

Method of transmitting timing advance data to a mobile in a cellular mobile radio network and corresponding mobile, base station and transmission system

5 The invention concerns the transmission of timing advance data to mobiles in a cellular mobile radio network such as a GSM (Groupe Spécial Mobile) network when mobiles move from one cell to another. The mobiles are car phones, for example, and the timing advance data must enable a mobile moving from one cell to another to
10 advance the timing of its transmission of digital data so that it is synchronised with the transceiver station of the new cell. The standard term for this procedure in the GSM system is "handover" and this term is used hereinafter.

15 The following description uses the standard GSM terminology. For more information on this reference may usefully be had to the proceedings of the "Digital Cellular Mobile Communication Seminar" held in Nice from 16 through 18 October 1990.

20 Figure 1 shows the structure of a cellular mobile radio network such as a GSM type network.

A mobile MS such as a car phone, for example, moves inside a cell C1 defined by the geographical coverage of a base transceiver station BTS1. Other cells C2, C3 each
25 comprise a respective base transceiver station BTS2, BTS3. Each of the stations BTS1 through BTS3 is one component of the GSM network and comprises one or more transceivers each associated with an antenna and processing equipment. The geographical coverage areas
30 overlap in part. The stations BTS1 through BTS3 are managed by a base station controller BSC. The functions of the BSC include management of BTS frequency channels. A BSC associated with a number of BTS constitutes a base station system BSS. Other controllers may also be
35 provided, each controlling a predetermined number of BTS

and each being connected to a mobile services switching centre MSC which is the master structure of a GSM network. A given MSC can therefore control the operation of several BSS constituting a public land mobile network (PLMN).

A network of this kind operates as follows: the mobile MS sends streams of digital data in the form of packets to the base transceiver station BTS1 while it is in the cell C1 and the station BTS1 forwards these streams to the BSC which sends them to their destination via the MSC. This destination may be another mobile or a fixed station.

Each data packet contains speech data, for example, and is transmitted in a 577 μ s time slot, eight consecutive time slots constituting a frame. Eight mobiles MS can therefore communicate on the same radio channel, i.e. using the same carrier frequency, using time division multiple access (TDMA). Between two and four channels are usually assigned to each BTS and between 16 and 32 radio channels are therefore available for transmission (and reception) in each cell.

A problem arising in the GSM system is that of synchronising time slots assigned to a mobile MS to the master clock at the BTS. It is necessary to allow for the propagation time of radio waves between a mobile MS and its BTS because the mobiles and the BTS serving them each have their own internal bit clock. As the duration of a time slot is 577 μ s and as a radio wave travels 300 m in 1 μ s (3×10^8 m/s), the clock of the mobile MS must allow for a time shift of 1 μ s per 300 m of distance between it and the BTS in order to avoid sending data during the time slot assigned to another mobile MS.

Figure 2 is a correlative timing diagram showing signals sent by the base transceiver station BTS1 and by the mobile MS. It shows how the appropriate timing

advance is communicated to the mobile.

The base transceiver station BTS1 managing the cell in which the mobile MS is located sends a clock signal H_0, H_1, H_2, H_3, H_4 regularly, at times T_0, T_1, T_2, T_3 and T_4 on a synchronisation channel SCH which is part of a broadcast control channel BCCH for transmitting synchronisation information to the mobiles. This clock signal is used when the mobile MS must be logged onto a cell of the GSM network, for example when it is switched on or in the event of handover (see below).

The mobile MS connects to the network for the first time after it is switched on and can receive the clock signal only from the time MS_{ON} at which it is switched on.

Given that the mobile MS is not usually located at the base transceiver station BTS1, the first clock signal H_1 that it receives after time MS_{ON} is shifted by a time τ relative to the time T_1 at which it is sent by the station BTS1. The signal H_1 is therefore received by the mobile at time $T_1 + \tau$.

At this time the mobile MS requiring to connect to the base transceiver station BTS1 sends to the latter on a signalling channel a random access message (access burst). In the case of handover this message is called the handover access message (HA). The duration of each handover access is less than that of a burst constituting a normal signal (normal burst), one containing speech data, for example, and accordingly cannot interfere with signals sent by another mobile in another time slot.

