Agenda Item: 15.1

Source: CSELT

Title: Criteria for Soft Handover Algorithm

Document for: Discussion and Decision

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1   Introduction

This document addresses the mechanisms of the Soft Handover and proposes an example of Soft Handover algorithm.

2   Soft Handover Criteria

2.1   Soft Handover Parameters and definitions

Soft Handover is an handover in which the mobile station starts communication with a new BS on a same carrier frequency, or sector of the same site (softer handover), performing utmost a change of code. For this reason Soft Handover allows easily the provision of macrodiversity transmission; for this intrinsic characteristic terminology tends to identify Soft Handover with macrodiversity even if they are two different concepts; for its nature soft handover is used in CDMA systems where the same frequency is assigned to adjacent cells. As a result of this definition there are areas of the UE operation in which the UE is connected to a number of BSs. With reference to Soft Handover, the "Active Set" is defined as the set of BSs the UE is simultaneously connected to (i.e., the UTRA cells currently assigning a downlink DPCH to the UE constitute the active set).

The Soft Handover procedure is composed of a number of single functions:
- Measurements;
- Filtering of Measurements;
- Reporting of Measurement results;
- The Soft Handover Algorithm;
- Execution of Handover.

The reminder of the document focuses on the Soft Handover Algorithm. The measurements of the monitored cells filtered in a suitable way constitute the basic input of the Soft Handover Agorithm. In order to exhaustively describe the Soft Handover Algorithm the following definitions are relevant:

"Candidate Set": the cells that are not currently in the Active Set but have been received by the UE with sufficient strength to indicate that the associated DPCH could be successfully demodulated.

"Neighbor Set": the cells that are not currently in the Active Set or the Candidate Set but are likely candidates for handoff.

Based on the measurements of the set of cells monitored, the Soft Handover function evaluates if any BS should be added to ("add"), removed from ("drop"), or replaced in ("rep") the Active Set; performing than what is known as "Active Set Update" procedure.

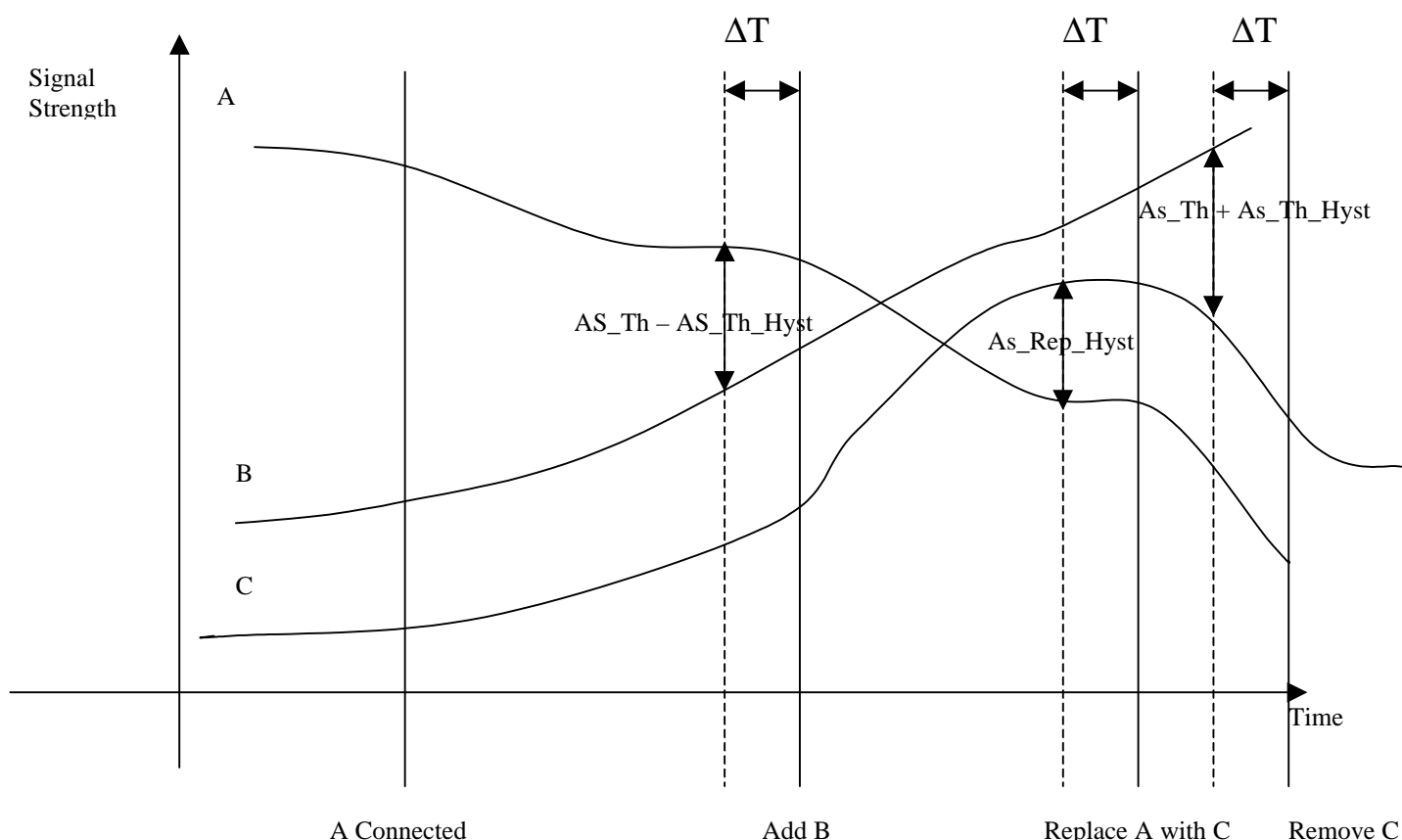For the description of the Soft Handover algorithm the definition of the following parameters is needed:

