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Request for grant of a European patent

For official use only		
1 Application number:	MKEY	**MKEY - EP17183827.9**
2 Date of receipt (Rule 35(2) EPC):	DREC	**DREC - 28 Jul 2017**
3 Date of receipt at EPO (Rule 35(4) EPC):	RENA	
4 Date of filing:		

5 Grant of European patent, and examination of the application under Article 94, are hereby requested. ☒

5.1 The applicant waives his right to be asked whether he wishes to proceed further with the application (Rule 70(2)) ☐

Procedural language: en

Description and/or claims filed in: en

6 Applicant's or representative's reference: ASU170707PEP

Filing Office: EP

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10-1 State of residence or of principal place of business: Chinese Taipei

14.1 The/Each applicant hereby declares that he is an entity or a natural person under Rule 6(4) EPC. ☐

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IPR2024-01036

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Inventor(s)

23 Inventor details filed separately ☒

24 Title of invention

Title of invention: METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

25 Declaration of priority (Rule 52)

A declaration of priority is hereby made for the following applications

	State	Filing date	Kind	Application number:	Search results under Rule 141(1) are attached
Priority 01	US	28.07.2016	pr	62/367,875	☐

25.2 This application is a complete translation of the previous application ☐

25.3 It is not intended to file a (further) declaration of priority ☐

26 Reference to a previously filed application

27 Divisional application ☐

28 Article 61(1)(b) application ☐

29 Claims

Number of claims: 15

29.1 ☒ as attached

29.2 ☐ as in the previously filed application (see Section 26.2)

29.3 ☐ The claims will be filed later

30 Figures

It is proposed that the abstract be published together with figure No. 12

31 Designation of contracting states

All the contracting states party to the EPC at the time of filing of the European patent application are deemed to be designated (see Article 79(1)).

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32 Different applicants for different contracting states

33 Extension/Validation

This application is deemed to be a request to extend the effects of the European patent application and the European patent granted in respect of it to all non-contracting states to the EPC with which extension or validation agreements are in force on the date on which the application is filed. However, the request is deemed withdrawn if the extension fee or the validation fee, whichever is applicable, is not paid within the prescribed time limit.

33.1 It is intended to pay the extension fee(s) for the following state(s):

33.2 It is intended to pay the validation fee(s) for the following state(s):

34 Biological material

38 Nucleotide and amino acid sequences

The European patent application contains a sequence listing as part of the description ☐

The sequence listing is attached in computer-readable format in accordance with WIPO Standard ST.25 ☐

The sequence listing is attached in PDF format ☐

Further indications

39 Additional copies of the documents cited in the European search report are requested

Number of additional sets of copies:

40 Refund of the search fee under to Article 9 of the Rules relating to Fees is requested ☐

Application or publication number of earlier search report:

42 Payment

Mode of payment: Debit from deposit account

The European Patent Office is hereby authorised, to debit from the deposit account with the EPO any fees and costs indicated on the fees section below.

Currency: EUR

Deposit account number: 28000600

Account holder: Hoefer & Partner Patentanwälte mbB

43 Refunds

Any refunds should be made to EPO deposit account: 28000600

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Account holder: Hoefer & Partner Patentanwälte mbB

Fees

	Factor applied	Fee schedule	Amount to be paid
001 Filing fee - EP direct - online	1	120.00	120.00
002 Fee for a European search - Applications filed on/after 01.07.2005	1	1 300.00	1 300.00
015 Claims fee - For the 16th to the 50th claim	0	235.00	0.00
015e Claims fee - For the 51st and each subsequent claim	0	585.00	0.00
501 Additional filing fee for the 36th and each subsequent page	21	15.00	315.00
Total:		**EUR**	**1 735.00**

44-A Forms

		Details:	System file name:
A-1	Request		as ep-request.pdf
A-2	1. Designation of inventor	1. Inventor	as f1002-1.pdf

44-B Technical documents

		Original file name:	System file name:
B-1	Specification	olf_specification.pdf Description; 15 claims; abstract	SPECEPO-1.pdf
B-2	Specification	olf_drawings.pdf 19 figure(s)	SPECEPO-2.pdf

44-C Other documents

Original file name:	System file name:

45

General authorisation:

46 Signature(s)

Place: **München**

Date: **28 July 2017**

Signed by: **Ingo Goerz 19384**

Association: **Hoefer & Partner Patentanwälte mbB**

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Representative name: **Ingo Görz**

Capacity: **(Representative)**

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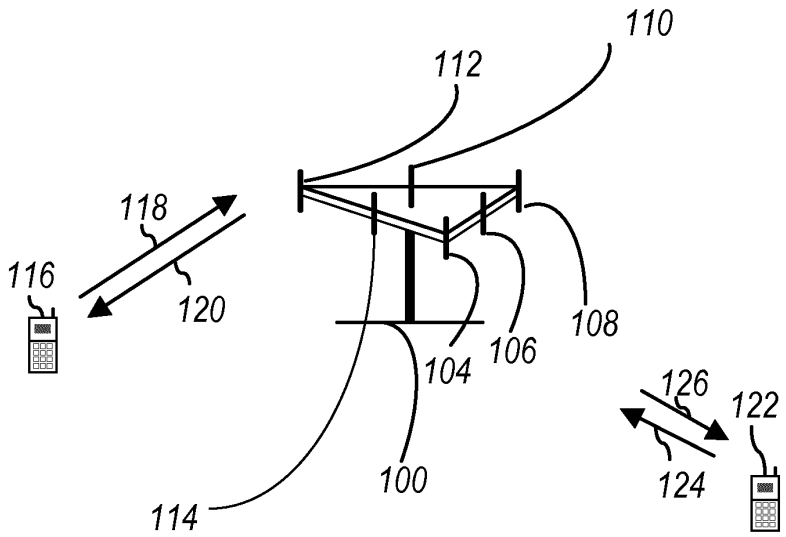


FIG. 1

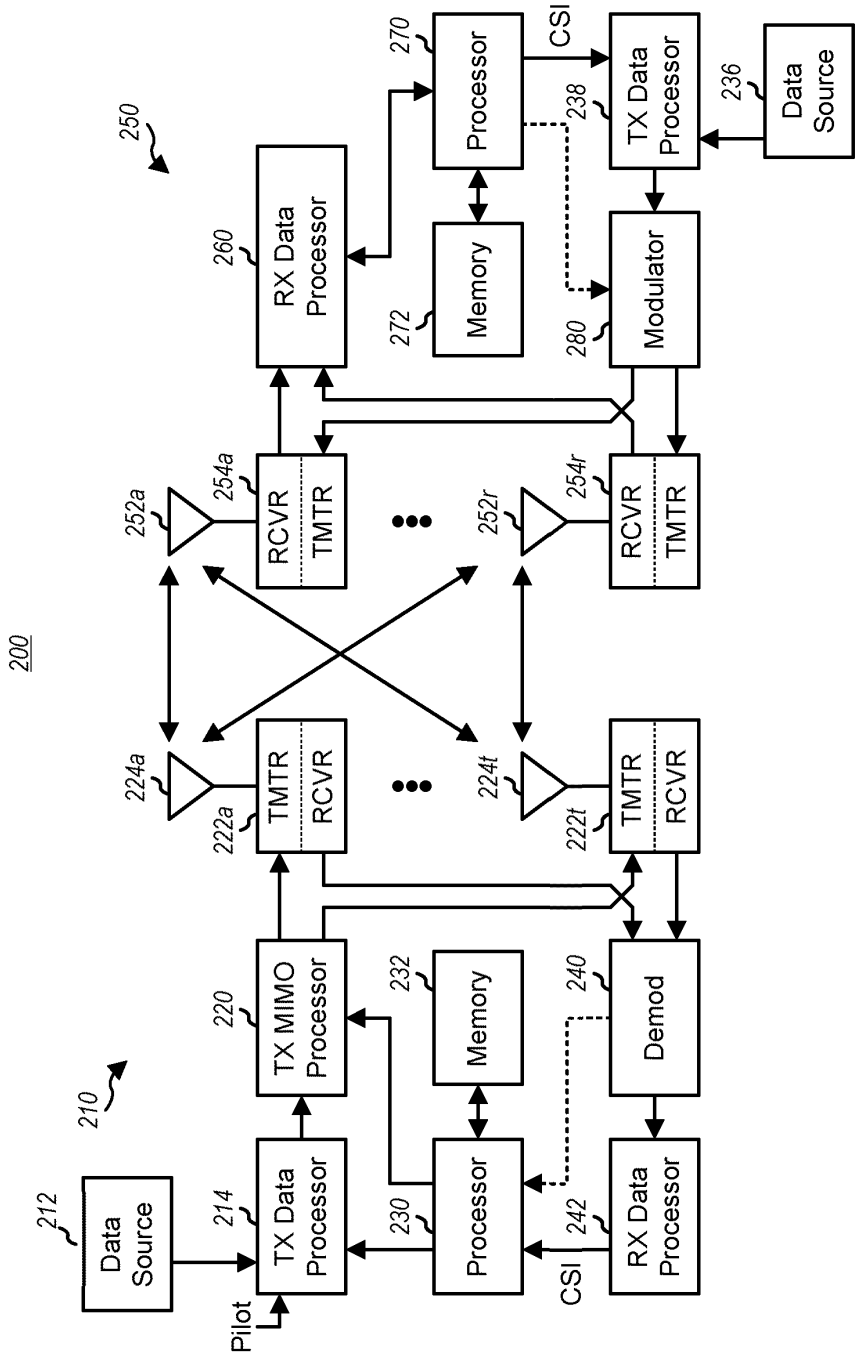

200
210
212
Data Source
214
TX Data Processor
Pilot
220
TX MIMO Processor
222a
TMTR
RCVR
224a
252a
254a
RCVR
TMTR
230
Processor
232
Memory
240
Demod
242
RX Data Processor
CSI
222t
TMTR
RCVR
224t
252r
254r
RCVR
TMTR
250
260
RX Data Processor
270
Processor
CSI
272
Memory
280
Modulator
238
TX Data Processor
236
Data Source

