

APPENDIX 3: PRELIMINARY INFRINGEMENT CONTENTIONS OF U.S. PATENT NO. 9,854,545

The Accused LGE '545 LTE Products are those that are compatible with the LTE Advanced, LTE Release 11 or later cellular communication standard, and specifically with 3GPP TS 36.300 (Release 11 and higher), 3GPP TS 36.321 (Release 11 and higher), 3GPP TS 36.213 (Release 11 and higher), 3GPP TS 36.211 (Release 11 and higher), and/or 3GPP TS 36.331 (Release 11 and higher). An exemplary identification of the Accused LGE '545 LTE Products, based on the information presently available, is set forth in Plaintiff Pantech Corporation's Patent Rule 3-1 and 3-2 Infringement Contentions, at Section A.

The Exemplary Evidence of Infringement disclosed herein establishes that asserted claims 2 and 3 of U.S. Patent No. 9,854,545 are essential to mandatory sections of the LTE standard (*i.e.*, with 3GPP TS 36.300 (Release 11 and higher), 3GPP TS 36.321 (Release 11 and higher), 3GPP TS 36.213 (Release 11 and higher), 3GPP TS 36.211 (Release 11 and higher), and/or 3GPP TS 36.331 (Release 11 and higher)). If "a patent covers mandatory aspects of a standard," it is "enough to prove infringement by showing standard compliance." *Godo Kaisha IP Bridge 1 v. TCL Commun. Tech. Holdings Ltd.*, 967 F.3d 1380, 1383-84 (Fed. Cir. 2020) ("In cases involving standard essential patents, we have endorsed standard compliance as a way of proving infringement"). Based on publicly available information, the Accused LGE '545 LTE Products comply with LTE Advanced, which indicates compliance with the LTE Release 11 or later cellular communication standard, including 3GPP TS 36.300 (Release 11 and higher), 3GPP TS 36.321 (Release 11 and higher), 3GPP TS 36.213 (Release 11 and higher), 3GPP TS 36.211 (Release 11 and higher), and/or 3GPP TS 36.331 (Release 11 and higher), and perform cellular communications in compliance with the aforementioned LTE Release 11 or later cellular communication standards. *See* Appendix 1: LGE Products Compliance with Standards.

The Exemplary Evidence of Infringement also establishes that each of the Accused LGE '545 LTE Products contains a chipset, application processor, SoC, or system-on-chip (*e.g.*, Qualcomm Snapdragon 865) (referred to herein as the "chipset") that incorporates a processor and modem. Each such chipset (and thus each accused device) complies with one or more of LTE Advanced, LTE Release 11 or later cellular communication protocols, including at least 3GPP TS 36.300, 3GPP TS 36.321, 3GPP TS 36.213, 3GPP TS 36.211, and/or 3GPP TS 36.331, and supports Radio Resource Control (RRC), random access, and timing advance mechanisms in accordance with the LTE Release 11 or later cellular communication standard. *See* Appendix 1: LGE Products Compliance with Standards. Furthermore, each of the Accused LGE '545 LTE Products contains an antenna or antennas, memory, and transceiver or combination of transmitter and receiver that assist with the RRC, random access, and timing advance mechanisms in accordance with the LTE Release 11 or later cellular communication standard. *See* Appendix 1: LGE Products Components.

Thus, Appendix 1, taken together with the showing made herein, demonstrates infringement of U.S. Patent No. 9,854,545 by the Accused LGE '545 LTE Products.

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[2.pre] A method for establishing an uplink (UL) synchronization by a User Equipment (UE), the method comprising:	Each of the Accused LGE '545 LTE Products is a user equipment configured to perform the claimed method for establishing an uplink synchronization by a user equipment. As shown in Appendix 1, each of the Accused LGE '545 LTE Products contains a chipset, antenna or antennas, memory, and transceiver or combination of transmitter and receiver that operate in accordance with LTE Advanced communication protocols and support the Radio Resource Control (RRC), random access, and timing advance mechanisms described in these technical specifications. <i>See Appendix 1.</i> Each Accused LGE '545 LTE Product complies with one or more of LTE Release 11 or later cellular communication protocols including at least 3GPP TS 36.300, 3GPP TS 36.321, 3GPP TS 36.213, 3GPP TS 36.211, and/or 3GPP TS 36.331, and supports the use of RRC, random access, and timing advance mechanisms in accordance with the LTE Advanced Standard, and is thus a UE. <i>See Appendix 1.</i> <3GPP TS 36.300 v11.6.0> 4 Overall architecture The E-UTRAN consists of eNBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME interface and to the Serving Gateway (S-GW) by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNBs. 3GPP TS 36.300 v11.6.0 at 19.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	5.5 Carrier Aggregation In Carrier Aggregation (CA), two or more Component Carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities: - A UE with single timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells sharing the same timing advance (multiple serving cells grouped in one TAG); - A UE with multiple timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells with different timing advances (multiple serving cells grouped in multiple TAGs). E-UTRAN ensures that each TAG contains at least one serving cell; - A non-CA capable UE can receive on a single CC and transmit on a single CC corresponding to one serving cell only (one serving cell in one TAG). CA is supported for both contiguous and non-contiguous CCs with each CC limited to a maximum of 110 Resource Blocks in the frequency domain using the Rel-8/9 numerology. 3GPP TS 36.300 v11.6.0 at 48.

	7.5 Carrier Aggregation When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC). Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells: - For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only); - From a UE viewpoint, each uplink resource only belongs to one serving cell; - The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5); - PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure); - PCell is used for transmission of PUCCH; - Unlike SCells, PCell cannot be de-activated (see subclause 11.2); - Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF; - NAS information is taken from PCell. The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells. 3GPP TS 36.300 v11.6.0 at 60.
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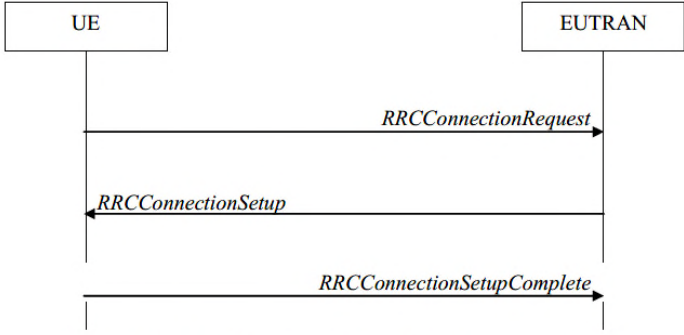
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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs. 3GPP TS 36.300 v11.6.0 at 72.