AS_Th: Threshold for macro diversity;

AS_Th_Hyst: Hysteresis for the threshold;

AS_Rep_Hyst: Replacement Hysteresis;

AS_Max_Size: Maximum size of Active Set

The following figure describes the meaning of this parameters

Figure 1 shows the signal strenght of three different cells highlighting which of the BS belongs to the active Set

In order to explain Figure 1 the following definitions are used:
- Best_Ss :the highest measured cell present in the Active Set;
- Worst_Old_Ss: the lowest measured cell present in the Active Set;
- Best_Cand_Set:the highest measured cell present in the candidate set .
- Meas_Sign :the measured and filtered signal strength.

As described in Figure 1:
- If Meas_Sign is below (Best_Ss - As_Th - As_Th_Hyst) for a period of ΔT remove Worst BS in the Active Set.
- If Meas_Sign is greater than (Best_Ss - As_Th + As_Th_Hyst) for a period of ΔT and the Active Set is not full add Best BS outside the Active Set in the Active Set.
- If Active Set is full and Best_Cand_Ss is greater than (Worst_Old_Ss + As_Rep_Hyst) for a period of ΔT add best BS outside Active Set and Remove Worst BS in the Active Set.

2.2 *Soft Handover Criteria*

- In this section a detailed flow chart of a Soft Handover Algorithm based on the criteria described above is presented. This algorithm uses as input the filtered measurements of the monitored cell.

```
                        ┌──────────────┐
                        │    Begin     │
                        └──────┬───────┘
                               │
                        ╱──────────────╲
                       ╱  Meas_Sign >    ╲
                      ╱   Best_Ss          ╲      No    ┌─────────────────┐
                      ╲   – As_Th –        ╱──────────→ │ Remove Worst_Bs │
                       ╲  as_Th_Hyst      ╱             │ in the Active Set│