FIG. 2

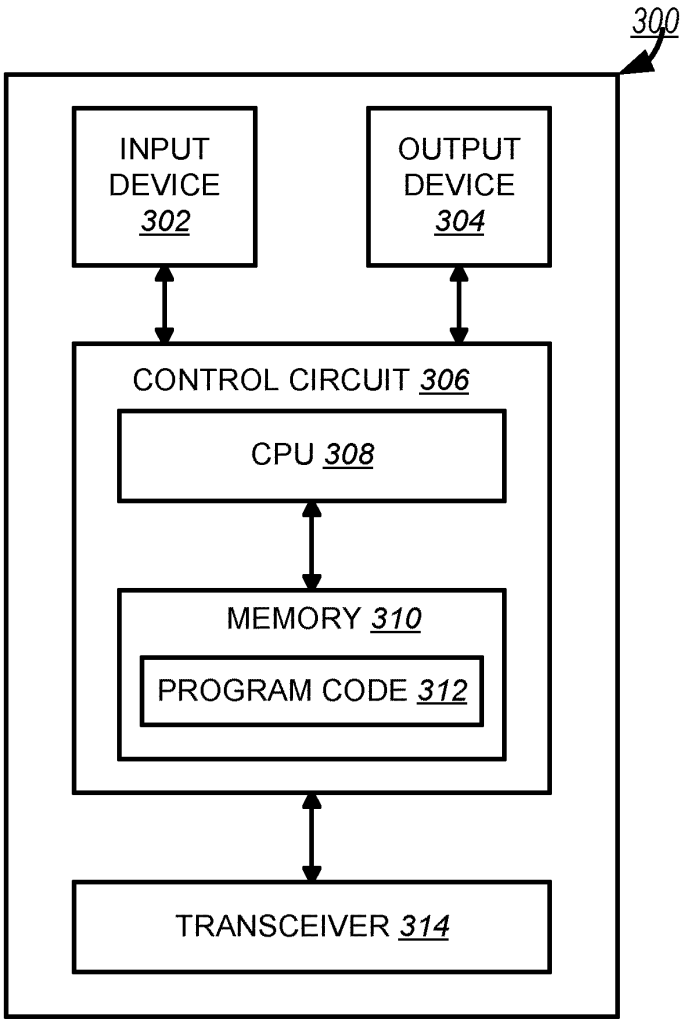

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. 3

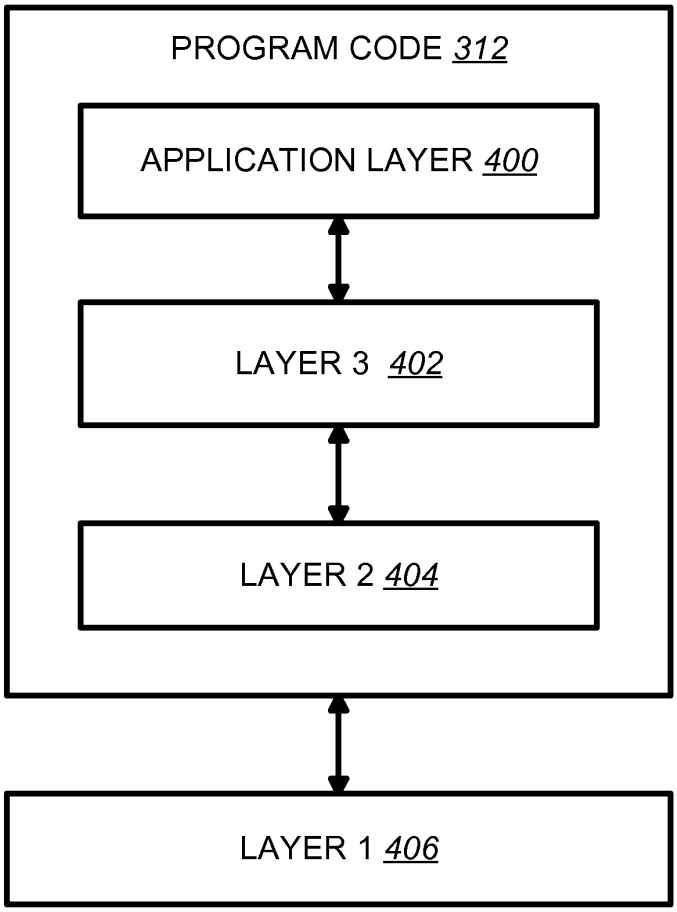

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. 4

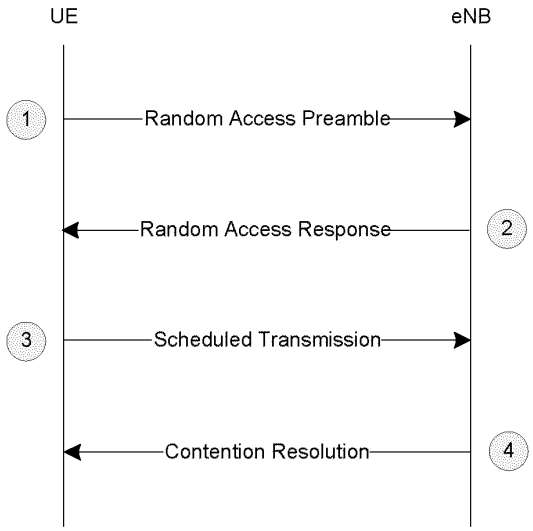

UE
eNB
1
Random Access Preamble
Random Access Response
2
3
Scheduled Transmission
Contention Resolution
4

FIG. 5

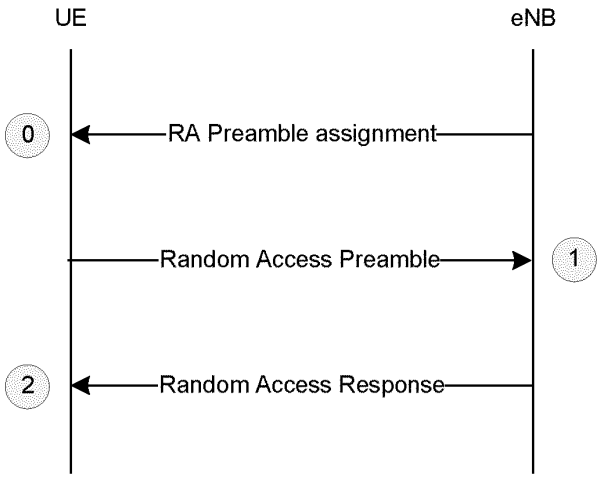

UE
eNB
0
RA Preamble assignment
Random Access Preamble
1
2
Random Access Response

FIG. 6

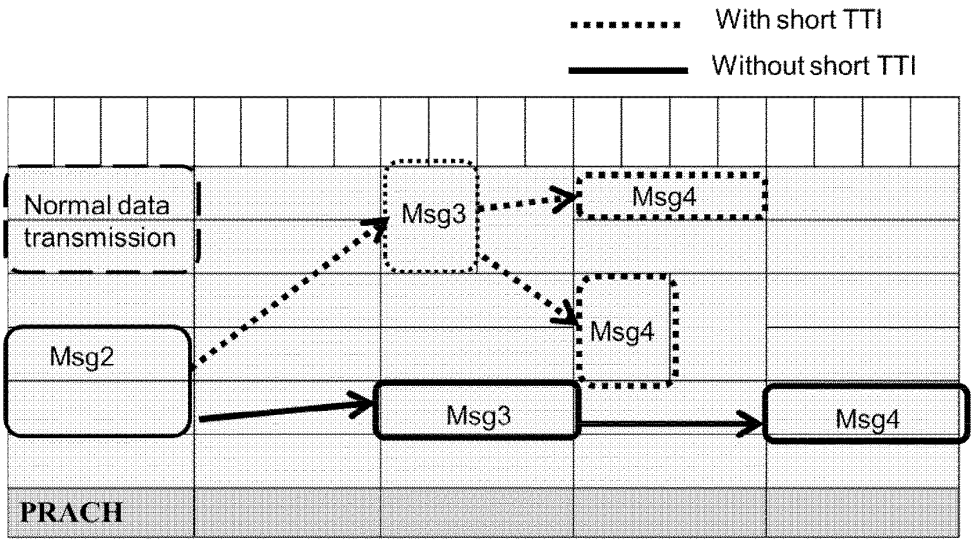

With short TTI
Without short TTI
Normal data transmission
Msg3
Msg4
Msg4
Msg2
Msg3
Msg4
PRACH

FIG. 7

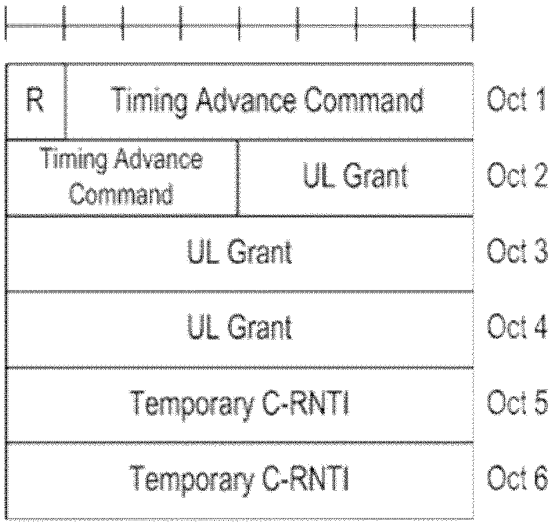

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6

FIG. 8

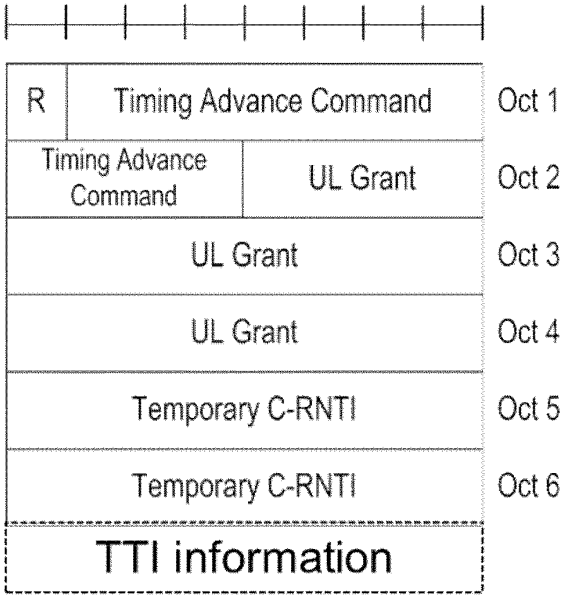

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6
TTI information

FIG. 9

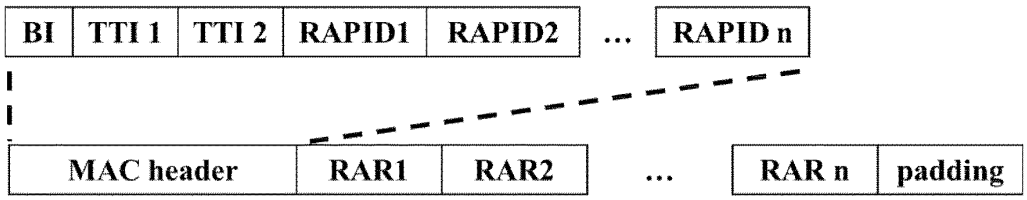

BI
TTI 1
TTI 2
RAPID1
RAPID2
…
RAPID n
MAC header
RAR1
RAR2
…
RAR n
padding

FIG. 10

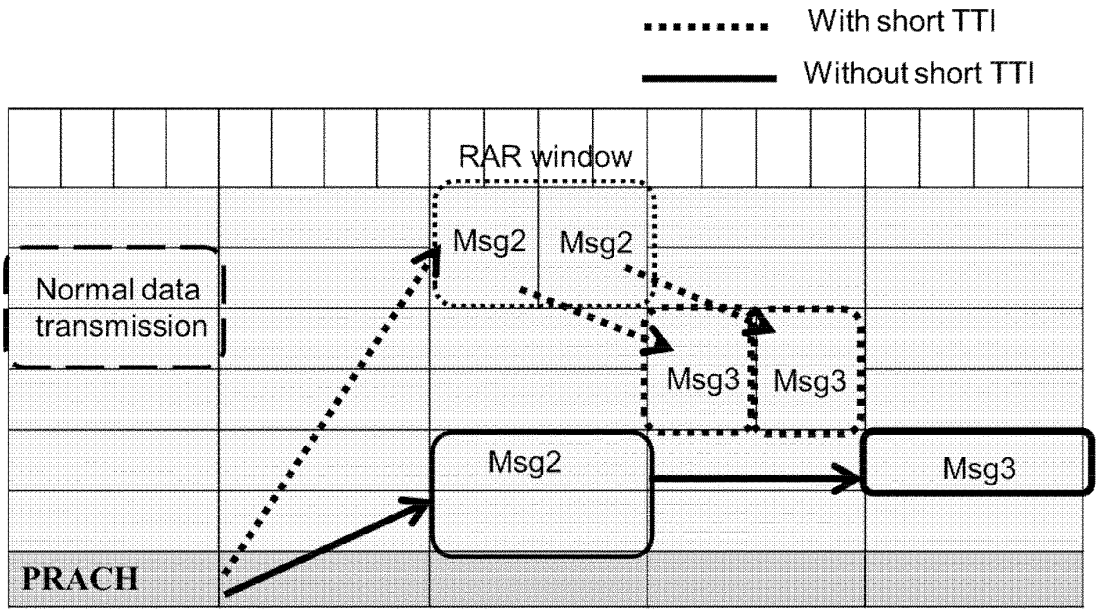

With short TTI
Without short TTI
RAR window
Msg2
Msg2
Normal data transmission
Msg3
Msg3
Msg2
Msg3
PRACH

