Abstract: A method of handover of a user device (3) from a serving base station (1) to a target base station (9) in a communication system comprises transferring from the serving base station (1) to the target base station (9), one or more parameters relating to operation of the user device (3) prior to handover.
A METHOD OF HANDOVER

In the universal mobile telecommunications system (UMTS) long term
evolution (LTE) cellular radio system, user devices, known as user equipments (UE)
can be in one of two radio resource control (RRC) states, RRC_Idle and
RRC_Connected. In RRC_Idle state a UE has no connection with any base station, or
enhanced node B (eNB) and performs autonomous cell reselection. In RRC_Connected
state the UE has a connection with a particular eNB and transition between cells is by
way of network-controlled handover.

Furthermore, a UE that is in RRC Connected state can be placed in a
discontinuous operating mode, sometimes referred to as discontinuous receiving (DRx),
whereby the UE need only receive during periodic time intervals. This enables power
saving by the UE and is appropriate when the UE has had a low rate of data transfer, or
has transferred no data for a period of time. The UE can be instructed to enter a DRx
state by the network, for example by the RRC entity in the eNB, or it could
autonomously enter a DRx state after a period of data transfer inactivity. The interval
between the times when the UE receives, the DRx period, could be increased the longer
the UE has been activity. This change in period can be signalled to the UE by the eNB,
or it can be changed autonomously by the UE. The eNB and the UE must both have a
precise knowledge of the DRx period in use by the UE, consequently if the UE changes
autonomously it must do so using predefined rules based on time intervals that are
known by the eNB. If the UE recommences data transfer, or the data transfer rate
increases above a threshold level the UE can be changed from DRx operation to normal
operation.

The relevant standards do not yet identify what will initiate the change of a
UE’s state from RRC Connected state to RRC Idle state, nor how the transition will be
controlled. One potential trigger for the change of RRC state is data transfer inactivity
detected at the serving eNB (i.e. at the eNB with which the UE has a signalling/ data
connection and which controls its behaviour). Data transfer activity might be measured
taking account of user data transfer and non-access stratum signalling. One possibility
would be for the eNB to set a timer running when activity in these domains stops, the
timer being stopped when activity recommences. Should this inactivity timer run,
without being stopped, for a defined time, the UE can then be transferred from RRC
Connected to RRC Idle by control signalling.
A second possible trigger for the change of RRC state is the time that the UE has been in DRx operation, or the completion, by the UE, of a particular length of time with a particular DRx period e.g. the maximum DRx period. The eNB is aware of the length of time that the UE has been in a particular DRx operating mode and can initiate the transition from RRC Connected state to RRC Idle state, when the completion of the appropriate time periods has been detected.

UMTS LTE UEs that are in RRC Connected state will change cells as a result of mobility by way of network-controlled handover. The serving eNB detects from measurement reports that the UE should change the eNB through which it operates. The serving eNB will select a target (replacement) eNB and request that it accepts the UE. If the target eNB is able to accept the UE, then the serving eNB transmits a Handover Command message to the UE, instructing it to establish communication through the target eNB. As part of this process the serving eNB transfers a UE context, i.e. a set of UE specific information, to the target eNB to enable communication with it e.g. security parameters.

In accordance with the present invention, a method of handover of a user device from a serving base station to a target base station in a communication system comprises transferring from the serving base station to the target base station, one or more parameters relating to operation the user device prior to handover.

Preferably, the parameters relate to elapsed time of operation of a particular state of the user device, or to the state of operation itself.

Preferably, the or each parameter is transferred as part of a context transfer.

Typically, the system is a UMTS LTE system, the user device is a UMTS LTE UE and the base station is an eNB.

In order to enable the target eNB to transfer the UE from RRC Connected to RRC Idle state at the time appropriate to its level of activity, the target eNB requires from the serving eNB, dependent upon how the change of state is triggered, one or a combination of more than one of the following parameters. The time elapsed by an inactivity timer in the serving eNB at the time the handover was initiated or executed; the length of time that the UE has been operating with a particular DRx period prior to the handover being initiated; and the DRx state (DRx period) that the UE was operating with prior to the handover being initiated.
The parameters can be transferred from the serving eNB to the target eNB as part of the UE context transfer. In the case of DRx, the UE may transition from DRx to make measurement reports and engage in RRC signalling associated with the handover hence there is some timing uncertainty. The present invention has the advantage that the state transition can be based on a UE’s activity level, even if handovers are taking place. This is particularly the case when UEs are fast moving and making frequent cell changes. If the necessary ones of the parameters listed above were not transferred with the context, then the inactivity history of the UE would be lost and inactivity timers and/or DRx activity timers would have to be restarted from a null state, meaning that UEs that move between cells often might never be moved to the appropriate operating conditions.

The signalling procedures involved in the method of the present invention is illustrated in Figure 1. Fig. 1 shows the context transfer within the handover procedure which enables the target eNB to restart timers at the transferred values and set the UE into the correct DRx state. A serving eNB 1 sets a DRx period 2 for a UE 3. The UE sends a measurement report 4 back to the serving eNB. The serving eNB resets the DRx timer 5, 6, whereas the inactivity timer continues to run 7 until the measurement report is received. The serving eNB 1 then sends a Handover Request 8 to a target eNB 9, which replies with a Handover Accept message 10. The serving eNB sends a Handover Command 11 to the UE and a context transfer 12 to the target eNB. When the UE 3 has sent a Handover Complete message 13 to the target eNB 9, the DRx timer 14 and inactivity timer 15 are restarted and the target eNB 9 sends a set DRx period 16 to the UE 3.
CLAMS

1. A method of handover of a user device from a serving base station to a target base station in a communication system, the method comprising transferring from the serving base station to the target base station, one or more parameters relating to operation of the user device prior to handover.

2. A method according to claim 1, wherein the parameters relate to elapsed time of operation of a particular state of the user device, or to state of operation itself.

3. A method according to claim 1 or claim 2, wherein the, or each, parameter is transferred as part of a context transfer.

4. A method according to any preceding claim, wherein the system is a UMTS LTE system, the user device is a UMTS LTE UE and the base station is an eNB.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INVENTION: H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. RELOCS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

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