METHODS AND ARRANGEMENTS IN A TELECOMMUNICATIONS NETWORK

TECHNICAL FIELD

The present invention relates to arrangements and methods in a telecommunications system, and in particular transmission timing alignment in a telecommunications system in which aggregation of component carriers is applied.

BACKGROUND

Figure 1 shows a part of a telecommunication network 10. The radio access network 10 comprises a plurality of radio base stations 11 (whereof only one is shown in the figure), each of which communicates with a plurality of UEs (user equipments) 12 located in the coverage area of the radio base station. The base station 11 further communicates with a core network 13. For example, where the network 10 is a standardized E-UTRAN (Evolved UMTS Terrestrial Radio Access Network), the core network 13 comprises an evolved packet core, itself comprising a mobility management entity (MME), a serving gateway and a PDN (packet data network) gateway.

The E-UTRAN currently supports bandwidths up to 20 MHz. However, one of the requirements of future releases of this standard such as LTE Advanced is the support of bandwidths larger than 20 MHz. A further important future requirement is to assure backward compatibility with previous releases. This also includes spectrum compatibility. That implies that a future-release carrier, wider than 20 MHz, appears as a number of carriers to a legacy UE. Each such carrier can be referred to as a component carrier. In particular for early deployments of future releases, it can be expected that there will be a smaller number of future-release UEs compared to many legacy UEs. Therefore, it is necessary to assure an efficient use of a wide carrier also for legacy UEs, i.e. that it is possible to implement carriers where legacy UEs can be scheduled in all parts of the wideband future-release carrier. The straightforward way to obtain this is by means of carrier aggregation. Carrier aggregation implies that a future-release UE can receive multiple component carriers, where the component carriers have, or at least have the possibility of having, the same structure as a carrier of previous releases.

Different examples of carrier aggregation are illustrated in **Figure 2a** to **2c**. A contiguous intra-band carrier aggregation is illustrated in **Figure 2a** where five component carriers 20, each of 20 MHz bandwidth, have been aggregated to form a bandwidth of 100 MHz. **Figure 2b** illustrates a non-contiguous intra-band carrier aggregation where three component carriers 20, each of 20 MHz bandwidth, have been aggregated together to form an aggregated bandwidth of 60 MHz. Finally, **Figure 2c** illustrates a inter-band carrier aggregation where two component carriers 20 in band x and band y respectively, each of 20 MHz bandwidth, have been aggregated together to form an aggregated bandwidth of 40 MHz.

The number of aggregated component carriers as well as the bandwidth of the individual component carrier may be different for uplink (UL) and downlink (DL). A symmetric configuration refers to the case where the number of component carriers in DL and UL is the same whereas an asymmetric configuration refers to the case that the number of component carriers is different. It should be noted that the number of component carriers configured in a network may be different from the number of component carriers seen by a UE. A UE may for example support more DL component carriers than UL component carriers, even though the network is configured with the same number of UL and DL component carriers.

The current E-UTRAN but also LTE Advanced uses DFTS-OFDM (Discrete Fourier Transform Spread - Orthogonal Frequency Division Multiplex) for modulation in the UL. DFTS-OFDM is a special kind of FDM (Frequency Division Multiplex) where different users are assigned different portions of the spectrum. Orthogonality among different users relies on the time-aligned arrival of the UL signals of the various users. In current E-UTRAN and LTE Advanced a cyclic prefix is used which relaxes the requirement on timing alignment slightly. Hence, it is sufficient if the signals are aligned within a fraction of the cyclic prefix. The normal cyclic prefix in LTE is around 5 μs; signals from different users should then be aligned within 1 μs or so.

UEs synchronize their DL timings to DL signals transmitted from an eNodeB, i.e. a radio base station of an E-UTRAN. Signals used for this purpose comprise synchronization signals and reference signals. After established downlink synchronization a UE can start to transmit signals in the UL from the UE to the eNodeB at a well defined offset relative to the DL timing. However, due to varying UE-eNodeB distances among UEs the synchronization signals arrive at different time instances at the UEs creating UE specific DL timings at each UE. This results in different transmission instances among the UEs. UEs close to the eNodeB receive the synchronization signal early and thus also start to transmit early; their respective UL signals require furthermore only a short propagation time to arrive at the eNodeB. UEs far away from the eNodeB start to transmit later and their UL signals require also more time to traverse the distance to the eNodeB resulting in later signal arrival times at the eNodeB. The time difference between arriving signals from two UEs is the difference in round trip time between these two UEs. Round trip time is defined as the time duration that is needed for a signal to traverse the distance eNodeB-UE and back (assuming zero processing delay at the UE) and is calculated as twice the distance eNodeB-UE divided by the speed of light.