FIG. 11

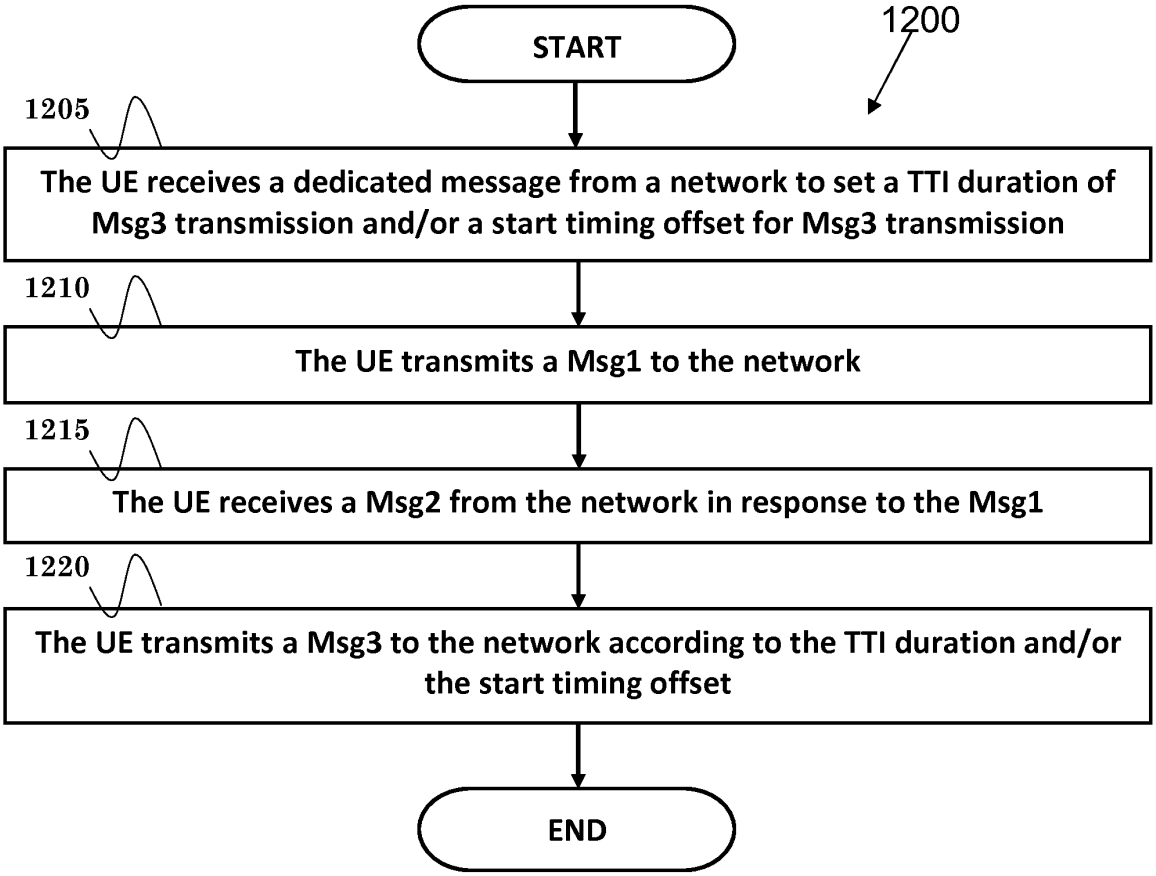

START
1200
1205
The UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission
1210
The UE transmits a Msg1 to the network
1215
The UE receives a Msg2 from the network in response to the Msg1
1220
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 12

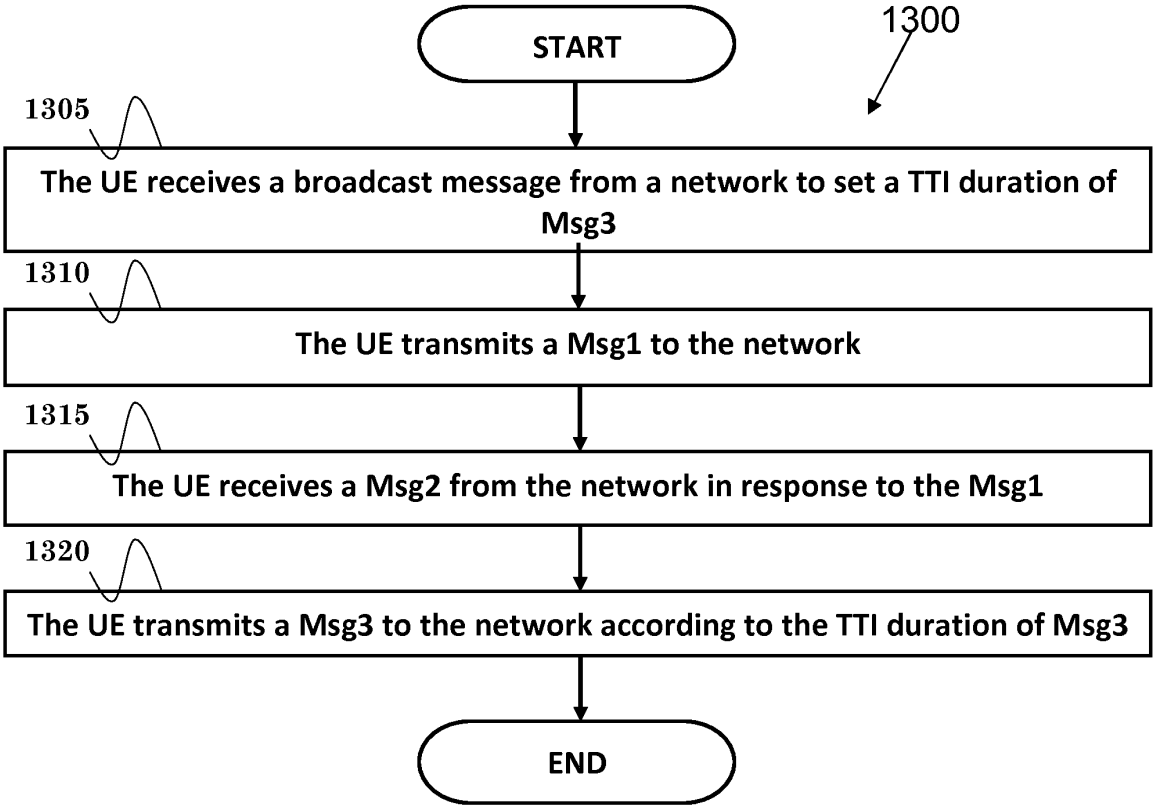

START
1300
1305
The UE receives a broadcast message from a network to set a TTI duration of Msg3
1310
The UE transmits a Msg1 to the network
1315
The UE receives a Msg2 from the network in response to the Msg1
1320
The UE transmits a Msg3 to the network according to the TTI duration of Msg3
END

FIG. 13

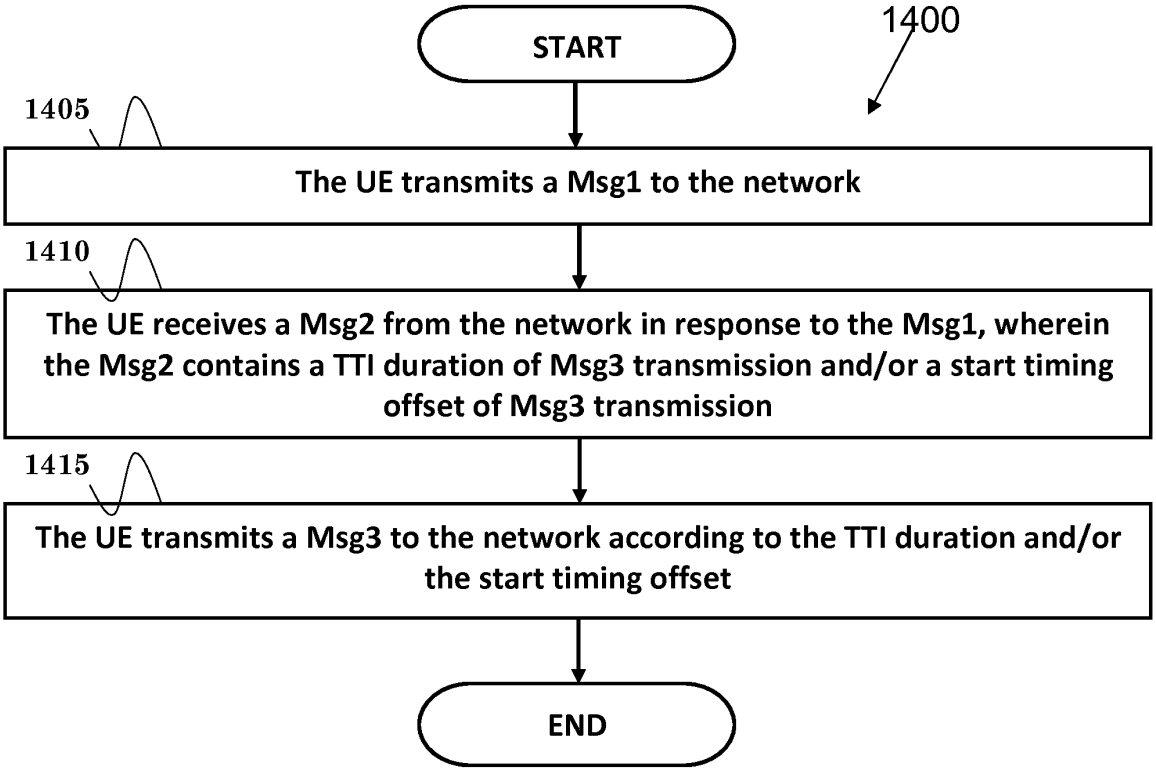

START
1400
1405
The UE transmits a Msg1 to the network
1410
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission
1415
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 14