                        ╲ for a period   ╱              └─────────────────┘
                         ╲  of ΔT       ╱
                          ╲────────────╱
                               │ Yes
                        ╱──────────────╲
                       ╱  Meas_Sign >    ╲
                      ╱  Best_Ss – As_Th  ╲   Yes      ╱──────────────╲
                      ╲  + as_Th_Hyst     ╱──────────→╱ Active Set Full ╲
                       ╲ for a period     ╱           ╲                 ╱
                        ╲  of ΔT         ╱             ╲───────────────╱
                         ╲──────────────╱       Yes │        No │
                            │ No                    │           │
                                          ╱──────────────╲   ┌──────────────┐
                                         ╱ Best_Cand_Ss > ╲  │ Add Best_Bs  │
                                        ╱  Worst_Old_Ss +  ╲ │ in the Active│
                                        ╲  As_Rep_Hyst     ╱ │     Set      │
                                         ╲ for a period    ╱ └──────────────┘
                                          ╲  of ΔT        ╱
                                           ╲────────────╱  No
                                      Yes │
                                 ┌──────────────────┐
                                 │ Add Best BS in   │
                                 │ Active Set and   │
                                 │ Remove Worst Bs  │
                                 │ from th Active Set│
                                 └──────────────────┘
```
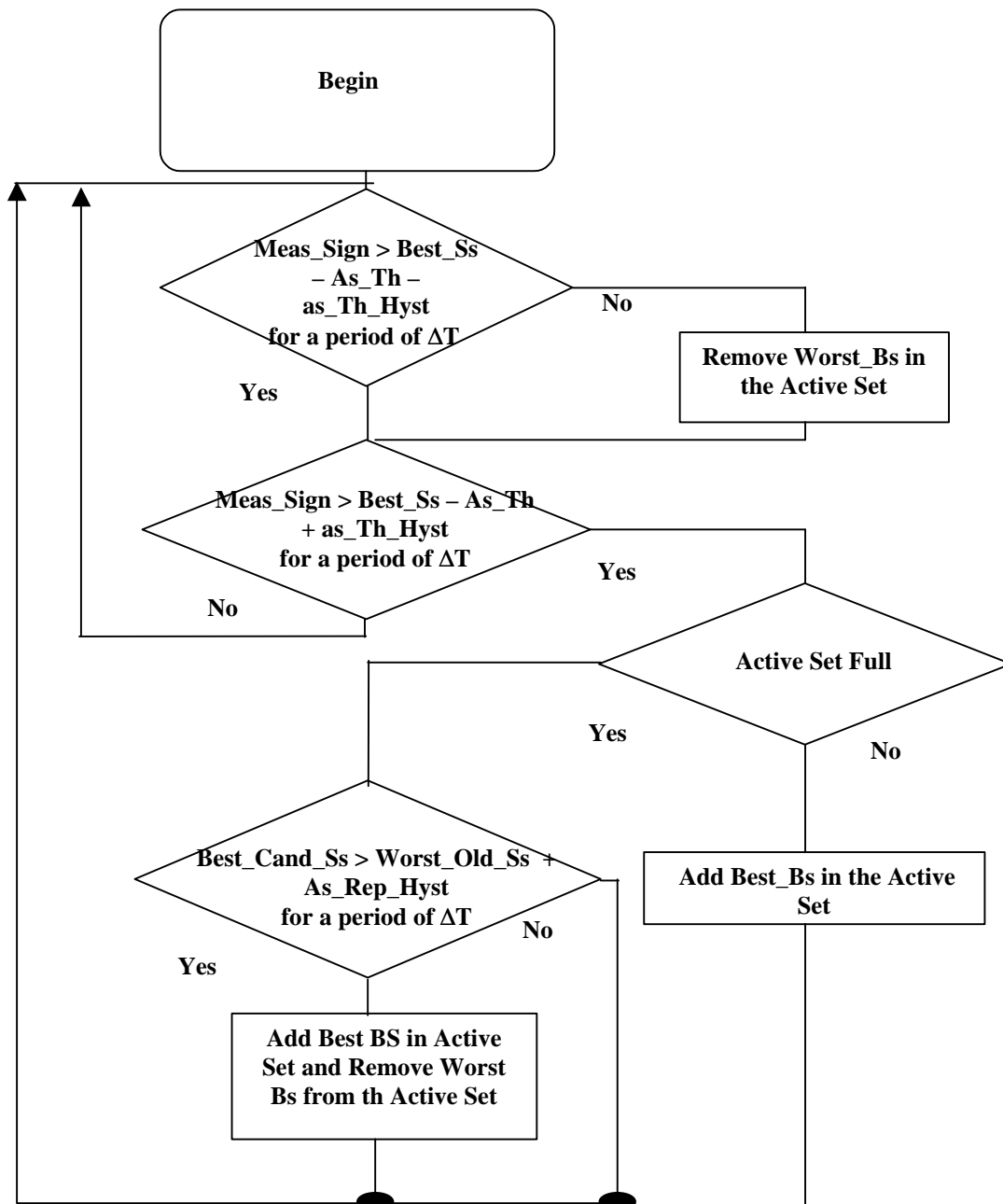
3 Conclusions

This document presents an example of algorithm for the implementation of the Soft Handover Execution and proposes to include this example as information in the proper sections in TR 25.922.