In order to align the arrival times of UL signals from different UEs the eNodeB measures the arrival times of the different signals relative to a desired arrival time reference and informs the UEs by how much they have to advance/delay their UL transmission timings (either relative to their UE specific DL timings or to the current UL transmission timing). This process is called timing alignment procedure and the command used to notify the UE about the required correction is called timing advance command.

In case of a UE with completely unsynchronized UL timing the UE does not transmit a regular UL signal but a random access signal. This signal is specifically designed for unsynchronized UEs. After the eNodeB has determined the required correction of UL transmit timing it transmits a corresponding timing advance command to the UE which corrects its UL timing accordingly. After that the UE can now start to transmit regular UL signals which assume aligned arrival timings. The eNodeB continuously monitors UL signal arrival timings and sends timing advance commands to maintain a valid UL timing. If a UE is not active in the UL for a long time or looses UL synchronization for another reason a new random access needs to be performed to establish a valid UL timing again.

In case of UL carrier aggregation all UL signals within a component carrier and/or across contiguous component carriers need to be timing aligned in order to maintain orthogonality.

SUMMARY

It is therefore an object of the present invention to provide a solution for transmission timing alignment in a telecommunication system in which aggregation of component carriers is applied.

The above stated object is achieved by means of methods and arrangements according to the independent claims, and by the embodiments according to the dependent claims.

According to a first aspect of the present invention, a method in a base station (600) for determining an uplink transmission timing correction for communication in a telecommunication system is provided. Aggregation of component carriers is applied in the telecommunication system. The method comprising receiving a signal on a selected uplink component carrier from a user equipment. An arrival time of the received signal is measured and a timing correction of the uplink transmission timing based on the measured arrival time is determined. Furthermore the method comprises the step of determining for which of the uplink component carriers used by the user equipment the determined timing correction is valid. Additionally, the method comprises the step of sending the timing correction and information on which of the uplink component carriers the timing correction is valid for to the user equipment.

According to a second aspect of the present invention, a method in a user equipment for determining an uplink transmission timing correction for communication in a telecommunication system is provided. Aggregation of component carriers is applied in the telecommunication system. The method comprises the step of sending a signal on an uplink component carrier to a base station. Furthermore, a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for is received from the base station. Thereupon, the method in the user equipment

adjusts the uplink transmission timing of the component carrier the timing correction is valid for based on the timing correction.

According to a third aspect of the present invention, a base station for determining an uplink transmission timing correction for communication in a telecommunication system is provided. Aggregation of component carriers is applied in the telecommunication system. The base station comprises a receiver for receiving a signal on a selected uplink component carrier from a user equipment and a unit for measuring an arrival time of the received signal. The base station further includes a unit for determining a timing correction of the uplink transmission timing based on the measured arrival time and for determining for which of the uplink component carriers used by the user equipment the determined timing correction is valid. Additionally, a transmitter for sending the timing correction and information on which of the uplink component carriers the timing correction is valid for to the user equipment is comprised in the base station.

According to a fourth aspect of the present invention, a user equipment for determining an uplink transmission timing correction for communication in a telecommunication system is provided. Aggregation of component carriers is applied in the telecommunication system. The user equipment comprises a transmitter for sending a signal on an uplink component carrier to a base station. Moreover, the user equipment includes a receiver for receiving a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for from the base station. Additionally, a unit for adjusting the uplink transmission timing of the component carrier the timing correction is valid for based on the timing correction is comprised in the user equipment.

An advantage of embodiments of the present invention is that they provide a possibility to use only one timing correction for all component carriers, e.g. a single UL timing advance command, when possible and reverts back to a timing correction for each component carrier, e.g. multiple UL timing advance commands, only if required.