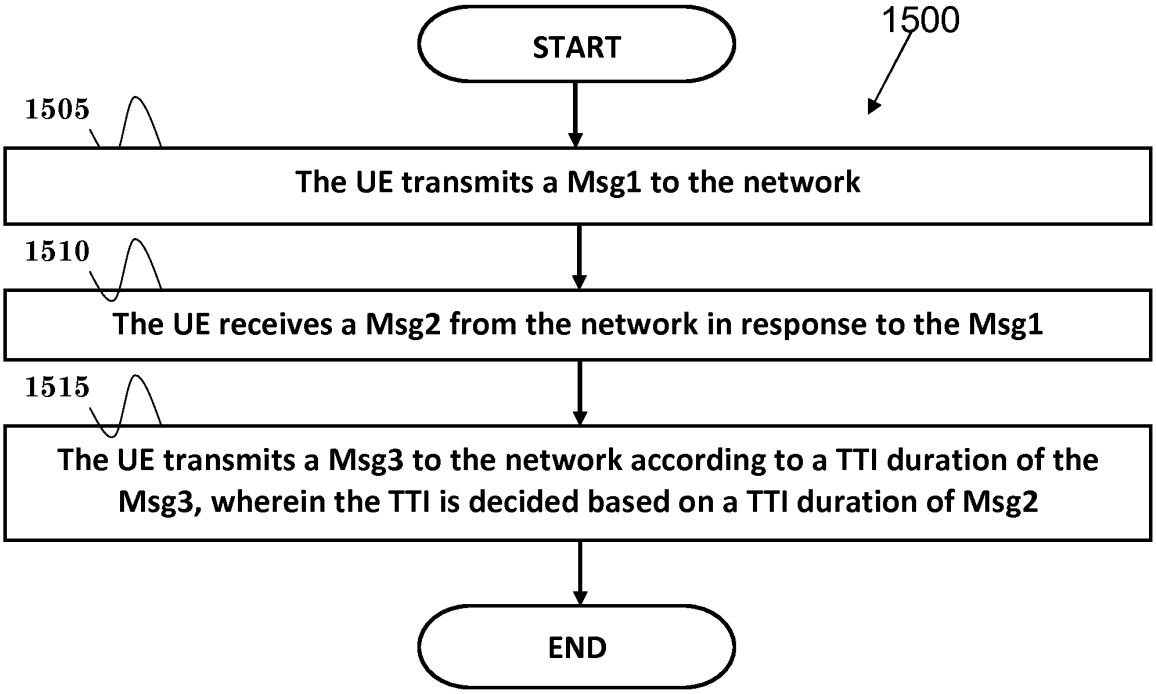

START
1500
1505
The UE transmits a Msg1 to the network
1510
The UE receives a Msg2 from the network in response to the Msg1
1515
The UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI is decided based on a TTI duration of Msg2
END

FIG. 15

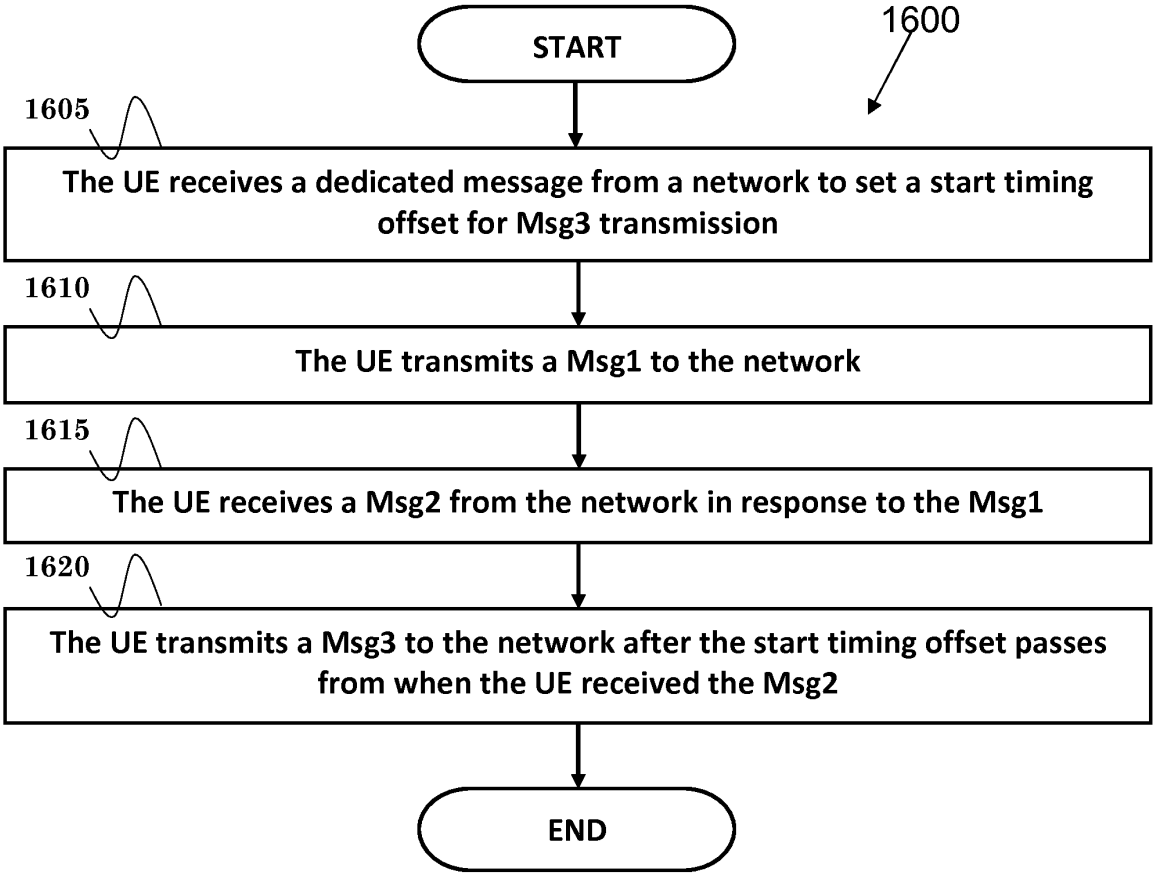

START
1600
1605
The UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission
1610
The UE transmits a Msg1 to the network
1615
The UE receives a Msg2 from the network in response to the Msg1
1620
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 16

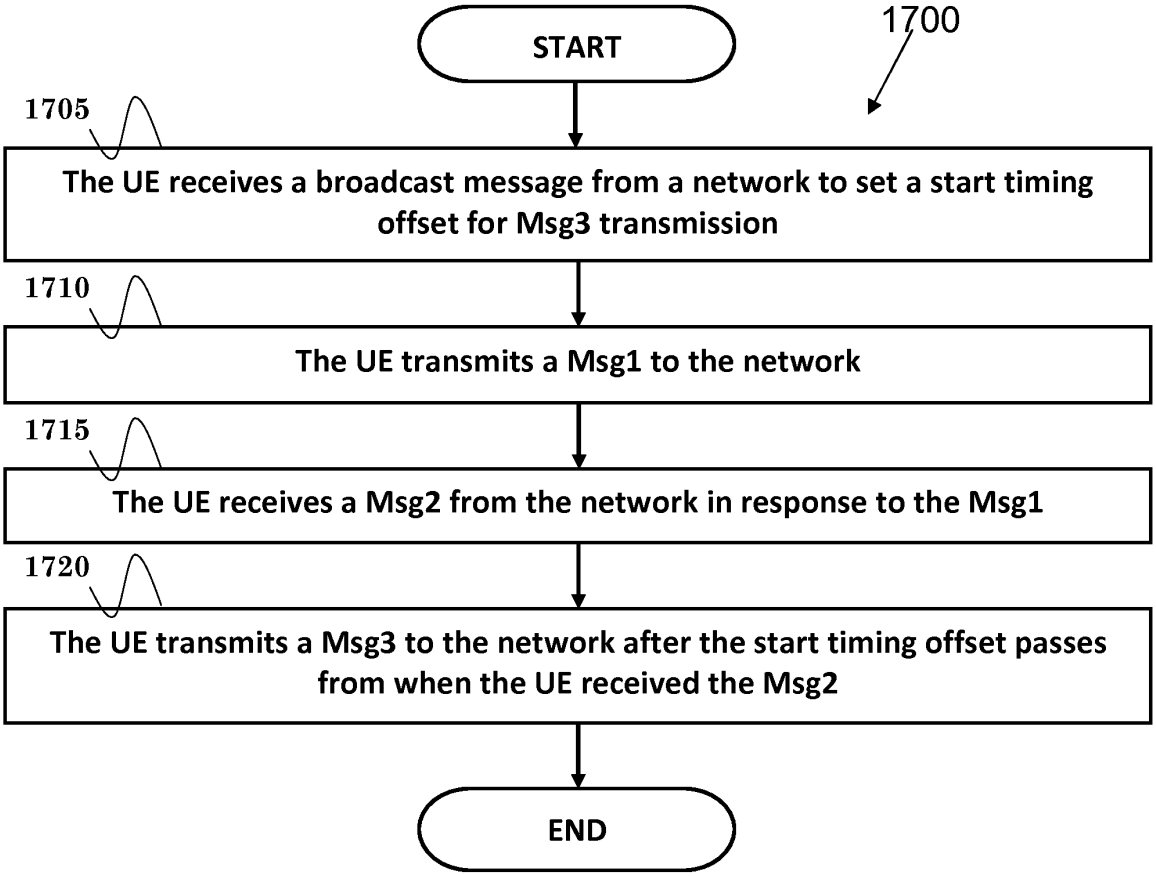

START
1700
1705
The UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission
1710
The UE transmits a Msg1 to the network
1715
The UE receives a Msg2 from the network in response to the Msg1
1720
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 17

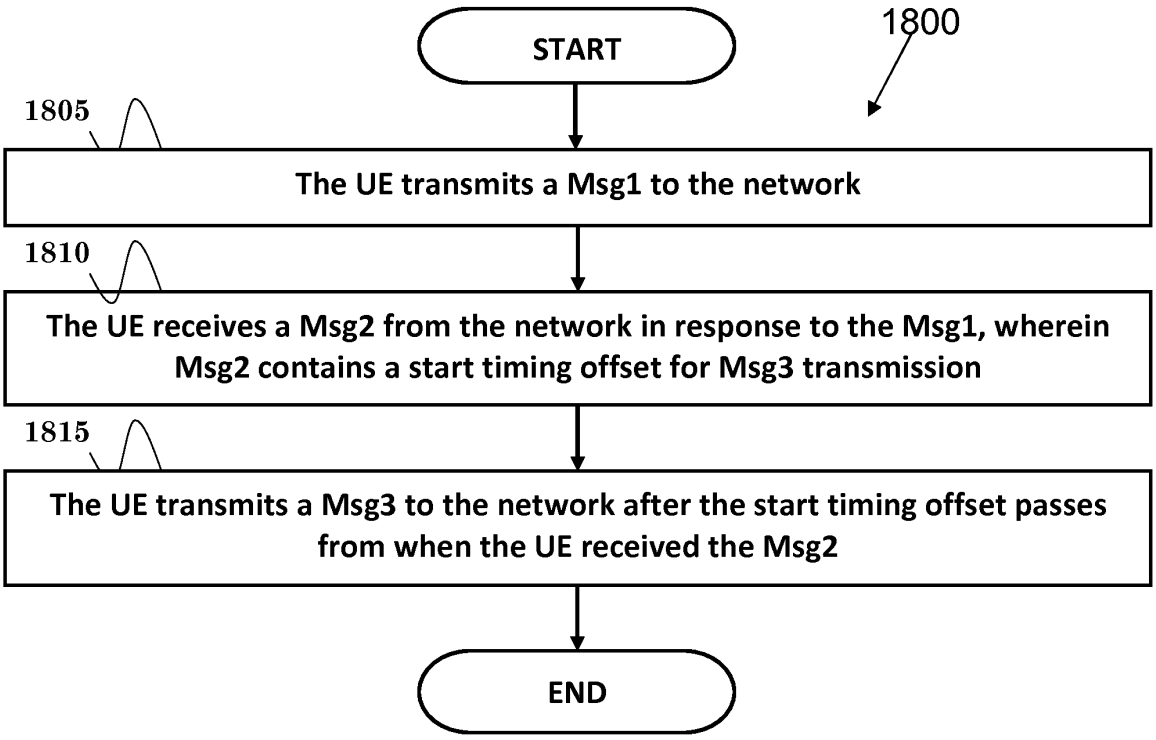

START
1800
1805
The UE transmits a Msg1 to the network
1810
The UE receives a Msg2 from the network in response to the Msg1, wherein Msg2 contains a start timing offset for Msg3 transmission
1815
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 18