On receiving this signal (at time $T_1 + TA$) the base transceiver station BTS1 can determine the timing advance TA between reception of this signal and transmission of the clock signal H_1 . This is equal to twice the time to transmit a signal between the mobile MS and the base transceiver station BTS1, i.e. twice the time τ . The

base transceiver station BTS1 then sends a message to the mobile MS over the access grant channel AGCH to tell it that it must send its signals with a timing advance TA relative to its clock signal: the mobile can then send normal signals without risk of them overlapping with those sent by other mobiles. This ensures that the signals sent by the various mobiles on a given transmission channel arrive in succession at the base transceiver station BTS1.

This ensures that the signals sent by the various mobiles on a given transmission channel arrive in succession at the same BTS without these signals overlapping. However, it is necessary to synchronise the mobiles MS frequently because their distance from the BTS serving them may vary.

The problem of managing movement of the mobile MS from one cell to another is well known. In figure 1 the mobile MS receives signals not only from base transceiver station BTS1 but also from base transceiver stations BTS2 and BTS3. If the power of the signals received from base transceiver station BTS1 falls below that of signals received from base transceiver station BTS2, for example, the BSC connects the mobile MS to base transceiver station BTS2 from which transmission then continues. This is the typical situation when the mobile MS moves away from base transceiver station BTS1 and towards base transceiver station BTS2. It is then necessary to modify the timing advance TA so that the mobile is synchronised to the base transceiver station BTS2 of the new cell C2.

There are three known types of handover for achieving such synchronisation: synchronous handover, pseudosynchronous handover and asynchronous handover. Which type is used depends on whether the base stations are respectively synchronised, have an internal clock at the same frequency and of known phase, or have

asynchronous clocks whose relative phase is unknown.

Synchronous handover consists in controlling the clocks of the various BTS of a given GSM system so that their clock signals are synchronised. It is therefore unnecessary to supply a mobile with a new timing advance when it moves from one cell to another because the new timing advance is deduced immediately from that previously used. To be generally adopted this solution would require synchronisation of all BTS, however, and would therefore be costly to implement.

To alleviate this problem pseudosynchronous handover is used to synchronise a mobile to the clock of the BTS of the new cell allowing for the time shifts between the clocks of the old and new BTS. This type of handover is described in European patent application n° 0 398 773 in the name of MATRA COMMUNICATION published on 22 November 1990, for example. This solution has the drawback that it is complex to implement and that the BSS requires a learning phase.

Asynchronous handover is the simplest method to implement and therefore the method most widely used. Figure 3 shows the general principle. Consider the case where the mobile MS leaves cell C1 to enter cell C2. Eight successive transmission stages are necessary.

Step 1 is that in which the mobile MS sends the base transceiver station BTS1 a message MEAS REP equivalent to a cell change request and containing measurement results used by the BSC to initiate handover. These measurement results indicate, for example, that the mobile is receiving the signals sent periodically by the base transceiver station BTS2 better than those sent by the base transceiver station BTS1. This message is sent to the base transceiver station BTS1 by the mobile MS every 0.5 s. In step 2 the base transceiver station BTS1 transmits this information (message MEAS RES) to the BSC

which decides if handover is needed. The decision criteria include the quality and the power of the signals received. Other types of information are available at the MSC or the BSC for deciding whether handover must be done. It is assumed here that this is so. In step 3 the base station controller BSC activates a channel of the base transceiver station BTS2 (message CHAN ACT) and the latter acknowledges the allocation (message CHAN ACT ACK). In step 4 the base station controller BSC sends a handover command (message HANDOVER CMD) to the base transceiver station BTS1 which immediately forwards it to the mobile MS transparently. The handover procedure at the mobile MS then begins (step 5). The mobile sends successive messages HA (handover access) to base transceiver station BTS2 with a null timing advance, i.e. without allowing for the distance between them. This step is that described previously with reference to figure 2. The new timing advance that the mobile MS must use is unknown to it and the base transceiver station BTS2 has to calculate it and supply it (message PHYS INFO including the TA). In step 6 the mobile MS sends a connection message SABM to the base transceiver station BTS2 using the new synchronisation. The base transceiver station BTS2 advises the base station controller BSC of this (message ESTABLISH INDICATION) and signals to the mobile MS that it has heard correctly (message UA). In step 7 the mobile MS sends a message HANDOVER COMPLT to the base transceiver station BTS2 to advise it that the handover procedure is finished. This station immediately forwards this message to the BSC. The BSC then advises the mobile services switching centre MSC (message HANDOVER PERFORMED). In step 8 the BSC sends the message RF CHAN REL to the base transceiver station BTS1 to tell it to release the time slot previously allocated to the mobile MS. The base transceiver station BTS1 responds

with the message RF CHAN REL ACK.