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[2.a] receiving a Radio Resource Control (RRC) signaling including a UL timing group information set, which has been set by an evolved NodeB (eNB),	Each of the Accused LGE '545 LTE Products is a user equipment configured to receive a Radio Resource Control (RRC) signaling including a UL timing group information set, which has been set by an evolved NodeB (eNB). <3GPP TS 36.300 v11.6.0> 1 Scope The present document provides an overview and overall description of the E-UTRAN radio interface protocol architecture. Details of the radio interface protocols are specified in companion specifications of the 36 series. 3GPP TS 36.300 v11.6.0 at 13. 4 Overall architecture The E-UTRAN consists of eNBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME interface and to the Serving Gateway (S-GW) by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNBs. 3GPP TS 36.300 v11.6.0 at 19. <table> <tr> <td>eNB</td><td>E-UTRAN NodeB</td></tr> <tr> <td>EPC</td><td>Evolved Packet Core</td></tr> <tr> <td>EPS</td><td>Evolved Packet System</td></tr> <tr> <td>E-RAB</td><td>E-UTRAN Radio Access Bearer</td></tr> <tr> <td>ETWS</td><td>Earthquake and Tsunami Warning System</td></tr> <tr> <td>E-UTRA</td><td>Evolved UTRA</td></tr> <tr> <td>E-UTRAN</td><td>Evolved UTRAN</td></tr> </table> 3GPP TS 36.300 v11.6.0 at 17.	eNB	E-UTRAN NodeB	EPC	Evolved Packet Core	EPS	Evolved Packet System	E-RAB	E-UTRAN Radio Access Bearer	ETWS	Earthquake and Tsunami Warning System	E-UTRA	Evolved UTRA	E-UTRAN	Evolved UTRAN
eNB	E-UTRAN NodeB														
EPC	Evolved Packet Core														
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ETWS	Earthquake and Tsunami Warning System														
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	<3GPP TS 36.331 v11.2.0> 5.3.3 RRC connection establishment 5.3.3.1 General  <pre> sequenceDiagram participant UE participant EUTRAN UE->>EUTRAN: RRCConnectionRequest EUTRAN-->>UE: RRCConnectionSetup UE->>EUTRAN: RRCConnectionSetupComplete </pre> Figure 5.3.3.1-1: RRC connection establishment, successful 3GPP TS 36.331 v11.2.0 at 40. 5.3.3.4 Reception of the <i>RRCConnectionSetup</i> by the UE NOTE: Prior to this, lower layer signalling is used to allocate a C-RNTI. For further details see TS 36.321 [6]; The UE shall: ... 1> enter RRC_CONNECTED; 1> stop the cell re-selection procedure; 1> consider the current cell to be the PCell; 3GPP TS 36.331 v11.2.0 at 43.

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	5.3 Connection control 5.3.1 Introduction 5.3.1.1 RRC connection control ... After having initiated the initial security activation procedure, E-UTRAN may configure a UE that supports CA, with one or more SCells in addition to the PCell that was initially configured during connection establishment. The PCell is used to provide the security inputs and upper layer system information (i.e. the NAS mobility information e.g. TAI). SCells are used to provide additional downlink and optionally uplink radio resources. 3GPP TS 36.331 v11.2.0 at 37.

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<3GPP TS 36.300 v11.6>

7.5 Carrier Aggregation

When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC).

Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC).

The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells:

- For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only);
- From a UE viewpoint, each uplink resource only belongs to one serving cell;
- The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5);
- PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure);
- PCell is used for transmission of PUCCH;
- Unlike SCells, PCell cannot be de-activated (see subclause 11.2);
- Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF;
- NAS information is taken from PCell.

The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells.

3GPP TS 36.300 v11.6.0 at 60.

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	5.5 Carrier Aggregation In Carrier Aggregation (CA), two or more Component Carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities: - A UE with single timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells sharing the same timing advance (multiple serving cells grouped in one TAG); - A UE with multiple timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells with different timing advances (multiple serving cells grouped in multiple TAGs). E-UTRAN ensures that each TAG contains at least one serving cell; - A non-CA capable UE can receive on a single CC and transmit on a single CC corresponding to one serving cell only (one serving cell in one TAG). CA is supported for both contiguous and non-contiguous CCs with each CC limited to a maximum of 110 Resource Blocks in the frequency domain using the Rel-8/9 numerology. 3GPP TS 36.300 v11.6.0 at 48.

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	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. 3GPP TS 36.300 v11.6.0 at 72. Timing Advance Group: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value. Primary Timing Advance Group: Timing Advance Group containing the PCell. Secondary Timing Advance Group: Timing Advance Group not containing the PCell. 3GPP TS 36.300 v11.6.0 at 16.

	<3GPP TS 36.331 v11.2.0> 5.3.5 RRC connection reconfiguration 5.3.5.1 General <pre>sequenceDiagram participant UE participant EUTRAN EUTRAN->>UE: RRCConnectionReconfiguration UE->>EUTRAN: RRCConnectionReconfigurationComplete</pre> Figure 5.3.5.1-1: RRC connection reconfiguration, successful ... The purpose of this procedure is to modify an RRC connection, e.g. to establish/ modify/ release RBs, to perform handover, to setup/ modify/ release measurements, to add/ modify/ release SCells. As part of the procedure, NAS dedicated information may be transferred from E-UTRAN to the UE. 3GPP TS 36.331 v11.2.0 at 50. 5.3.5.3 Reception of an <i>RRCConnectionReconfiguration</i> not including the <i>mobilityControlInfo</i> by the UE If the <i>RRCConnectionReconfiguration</i> message does not include the <i>mobilityControlInfo</i> and the UE is able to comply with the configuration included in this message, the UE shall: ...
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	1> if the received <i>RRConnectionReconfiguration</i> includes the <i>sCellToReleaseList</i>: 2> perform SCell release as specified in 5.3.10.3a; 1> if the received <i>RRConnectionReconfiguration</i> includes the <i>sCellToAddModList</i>: 2> perform SCell addition or modification as specified in 5.3.10.3b; 3GPP TS 36.331 v11.2.0 at 51.
[2.b] configuring one or more UL timing groups based on the UL timing group information set, the one or more UL timing groups each comprising one or more UL CCs;	Each of the Accused LGE '545 LTE Products is a user equipment configured to configure one or more UL timing groups based on the UL timing group information set, the one or more UL timing groups each comprising one or more UL CCs. <3GPP TS 36.331 v11.2.0> 5.3.10 Radio resource configuration 5.3.10.0 General The UE shall: 1> if the received <i>radioResourceConfigDedicated</i> includes the <i>mac-MainConfig</i>: 2> perform MAC main reconfiguration as specified in 5.3.10.4; 3GPP TS 36.331 v11.2.0 at 64.

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	5.3.10.4 MAC main reconfiguration The UE shall: 1> reconfigure the MAC main configuration in accordance with the received <i>mac-MainConfig</i> other than <i>secTAG-ToReleaseList</i> and <i>secTAG-ToAddModList</i>; 1> if the received <i>mac-MainConfig</i> includes the <i>secTAG-ToReleaseList</i>: 2> for each <i>SecTAG-Id</i> value included in the <i>secTAG-ToReleaseList</i> that is part of the current UE configuration: 3> release the secondary TAG indicated by <i>SecTAG-Id</i>; 1> if the received <i>mac-MainConfig</i> includes the <i>secTAG-ToAddModList</i>: 2> for each <i>secTAG-Id</i> value included in <i>secTAG-ToAddModList</i> that is not part of the current UE configuration (secondary TAG addition): 3> add the secondary TAG, corresponding to the <i>secTAG-Id</i>, in accordance with the received <i>timeAlignmentTimerSecTAG</i>; 2> for each <i>secTAG-Id</i> value included in <i>secTAG-ToAddModList</i> that is part of the current UE configuration (secondary TAG modification): 3> reconfigure the secondary TAG, corresponding to the <i>secTAG-Id</i>, in accordance with the received <i>timeAlignmentTimerSecTAG</i>;

3GPP TS 36.331 v11.2.0 at 66.

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	MAC-MainConfig information element <pre>-- ASN1START MAC-MainConfig ::= SEQUENCE { ... SecTAG-ToReleaseList-r11 ::= SEQUENCE (SIZE (1.. maxSecTAG-r11)) OF SecTAG-Id-r11 SecTAG-ToAddModList-r11 ::= SEQUENCE (SIZE (1.. maxSecTAG-r11)) OF SecTAG-ToAddMod-r11 SecTAG-ToAddMod-r11 ::= SEQUENCE { secTAG-Id-r11 SecTAG-Id-r11, timeAlignmentTimerSecTAG-r11 TimeAlignmentTimer, SecTAG-Id-r11 ::= INTEGER (1.. maxSecTAG-r11) -- ASN1STOP</pre> 3GPP TS 36.331 v11.2.0 at 195-97. secTAG-Id Indicates the TAG of an SCell, see TS 36.321 [6]. If the field is not configured for an SCell (e.g. absent in <i>MAC-MainConfigSCell</i>), the SCell is part of the primary TAG. secTAG-ToAddModList, secTAG-ToReleaseList Used to configure one or more secondary TAGs. E-UTRAN ensures that a secondary TAG contains at least one SCell with configured uplink. If, as part of a reconfiguration that due to SCell release would result in an 'empty' TAG, E-UTRAN releases the concerned TAG. 3GPP TS 36.331 v11.2.0 at 198.