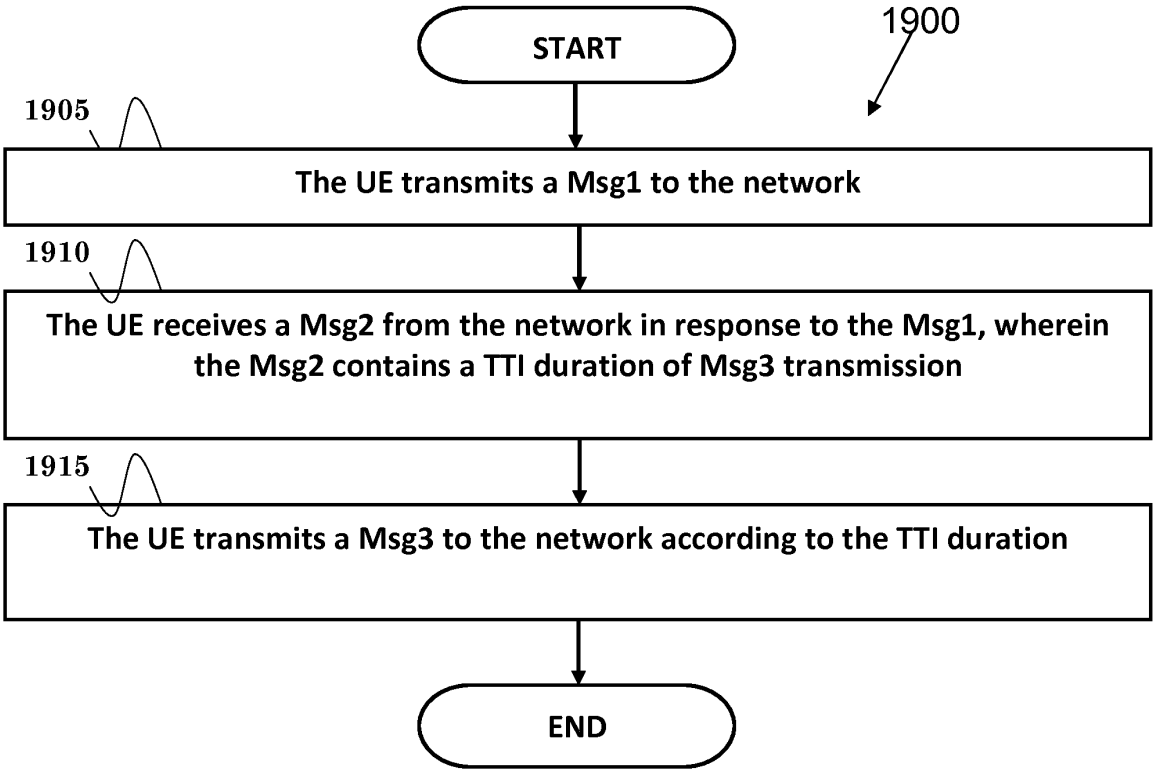

START
1900
1905
The UE transmits a Msg1 to the network
1910
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission
1915
The UE transmits a Msg3 to the network according to the TTI duration
END

FIG. 19

Form 1002 - 1: Public inventor(s)

Designation of inventor

User reference: ASU170707PEP
Application No:

Public

	Inventor	
	Name:	CHEN Wei-Yu
	Address:	c/o ASUSTek Computer Inc. No.15, Lite Rd., Peitou Dist. Taipei City 112 Chinese Taipei
	The applicant has acquired the right to the European patent:	Under agreement: 27 July 2016
	Inventor	
	Name:	TSENG Li-Chih
	Address:	c/o ASUSTek Computer Inc. No.15, Lite Rd., Peitou Dist. Taipei City 112 Chinese Taipei
	The applicant has acquired the right to the European patent:	Under agreement: 27 July 2016

Signature(s)

Place:	**München**
Date:	**28 July 2017**
Signed by:	**Ingo Goerz 19384**
Association:	**Hoefer & Partner Patentanwälte mbB**
Representative name:	**Ingo Görz**
Capacity:	**(Representative)**

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METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

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SUMMARY

A method and apparatus, from the perspective of the UE, for performing random access procedure are disclosed are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. Preferably, the method includes the UE receiving a message from a network. The message includes a TTI information of Msg3. In addition, the method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagram of a wireless communication system according to one exemplary embodiment.

FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE) according to one exemplary embodiment.

FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

FIG. 5 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0.

FIG. 6 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300 v13.2.0.

FIG. 7 is a diagram according to one exemplary embodiment.

FIG. 8 is a diagram according to one exemplary embodiment.

FIG. 9 is a diagram according to one exemplary embodiment.

FIG. 10 is a diagram according to one exemplary embodiment.

FIG. 11 is a diagram according to one exemplary embodiment.

FIG. 12 is a flow chart according to one exemplary embodiment.

FIG. 13 is a flow chart according to one exemplary embodiment.

FIG. 14 is a flow chart according to one exemplary embodiment.

FIG. 15 is a flow chart according to one exemplary embodiment.

FIG. 16 is a flow chart according to one exemplary embodiment.

FIG. 17 is a flow chart according to one exemplary embodiment.

FIG. 18 is a flow chart according to one exemplary embodiment.

FIG. 19 is a flow chart according to one exemplary embodiment.

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DETAILED DESCRIPTION

The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A or LTE-Advanced (Long Term Evolution Advanced), 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

In particular, the exemplary wireless communication systems devices described below may be designed to support one or more standards such as the standard offered by a consortium named "3rd Generation Partnership Project" referred to herein as 3GPP, including: TR 38.913 v0.3.0, "Study on Scenarios and Requirements for Next Generation Access Technologies"; TS 36.300 v13.2.0, "Overall Description; Stage 2"; TS 36.913, v13.0.0, "Requirements for further advancements for Evolved Universal Terrestrial Radio Access (E-UTRA)"; TS 36.331 v13.2.0, "Radio Resource Control (RRC); Protocol specification"; TS 36.321 v13.1.0, "Medium Access Control (MAC) protocol specification"; and R2-163445, "Scheduling Framework and Requirements", Nokia and Alcatel-Lucent Shanghai Bell.

FIG. 1 shows a multiple access wireless communication system according to one embodiment of the invention. An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In FIG. 1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency then that used by reverse link 118.

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Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an evolved Node B (eNB), or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

FIG. 2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

Preferably, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

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The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and

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processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

Turning to FIG. 3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in FIG. 3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in FIG. 1 or the base station (or AN) 100 in FIG. 1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly. The communication device 300 in a wireless communication system can also be utilized for realizing the AN 100 in FIG. 1.

FIG. 4 is a simplified block diagram of the program code 312 shown in FIG. 3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

One of the general objectives of the present application is to study the frame structure used in New RAT (NR) for 5G, to accommodate various type of requirement (discussed in 3GPP TR 38.913) for time and frequency resource, e.g., from ultra-low latency (~0.5 ms) to expected longer TTI (Transmission Time Interval) for MTC (Machine Type Communication), from high peak rate for eMBB (enhanced Mobile Broadband) to very low data rate for MTC. An important focus is low latency aspect, while other aspect of mixing/adapting different TTIs can also be considered in the study. In addition to diverse services and requirements, forward compatibility is an important consideration in initial NR frame structure design as not all features of NR would be included in the beginning phase/release.

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[0001] 3GPP TS 36.300 includes the following random access (RA) procedure related description:

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;

The random access procedure is performed for the following events related to the PCell:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- Handover;
- DL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised".
- UL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised" or there are no PUCCH resources for SR available.
- For positioning purpose during RRC_CONNECTED requiring random access procedure;
  - E.g. when timing advance is needed for UE positioning.

The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG.

In DC, the random access procedure is also performed on at least PSCell upon SCG addition/modification, if instructed, or upon DL/UL data arrival during RRC_CONNECTED requiring random access procedure. The UE initiated random access procedure is performed only on PSCell for SCG.

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).

Normal DL/UL transmission can take place after the random access procedure.

An RN supports both contention-based and non-contention-based random access. When an RN performs the random access procedure, it suspends any current RN subframe

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configuration, meaning it temporarily disregards the RN subframe configuration. The RN subframe configuration is resumed at successful random access procedure completion.

10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

[Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 5]

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:
   - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.
2) Random Access Response generated by MAC on DL-SCH:
   - Semi-synchronous (within a flexible window of which the size is one or more TTI) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least RA-preamble identifier, Timing Alignment information for the pTAG, initial UL grant and assignment of Temporary C-RNTI (which may or may not be made permanent upon Contention Resolution);
   - Intended for a variable number of UEs in one DL-SCH message.
3) First scheduled UL transmission on UL-SCH:
   - Uses HARQ;
   - Size of the transport blocks depends on the UL grant conveyed in step 2.
   - For initial access:
     - Conveys the RRC Connection Request generated by the RRC layer and transmitted via CCCH;
     - Conveys at least NAS UE identifier but no NAS message;

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- RLC TM: no segmentation.

- For RRC Connection Re-establishment procedure:
  - Conveys the RRC Connection Re-establishment Request generated by the RRC layer and transmitted via CCCH;
  - RLC TM: no segmentation;
  - Does not contain any NAS message.
- After handover, in the target cell:
  - Conveys the ciphered and integrity protected RRC Handover Confirm generated by the RRC layer and transmitted via DCCH;
  - Conveys the C-RNTI of the UE (which was allocated via the Handover Command);
  - Includes an uplink Buffer Status Report when possible.
- For other events:
  - Conveys at least the C-RNTI of the UE.

4) Contention Resolution on DL:
   - Early contention resolution shall be used i.e. eNB does not wait for NAS reply before resolving contention;
   - Not synchronised with message 3;
   - HARQ is supported;
   - Addressed to:
     - The Temporary C-RNTI on PDCCH for initial access and after radio link failure;
     - The C-RNTI on PDCCH for UE in RRC_CONNECTED.
   - HARQ feedback is transmitted only by the UE which detects its own UE identity, as provided in message 3, echoed in the Contention Resolution message;
   - For initial access and RRC Connection Re-establishment procedure, no segmentation is used (RLC-TM).

The Temporary C-RNTI is promoted to C-RNTI for a UE which detects RA success and does not already have a C-RNTI; it is dropped by others. A UE which detects RA success and already has a C-RNTI, resumes using its C-RNTI.

When CA is configured, the first three steps of the contention based random access procedures occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell.

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When DC is configured, the first three steps of the contention based random access procedures occur on the PCell in MCG and PSCell in SCG. When CA is configured in SCG, the first three steps of the contention based random access procedures occur on the PSCell while contention resolution (step 4) can be cross-scheduled by the PSCell.

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 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 6]

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-

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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.

When performing non-contention based random access on the PCell or PSCell while DC 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 corresponding cell. 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 not including PSCell. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell for MCG and PSCell for SCG.

Details of each random access step and related control element are described in Sections 5.1, 5.4, 6, and 7 of 3GPP TS 36.321. Furthermore, some configurations for random access and obtaining procedure are discussed in 3GPP 36.331.