At this stage the mobile MS is communicating with the base transceiver station BTS2 which has allocated it a time slot in a frame carried by a given carrier and a timing advance TA.

The main drawback of asynchronous handover is that the sending of the timing advance TA to the mobile is time-consuming: it takes about 40 ms plus about 10 ms for calculating the TA. The mobile is not able to send data during this time. Also, sending of the signals HA is mandatory in the GSM system and takes 5 ms per signal. Other delays contribute to delaying handover and calls are frequently interrupted for more than 100 ms. Speech extrapolation software is available for masking interruptions in transmission but is effective only for a subjectively determined time dependent on the hearing of the persons concerned. It is generally agreed that an interruption in communication exceeding 80 ms is audible to a person with good hearing whereas a party paying no particular attention to the quality of the speech signals received may not notice for 200 ms that what he is hearing is not what he should be hearing (because the signals are generated by the speech extrapolation software).

Likewise the mobile user cannot receive speech type data while the mobile is in the handover phase. This drawback is a particular problem in urban areas where cell sizes are smaller and the user may pass through several cells during the course of the same conversation. A system of this kind is not comfortable to use for this reason.

One object of the present invention is to remedy these drawbacks.

To be more precise, one object of the invention is to provide a handover method that can be applied to a

cellular mobile radio network in which the base transceiver stations are not synchronised, for example an asynchronous type network, the least costly and the most widely used type, so that the time for which communication is actually interrupted during handover is reduced.

Another object of the invention is to provide a mobile, a station controller and an information exchange system which can reduce the time for which speech is interrupted during handover.

These objects and others that will emerge hereinafter are achieved by virtue of a method of exchanging information between a mobile, at least two transceiver stations and at least one station controller of a cellular mobile radio network in which exchanges of information between the mobile and the stations are of the time division multiple access type, said method consisting in supplying a predetermined timing advance to the mobile when it passes from a first cell defined by the geographical coverage of a first station to a second cell defined by the geographical coverage of a second station.

This eliminates the time otherwise taken to calculate the timing advance.

Advantageously this method further consists in transmitting a change cell command from the first station to the mobile in response to a change cell request formulated by the mobile, the predetermined timing advance being transmitted to the mobile by the first station at the same time as the change cell command. Using this handover procedure it is not necessary for the second cell to send the mobile any timing advance TA before the speech path is set up.

The timing advance is preferably transmitted by the controller of the first station, received by the first

station and forwarded from the first station to the mobile transparently.

5 The change cell command may be transmitted to the first station by the controller of the first station, the predetermined timing advance being transmitted transparently to the mobile by the first station at the same time as the change cell command.

10 This method is advantageously used in a cellular mobile radio network in which the stations are asynchronous.

In a first advantageous embodiment the timing advance is equivalent to the time to transmit a radio signal between the second station and a mobile at the maximum radius of the second cell.

15 In a second advantageous embodiment the timing advance is equal to:

$$(TA_M + TA_m)/2$$

20 where TA_M is the maximal timing advance of the mobiles when they connect to the second station and TA_m is the minimal timing advance of the mobiles.

This method may be applied to an internal or external handover procedure.

The cellular mobile radio network may be of the GSM type.

25 In another aspect the invention consists in a mobile adapted to communicate by time division multiple access with transceiver stations of a cellular mobile radio network, the mobile comprising means for extracting a timing advance from a message transmitted by one of the stations on passing from a first cell defined by the geographical coverage of a first station to a second cell defined by the geographical coverage of a second station, said message being a change cell command transmitted to it by the first station.