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	<3GPP TS 36.300 v11.6> 10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. 3GPP TS 36.300 v11.6.0 at 72.
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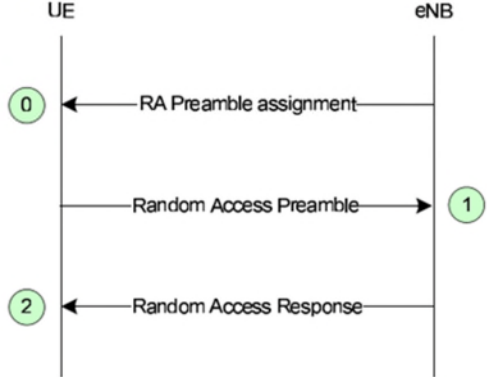
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[2.c] transmitting a Random Access Preamble (RAP), through one or more UL CCs, each of the one or more UL CCs transmitting an RAP	Each of the Accused LGE '545 LTE Products is an LTE-compliant user equipment configured to transmit a random access preamble through one or more UL CCs, each such UL CC being set as a delegate CC in the respective UL timing group. For example, the eNB may initiate the random access procedure on a

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being set as a delegate CC in the respective UL timing group;	scheduling cell of an activated SCell, which can be used by the UE as a timing reference cell. <i>See</i> 3GPP TS 36.300 v11.6.0 at 72, 74-75. <3GPP TS 36.300 v11.6.0> 10.1.5 Random Access Procedure The random access procedure is characterized by: - Common procedure for FDD and TDD; - One procedure irrespective of cell size and the number of serving cells when CA is configured; 3GPP TS 36.300 v11.6.0 at 72. The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG. Furthermore, the random access procedure takes two distinct forms: - Contention based (applicable to first five events); - Non-contention based (applicable to only handover, DL data arrival, positioning and obtaining timing advance alignment for a sTAG). 3GPP TS 36.300 v11.6.0 at 73.

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	10.1.5.2 Non-contention based random access procedure The non-contention based random access procedure is outlined on Figure 10.1.5.2-1 below: <pre>sequenceDiagram participant UE participant eNB Note over UE: 0 eNB->>UE: RA Preamble assignment UE->>eNB: Random Access Preamble Note over eNB: 1 eNB->>UE: Random Access Response Note over UE: 2</pre> Figure 10.1.5.2-1: Non-contention based Random Access Procedure

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	The three steps of the non-contention based random access procedures are: 0) Random Access Preamble assignment via dedicated signalling in DL: - eNB assigns to UE a non-contention Random Access Preamble (a Random Access Preamble not within the set sent in broadcast signalling). - Signalled via: - HO command generated by target eNB and sent via source eNB for handover; - PDCCH in case of DL data arrival or positioning; - PDCCH for initial UL time alignment for a sTAG. 1) Random Access Preamble on RACH in uplink: - UE transmits the assigned non-contention Random Access Preamble. 2) Random Access Response on DL-SCH: - Semi-synchronous (within a flexible window of which the size is two or more TTIs) with message 1; - No HARQ; - Addressed to RA-RNTI on PDCCH; - Conveys at least: - Timing Alignment information and initial UL grant for handover; - Timing Alignment information for DL data arrival; - RA-preamble identifier. - Intended for one or multiple UEs in one DL-SCH message. When performing non-contention based random access on the PCell while CA is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the PCell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the sTAG. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell. 3GPP TS 36.300 v11.6.0 at 74-75.

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	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs. 3GPP TS 36.300 v11.6.0 at 72.

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	Timing Advance Group: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value. Primary Timing Advance Group: Timing Advance Group containing the PCell. Secondary Timing Advance Group: Timing Advance Group not containing the PCell. 3GPP TS 36.300 v11.6.0 at 16. 7.5 Carrier Aggregation When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC). Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells: - For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only); - From a UE viewpoint, each uplink resource only belongs to one serving cell; - The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5); - PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure); - PCell is used for transmission of PUCCH; - Unlike SCells, PCell cannot be de-activated (see subclause 11.2); - Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF; - NAS information is taken from PCell. The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells. 3GPP TS 36.300 v11.6.0 at 60.

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	To the extent LGE argues that this limitation is not literally met by any Accused LGE '545 LTE Product, Pantech asserts that this limitation is met under the doctrine of equivalents because the identified method performed by the Accused LGE '545 LTE Products matches the function, way, and result of the claimed method and, to the extent there is a difference, the difference is insubstantial. For example, to the extent that LGE argues that Accused LGE '545 LTE Products do not transmit a random access preamble through one or more UL component carriers (CCs) “being set as a delegate CC in the respective UL timing group,” the identified timing reference cell for a secondary Timing Advance Group (sTAG) will accomplish the same aim by performing the same function as “a delegate CC in the respective UL timing group,” in the same way as claimed, such as by transmitting the random access preamble through a CC associated with the timing reference cell for the sTAG. The performance of this method achieves substantially the same result, for example, the random access preamble is transmitted through a CC designated for the respective UL timing group.
[2.d] receiving a Random Access Response (RAR) including a Timing Advanced (TA) value for UL CCs in the respective UL timing group,	Each of the Accused LGE '545 LTE Products is an LTE-compliant user equipment configured to receive a random access response including a Timing Advanced (TA) value for UL CCs in the respective UL timing group.

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<3GPP TS 36.300 v11.6.0>

10.1.5.2 Non-contention based random access procedure

The non-contention based random access procedure is outlined on Figure 10.1.5.2-1 below:

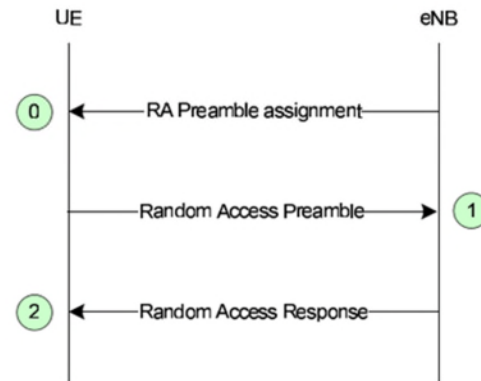


Figure 10.1.5.2-1: Non-contention based Random Access Procedure

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	The three steps of the non-contention based random access procedures are: 0) Random Access Preamble assignment via dedicated signalling in DL: - eNB assigns to UE a non-contention Random Access Preamble (a Random Access Preamble not within the set sent in broadcast signalling). - Signalled via: - HO command generated by target eNB and sent via source eNB for handover; - PDCCH in case of DL data arrival or positioning; - PDCCH for initial UL time alignment for a sTAG. 1) Random Access Preamble on RACH in uplink: - UE transmits the assigned non-contention Random Access Preamble. 2) Random Access Response on DL-SCH: - Semi-synchronous (within a flexible window of which the size is two or more TTIs) with message 1; - No HARQ; - Addressed to RA-RNTI on PDCCH; - Conveys at least: - Timing Alignment information and initial UL grant for handover; - Timing Alignment information for DL data arrival; - RA-preamble identifier. - Intended for one or multiple UEs in one DL-SCH message. When performing non-contention based random access on the PCell while CA is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the PCell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the sTAG. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell. 3GPP TS 36.300 v11.6.0 at 76-77.