Another advantage of embodiments of the present invention is that they reduce the signal overhead in the telecommunication system.

Yet another advantage of embodiments of the present invention is that the complexity of the processing of the user equipment is reduced when a single timing correction, e.g. one common timing advance command, is used for several component carriers.

Further advantages and features of embodiments of the present invention will become apparent when reading the following detailed description in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding, reference is made to the following drawings and preferred embodiments of the invention.

Figure 1 depict schematically a telecommunication system, wherein embodiments of the present invention may be implemented.

Figure 2a to 2c show different examples of carrier aggregation.

Figure 3 is a schematic block diagram illustrating an embodiment of the present invention wherein the DL timing references are related to each other.

Figure 4 is a schematic block diagram illustrating an embodiment of the present invention wherein the DL timing references are not related to each other.

Figure 5a and 5b are flowcharts of the method according to an embodiment of the present invention performed in the base station and the user equipment, respectively.

Figure 6 is a schematic block diagram illustrating a base station according to an embodiment of the present invention.

Figure 7 is a schematic block diagram illustrating a user equipment according to an embodiment of the present invention.

DETAILED DESCRIPTION

In the following description, for purposes of explanation and not limitation, specific details are set forth, such as particular sequences of steps, signaling protocols and device configurations in order to provide a thorough understanding of the present

invention. It will be apparent to one skilled in the art that the present invention may be practised in other embodiments that depart from these specific details. In the drawings, like reference signs refer to like elements.

Moreover, those skilled in the art will appreciate that the means and functions explained herein below may be implemented using software functioning in conjunction with a programmed microprocessor or general purpose computer, and/or using an application specific integrated circuit (ASIC). It will also be appreciated that while the current invention is primarily described in the form of methods and devices, the invention may also be embodied in a computer program product as well as a system comprising a computer processor and a memory coupled to the processor, wherein the memory is encoded with one or more programs that may perform the functions disclosed herein.

The present invention is described herein by way of reference to particular example scenarios. In particular embodiments of the invention are described in a non-limiting general context in relation to an E-UTRAN. It should though be noted that the invention and its exemplary embodiments may also be applied to other types of radio access networks in which aggregation of component carriers is applied.

In a telecommunication system in which aggregation of UL component carriers is applied all UL signals within a component carrier and/or across contiguous component carriers need to be timing aligned in order to maintain orthogonality.

The arrival time of two or more UL component carriers at the base station is influenced by the transmission timing of each respective UL carrier as well as the propagation delay experienced by each UL signal. However in most cases, the arrival time of the UL component carrier is mainly determined by the transmission timing.

According to the basic concept of the present invention, the base station receives a signal from a user equipment on an UL component carrier and measures the arrival time of the signal. A timing correction of the UL transmission timing based on the arrival time of the signal is determined. Thereupon the base station determines for which of the uplink component carriers used by the user equipment the timing correction is valid. The timing correction and the validity information is sent to the

user equipment. The user equipment adjusts the UL transmission timing for each UL component carrier the timing correction is valid for.

A message carrying the information for which UL component carrier the timing correction is valid can either be an independent message or it can be sent together with the timing correction. An independent signalling of validity information can for example be signalled via RRC (Radio Resource Control) signalling or MAC (Media Access Control) control elements. A combined message carrying both timing correction and validity information is typically signalled as MAC control element but other signalling schemes are possible as well. In one embodiment of the present invention the timing correction is sent in a timing advance command to the user equipment.

In one embodiment of the present invention the UL component carriers used by a user equipment are associated with a common DL timing reference – and thus should have the same UL transmit timing – and should have the same UL receive timing, one timing advance command is sufficient for all UL component carriers used by the user equipment. The same also applies if they use different – but well defined with respect to each other – DL timing references. The UL transmit timings and thus also the UL receive timings will have the same relationship to each other as the DL timing references. **Figure 3** shows a user equipment 30 which is configured with a first DL component carrier 31 and a second DL component carrier 32 and a first UL component carrier 33 and a second component carrier 34. Both the first and the second UL component carrier 33, 34 derive their UL transmission timings from the first DL component carrier 31. Thus, only one timing advance command TA is needed.