35 In a further aspect the invention consists in a

transceiver station controller of a cellular mobile radio network comprising a table in which a predetermined timing advance is assigned to each station and wherein when the mobile moves from a first cell defined by the geographical coverage of a first station to a second cell defined by the geographical coverage of a second station the controller transmits to the first station a change cell command including the timing advance assigned to the second station.

10 In a yet further aspect the invention consists in a system for exchange information between a mobile, at least two transceiver stations and at least one station controller of a cellular mobile radio network in which exchanges of information between the mobile and the stations are of the time division multiple access type, the mobile comprising means for extracting a predetermined timing advance from a message transmitted by one station on passing from a first cell defined by the geographical coverage of a first station to a second cell defined by the geographical coverage of a second station.

20 This message is advantageously a change cell command transmitted in response to a change cell request formulated by the mobile, the predetermined timing advance being transmitted to the mobile by the first station at the same time as said change cell command.

25 The controller used in a system of this kind preferably includes a table in which a predetermined timing advance is assigned to each station and when the mobile passes from a first cell defined by the geographical coverage of a first station to a second cell defined by the geographical coverage of a second station the controller transmits a change cell command to the first station, said change cell command including the timing advance assigned to the second station.

Other features and advantages of the invention will emerge from the following description of a preferred embodiment of the invention given by way of non-limiting illustrative example with reference to the appended drawings in which:

- figure 1 shows the structure of a GSM type network;

- figure 2 is a correlative timing diagram of signals exchanged between a station and a mobile;

- figure 3 shows a handover procedure requested by a mobile requiring to connect to the station of a cell;

- figure 4 shows an internal handover procedure in accordance with the invention;

- figure 5 shows an external handover procedure in accordance with the invention;

- figure 6 shows a simplified structure of a mobile used in the present invention;

- figure 7 shows a table in which a predetermined timing advance is assigned to each station.

According to the invention, when a mobile must carry out handover (message HANDOVER CMD) the timing advance transmitted to it relates to the distance between it and the station it is receiving best (base transceiver station BTS2). This value is transmitted to it by the base transceiver station BTS1 with which it is communicating.

Figure 4 shows a handover procedure in accordance with the invention. This handover is "internal" in the sense that the stations are controlled by the same controller.

Steps 1 through 3 of this procedure are identical to those of figure 3, i.e. the mobile MS sends measurement results to the base station controller BSC which decides if a handover procedure must be started. The controller then activates a channel of the base

transceiver station BTS2 and this station acknowledges allocation of the channel.

5 However, during step 4 the BSC sends a specific command to the base transceiver station BTS1 which is still communicating with the mobile MS. This is the (known) HANDOVER CMD command to which is added a predetermined timing advance TA. The information transmitted is denoted "HANDOVER CMD (TA-BTS2)" hereinafter which means that the mobile MS is ordered
10 to connect to the base transceiver station BTS2 with the associated timing advance TA. The base transceiver station BTS1 transmits this HANDOVER CMD (TA-BTS2) command transparently to the mobile MS which is then advised of the time by which it must advance transmission
15 of its data. In step 5 the mobile MS sends at least one HANDOVER ACCESS message to the base transceiver station BTS2 (in this example four consecutive messages are sent to enhance the reliability of the link, as in the case of synchronous handover) so that this station measures the
20 actual TA to be communicated to the mobile in the next SACCH message without interfering with the transmission of speech.

 The HANDOVER CMD signal used in the prior art has bits that can be used to send the timing advance TA.

25 Steps 6 through 8 are identical to those previously described with reference to figure 3.

 The BSC includes a table (figure 7) in which a predetermined timing advance is assigned to each BTS. When any mobile advises it that it is receiving
30 synchronisation signals from a given second station, or target cell station, at a power higher than those received from the first station with which it is communicating, the BSC is therefore able to give it the TA for this second station.

35 This TA represents, for example, the time taken for

a radio signal propagating at the speed of light transmitted by a mobile at the boundary of the target cell to reach the target cell. Each station knows the maximum radius of its cell (shown as R2 in figure 1 in case of cell C2) which depends on the traffic of the cell. This TA can also allow for the guard time available at each BTS. This will be explained later.