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	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs.

3GPP TS 36.300 v11.6.0 at 72.

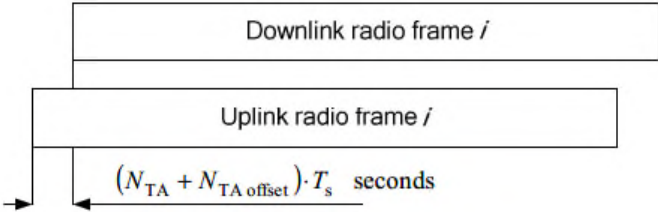
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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement																					
	<3GPP TS 36.321 v11.1.0> 6.1.5 MAC PDU (Random Access Response) A MAC PDU consists of a MAC header and zero or more MAC Random Access Responses (MAC RAR) and optionally padding as described in figure 6.1.5-4. ... A MAC RAR consists of the four fields R/Timing Advance Command/UL Grant/Temporary C-RNTI (as described in figure 6.1.5-3). <table><tr><td colspan="3"> </td></tr><tr><td>R</td><td>Timing Advance Command</td><td>Oct 1</td></tr><tr><td>Timing Advance Command</td><td>UL Grant</td><td>Oct 2</td></tr><tr><td colspan="2">UL Grant</td><td>Oct 3</td></tr><tr><td colspan="2">UL Grant</td><td>Oct 4</td></tr><tr><td colspan="2">Temporary C-RNTI</td><td>Oct 5</td></tr><tr><td colspan="2">Temporary C-RNTI</td><td>Oct 6</td></tr></table> Figure 6.1.5-3: MAC RAR 3GPP TS 36.321 v11.1.0 at 43-44.				R	Timing Advance Command	Oct 1	Timing Advance Command	UL Grant	Oct 2	UL Grant		Oct 3	UL Grant		Oct 4	Temporary C-RNTI		Oct 5	Temporary C-RNTI		Oct 6
R	Timing Advance Command	Oct 1																				
Timing Advance Command	UL Grant	Oct 2																				
UL Grant		Oct 3																				
UL Grant		Oct 4																				
Temporary C-RNTI		Oct 5																				
Temporary C-RNTI		Oct 6																				

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	6.2.3 MAC payload for Random Access Response The MAC RAR is of fixed size and consists of the following fields: - R: Reserved bit, set to "0"; - Timing Advance Command: The Timing Advance Command field indicates the index value T_A (0, 1, 2... 1282) used to control the amount of timing adjustment that UE has to apply (see subclause 4.2.3 of [2]). The size of the Timing Advance Command field is 11 bits; - UL Grant: The UpLink Grant field indicates the resources to be used on the uplink (see subclause 6.2 of [2]). The size of the UL Grant field is 20 bits; - Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the UE during Random Access. The size of the Temporary C-RNTI field is 16 bits. The MAC RAR is octet aligned. 3GPP TS 36.321 v11.1.0 at 46. <3GPP TS 36.213 v11.1.0> 4.2.3 Transmission timing adjustments Upon reception of a timing advance command for a TAG containing the primary cell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS of the primary cell based on the received timing advance command. The UL transmission timing for PUSCH/SRS of a secondary cell is the same as the primary cell if the secondary cell and the primary cell belong to the same TAG. Upon reception of a timing advance command for a TAG not containing the primary cell, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG based on the received timing advance command where the UL transmission timing for PUSCH /SRS is the same for all the secondary cells in the TAG. The timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG as multiples of $16 T_s$. The start timing of the random access preamble is specified in [3]. 3GPP TS 36.213 v11.1.0 at 9-10.

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	<3GPP TS 36.211 v11.1.0> 8.1 Uplink-downlink frame timing Transmission of the uplink radio frame number i from the UE shall start $(N_{TA} + N_{TA\ offset}) \times T_s$ seconds before the start of the corresponding downlink radio frame at the UE, where $0 \leq N_{TA} \leq 20512$, $N_{TA\ offset} = 0$ for frame structure type 1 and $N_{TA\ offset} = 624$ for frame structure type 2. Note that not all slots in a radio frame may be transmitted. One example hereof is TDD, where only a subset of the slots in a radio frame is transmitted.  Figure 8.1-1: Uplink-downlink timing relation. 3GPP TS 36.211 v11.1.0 at 104.
[2.e] wherein each TA value is transmitted from the eNB for the respective UL timing group based on the transmitted RAP associated with a delegate CC of the respective UL timing group; and	Each TA value is transmitted from the eNB for the respective UL timing group based on the transmitted random access preamble associated with a delegate CC of the respective UL timing group. <3GPP TS 36.321 v11.1.0> Timing Advance Group: A group of Serving Cells that is configured by RRC and that, for the cells with an UL configured, using the same timing reference cell and the same Timing Advance value. NOTE: A timer is running once it is started, until it is stopped or until it expires; otherwise it is not running. A timer can be started if it is not running or restarted if it is running. A Timer is always started or restarted from its initial value.

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	3GPP TS 36.321 v11.1.0 at 8. <3GPP TS 36.300 v11.6.0> 10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs.

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	3GPP TS 36.300 v11.6.0 at 72. To the extent LGE argues that this limitation is not literally met by any Accused LGE '545 LTE Product, Pantech asserts that this limitation is met under the doctrine of equivalents because the identified method performed by the Accused LGE '545 LTE Products matches the function, way, and result of the claimed method and, to the extent there is a difference, the difference is insubstantial. For example, to the extent that LGE argues that Accused LGE '545 LTE Products do not transmit each TA value “based on the transmitted RAP associated with a delegate CC of the respective UL timing group,” the identified transmission, from the eNB, of a timing advance value for a sTAG in MAC PDUs as part of the random access response will accomplish the same aim by performing the same function as a transmission “based on the transmitted RAP associated with a delegate CC of the respective UL timing group,” in the same way as claimed, such as by transmitting the timing advance value in the random access response, which is transmitted from the eNB in response to the random access preamble transmitted through a CC associated with the timing reference cell of a sTAG. The performance of this method achieves substantially the same result, for example, the TA value is transmitted in response to a random access preamble transmitted through a CC designated for the respective UL timing group.
[2.f] applying each TA value to CCs in the respective UL timing group.	Each of the Accused LGE '545 LTE Products is a user equipment configured to apply each TA value to CCs in the respective UL timing group according to the claimed communication method.

<3GPP TS 36.321 v11.1.0>

5.2 Maintenance of Uplink Time Alignment

The UE has a configurable timer *timeAlignmentTimer* per TAG. The *timeAlignmentTimer* is used to control how long the UE considers the Serving Cells belonging to the associated TAG to be uplink time aligned [8].

The UE shall:

- when a Timing Advance Command MAC control element is received:
 - apply the Timing Advance Command for the indicated TAG;
 - start or restart the *timeAlignmentTimer* associated with the indicated TAG.
- when a Timing Advance Command is received in a Random Access Response message for a serving cell belonging to a TAG:
 - if the Random Access Preamble was not selected by UE MAC:
 - apply the Timing Advance Command for this TAG;
 - start or restart the *timeAlignmentTimer* associated with this TAG.

3GPP TS 36.321 v11.1.0 at 17-18.

<3GPP TS 36.213 v11.1.0>

4.2.3 Transmission timing adjustments

Upon reception of a timing advance command for a TAG containing the primary cell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS of the primary cell based on the received timing advance command. The UL transmission timing for PUSCH/SRS of a secondary cell is the same as the primary cell if the secondary cell and the primary cell belong to the same TAG.