A common DL timing reference could be for example the synchronization signal or the reference signals of one DL component carrier. Another example of a common DL timing reference could be synchronization signals on different component carriers if they are synchronized. DL timing references that are not the same but anyway share a well defined relation with each other could be synchronization signals on DL component carriers where the transmit timings are not the same but have a clearly defined offset relative to each other.

In another embodiment of the present invention the DL timing references are not related to each other. **Figure 4** shows a user equipment 40 which is configured with a first DL component carrier 41, a second DL component carrier 42 and a third DL component carrier 43. It is further configured with a first UL component carrier 44 and a second component carrier 45. The DL timing reference of the first DL component carrier 41 is not related to the DL timing reference of the third DL component carrier 43. In order to guarantee clearly defined UL receive timings for both UL component carriers individual UL timing advance commands for each UL component carrier are required. Thus, the first UL component carrier 44 derives its UL transmission timing from the first DL component carrier 41 and the second UL component carrier 45 derives its UL transmission timing from the third DL component carrier 43. Thus, the user equipment receives a first timing advance command TA_1 and a second timing advance command TA_2.

An example where an UL timing advance command for each UL component carrier should be used is in a case with aggregation of multiple time-division duplex (TDD) component carriers with different DL and UL allocations across them. Since TDD DL transmitters are typically timing aligned with neighboring TDD DL transmitters to mitigate interference it is necessary that each of the TDD component carriers can set their DL timing references individually. Due to possible different DL and UL allocations individual UL receive timings are required making individual UL timing advance commands necessary.

In the following the above embodiments will be further explained with reference to **figures 5a-b, 6** and **7**.

Figure 5a is a flowchart of a method in a base station (BS) for determining an uplink transmission timing correction for communication in a telecommunication system of the present invention. Aggregation of component carriers is applied in the telecommunication system. In a step 50, the base station receives a signal on a selected uplink component carrier of several aggregated component carriers from a user equipment. Next, the base station measures an arrival time of the received signal in a step 51. Thereupon, in a step 52, the base station determines a timing correction of the uplink transmission, i.e. the timing correction that is to be applied on the uplink transmissions from the UE, based on the measured arrival time. In next step 53, the validity of the timing correction is determined. That is, it is determined for which of the uplink component carriers used by the user equipment

the determined timing correction is valid. In one embodiment the mentioned determination is based on a downlink timing reference associated with the respective uplink component carrier used by the user equipment.

In a step 54, the timing correction and the information on which of the uplink component carriers the timing correction is valid for are sent to the user equipment. This could be executed in different ways. A message carrying the information for which UL component carrier the timing correction is valid can either be an independent message or it can be sent together with the timing correction. An independent signalling of the information on which component carrier the timing correction is valid for could be done with RRC signaling or with MAC control elements. A combined message carrying both timing correction and validity information is typically signalled as MAC control element but other signalling schemes are possible as well. In one embodiment of the present invention the timing correction is sent in a timing advance command to the user equipment.

In one embodiment, the timing correction could be determined to be valid for the uplink component carrier of the aggregated component carriers which has an associated downlink timing reference aligned with the downlink timing reference associated with the selected uplink component carrier. In such a case the downlink timing reference could be a synchronization signal or reference signal of one of the downlink component carrier used by the user equipment.

In another embodiment were the downlink timing reference associated with a component carrier is not the same but has a well defined relation with the downlink timing reference associated with the selected component carrier, the timing correction could be determined to be valid for said uplink component carrier. That is, the timing correction is determined to be valid for all uplink component carriers which have an associated downlink timing reference with a defined offset relative to the downlink timing reference associated with the selected uplink component carrier on which the signal is received from the user equipment in step 50. In this case, the downlink timing references could be synchronization signals or reference signals on different downlink component carriers.

It should be pointed out that the validity information, i.e. the validity of the timing correction, is in one embodiment of the present invention determined during setup

of the base station and sent to the UE when an UL component carrier is added. Thus, the validity information could be sent to the UE before the timing correction is sent to the UE and also less frequent than the timing correction.

In an exemplary embodiment of the present invention the base station measures the arrival time of the signal received from the UE and relates the measured time to an arrival time reference. The arrival time reference could be the arrival time which the base station desires to receive a signal from the UE. Thus, the timing correction determined by the base station could be based on the measured arrival time of the received signal and the arrival time reference.