The present invention applies to the handover procedure that is carried out when the mobile MS attempts to enter into communication with the BTS of a smaller cell. In the GSM system a mobile must be able to communicate with a station BTS if the multipath time of the signals that it transmits is below 16 μ s. This value represents for a signal transmitted by the mobile to the station a maximum time-delay relative to the time at which the signal would theoretically reach the BTS and it must be possible to receive this signal correctly at the BTS, whether or not it is subject to a time-delay up to this amount. Large values of multipath time occur in mountainous areas but are virtually unheard of in urban areas, especially on level ground. Buildings introduce little multipath time and tend rather to attenuate the signal or to produce interference. If the multipath time is low, for example in the order of 6 μ s, the station has a guard time of 10 μ s allowing the mobile to transmit data at a time other than the exact time advised to it by means of the timing advance TA. Consequently, a relatively large error in respect of the TA transmitted by the BTS to the mobile can be tolerated when the multipath time is low, i.e. in an urban environment where the cells are smaller.

It is a simple matter to calculate this error knowing the maximum multipath time at each BTS. Taking a BTS with a maximum multipath time of 6 μ s, for example, there remains a guard time of 10 μ s and a distance error

can therefore be authorised. This distance error represents the difference between the actual distance to the mobile requesting to connect to the station and the distance equivalent to the TA assigned to that mobile.

5 The guard time of 10 μ s represents a distance of 3 000 m and if it is assumed that the candidate cell has a radius of 1 500 m, the timing advance assigned to the mobile by the BTS will correspond to this distance of 1 500 m. However, as the mobile which is requesting handover may
10 in the worst case scenario be immediately adjacent the BTS with which it is currently communicating (it is possible for a mobile to be near a station but to be unable to communicate with it because of masking or local interference and in this case it is necessary to be able
15 to perform handover successfully to another cell) the distance error will be 1 500 m (10 μ s error on TA) but this will be transparent for the BTS which will still receive the signal from the mobile correctly because of the guard time.

20 The authorised TA error is 16 μ s - Tmt where Tmt is the maximum multipath time measured by the second station.

With the above configuration the handover method in accordance with the invention can be applied to any cell
25 whose farthest range from the BTS is 1 500 m (for a multipath time of 6 μ s) if it must be possible to deal with a handover request from a mobile in the immediate vicinity of another BTS.

For example, with a multipath time of 6 μ s the
30 uncertainty as to the TA supplied represents a distance of 1 500 m. In an urban environment, if the cells have a maximum radius of 1 500 m handover will be successful within a radius of 3 000 m from the target station:

- if the mobile is 1 500 m from the target station,
35 the TA supplied is exactly equivalent to the position of

the mobile,

- if the mobile is in the immediate proximity of the target station, the error in the TA supplied is an advance of 10 μ s which has no effect on the signals transmitted by the mobile because of the guard time,

- if the mobile is 3 000 m from the target station the error is a delay of 10 μ s and also has no effect on the signals transmitted.

The method of the invention applies also to large target cells if the multipath time is low.

In one advantageous embodiment of the invention the timing advance TA is equivalent to the maximum radius of the target cell. If the cells have a radius less than or equal to the TA error (dependent on the multipath time), it is possible for a mobile to perform handover successfully if it is in the immediate proximity of the target station or at twice the distance equivalent to the error from the target station.

In another embodiment of the method of the invention the timing advance is calculated allowing for the actual configuration of the target cell. It is possible to measure the timing advance of each mobile which connects to the station of a cell and thus to define a minimal timing advance and a maximal timing advance. A statistical calculation may also be carried out on the basis of the measured timing advances. Thus if TA_m is the minimal timing advance of the mobiles when they connect to the new station and TA_M is their maximal timing advance, the timing advance TA assigned to each mobile requiring to connect to the station of this cell will be equal to:

$$TA = (TA_M + TA_m) / 2$$

Now that these terms have been defined, it may be assumed that the present invention may be applied provided that the following condition is met:

$$TA_M - TA_m < 2 \times (16 - T_{mt})$$

The present invention applies not only to handover performed in the same BSS (internal handover) but also to inter-BSS handover (external handover) as shown in figure 2.