Upon reception of a timing advance command for a TAG not containing the primary cell, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG based on the received timing advance command where the UL transmission timing for PUSCH/SRS is the same for all the secondary cells in the TAG.

The timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG as multiples of $16 T_s$. The start timing of the random access preamble is specified in [3].

3GPP TS 36.213 v11.1.0 at 9-10.

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[3.pre] A User Equipment (UE) to establish an uplink (UL) synchronization in a wireless communication system, the UE comprising:	Each of the Accused LGE '545 LTE Products is an LTE-compliant user equipment, and therefore constitutes user equipment (UE). The Accused LGE '545 LTE Products establish an uplink (UL) synchronization in a wireless communication system. As shown in Appendix 1, each of the Accused LGE '545 LTE Products contains a chipset, antenna or antennas, memory, and transceiver or combination of transmitter and receiver that operate in accordance LTE Advanced communication protocols and support the Radio Resource Control (RRC), random access, and timing advance mechanisms described in these technical specifications. <i>See</i> Appendix 1. Each Accused LGE '545 LTE Product complies with one or more of LTE Release 11 or later cellular communication protocols including at least 3GPP TS 36.300, 3GPP TS 36.321, 3GPP TS 36.213, 3GPP TS 36.211, and/or 3GPP TS 36.331, and supports the use of RRC, random access, and timing advance mechanisms in accordance with the LTE Advanced Standard, and is thus a UE. <i>See</i> Appendix 1. <3GPP TS 36.300 v11.6.0> 4 Overall architecture The E-UTRAN consists of eNBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME interface and to the Serving Gateway (S-GW) by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNBs. 3GPP TS 36.300 v11.6.0 at 19.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	5.5 Carrier Aggregation In Carrier Aggregation (CA), two or more Component Carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities: - A UE with single timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells sharing the same timing advance (multiple serving cells grouped in one TAG); - A UE with multiple timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells with different timing advances (multiple serving cells grouped in multiple TAGs). E-UTRAN ensures that each TAG contains at least one serving cell; - A non-CA capable UE can receive on a single CC and transmit on a single CC corresponding to one serving cell only (one serving cell in one TAG). CA is supported for both contiguous and non-contiguous CCs with each CC limited to a maximum of 110 Resource Blocks in the frequency domain using the Rel-8/9 numerology. 3GPP TS 36.300 v11.6.0 at 48.

	7.5 Carrier Aggregation When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC). Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells: - For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only); - From a UE viewpoint, each uplink resource only belongs to one serving cell; - The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5); - PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure); - PCell is used for transmission of PUCCH; - Unlike SCells, PCell cannot be de-activated (see subclause 11.2); - Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF; - NAS information is taken from PCell. The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells. 3GPP TS 36.300 v11.6.0 at 60.
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10.1.2.7 Timing Advance

In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC.

For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary.

In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink:

- as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH.

For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include:

- Expiration of a timer specific to the TAG;
- Non-synchronised handover;

The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running.

The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG:

- restarted to a UE specific value if any; or
- restarted to a cell specific value otherwise.

The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG.

Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status.

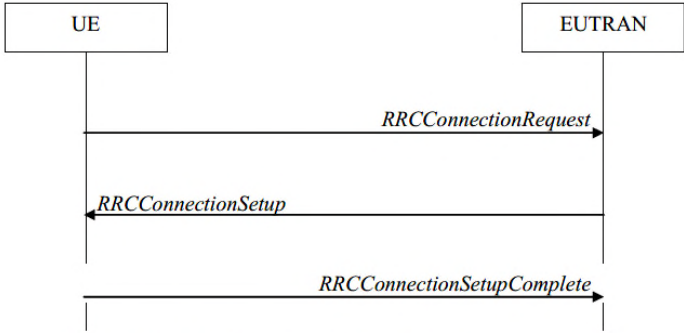
Timing advance updates are signalled by the eNB to the UE in MAC PDUs.

3GPP TS 36.300 v11.6.0 at 72.

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[3.a] a transceiver configured to receive a Radio Resource Control (RRC) signaling including a UL timing group information set, which has been set by an evolved NodeB (eNB);	Each of the Accused LGE '545 LTE Products includes a transceiver configured to receive a Radio Resource Control (RRC) signaling including a UL timing group information set, which has been set by an evolved NodeB (eNB). For example, each of the Accused LGE '545 LTE Products contains a transceiver that is configured to receive RRC signaling. <i>See</i> Appendix 1. The RRC signaling includes a UL timing group information set, which has been set by an eNB. <3GPP TS 36.300 v11.6.0> 1 Scope The present document provides an overview and overall description of the E-UTRAN radio interface protocol architecture. Details of the radio interface protocols are specified in companion specifications of the 36 series. 3GPP TS 36.300 v11.6.0 at 13. 4 Overall architecture The E-UTRAN consists of eNBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME interface and to the Serving Gateway (S-GW) by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNBs. 3GPP TS 36.300 v11.6.0 at 19. <table> <tr> <td>eNB</td><td>E-UTRAN NodeB</td></tr> <tr> <td>EPC</td><td>Evolved Packet Core</td></tr> <tr> <td>EPS</td><td>Evolved Packet System</td></tr> <tr> <td>E-RAB</td><td>E-UTRAN Radio Access Bearer</td></tr> <tr> <td>ETWS</td><td>Earthquake and Tsunami Warning System</td></tr> <tr> <td>E-UTRA</td><td>Evolved UTRA</td></tr> <tr> <td>E-UTRAN</td><td>Evolved UTRAN</td></tr> </table>	eNB	E-UTRAN NodeB	EPC	Evolved Packet Core	EPS	Evolved Packet System	E-RAB	E-UTRAN Radio Access Bearer	ETWS	Earthquake and Tsunami Warning System	E-UTRA	Evolved UTRA	E-UTRAN	Evolved UTRAN
eNB	E-UTRAN NodeB														
EPC	Evolved Packet Core														
EPS	Evolved Packet System														
E-RAB	E-UTRAN Radio Access Bearer														
ETWS	Earthquake and Tsunami Warning System														
E-UTRA	Evolved UTRA														
E-UTRAN	Evolved UTRAN														

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	3GPP TS 36.300 v11.6.0 at 17. <3GPP TS 36.331 v11.2.0> 5.3.3 RRC connection establishment 5.3.3.1 General  <pre> sequenceDiagram participant UE participant EUTRAN UE->>EUTRAN: RRCConnectionRequest EUTRAN-->>UE: RRCConnectionSetup UE->>EUTRAN: RRCConnectionSetupComplete </pre> Figure 5.3.3.1-1: RRC connection establishment, successful 3GPP TS 36.331 v11.2.0 at 40. 5.3.3.4 Reception of the <i>RRCConnectionSetup</i> by the UE NOTE: Prior to this, lower layer signalling is used to allocate a C-RNTI. For further details see TS 36.321 [6]; The UE shall: ... 1> enter RRC_CONNECTED; 1> stop the cell re-selection procedure; 1> consider the current cell to be the PCell; 3GPP TS 36.331 v11.2.0 at 43.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	5.3 Connection control 5.3.1 Introduction 5.3.1.1 RRC connection control ... After having initiated the initial security activation procedure, E-UTRAN may configure a UE that supports CA, with one or more SCells in addition to the PCell that was initially configured during connection establishment. The PCell is used to provide the security inputs and upper layer system information (i.e. the NAS mobility information e.g. TAI). SCells are used to provide additional downlink and optionally uplink radio resources. 3GPP TS 36.331 v11.2.0 at 37.

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<3GPP TS 36.300 v11.6>

7.5 Carrier Aggregation

When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC).

Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC).