Figure 5b is a flowchart of a method in a user equipment for determining an uplink transmission timing correction for communication in a telecommunication system of the present invention. Aggregation of component carriers is applied in the telecommunication system. In a step 55, the user equipment sends a signal on a selected uplink component carrier of several aggregated component carriers to the base station. Thereupon, the user equipment receives from the base station a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for in a step 56. As mention previously, this step could be executed in different ways. A message carrying the information for which UL component carrier the timing correction is valid can either be an independent message or it can be received together with the timing correction. An independent signalling of the information on which component carrier the timing correction is valid for could be done with RRC signaling or with MAC control elements. A combined message carrying both timing correction and validity information is typically received as MAC control element but other signalling schemes are possible as well. In one embodiment the timing correction is received by the user equipment in a timing advance command.

In another embodiment when the component carriers are time division duplex carriers with different downlink or uplink allocations across the carriers, the timing correction is determined to be valid for only the selected component carrier.

Schematically illustrated in **figure 6** and according to embodiments described above, the base station 600 comprises a receiver 620 for receiving a signal on a selected uplink component carrier from a user equipment and a unit for measuring

630 an arrival time of the received signal. It further comprises at least one unit for determining 640 a timing correction of the uplink transmission timing based on the measured arrival time and for determining for which of the uplink component carriers used by the user equipment the determined timing correction is valid. Finally, a transmitter 650 is comprised in the base station for sending the timing correction and information on which of the uplink component carriers the timing correction is valid for to the user equipment.

Schematically illustrated in **figure 7** and according to embodiments described above, the user equipment 700 comprises a transmitter 720 for sending a signal on a selected uplink component carrier to a base station and a receiver 730 for receiving a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for from the base station. It further includes a unit for adjusting 740 the uplink transmission timing of the component carrier the timing correction is valid for based on the timing correction.

It should be noted that the units illustrated in **figure 6** and **7**, respectively, could be implemented as a single unit or be divided into several units. The units may be implemented by physical or logical entities such as processing circuits 610, 710 using software functioning in conjunction with a programmed microprocessor or a general purpose computer, and/or using an application specific circuit (ASIC).

The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

CLAIMS

1. A method in a base station (600) for determining an uplink transmission timing correction for communication in a telecommunication system in which aggregation of component carriers is applied, the method comprising
- receiving (50) a signal on a selected uplink component carrier from a user equipment (700),
- measuring (51) an arrival time of the received signal,
- determining (52) a timing correction of the uplink transmission timing based on the measured arrival time,
- determining (53) for which of the uplink component carriers used by the user equipment the determined timing correction is valid,
- sending (54) the timing correction and information on which of the uplink component carriers the timing correction is valid for to the user equipment.

2. The method according to claim 1, wherein the determination for which of the uplink component carriers the determined timing correction is valid is based on a downlink timing reference associated with the respective uplink component carrier.

3. The method according to claim 2, wherein the timing correction is determined to be valid for the uplink component carrier which has an associated downlink timing reference aligned with the downlink timing reference associated with the selected uplink component carrier.

4. The method according to claim 3, wherein the downlink timing reference is a synchronization signal or reference signal of one downlink component carrier.

5. The method according to claim 2, wherein the timing correction is determined to be valid for the uplink component carrier which has an associated downlink timing reference with a defined offset relative to the downlink timing reference associated with the selected uplink component carrier.

6. The method according to claim 3 or 5, wherein the downlink timing references are synchronization signals or reference signals on different downlink component carriers.

7. The method according to claim 1, wherein the timing correction is determined to be valid for only the selected component carrier when the component carriers are time division duplex carriers with different downlink or uplink allocations across the carriers.

8. The method according to any of claims 1 to 7, wherein information on which component carrier the timing correction is valid for is configured via RRC signaling.

9. The method according to any of claims 1 to 7, wherein information on which component carrier the timing correction is valid for is signalled with MAC control elements.

10. The method according to any of claims 1 to 9, wherein the timing correction is sent in a timing advance command.

11. The method according to any of claims 1 to 7, wherein a message comprising both the timing correction and information on which of the uplink component carriers the timing correction is valid for is sent to the user equipment via RRC or MAC control elements.