In step 1 the base station controller BSC1 transmits to the mobile services switching centre MSC a message HO REQ indicating that the mobile MS requires to enter into communication with the base transceiver station BTS2. In step 2 the MSC transmits this request to base station controller BSC2 (message HO REQUEST) which allocates a base transceiver station BTS2 channel (message CHAN ACT). The base transceiver station BTS2 responds with a message CHAN ACT ACK and base station controller BSC2 transmits a message HO REQ ACK to the MSC. In step 3 the MSC generates a handover command (message HO CMD) addressed to base station controller BSC1. In step 4 base station controller BSC1, which is the controller of the station with which the mobile MS is communicating, sends the previously defined message HANDOVER CMD (TA-BTS2) to the mobile MS which interrupts the call in progress and generates four consecutive HO ACCESS, for example (step 5). The base transceiver station BTS2 detects the first message HO ACCESS 1 and sends a message HO DETECTION to base station controller BSC2 which forwards it to the MSC. The remainder of the procedure (steps 7 and 8) is identical to that of figure 4.

Steps 4 and 5 of the invention are equivalent to those of synchronous handover with no provision of the timing advance TA by the destination BTS. Thus the handover procedure of the invention enables handover to be as effective as synchronous handover but in a GSM network in which the BTS are asynchronous. The same performance as synchronous handover is achieved at

significantly reduced cost because there is no need to synchronise the network.

Figure 6 shows a simplified structure of a mobile used in the present invention.

5 The mobile MS comprises transceiver means 60, synchronisation extractor means 61 and timing advance extractor means 62. The transceiver means 60 are connected to an antenna 63 and include a modulator and a demodulator. The synchronisation extractor means 61
10 handle timing recovery (clock pulses transmitted by the base station) and monitoring of the various functions at the mobile. The timing advance extractor means 62 extract the timing advance from the signal received (HANDOVER CMD) and cause the transceiver means 60 to
15 transmit speech data in the time slot allocated to the mobile. The means 61 and 62 are essentially implemented in software.

Figure 7 shows a table 70 in which a predetermined timing advance is assigned to each possible target
20 station. This table is advantageously held in the controller of the target station in the case of external handover and in the controller of the current station in the case of internal handover. However, communications pass through the controller of the station with which the
25 mobile is communicating.

In the figure the table contains predefined timing advances TA-BTS1 through TA-BTSn for n possible target stations connected to this controller. If the target station is base transceiver station BTS3, for example,
30 the timing advance sent to the mobile is TA-BTS3.

The main advantage of the invention is that it does not require calculation of the timing advance because this is predetermined. Also, it may be transmitted in an existing message and so does not take up any significant
35 time of the communication in progress.

Note that it is also possible to transmit to the mobile an indication that the target cell has a size related to a predefined timing advance held in memory by the mobile. This information may be transmitted to the mobile at the same time as the change cell command and the mobile may then adopt this predetermined timing advance to advance the transmission of its signals. This mode of operation is valid only if the size of the target cell is substantially equivalent to the timing advance held in memory by the mobile, however. If this is not the case, the timing advance that the mobile is to use is transmitted at the same time as the change cell command.

CLAIMS

1. Method of exchanging information between a mobile (MS), at least two transceiver stations (BTS) and at least one station controller (BSC) of a cellular mobile radio network in which exchanges of information between said mobile (MS) and said stations (BTS) are of the time division multiple access type, said method consisting in supplying a timing advance (TA) to said mobile (MS) when it passes from a first cell (C1) defined by the geographical coverage of a first station (BTS1) to a second cell (C2) defined by the geographical coverage of a second station (BTS2), characterised in that said timing advance (TA) has a predetermined value.

2. Method according to claim 1 characterised in that it further consists in transmitting a change cell command (HANDOVER CMD) from said first station (BTS1) to said mobile (MS) in response to a change cell request (MEAS REP) formulated by said mobile (MS), said predetermined timing advance (TA) being transmitted to said mobile (MS) by said first station (BTS1) at the same time as said change cell command (HANDOVER CMD).

3. Method according to claim 1 characterised in that said timing advance (TA) is transmitted by the controller of said first station (BTS1) and received by said first station (BTS1) and in that said first station (BTS1) forwards said timing advance (TA) to said mobile (MS) transparently.