The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells:

- For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only);
- From a UE viewpoint, each uplink resource only belongs to one serving cell;
- The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5);
- PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure);
- PCell is used for transmission of PUCCH;
- Unlike SCells, PCell cannot be de-activated (see subclause 11.2);
- Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF;
- NAS information is taken from PCell.

The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells.

3GPP TS 36.300 v11.6.0 at 60.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	5.5 Carrier Aggregation In Carrier Aggregation (CA), two or more Component Carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities: - A UE with single timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells sharing the same timing advance (multiple serving cells grouped in one TAG); - A UE with multiple timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells with different timing advances (multiple serving cells grouped in multiple TAGs). E-UTRAN ensures that each TAG contains at least one serving cell; - A non-CA capable UE can receive on a single CC and transmit on a single CC corresponding to one serving cell only (one serving cell in one TAG). CA is supported for both contiguous and non-contiguous CCs with each CC limited to a maximum of 110 Resource Blocks in the frequency domain using the Rel-8/9 numerology. 3GPP TS 36.300 v11.6.0 at 48.

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	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. 3GPP TS 36.300 v11.6.0 at 72. Timing Advance Group: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value. Primary Timing Advance Group: Timing Advance Group containing the PCell. Secondary Timing Advance Group: Timing Advance Group not containing the PCell. 3GPP TS 36.300 v11.6.0 at 16.

	<3GPP TS 36.331 v11.2.0> 5.3.5 RRC connection reconfiguration 5.3.5.1 General <pre>sequenceDiagram participant UE participant EUTRAN EUTRAN->>UE: RRCConnectionReconfiguration UE->>EUTRAN: RRCConnectionReconfigurationComplete</pre> Figure 5.3.5.1-1: RRC connection reconfiguration, successful ... The purpose of this procedure is to modify an RRC connection, e.g. to establish/ modify/ release RBs, to perform handover, to setup/ modify/ release measurements, to add/ modify/ release SCells. As part of the procedure, NAS dedicated information may be transferred from E-UTRAN to the UE. 3GPP TS 36.331 v11.2.0 at 50. 5.3.5.3 Reception of an <i>RRCConnectionReconfiguration</i> not including the <i>mobilityControlInfo</i> by the UE If the <i>RRCConnectionReconfiguration</i> message does not include the <i>mobilityControlInfo</i> and the UE is able to comply with the configuration included in this message, the UE shall: ...
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	1> if the received <i>RRConnectionReconfiguration</i> includes the <i>sCellToReleaseList</i>: 2> perform SCell release as specified in 5.3.10.3a; 1> if the received <i>RRConnectionReconfiguration</i> includes the <i>sCellToAddModList</i>: 2> perform SCell addition or modification as specified in 5.3.10.3b; 3GPP TS 36.331 v11.2.0 at 51.
[3.b] a controller configured to configure one or more UL timing groups based on the UL timing group information set, the one or more UL timing groups each comprising one or more UL CCs,	Each of the Accused LGE '545 LTE Products includes a controller configured to configure one or more UL timing groups based on the UL timing group information set, the one or more UL timing groups each comprising one or more UL CCs. For example, each of the Accused LGE '545 LTE Products includes a chipset configured in the manner claimed. See Appendix 1. <3GPP TS 36.331 v11.2.0> 5.3.10 Radio resource configuration 5.3.10.0 General The UE shall: 1> if the received <i>radioResourceConfigDedicated</i> includes the <i>mac-MainConfig</i>: 2> perform MAC main reconfiguration as specified in 5.3.10.4; 3GPP TS 36.331 v11.2.0 at 64.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	5.3.10.4 MAC main reconfiguration The UE shall: 1> reconfigure the MAC main configuration in accordance with the received <i>mac-MainConfig</i> other than <i>secTAG-ToReleaseList</i> and <i>secTAG-ToAddModList</i>; 1> if the received <i>mac-MainConfig</i> includes the <i>secTAG-ToReleaseList</i>: 2> for each <i>SecTAG-Id</i> value included in the <i>secTAG-ToReleaseList</i> that is part of the current UE configuration: 3> release the secondary TAG indicated by <i>SecTAG-Id</i>; 1> if the received <i>mac-MainConfig</i> includes the <i>secTAG-ToAddModList</i>: 2> for each <i>secTAG-Id</i> value included in <i>secTAG-ToAddModList</i> that is not part of the current UE configuration (secondary TAG addition): 3> add the secondary TAG, corresponding to the <i>secTAG-Id</i>, in accordance with the received <i>timeAlignmentTimerSecTAG</i>; 2> for each <i>secTAG-Id</i> value included in <i>secTAG-ToAddModList</i> that is part of the current UE configuration (secondary TAG modification): 3> reconfigure the secondary TAG, corresponding to the <i>secTAG-Id</i>, in accordance with the received <i>timeAlignmentTimerSecTAG</i>;

3GPP TS 36.331 v11.2.0 at 66.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	MAC-MainConfig information element <pre>-- ASN1START MAC-MainConfig ::= SEQUENCE {</pre> ... <pre>SecTAG-ToReleaseList-r11 ::= SEQUENCE (SIZE (1.. maxSecTAG-r11)) OF SecTAG-Id-r11 SecTAG-ToAddModList-r11 ::= SEQUENCE (SIZE (1.. maxSecTAG-r11)) OF SecTAG-ToAddMod-r11 SecTAG-ToAddMod-r11 ::= SEQUENCE { secTAG-Id-r11 SecTAG-Id-r11, timeAlignmentTimerSecTAG-r11 TimeAlignmentTimer,</pre> <pre>SecTAG-Id-r11 ::= INTEGER (1.. maxSecTAG-r11) -- ASN1STOP</pre> 3GPP TS 36.331 v11.2.0 at 195-97. secTAG-Id Indicates the TAG of an SCell, see TS 36.321 [6]. If the field is not configured for an SCell (e.g. absent in <i>MAC-MainConfigSCell</i>), the SCell is part of the primary TAG. secTAG-ToAddModList, secTAG-ToReleaseList Used to configure one or more secondary TAGs. E-UTRAN ensures that a secondary TAG contains at least one SCell with configured uplink. If, as part of a reconfiguration that due to SCell release would result in an 'empty' TAG, E-UTRAN releases the concerned TAG. 3GPP TS 36.331 v11.2.0 at 198.

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	<3GPP TS 36.300 v11.6> 10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. 3GPP TS 36.300 v11.6.0 at 72.
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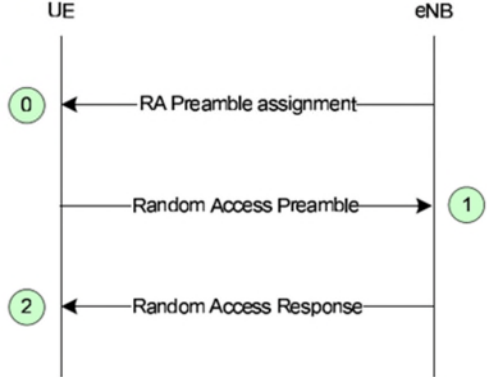
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	7.5 Carrier Aggregation When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC). Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells: - For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only); - From a UE viewpoint, each uplink resource only belongs to one serving cell; - The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5); - PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure); - PCell is used for transmission of PUCCH; - Unlike SCells, PCell cannot be de-activated (see subclause 11.2); - Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF; - NAS information is taken from PCell. The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells. 3GPP TS 36.300 v11.6.0 at 60.
[3.c] wherein the transceiver transmits a Random Access Preamble (RAP) through one or more UL CCs, each of the one or	The transceiver of each of the Accused LGE '545 LTE Products transmits a Random Access Preamble (RAP) through one or more UL CCs, each of the one or more UL CCs transmitting an RAP being set as a delegate CC in the respective UL timing group. For example, each of the Accused LGE '545 LTE Products contains a transceiver that transmits a RAP through one or more UL CCs. <i>See Appendix 1.</i> Each

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more UL CCs transmitting an RAP being set as a delegate CC in the respective UL timing group, and	such UL CC transmitting the RAP is set as a delegate CC in the respective UL timing group. For example, the eNB may initiate the random access procedure on a scheduling cell of an activated SCell, which can be used by the UE as a timing reference cell. <i>See</i> 3GPP TS 36.300 v11.6.0 at 72, 74-75. <3GPP TS 36.300 v11.6.0> 10.1.5 Random Access Procedure The random access procedure is characterized by: - Common procedure for FDD and TDD; - One procedure irrespective of cell size and the number of serving cells when CA is configured; 3GPP TS 36.300 v11.6.0 at 72. The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG. Furthermore, the random access procedure takes two distinct forms: - Contention based (applicable to first five events); - Non-contention based (applicable to only handover, DL data arrival, positioning and obtaining timing advance alignment for a sTAG). 3GPP TS 36.300 v11.6.0 at 73.