One NR requirement listed in 3GPP TR 38.913 lists the following NR requirement: "*Control plane latency refers to the time to move from a battery efficient state (e.g., IDLE) to start of continuous data transfer (e.g., ACTIVE). The target for control plane latency should be **10ms***." Regarding similar requirement in LTE, the control plane latency requirement is set to 50ms (as discussed in 3GPP TS 36.913). There is a huge gap between latency requirement of LTE and latency requirement of NR. Therefore, it would be better to reduce possible transmission and processing latency as much as possible. As discussed below, the present application first focuses on random access latency.

In LTE, there are two kinds of random access procedure, contention and non-contention. The contention random access procedure consists of 4 steps, including: Msg1, Msg2, Msg3, and Msg4. FIG. 5 is an exemplary embodiment for the contention random access. The Msg1 and Msg3 are transmitted from a UE to a network. And the resource for performing Msg1 transmission and Msg3 transmission are contention resource. If the network can successfully receive a Msg3, the network could identify the UE based on contents in Msg3, and transmit a Msg4 to the UE for finishing the contention.

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On the other hand, a dynamic TTI adjusting concept is discussed in 3GPP R2-163445, which proposes to set the TTI size per scheduling grant for optimizing TCP(Transmission Control Protocol) transmission case. In particular, short TTI can be used to accelerate TCP slow start process, and long TTI can be used in steady transmission rate state for reduce control signaling overhead.

Considering such dynamic TTI concept, the present application further discusses whether it can also be used to accelerate random access procedure and how to achieve dynamic TTI change in random access. The following discussion mainly focuses on the Msg3 transmission step in a random access procedure. In addition, the discussion below does not include UE's RF/Baseband capability differentiation (e.g., differentiation between normal cell phone in LTE and NB-IoT devices in LTE) case.

In LTE, there could be three different random access configurations in LTE system. The first configuration is generally for normal UEs with enough RF/Baseband capability to monitor whole system bandwidth (e.g., cell phones, high end MTC devices). The second configuration is generally for low-end MTC devices and normal UEs with enough RF/Baseband capability but worked in power limited condition. The third configuration is generally for NB-IoT (Narrow Band-Internet of Thing) UEs which pool RF/Baseband capability and can only perform transmission/reception on a narrow band (e.g., 1.4MHz). The last configuration is generally defined as a new RAT (Radio Access Technology). Normally, low-end MTC devices will only worked on the second configuration, and NB-IoT devices will work only on the third configuration. For a normal UE with enough RF/Baseband capability, the UE will only change RA configuration when it enters the power limited state (e.g., cell edge or even far away).

If short TTI applies to Msg3 transmission, the average random access latency could be reduced due to early start to monitor Msg4. A possible case for such benefit is shown in FIG. 7. As shown in FIG. 7, although the processing delay is a fixed period, the UE could start to receive Msg4 earlier owing to early Msg3 transmission. Moreover, two possibilities for monitoring Msg4 are shown in FIG. 7. The UE may expect either TTI format if the TTI length information is not be carried in scheduling control signal. Otherwise, the UE may expect multiple possibilities of TTI length.

Another possible benefit may be improving resource efficiency. If the dynamic TTI concept is applied to Msg3, the network can more flexibly adjust resource allocation. In LTE, the TTI

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length for Msg3 is fixed. In the same modulation scheme condition, LTE system could only schedule radio resource in PRB level, while NR may be able to schedule in symbol level.

To achieve dynamic TTI concept, a UE needs to derive TTI information (e.g., TTI length, numerology) for transmitting Msg3 on air interface. In this aspect, possible candidates for the UE are proposed to obtain such information. One or multiple solutions can be applied in a NR system.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional TTI information is added into RAR for scheduling Msg3. Preferably, the new TTI information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field. A possible exemplary embodiment is shown in FIG. 9.

Solution 2 – Common field in Msg2. In Solution 2, the TTI information is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI length has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry TTI information. A possible example is shown in FIG. 10. The TTI information 1 could be provided to preamble set 1 (e.g., rapid 0~20), and the TTI information 2 could be provided to preamble set 2 (e.g., rapid 21~40).

The TTI information carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g., PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access

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configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 3 – Broadcast Information. In Solution 3, a UE could derive TTI information for Msg3 transmission through a broadcast message (e.g., system information(s), MIB, etc) from a network (e.g. gNB, base station, TRP, etc). If multiple TTI information for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol

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type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects TTI information in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the broadcast message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select TTI information in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the broadcast message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to

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radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 4, a UE could derive TTI information for Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple TTI information for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the dedicated message based on the service type indicated by the service indication.

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Preferably, the UE selects TTI information in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select TTI information in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the dedicated message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

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Solution 5 – Implicitly derive from Msg2 Transmission. In this solution, a UE could derive TTI information for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives TTI information for Msg3 based on TTI information used by Msg2. For example, the TTI duration of Msg3 transmission may be N times of TTI duration of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives TTI information for Msg3 based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different TTI informations. The corresponding TTI information may be predefined and/or provided through system information and/or provided through dedicated RRC message.

Msg3 start timing offset - In LTE, there is a fixed gap period between Msg2 reception and Msg3 transmission. The fixed gap period is designed for covering UE's Msg2/3 processing time (e.g., decode, (de-)multiplexing transport block). However, in NR, some possible methods can bring benefits to reduce such fixed gap period. For example, if short TTI is applied to both Msg2/Msg3 transmissions as FIG. 11, the minimum of the fixed gap between Msg2 and Msg3 can be set to short TTI. Otherwise, the minimum gap could only be set to normal sub-frame length like without short TTI case.

There are also many other ways for reducing processing time (e.g. provision TB size). These methods will bring not only the benefit, but also some limitations and/or complexity. As a conclusion, we think that it could be beneficial for network be capable to decide the length of gap period. For achieving the concept, a UE will need to know the gap information (or called Msg3 start timing offset) by information provided from network. The possible solutions are listed below.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional information is added into RAR for adjusting Msg3 start timing offset. Preferably, the additional information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field.

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Solution 2 – Common field in Msg2. In Solution 2, the Msg3 start timing offset is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And MAC sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI information has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry Msg3 start timing offset.

The Msg3 start timing offset carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g. PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

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Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 3 – Broadcast Information. In Solution 3, a UE could derive Msg3 start timing offset for Msg3 transmission through a broadcast message (e.g., system information(s), MIB,

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etc) from a network (e.g. gNB, base station, TRP, etc). If multiple Msg3 start timing offsets for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offsets in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the broadcast message for potential message size larger than the threshold.

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Preferably, the UE selects Msg3 start timing offset in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the broadcast message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 4, a UE could derive Msg3 start timing offset for Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple Msg3 start timing offsets for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offset in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the dedicated message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock,

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data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the dedicated message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 5 – Implicitly derive from Msg2 Transmission. In this solution, a UE could derive Msg3 start timing offset for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives Msg3 start timing offset based on start timing offset used by Msg2. For example, the Msg3 start timing offset of Msg3 transmission may be N times of start timing offset of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives Msg3 start timing offset based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different Msg3 start timing offsets. The corresponding Msg3 start timing offset may be predefined and/or provided through system information and/or provided through dedicated RRC message.

The Msg3 start timing offset can be derived through the solution 1 to 5 mentioned above or combination of those solutions, while Msg3 start timing offset and TTI information of Msg3

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can apply the same or different solutions. The Msg3 start timing offset can be indicated in TTI duration, numerology, symbol, slot, microsecond, millisecond or N times of periodicity of periodic behavior. N value can be integer or decimal.

FIG. 12 is a flow chart 1200 according to one exemplary embodiment from the perspective of a UE. In step 1205, the UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission. In step 1210, the UE transmits a Msg1 to the network. In step 1215, the UE receives a Msg2 from the network in response to the Msg1. In step 1220, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 13 is a flow chart 1300 according to one exemplary embodiment from the perspective of a UE. In step 1305, the UE receives a broadcast message from a network to set TTI duration of Msg3. In step 1310, the UE transmits a Msg1 to the network. In step 1315, the UE receives a Msg2 from the network in response to the Msg1. In step 1320, the UE transmits a Msg3 to the network according to the TTI duration of Msg3.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set TTI duration of Msg3, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration of Msg3. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 14 is a flow chart 1400 according to one exemplary embodiment from the perspective of a UE. In step 1405, the UE transmits a Msg1 to a network. In step 1410, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration

of Msg3 transmission and/or a start timing offset of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. Preferably, the start timing offset of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the start timing offset of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1415, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 15 is a flow chart 1500 according to one exemplary embodiment from the perspective of a UE. In step 1505, the UE transmits a Msg1 to a network. In step 1510, the UE receives a Msg2 from the network in response to the Msg1. In step 1515, the UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, and (iii) to transmit a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 16 is a flow chart 1600 according to one exemplary embodiment from the perspective of a UE. In step 1605, the UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission. In step 1610, the UE transmits a Msg1 to the network. In step 1615, the UE receives a Msg2 from the network in response to the Msg1. In step 1620, the

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UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 17 is a flow chart 1700 according to one exemplary embodiment from the perspective of a UE. In step 1705, the UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission. In step 1710, the UE transmits a Msg1 to the network. In step 1715, the UE receives a Msg2 from the network in response to the Msg1. In step 1720, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 18 is a flow chart 1800 according to one exemplary embodiment from the perspective of a UE. In step 1805, the UE transmits a Msg1 to the network. In step 1810, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission. In step 1815, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to the network, (iii) to receive a

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Msg2 from the network in response to the Msg1, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission, and (iii) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 19 is a flow chart 1900 according to one exemplary embodiment from the perspective of a UE. In step 1905, the UE transmits a Msg1 to a network. In step 1910, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1915, the UE transmits a Msg3 to the network according to the TTI duration.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

With respect to the embodiments illustrated in FIGS. 12 through 19 and discussed above, preferably, the UE selects a TTI duration of Msg3 if there are multiple TTI durations of Msg3 in the dedicated message, the broadcast message, or the Msg2. Furthermore, the TTI duration of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Preferably, the UE selects a TTI duration of Msg3 if there are multiple start timing offsets for Msg3 transmission in the dedicated message, the broadcast message, or the Msg2. Furthermore, the start timing offset of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings

herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an

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integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the

aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

While the invention has been described in connection with various aspects, it could be understood that the invention is capable of further modifications. This application is intended to cover any variations, uses or adaptation of the invention following, in general, the principles of the invention, and including such departures from the present disclosure as come within the known and customary practice within the art to which the invention pertains.

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CLAIMS

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE receives a message from a network, wherein the message includes a Transmission Time Interval, in the following also referred to as TTI, information of Msg3 (1205; 1305; 1605; 1705);

the UE transmits a preamble to the network (1210; 1310; 1610; 1710);

the UE receives a Msg2 from the network for responding the preamble (1215; 1315; 1615; 1715); and

the UE performs a Msg3 transmission to the network according to the TTI information of Msg3 (1220; 1320; 1620; 1720).

2. The method of claim 1, further comprising:

the UE selects the TTI information of Msg3 based on PRACH resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of Msg3 in the message.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of Msg3 based on random access purpose, if there are multiple TTI information of Msg3 in the message.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of Msg3 in the message.

5. The method of any one of claims 1 to 4, wherein the message is a downlink control signal.

6. The method of any one of claims 1 to 5, wherein the message is a RRC message.

7. The method of any one of claims 1 to 6, further comprising:

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the UE selects the TTI information of Msg3 based on a random access configuration of the preamble transmission, if there are multiple TTI information of Msg3 in the message.