4. Method according to claim 3 characterised in that said change cell command (HANDOVER CMD) is transmitted to said first station (BTS1) by the controller of said first station (BTS1), said predetermined timing advance (TA) being transmitted transparently to said mobile (MS) by said first station (BTS1) at the same time as said change cell command



(HANDOVER CMD).

5 5. Method according to any one of claims 1 to 4 characterised in that it is used in a cellular mobile radio network in which said stations (BTS) are asynchronous.

10 6. Method according to any one of claims 1 to 5 characterised in that said timing advance (TA) is equivalent to the time to transmit a radio signal between said second station (BTS2) and a mobile (MS) at the maximum radius of said second cell (C2).

 7. Method according to any one of claims 1 to 5 characterised in that said timing advance (TA) is equal to:

$$(TA_M + TA_m)/2$$

15 where TA_M is the maximal timing advance of the mobiles (MS) when they connect to said second station (BTS2) and TA_m is the minimal timing advance of said mobiles (MS).

20 8. Method according to any one of claims 1 to 7 characterised in that it is applied to an internal handover procedure.

 9. Method according to any one of claims 1 to 7 characterised in that it is applied to an external handover procedure.

25 10. Method according to any one of claims 1 to 9 characterised in that said cellular mobile radio network is of the GSM type.

30 11. Mobile (MS) adapted to communicate by time division multiple access with transceiver stations (BTS) of a cellular mobile radio network, said mobile (MS) comprising means (62) for extracting a timing advance (TA) from a message transmitted by one station (BTS1) on passing from a first cell (C1) defined by the geographical coverage of a first station (BTS1) to a second cell (C2) defined by the geographical coverage of
35 a second station (BTS2), said message (HANDOVER CMD)



being a change cell command transmitted to it by said first station (BTS1).

12. Transceiver station controller (BSC) of a cellular mobile radio network characterised in that it comprises a table (70) in which a predetermined timing advance (TA) is assigned to each station (BTS) and in that when said mobile (MS) moves from a first cell (C1) defined by the geographical coverage of a first station (BTS1) to a second cell (C2) defined by the geographical coverage of a second station (BTS2) said controller (BSC) transmits a change cell command (HANDOVER CMD) to said first station (BTS1), said change cell command (HANDOVER CMD) including the timing advance (TA-BTS2) assigned to said second station (BTS2).

13. System for exchange of information between a mobile (MS), at least two transceiver stations (BTS) and at least one station controller (BSC) of a cellular mobile radio network in which said exchanges of information between said mobile (MS) and said stations (BTS) are of the time division multiple access type, said mobile (MS) comprising means for extracting a timing advance (TA) from a message (HANDOVER CMD) transmitted by one station (BTS1) on passing from a first cell (C1) defined by the geographical coverage of a first station (BTS1) to a second cell (C2) defined by the geographical coverage of a second station (BTS2), characterised in that said timing advance (TA) has a predetermined value.

14. System according to claim 13 characterised in that said message is a change cell command (HANDOVER CMD) transmitted in response to a change cell request (MEAS REP) formulated by said mobile (MS), said predetermined timing advance (TA) being transmitted to said mobile (MS) by said first station (BTS1) at the same time as said change cell command (HANDOVER CMD).

15. System according to claim 13 or claim 14



characterised in that said controller (BSC) includes a table in which a predetermined timing advance (TA) is assigned to each station (BTS) and in that when said mobile (MS) passes from a first cell (C1) defined by the geographical coverage of a first station (BTS1) to a second cell (C2) defined by the geographical coverage of a second station (BTS2) said controller (BSC) transmits to said first station (BTS1) a change cell command (HANDOVER CMD) including the timing advance (TA-BTS2) assigned to said second station (BTS2).

16. System according to any one of claims 13 to 15 characterised in that said timing advance (TA) is equivalent to the time to transmit a radio signal between said second station (BTS2) and a mobile (MS) situated at the maximum radius of said second cell (C2).

17. System according to any one of claims 13 to 15 characterised in that said timing advance (TA) is equal to:

$$(TA_M + TA_m)/2$$

where TA_M is the maximal timing advance of the mobiles (MS) when they connect to said second station (BTS2) and TA_m is the minimal timing advance of said mobiles (MS).