12. The method according to any of claims 1 to 11, wherein determining the timing correction of the uplink transmission timing is also based on an arrival time reference.

13. A method in a user equipment (700) for determining an uplink transmission timing correction for communication in a telecommunication system in which aggregation of component carriers is applied, the method comprising
- sending (55) a signal on an uplink component carrier to a base station (600),
- receiving (56) a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for from the base station,
- adjusting (57) the uplink transmission timing of the component carrier the timing correction is valid for based on the timing correction.

14. The method according to claim 13, wherein information on which component carrier the timing correction is valid for is configured via RRC signaling.

15. The method according to claim 13, wherein information on which component carrier the timing correction is valid for is signalled with MAC control elements.

16. The method according to claims 13 to 15, wherein the timing correction is received in a timing advance command.

17. The method according to claim 13, wherein a message comprising both the timing correction and information on which of the uplink component carriers the timing correction is valid for is received from the base station via RRC or MAC control elements.

18. A base station (600) for determining an uplink transmission timing correction for communication in a telecommunication system in which aggregation of component carriers is applied, the base station comprises

a receiver (620) for receiving a signal on a selected uplink component carrier from a user equipment (700),

a unit for measuring (630) an arrival time of the received signal,

a unit for determining (640) a timing correction of the uplink transmission timing based on the measured arrival time, and for determining for which of the uplink component carriers used by the user equipment the determined timing correction is valid,

a transmitter (650) for sending the timing correction and information on which of the uplink component carriers the timing correction is valid for to the user equipment.

19. The base station according to claim 18, wherein the determination for which of the uplink component carriers the determined timing correction is valid is based on the downlink timing reference associated with the respective UL component carrier.

20. The base station according to claim 19, wherein the timing correction is determined to be valid for the uplink component carrier which has an associated downlink timing reference aligned with the downlink timing reference associated with the selected uplink component carrier.

21. The base station according to claim 20, wherein the downlink timing reference is a synchronization signal or reference signal of one downlink component carrier.

22. The base station according to claim 19, wherein the timing correction is determined to be valid for the uplink component carrier which has an associated downlink timing reference with a defined offset relative to the downlink timing reference associated with the selected uplink component carrier.

23. The base station according to claim 20 or 22, wherein the downlink timing references are synchronization signals or reference signals on different downlink component carriers.

24. The base station according to claim 18, wherein the timing correction is determined to be valid for only the selected component carrier when the component carriers are time division duplex carriers with different downlink or uplink allocations across the carriers.

25. The base station according to any of claims 18 to 24, wherein information on which component carrier the timing correction is valid for is configured via RRC signaling.

26. The base station according to any of claims 18 to 24, wherein information on which component carrier the timing correction is valid for is signalled with MAC control elements.

27. The base station according to any of claims 18 to 26, wherein the timing correction is sent in a timing advance command.

28. The base station according to any of claims 18 to 24, wherein a message comprising both the timing correction and information on which of the uplink component carriers the timing correction is valid for is sent to the user equipment via RRC or MAC control elements.

29. The base station according to any of claims 18 to 28, wherein the timing correction of the uplink transmission timing is also based on an arrival time reference.

30. A user equipment (700) for determining an uplink transmission timing correction for communication in a telecommunication system in which aggregation of component carriers is applied, the user equipment comprises

a transmitter (720) for sending a signal on an uplink component carrier to a base station (600),

a receiver (730) for receiving a timing correction of the uplink transmission timing and information on which uplink component carrier the timing correction is valid for from the base station,

a unit for adjusting (740) the uplink transmission timing of the component carrier the timing correction is valid for based on the timing correction.

31. The user equipment according to claim 30, wherein information on which component carrier the timing correction is valid for is configured via RRC signaling.

32. The user equipment according to claim 30, wherein information on which component carrier the timing correction is valid for is signalled with MAC control elements.

33. The user equipment according to claims 30 to 32, wherein the timing correction is received in a timing advance command.

34. The user equipment according to claim 30, wherein a message comprising both the timing correction and information on which of the uplink component carriers the timing correction is valid for is received from the base station via RRC or MAC control elements.