3GPP TSG RAN WG4 #2 **Tdoc R4-99-068**
Turin, Italy **Agenda Item 7.4**
15 – 19 February 1999

Title: Requirements on Handover for 3G

Source: Vodafone, Telia, France Telecom.

Purpose: Discussion and Decision

1 Introduction

Handover is a complex tool that requires careful consideration and understanding of the requirements in order to ensure the best QoS is provided to the user. From a high level perspective handover provides the following

- **Continuity of call**
- **Optimum radio link selection**
- **Traffic distribution**

This contribution addresses the issue of handover and provides a description of the requirements as identified by operators. The paper is divided into a generic descriptive text for handover process, strategy, causes, procedures and requirements, which should be included in S4.03. The paper goes on to present some requirements for handover within and from UTRA FDD.

2 Overall process

<This section is to be added to S4.03 pending approval>

The overall handover process will be implemented in the UE and RNS. Measurement of serving radio connection downlink performance and surrounding cells received signal strengths and quality from must be made in the UE. These measurements will be signalled to the RNS for assessment. The RNS measures the uplink performance for the UE being served. The RNC uses measurements in conjunction with defined thresholds and handover strategy to make a handover decision

3 Handover strategy

<This section is to be added to S4.03 pending approval>

The handover strategy employed by the network for radio link control determines the handover decision that will be made based on the measurement results reported by the UE/base station and various parameters set for each cell. Network directed handover might also occur for reasons other than radio link control, e.g. to control traffic distribution between cells. The network operator will determine the exact handover strategies.

4 Causes

<This section is to be added to S4.03 pending approval>

The following is a non-exhaustive list for causes for the initiation of a handover process.

- Uplink quality
- Uplink signal strength
- Downlink quality
- Downlink signal strength
- Distance
- Change of service
- Better cell
- O&M intervention
- Directed retry
- Traffic
- Pre-emption

5 Requirements

<This section is to be added to S4.03 pending approval>

The reliability of handover in all its different formats is essential to the successful operation of a network. In performing handover preparation and execution the general requirements shall be

- Quick detection of candidate cells
- Quick synchronisation to candidate cells
- Reporting of sufficient number of candidate cells
- Quick detection of degradation of link quality
- Reliable measurement procedures of serving and target cells
- Reliable and quick reporting mechanisms
- Reliable synchronisation mechanism
- Quick and safe release of resource
- Safe guards for failed handoffs
- Minimal disruption to service
- Minimal degradation to link quality
- Minimal degradation to other users
- Full flexibility and efficiency to seamlessly handle all the spectrum allocated to a network operator

Obviously there are requirements on the network nodes to communicate reliably and for the controlling entity (SRNS) to know of resource availability.

6 Procedures

<This section is to be added to S4.03 pending approval>

6.1 UE measurement procedure

A procedure shall be implemented in the UE by which it monitors the downlink received signal level and quality from its serving cell and the downlink signal level and identity of the handover candidate cells. The method of identification of candidate cells is [FFS]. The requirements for the UE measurements are given in section.

6.2 Lists

<This section is to be added to S4.03 pending approval>

There shall be a set of frequency lists, which the network will transmit to the UE. These lists may include information about other UTRA FDD cells and some identification parameter, e.g. an identity code and position on the raster. They may also include TDD frequencies as well as GSM carriers. For GSM carriers, a frequency list shall be able to up to 32 carriers, *cf GSM.*

The subject of lists shall be considered for each type of handover separately.

7 Handover 3G to 3G

For the time being this is describing FDD handovers only.

7.1 FDD soft/softer handover

This is the basic form of handover within UTRA FDD. The aim is to ensure that the UE is communicating with the least interference possible. Some work has been performed on this issue and in particular in relation to cell acquisition. The importance of speedy detection, synchronisation and measurements of target cells cannot be overemphasised.

7.2 FDD inter-frequency hard handover

<This section is to be added to S4.03 pending approval>

There will be the need to perform inter-frequency hard handover between two carriers in FDD mode. This is particularly the case for networks that support Hierarchical Cell Structures (HCS), i.e., combinations of macro, micro, pico and other specific application cells. This is in general agreement with literature from many sources that state their view that, for example, a cell on a different carrier can support hot spots.

It is known that that the service provided by a specific layer will not be continuous. This means that there are trans-layer handovers where the UE will be handed over to a macro layer, before returning again to the micro layer.

This necessitates good performance and also introduces the fact that during soft handoff within one layer, the UE shall be able to monitor other FDD carriers for the purpose of inter-frequency handover.

From the system perspective, the inter-frequency hard handover must have comparable performance to that of soft handover.

8 Handover 3G to 2G

<This section is to be added to S4.03 pending approval>

In the early days of UMTS deployment it can be anticipated that the service area will not be as contiguous and extensive as existing second generation systems. It is also anticipated that UMTS network will be an overlay on the 2nd generation network and utilise the latter, in the minimum case, as a fall back to ensure continuity of service and maintain a good QoS as perceived by the user. This is crucial for the success of the UMTS with the consequences affecting the whole of the community.

8.1 Requirements

<This section is to be added to S4.03 pending approval>

The underlying requirement is to ensure continuity of service to the UMTS user. There will be performance requirements that should be set by operators such that the behaviour of the MS in idle and dedicated mode presents a high QoS impression to the subscriber. This means that the choice of GSM cell in a handover decision must be at a high level of 'accuracy' to ensure the optimum performance. The handover from 3G to GSM should be at least as good as GSM handovers.

8.1.1 Handover to GSM

<This section is to be added to S4.03 pending approval>

This section presents some of the important aspects of GSM handover required to be performed by the UE. For the full specifications reference should be made the GSM recommendations.

- The MS (GSM terminology) shall be able to monitor up to 32 carriers.
- The MS shall be able synchronise to 6 carriers
- The MS shall be able to report back to the network on the 6 strongest cells with correctly identified BSIC.
- The MS shall be able to perform this task at levels down to the reference sensitivity level or reference interference levels as specified in GSM 05.05.
- The MS shall demodulate the SCH on the BCCH carrier of each surrounding cell and decode the BSIC as often as possible, and as a minimum at least once every 10 seconds.

8.2 Measurement reporting

<This section is to be added to S4.03 pending approval>

The MS shall assess during the reporting period and transmit to the BSS in the next SACCH message block the following:

- RXLEV for the BCCH carrier of the 6 cells with the highest RXLEV among those with known and allowed NCC part of BSIC. For a GSM multi band MS the number of cells, for each frequency band supported, which shall be included is specified in GSM 05.08.
- The number of samples on each BCCH carrier will depend on the number of carriers defined in the BCCH Allocation (BA) and may be different.