outside service area in BA list. Each RLA_C requires at least five level measurement samples and has to be updated from time to time. Service area samples the Relev at least once for each paging block to mobile. RLA_C is calculated by averaging the level samples received from 5s to Max {5s, five consecutive paging blocks of that MS}.

Each RLA_C update is followed by the update of the six BCCH TRXs outside the service area in BA list. And the latter update may be even faster.

Mobile phone decodes all the BCCH data in a service cell every other 30 s and the BCCH data blocks related to cell re-selection parameters of the six BCCH TRXs with strongest signals every other five minutes. When the mobile phone detects that a new BCCH TRX becomes one of the six TRXs with strongest signals, this BCCH TRX data should be decoded within 30 s. Mobile phone checks the BSICs of the six BCCH TRXs with strongest signals to make sure they are in the same cell. If the BSIC of a TRX is changed, the MS will regard the TRX as new TRX and reread the BCCH data.

MS will re-select a neighbor cell as service cell under certain condition. This condition includes several factors, such as RLA_C, cell restriction (decided by cell_bar and cell_bar_qualify), and access state of the neighbor cell.

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Cell re-selection adopts C2 algorithm. The calculation formula is as follows:
When PENALTY TIME is not 11111
C2=C1+CELL_RESELECT_OFFSET–TEMPORARY_OFFSET*H (PENALTY_TIME–T);
When PENALTY_TIME is 11111
C2=C1-CELL_RESELECT_OFFSET.
When X>0, function H(x) =0; when X≤O, function H(x) =1.
T is a timer; its initial value is 0. When a cell is included in the six neighbor cells with strongest signals by MS, the timer T of this cell begins to time; when a cell is excluded from the six neighbor cells with strongest signals by MS, T will be reset.
CELL_RESELECT_OFFSET adjusts the value of C2.
After T starts, TEMPORARY_OFFSET will modify the C2 algorithm according to the defined value before the penalty time in order to avoid a micro cell or a cell with small coverage area is selected by a fast moving MS. If the defined penalty time is out, the temporary offset will be ignored. Penalty time can avoid the frequent cell re-selection in those coverage areas like express highway.
These parameters in C2 algorithm works only when CELL_RESELECTION_INDICATION is activated. Otherwise, MS will ignore the setting of CELL_RESELECT_OFFSET, TEMPORARY_OFFSET, and PENALTY_TIME, under such circumstances, C2=C1.
Cell re-selection will be triggered under the following conditions:
The C2 value of a certain cell (belonging to the same location area with the current cell) exceeds that of the current cell by 5 seconds successively;
The C2 value of a certain cell (belonging to different location area from the current cell) exceeds the sum of the C2 value of the current service cell and cell selection hysteresis value by 5 seconds successively;
The current service cell is barred;
MS detects downlink failure;
The C1 value of the service cell is less than 0 for 5 seconds successively.
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