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	10.1.5.2 Non-contention based random access procedure The non-contention based random access procedure is outlined on Figure 10.1.5.2-1 below: <pre>sequenceDiagram participant UE participant eNB Note over UE: 0 eNB->>UE: RA Preamble assignment UE->>eNB: Random Access Preamble Note over eNB: 1 eNB->>UE: Random Access Response Note over UE: 2</pre> Figure 10.1.5.2-1: Non-contention based Random Access Procedure

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	The three steps of the non-contention based random access procedures are: 0) Random Access Preamble assignment via dedicated signalling in DL: - eNB assigns to UE a non-contention Random Access Preamble (a Random Access Preamble not within the set sent in broadcast signalling). - Signalled via: - HO command generated by target eNB and sent via source eNB for handover; - PDCCH in case of DL data arrival or positioning; - PDCCH for initial UL time alignment for a sTAG. 1) Random Access Preamble on RACH in uplink: - UE transmits the assigned non-contention Random Access Preamble. 2) Random Access Response on DL-SCH: - Semi-synchronous (within a flexible window of which the size is two or more TTIs) with message 1; - No HARQ; - Addressed to RA-RNTI on PDCCH; - Conveys at least: - Timing Alignment information and initial UL grant for handover; - Timing Alignment information for DL data arrival; - RA-preamble identifier. - Intended for one or multiple UEs in one DL-SCH message. When performing non-contention based random access on the PCell while CA is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the PCell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the sTAG. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell. 3GPP TS 36.300 v11.6.0 at 74-75.

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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement
	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs. 3GPP TS 36.300 v11.6.0 at 72.

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	Timing Advance Group: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value. Primary Timing Advance Group: Timing Advance Group containing the PCell. Secondary Timing Advance Group: Timing Advance Group not containing the PCell. 3GPP TS 36.300 v11.6.0 at 16. 7.5 Carrier Aggregation When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC). Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC). The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells: - For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only); - From a UE viewpoint, each uplink resource only belongs to one serving cell; - The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5); - PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure); - PCell is used for transmission of PUCCH; - Unlike SCells, PCell cannot be de-activated (see subclause 11.2); - Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF; - NAS information is taken from PCell. The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells. 3GPP TS 36.300 v11.6.0 at 60.

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	To the extent LGE argues that this limitation is not literally met by any Accused LGE '545 LTE Product, Pantech asserts that this limitation is met under the doctrine of equivalents because the identified method performed by the Accused LGE '545 LTE Products matches the function, way, and result of the claimed method and, to the extent there is a difference, the difference is insubstantial. For example, to the extent that LGE argues that Accused LGE '545 LTE Products do not transmit a random access preamble through one or more UL component carriers (CCs) “being set as a delegate CC in the respective UL timing group,” the identified timing reference cell for a secondary Timing Advance Group (sTAG) will accomplish the same aim by performing the same function as “a delegate CC in the respective UL timing group,” in the same way as claimed, such as by transmitting the random access preamble through a CC associated with the timing reference cell for the sTAG. The performance of this method achieves substantially the same result, for example, the random access preamble is transmitted through a CC designated for the respective UL timing group.
[3.d] receives a Random Access Response (RAR) including a Timing Advanced (TA) value for UL CCs in the respective UL timing group,	The transceiver of each of the Accused LGE '545 LTE Products receives a Random Access Response (RAR) including a Timing Advanced (TA) value for UL CCs in the respective UL timing group. For example, each of the Accused LGE '545 LTE Products contains a transceiver that receives a RAR. See Appendix 1. The RAR includes a TA value for UL CCs in the respective UL timing group.

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<3GPP TS 36.300 v11.6.0>

10.1.5.2 Non-contention based random access procedure

The non-contention based random access procedure is outlined on Figure 10.1.5.2-1 below:

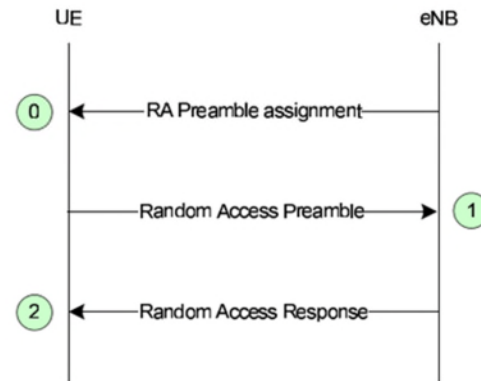


Figure 10.1.5.2-1: Non-contention based Random Access Procedure

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	The three steps of the non-contention based random access procedures are: 0) Random Access Preamble assignment via dedicated signalling in DL: - eNB assigns to UE a non-contention Random Access Preamble (a Random Access Preamble not within the set sent in broadcast signalling). - Signalled via: - HO command generated by target eNB and sent via source eNB for handover; - PDCCH in case of DL data arrival or positioning; - PDCCH for initial UL time alignment for a sTAG. 1) Random Access Preamble on RACH in uplink: - UE transmits the assigned non-contention Random Access Preamble. 2) Random Access Response on DL-SCH: - Semi-synchronous (within a flexible window of which the size is two or more TTIs) with message 1; - No HARQ; - Addressed to RA-RNTI on PDCCH; - Conveys at least: - Timing Alignment information and initial UL grant for handover; - Timing Alignment information for DL data arrival; - RA-preamble identifier. - Intended for one or multiple UEs in one DL-SCH message. When performing non-contention based random access on the PCell while CA is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the PCell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the sTAG. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell. 3GPP TS 36.300 v11.6.0 at 76-77.

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	10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs. 3GPP TS 36.300 v11.6.0 at 72.