8. A method of a User Equipment, in the following also referred to as UE , for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405; 1505; 1805; 1905);

the UE receives a Msg2 from the network in response to the Preamble, wherein the Msg2 contains a Transmission Time Interval, in the following also referred to as TTI, information of Msg3 (1410; 1510; 1810; 1910); and

the UE performs a Msg3 transmission to the network according to the TTI information of Msg3 (1415; 1515; 1815; 1915).

9. The method of claim 8, further comprising:

the UE selects the TTI information of Msg3 based on random access purpose, if there are multiple TTI information of Msg3 in the Msg2.

10. The method of claim 8 or 9, further comprising:

the UE selects the TTI information of Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of Msg3 in the Msg2.

11. The method of any one of claims 8 to 10, further comprising:

the UE selects the TTI information of Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of Msg3 in the Msg2.

12. The method of any one of claims 8 to 11, wherein the TTI information of Msg3 is included in a Random Access Response , in the following also referred to as RAR, for responding the Preamble.

13. The method of any one of claims 8 to 11, wherein the TTI information of Msg3 is included in a common field for multiple RARs in the Msg2.

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14. The method of any one of claims 1 to 13, wherein the TTI information of Msg3 includes a TTI duration of the Msg3 transmission and/or a start timing offset of the Msg3 transmission.

15. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

wherein the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

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IPR2024-01036

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Acknowledgement of receipt

We hereby acknowledge receipt of your request for grant of a European patent as follows:

Submission number	5491530
Application number	EP17183827.9
File No. to be used for priority declarations	EP17183827
Date of receipt	28 July 2017
Your reference	ASU170707PEP
Applicant	ASUSTek Computer Inc.
Country	TW
Title	METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM
Documents submitted	package-data.xml application-body.xml SPECEPO-1.pdf\olf_specification.pdf (37 p.) f1002-1.pdf (1 p.) ep-request.xml ep-request.pdf (5 p.) SPECEPO-2.pdf\olf_drawings.pdf (19 p.)
Submitted by	CN=Ingo Goerz 19384
Method of submission	Online
Date and time receipt generated	28 July 2017, 15:29 (CEST)
Message Digest	54:B2:B1:BC:06:FA:E5:7F:53:3C:B4:1C:B3:66:75:16:87:AC:35:51

Samsung Exhibit 1008, Page 62 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
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Correction by the EPO of errors in debit instructions filed by eOLF

Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

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ABSTRACT

A method and apparatus are disclosed, from the perspective of the UE, for performing random access procedure. Preferably, the method includes the UE receiving a message from a network. The message includes a TTI information of Msg3 transmission (1205). In addition, the method includes the UE transmitting a Msg1 to the network (1210). The method also includes the UE receiving a Msg2 from the network for responding the Msg1 (1215). The method further includes the UE transmitting a Msg3 to the network according to the TTI information (1220).

(FIG.12)

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TSENG, Li-Chih
c/o ASUSTek Computer Inc.
No.15, Lite Rd., Peitou Dist.
Taipei City 112
TAIPEI CHINOIS

Date
20.09.17

Reference	Application No./Patent No.
	17183827.9 - 1857
Applicant/Proprietor	
ASUSTek Computer Inc.	

Designation as inventor - communication under Rule 19(3) EPC

You have been designated as inventor in the above-mentioned European patent application. Below you will find the data contained in the designation of inventor and further data mentioned in Rule 143(1) EPC:

DATE OF FILING : 28.07.17

PRIORITY : US/28.07.16/ USP201662367875

TITLE : METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

DESIGNATED STATES : AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

INVENTOR (PUBLISHED = 1, NOT PUBLISHED = 0):

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1/TSENG, Li-Chih/c/o ASUSTek Computer Inc. No.15, Lite Rd., Peitou Dist./Taipei City 112/TW

DECLARATION UNDER ARTICLE 81 EPC:
The applicant(s) has (have) acquired the right to the European patent under an agreement dated 27.07.16

Receiving Section

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
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CHEN, Wei-Yu
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TAIPEI CHINOIS

Date
20.09.17

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INVENTOR (PUBLISHED = 1, NOT PUBLISHED = 0):

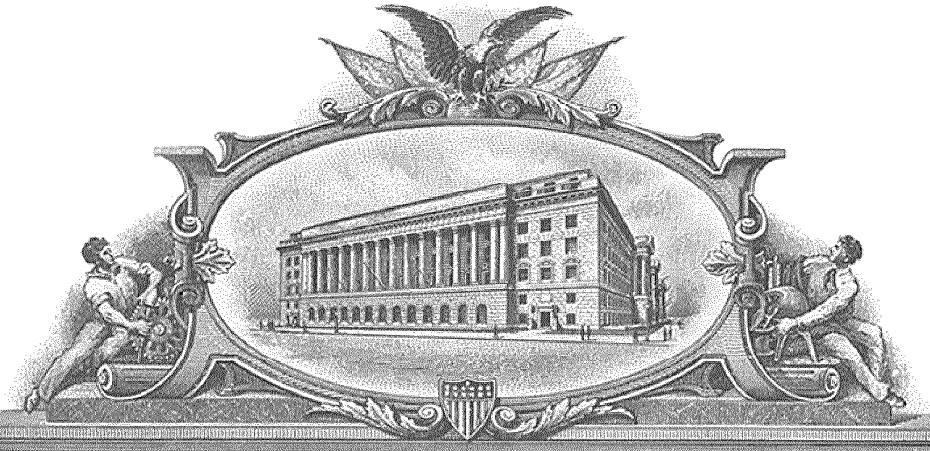
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DECLARATION UNDER ARTICLE 81 EPC:
The applicant(s) has (have) acquired the right to the European patent under an agreement dated 27.07.16

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THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

September 28, 2017

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: ***62/367,875***
FILING DATE: ***July 28, 2016***

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS ***US62/367,875***



Certified by

Michelle K. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	26481438
Application Number:	62367875
International Application Number:	
Confirmation Number:	2182
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Wei-Yu Chen
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-136.001
Receipt Date:	28-JUL-2016
Filing Date:	
Time Stamp:	15:40:23
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$260
RAM confirmation Number	2244
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	126186 cf45e658fb5b312a1bdcb0fdfafd3288ed9de6c2	no	8
Warnings:					
Information:					
2		1426-136-001--Package.pdf	996035 d716496b2c2cf3a9cb824dac2bbcbf2329e2339b	yes	32

Multipart Description/PDF files in .zip description

Document Description	Start	End
Provisional Cover Sheet (SB16)	1	2
Specification	3	20
Drawings-only black and white line drawings	21	23
Specification	24	27
Drawings-only black and white line drawings	28	31
Miscellaneous Incoming Letter	32	32

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30137 cbcaaf3cd95bb89960c2bcfc86ab0a00fadce14b	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1152358	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Wei-Yu		Chen	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

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Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Li-Chih		Tseng	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

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Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	106622		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM		
Attorney Docket Number	1426-136.001	**Small Entity Status Claimed**	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	106622		

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	
					Remove
Registration Number					
Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	
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Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country	Filing Date (YYYY-MM-DD)	Access Code (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-136.001
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM		

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	ASUSTeK Computer Inc.

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Country[i]	TW	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

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Assignee Information including Non-Applicant Assignee Information:

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Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-136.001
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM	

Signature:

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This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e. g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Sang N. Dang/			Date (YYYY-MM-DD)	
First Name	Sang N.	Last Name	Dang	Registration Number	51186

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. _____

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Wei-Yu	Chen	Taipei City, Taiwan
Li-Chih	Tseng	Taipei City, Taiwan

Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max):

METHOD AND APPARATUS FOR IMPROVING Msg3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☑ The address corresponding to Customer Number: 106622

OR

☐ Firm or Individual Name

Address

City	State	Zip
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ENCLOSED APPLICATION PARTS (*check all that apply*)

☑ Application Data Sheet. See 37 CFR 1.76.
☐ CD(s), Number of CDs _____
☑ Drawing(s) *Number of Sheets* 7
☐ Other (specify) _____
☑ Specification (e.g., description of the invention) *Number of Pages* 22

Fees Due: Filing Fee of $260 ($130 for small entity) ($65 for micro entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant asserts small entity status. See 37 CFR 1.27.
☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
☐ A check or money order made payable to the *Director of the United States Patent and Trademark Office* is enclosed to cover the filing fee and application size fee (if applicable).
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This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 10 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 2 of 2

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the invention was made by an agency of the U.S. Government. The U.S. Government agency name is: _____

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SIGNATURE /Sang N. Dang/ DATE July 28, 2016

TYPED OR PRINTED NAME Sang N. Dang REGISTRATION NO. 51,186 (*if appropriate*)

TELEPHONE (714) 839-3800 DOCKET NUMBER 1426-136.001

Method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system

Background:

Table of abbreviations:

Abbreviation	Full name
3GPP	3rd Generation Partnership Project
5G	5th Generation
AS	Access Stratum
BI	Back-off Indicator
BS	Base Station
BSR	Buffer Status Report
CCCH	Common Control Channel
DL	Downlink
eMBB	enhanced Mobile BroadBand
E-UTRA	Evolved Universal Terrestrial Radio Access
EUTRAN	Evolved Universal Terrestrial Radio Access Network
ID	Identity
IE	Information Element
LC	Logical Channel
LCG	Logical Channel Group
LTE	Long Term Evolution
LTE-A	LTE-Advanced
MAC	Medium Access Control
MIB	Master Information Block
Msg1	Message 1
Msg2	Message 2
Msg3	Message 3
Msg4	Message 4
mMTC	massive Machine Type Communications
MTC	Machine Type Communication
NAS	Non-Access Stratum
NB-IoT	Narrow Band-Internet of Thing
NR	New RAT
PDCCH	Physical Downlink Control Channel
PDCP	Packet Data Convergence Protocol
PHY	Physical
PRACH	Physical Random Access Channel
RA	Random Access

RAN	Radio Access Network
RAR	Random Access Response
RA-RNTI	Random Access Radio Network Temporary Identifier
RAT	Radio Access Technology
RB	Radio Bearer
RLC	Radio Link Control
RRC	Radio Resource Control
TB	Transport Block
TCP	Transmission Control Protocol
TR	Technical Report
TS	Technical Specification
TTI	Transmission Time Interval
UE	User Equipment
URLLC	Ultra-Reliable and Low Latency Communications
UTRAN	Universal Terrestrial Radio Access Network
WG	Working Group

The objective of this analysis is to study the frame structure used in New RAT (NR) for 5G, to accommodate various type of requirement [1] for time and frequency resource, e.g. from ultra-low latency (~0.5 ms) to expected longer TTI for MTC, from high peak rate for eMBB to very low data rate for MTC. An important focus of this study is low latency aspect, while other aspect of mixing/adapting different TTIs can also be considered in the study. In addition to diverse services and requirements, forward compatibility is an important consideration in initial NR frame structure design as not all features of NR would be included in the beginning phase/release.

3GPP TS 36.300 [2] has random access(RA) procedure related description

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;

The random access procedure is performed for the following events related to the PCell:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;

- Handover;
- DL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised".
- UL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised" or there are no PUCCH resources for SR available.
- For positioning purpose during RRC_CONNECTED requiring random access procedure;
  - E.g. when timing advance is needed for UE positioning.

The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG.