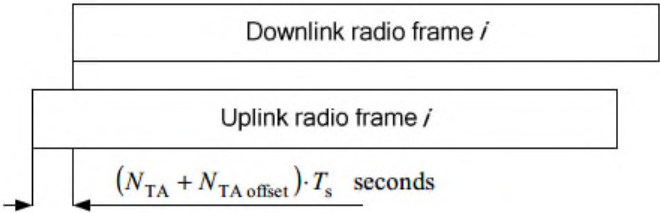
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U.S. Patent No. 9,854,545	Exemplary Evidence of Infringement																											
	<3GPP TS 36.321 v11.1.0> 6.1.5 MAC PDU (Random Access Response) A MAC PDU consists of a MAC header and zero or more MAC Random Access Responses (MAC RAR) and optionally padding as described in figure 6.1.5-4. ... A MAC RAR consists of the four fields R/Timing Advance Command/UL Grant/Temporary C-RNTI (as described in figure 6.1.5-3). <table><tr><td colspan="3"> </td></tr><tr><td>R</td><td colspan="2">Timing Advance Command</td><td>Oct 1</td></tr><tr><td colspan="2">Timing Advance Command</td><td>UL Grant</td><td>Oct 2</td></tr><tr><td colspan="3">UL Grant</td><td>Oct 3</td></tr><tr><td colspan="3">UL Grant</td><td>Oct 4</td></tr><tr><td colspan="3">Temporary C-RNTI</td><td>Oct 5</td></tr><tr><td colspan="3">Temporary C-RNTI</td><td>Oct 6</td></tr></table> Figure 6.1.5-3: MAC RAR 3GPP TS 36.321 v11.1.0 at 43-44.				R	Timing Advance Command		Oct 1	Timing Advance Command		UL Grant	Oct 2	UL Grant			Oct 3	UL Grant			Oct 4	Temporary C-RNTI			Oct 5	Temporary C-RNTI			Oct 6
R	Timing Advance Command		Oct 1																									
Timing Advance Command		UL Grant	Oct 2																									
UL Grant			Oct 3																									
UL Grant			Oct 4																									
Temporary C-RNTI			Oct 5																									
Temporary C-RNTI			Oct 6																									

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	6.2.3 MAC payload for Random Access Response The MAC RAR is of fixed size and consists of the following fields: - R: Reserved bit, set to "0"; - Timing Advance Command: The Timing Advance Command field indicates the index value T_A (0, 1, 2... 1282) used to control the amount of timing adjustment that UE has to apply (see subclause 4.2.3 of [2]). The size of the Timing Advance Command field is 11 bits; - UL Grant: The UpLink Grant field indicates the resources to be used on the uplink (see subclause 6.2 of [2]). The size of the UL Grant field is 20 bits; - Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the UE during Random Access. The size of the Temporary C-RNTI field is 16 bits. The MAC RAR is octet aligned. 3GPP TS 36.321 v11.1.0 at 46. <3GPP TS 36.213 v11.1.0> 4.2.3 Transmission timing adjustments Upon reception of a timing advance command for a TAG containing the primary cell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS of the primary cell based on the received timing advance command. The UL transmission timing for PUSCH/SRS of a secondary cell is the same as the primary cell if the secondary cell and the primary cell belong to the same TAG. Upon reception of a timing advance command for a TAG not containing the primary cell, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG based on the received timing advance command where the UL transmission timing for PUSCH /SRS is the same for all the secondary cells in the TAG. The timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG as multiples of $16 T_s$. The start timing of the random access preamble is specified in [3]. 3GPP TS 36.213 v11.1.0 at 9-10.

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	<3GPP TS 36.211 v11.1.0> 8.1 Uplink-downlink frame timing Transmission of the uplink radio frame number i from the UE shall start $(N_{TA} + N_{TA\ offset}) \times T_s$ seconds before the start of the corresponding downlink radio frame at the UE, where $0 \leq N_{TA} \leq 20512$, $N_{TA\ offset} = 0$ for frame structure type 1 and $N_{TA\ offset} = 624$ for frame structure type 2. Note that not all slots in a radio frame may be transmitted. One example hereof is TDD, where only a subset of the slots in a radio frame is transmitted.  Figure 8.1-1: Uplink-downlink timing relation. 3GPP TS 36.211 v11.1.0 at 104.
[3.e] wherein each TA value is transmitted from the eNB for the respective UL timing group based on the transmitted RAP associated with a delegate CC of the respective UL timing group, and	Each TA value is transmitted from the eNB for the respective UL timing group based on the transmitted random access preamble associated with a delegate CC of the respective UL timing group. <3GPP TS 36.321 v11.1.0> Timing Advance Group: A group of Serving Cells that is configured by RRC and that, for the cells with an UL configured, using the same timing reference cell and the same Timing Advance value. NOTE: A timer is running once it is started, until it is stopped or until it expires; otherwise it is not running. A timer can be started if it is not running or restarted if it is running. A Timer is always started or restarted from its initial value. 3GPP TS 36.321 v11.1.0 at 8.

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	<3GPP TS 36.300 v11.6.0> 10.1.2.7 Timing Advance In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. For the pTAG the UE uses the PCell as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary. In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink: - as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH. For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include: - Expiration of a timer specific to the TAG; - Non-synchronised handover; The synchronisation status of the UE follows the synchronisation status of the pTAG. When the timer associated with pTAG is not running, the timer associated with a sTAG shall not be running. The value of the timer associated to the pTAG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG: - restarted to a UE specific value if any; or - restarted to a cell specific value otherwise. The value of the timer associated to a sTAG is managed through dedicated signalling between the UE and the eNB, and the timers associated to different sTAGs can be configured with different values. The timer of a sTAG is normally restarted whenever a new timing advance is given by the eNB for the corresponding sTAG. Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status. Timing advance updates are signalled by the eNB to the UE in MAC PDUs. 3GPP TS 36.300 v11.6.0 at 72. To the extent LGE argues that this limitation is not literally met by any Accused LGE '545 LTE Product, Pantech asserts that this limitation is met under the doctrine of equivalents because the identified method performed by the Accused LGE '545 LTE Products matches the function, way, and result of the claimed
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	method and, to the extent there is a difference, the difference is insubstantial. For example, to the extent that LGE argues that Accused LGE '545 LTE Products do not transmit each TA value “based on the transmitted RAP associated with a delegate CC of the respective UL timing group,” the identified transmission, from the eNB, of a timing advance value for a sTAG in MAC PDUs as part of the random access response will accomplish the same aim by performing the same function as a transmission “based on the transmitted RAP associated with a delegate CC of the respective UL timing group,” in the same way as claimed, such as by transmitting the timing advance value in the random access response, which is transmitted from the eNB in response to the random access preamble transmitted through a CC associated with the timing reference cell of a sTAG. The performance of this method achieves substantially the same result, for example, the TA value is transmitted in response to a random access preamble transmitted through a CC designated for the respective UL timing group.
[3.f] wherein the controller applies each TA value to CCs in the respective UL timing group.	The controller of each of the Accused LGE '545 LTE Products applies each TA value to CCs in the respective UL timing group. For example, each of the Accused LGE '545 LTE Products contains a chipset that applies each TA value to CCs in the respective UL timing group.

<3GPP TS 36.321 v11.1.0>

5.2 Maintenance of Uplink Time Alignment

The UE has a configurable timer *timeAlignmentTimer* per TAG. The *timeAlignmentTimer* is used to control how long the UE considers the Serving Cells belonging to the associated TAG to be uplink time aligned [8].

The UE shall:

- when a Timing Advance Command MAC control element is received:
 - apply the Timing Advance Command for the indicated TAG;
 - start or restart the *timeAlignmentTimer* associated with the indicated TAG.
- when a Timing Advance Command is received in a Random Access Response message for a serving cell belonging to a TAG:
 - if the Random Access Preamble was not selected by UE MAC:
 - apply the Timing Advance Command for this TAG;
 - start or restart the *timeAlignmentTimer* associated with this TAG.

3GPP TS 36.321 v11.1.0 at 17-18.

<3GPP TS 36.213 v11.1.0>

4.2.3 Transmission timing adjustments

Upon reception of a timing advance command for a TAG containing the primary cell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS of the primary cell based on the received timing advance command. The UL transmission timing for PUSCH/SRS of a secondary cell is the same as the primary cell if the secondary cell and the primary cell belong to the same TAG.

Upon reception of a timing advance command for a TAG not containing the primary cell, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG based on the received timing advance command where the UL transmission timing for PUSCH/SRS is the same for all the secondary cells in the TAG.

The timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG as multiples of $16 T_s$. The start timing of the random access preamble is specified in [3].

3GPP TS 36.213 v11.1.0 at 9-10.

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