In DC, the random access procedure is also performed on at least PSCell upon SCG addition/modification, if instructed, or upon DL/UL data arrival during RRC_CONNECTED requiring random access procedure. The UE initiated random access procedure is performed only on PSCell for SCG.

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).

Normal DL/UL transmission can take place after the random access procedure.

An RN supports both contention-based and non-contention-based random access. When an RN performs the random access procedure, it suspends any current RN subframe configuration, meaning it temporarily disregards the RN subframe configuration. The RN subframe configuration is resumed at successful random access procedure completion.

10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

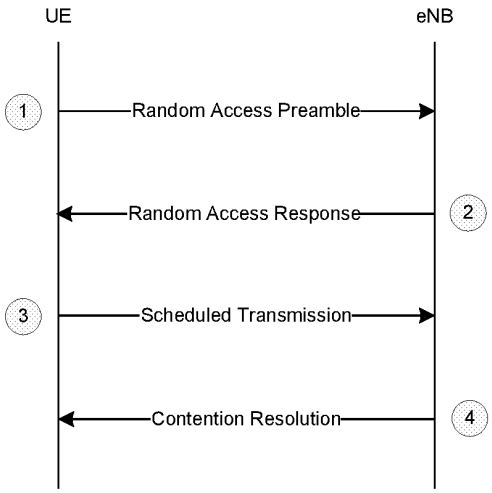


Figure 10.1.5.1-1: Contention based Random Access Procedure

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:

   - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.

2) Random Access Response generated by MAC on DL-SCH:

   - Semi-synchronous (within a flexible window of which the size is one or more TTI) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least RA-preamble identifier, Timing Alignment information for the pTAG, initial UL grant and assignment of Temporary C-RNTI (which may or may not be made permanent upon Contention Resolution);
   - Intended for a variable number of UEs in one DL-SCH message.

3) First scheduled UL transmission on UL-SCH:

   - Uses HARQ;
   - Size of the transport blocks depends on the UL grant conveyed in step 2.

- For initial access:
  - Conveys the RRC Connection Request generated by the RRC layer and transmitted via CCCH;
  - Conveys at least NAS UE identifier but no NAS message;
  - RLC TM: no segmentation.
- For RRC Connection Re-establishment procedure:
  - Conveys the RRC Connection Re-establishment Request generated by the RRC layer and transmitted via CCCH;
  - RLC TM: no segmentation;
  - Does not contain any NAS message.
- After handover, in the target cell:
  - Conveys the ciphered and integrity protected RRC Handover Confirm generated by the RRC layer and transmitted via DCCH;
  - Conveys the C-RNTI of the UE (which was allocated via the Handover Command);
  - Includes an uplink Buffer Status Report when possible.
- For other events:
  - Conveys at least the C-RNTI of the UE.

4) Contention Resolution on DL:

- Early contention resolution shall be used i.e. eNB does not wait for NAS reply before resolving contention;
- Not synchronised with message 3;
- HARQ is supported;
- Addressed to:
  - The Temporary C-RNTI on PDCCH for initial access and after radio link failure;
  - The C-RNTI on PDCCH for UE in RRC_CONNECTED.
- HARQ feedback is transmitted only by the UE which detects its own UE identity, as provided in message 3, echoed in the Contention Resolution message;

- For initial access and RRC Connection Re-establishment procedure, no segmentation is used (RLC-TM).

The Temporary C-RNTI is promoted to C-RNTI for a UE which detects RA success and does not already have a C-RNTI; it is dropped by others. A UE which detects RA success and already has a C-RNTI, resumes using its C-RNTI.

When CA is configured, the first three steps of the contention based random access procedures occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell.

When DC is configured, the first three steps of the contention based random access procedures occur on the PCell in MCG and PSCell in SCG. When CA is configured in SCG, the first three steps of the contention based random access procedures occur on the PSCell while contention resolution (step 4) can be cross-scheduled by the PSCell.

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:

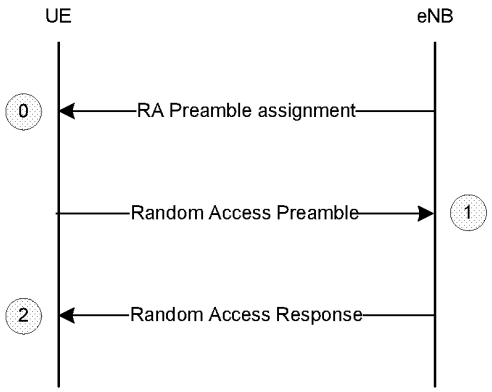


Figure 10.1.5.2-1: Non-contention based Random Access Procedure

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.

When performing non-contention based random access on the PCell or PSCell while DC 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 corresponding cell. 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 not including PSCell. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell for MCG and PSCell for SCG.

In TS36.321 [5], the details of each random access steps and related control element are described in sections 5.1, 5.4, 6, and 7. In 36.331 [4], some configurations for random access and obtaining procedure are captured.

Description of the inventions

Any two or more than two of the following paragraphs, (sub)-bullets, points, actions, or claims described in each invention may be combined logically, reasonably, and properly to form a specific method.

Any sentence, paragraph, (sub)-bullet, point, action, or claim described in each of the following invention(s) may be implemented independently and separately to form a specific method. Dependency, e.g. "based on", "more specifically", or etc., in the following invention(s) is just one possible embodiment which would not restrict the specific method.

Issue and Solution:

"*Control plane latency refers to the time to move from a battery efficient state (e.g., IDLE) to start of continuous data transfer (e.g., ACTIVE). The target for control plane latency should be* ***10ms***." is one NR requirement listed in [1]. Regarding similar requirement in LTE, the control plane latency requirement is set to 50ms [3]. There is a huge gap between latency requirement of LTE and latency requirement of NR. Therefore, it would be better to reduce possible transmission and processing latency as much as possible. In below part, we firstly focus on random access latency.
In LTE, there are two kinds of random access procedure, contention and non-contention. In contention random access procedure, it consists of 4 steps, Msg1, Msg2, Msg3, and Msg4. The figure 4.3.2-1 is an exemplary embodiment for the contention random access. The Msg1 and Msg3 are transmitted from UE to network. And the resource for performing Msg1 transmission and Msg3 transmission are contention resource. If network can successfully receive a Msg3, network will identify a UE based on contents in Msg3 and will transmit a Msg4 to the UE for finishing the contention.

On the other hand, a dynamic TTI adjusting concept is mentioned in [6]. And they propose to set TTI size per scheduling grant for optimizing TCP transmission case. More concretely, short TTI can be used to **accelerate** TCP slow start process and long TTI can be used in steady transmission rate state for reduce control signaling overhead.

Considering such dynamic TTI concept, we would like to further discuss whether it can also be used to accelerate random access procedure and how to achieve dynamic TTI change in random access. In the following, we mainly focus on the Msg3 transmission step in a random access procedure.

In addition, the discussion below doesn't include UE's RF/Baseband capability differentiation

(e.g. differentiation between normal cell phone in LTE and NB-IoT devices in LTE) case. In LTE, there could be three different random access configurations in LTE system. First one for normal UE with enough RF/Baseband capability can monitor whole system bandwidth (e.g. cell phone, high end MTC device). Second one is for low-end MTC devices and normal UE with enough RF/Baseband capability but worked in power limited condition. The third one is for NB-IoT UE which is pool RF/Baseband capability and can only perform transmission/reception on a narrow band (e.g. 1.4MHz). And the last one is defined as a new RAT. Normally, low-end MTC devices will only worked on the second one and NB-IoT device will work only on the third one. For normal UE with enough RF/Baseband capability, it will only change RA configuration when the UE enters power limited state (e.g. cell edge or even far away).

If short TTI applies to Msg3 transmission, the average random access latency could be reduced due to early start to monitor Msg4. A possible case for such benefit is shown in figure 4.3.1-2. In figure 4.3.1-2, although the processing delay is a fixed period, the UE could start to receive Msg4 earlier owing to early Msg3 transmission. Moreover, in the graph 4.3.1-2, two possibilities for monitoring Msg4 are shown. The UE may expect either one TTI format, if TTI length information will not be carried in scheduling control signal. Else, the UE may expect multiple possibilities of TTI length.

Another possible benefit may be improving resource efficiency. If we applies dynamic TTI concept to Msg3, the network can more flexibly adjust resource allocation. In LTE, the TTI length for Msg3 is fixed. In the same modulation scheme condition, LTE system could only schedule radio resource in PRB level, while NR may be able to schedule in symbol level.

For achieving dynamic TTI concept, a UE will need to derive TTI information (e.g. TTI length, numerology) for transmitting Msg3 on air interface. In this aspect, we propose possible candidates for UE to obtain such information. And one or multiple solution can be applied in NR system.

Solution 1 -RAR

In LTE, Msg3 transmission is scheduled by UL grant field in RAR. And a RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in figure 4.3.1-3.

The Msg3 transmission is scheduled according to UL grant field in the RAR. In this solution, we add additional TTI information into RAR for scheduling Msg3. In one embodiment, the

new TTI information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field. A possible exemplary embodiment is shown in figure 4.3.1-4.

Solution 2 – Common field in Msg2

In solution 2, we expect the TTI information is also carried in Msg2 similar to solution 1. However, since we think the TTI length will be limited choices, there may be no need to repeatedly include the redundant information. Hence, we propose to use common field(s) in Msg2 to carry TTI information. A possible example is shown in figure 4.3.1-5. The TTI information 1 could be provided to preamble set 1 (e.g. rapid 0~20) and the TTI information 2 could be provided to preamble set 2 (e.g. rapid 21 ~ 40).

The TTI information carried in a common field will be applied to UEs performed different Msg1 transmission (e.g. different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC header. Alternatively, the common field(s) may be carried as data (e.g. RRC configuration). Alternatively, the common field(s) may be carried in control signal (e.g. PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE will select one of them to apply to Msg3 transmission. Preferably, the UE selects common field based on its Msg1 transmission (e.g. preamble set, PRACH resource set, Msg1 length or format, ...). Preferably, the UE selects common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g. URLLC service type), then the UE will select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field). Alternatively, the UE may understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). For another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE will select common field for URLLC service type. For another example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE will select common field based on the service type indicated by the service indication. Preferably, the UE selects common field based on random access purpose (e.g. request system information, paging, positioning,

location update, control plane establishment, ...). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE. Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold. Preferably, the UE selects common field based on its DL measurement. Preferably, the UE selects common field based on connection establishment cause (e.g. emergency call, mo-data, mt-data, …). Preferably, the UE selects common field based on its current power ramping result. Preferably, the UE selects common field based on UE priority provided from network or UE subscription. Preferably, the UE selects common field based on Msg3 contents (e.g. which type control element will be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 will include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE will select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and). For another example, if Msg3 will include a special control element / special message, the UE will select common field related to the special control element/message. Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE will select common field based on whether priority 2 is over a threshold or not. Preferably, the UE selects common field based on highest priority of logical channels having available data. Preferably, the UE selects common field based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 3 – Broadcast Information

In solution 3, a UE will derive TTI length for Msg3 transmission through broadcast message (e.g. system information(s), MIB, …) from a network. If multiple TTI information for Msg3 transmission are included in the broadcast message, a UE will select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in broadcast message based on its Msg1 transmission (e.g. preamble set, PRACH resource set, Msg1 length or format, ...). Preferably, the UE selects TTI information in broadcast message based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g. URLLC service type), then the UE will select TTI information in broadcast message for the specific service type. Moreover, the UE may understand the data

belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field). Alternatively, the UE may understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). For another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE will select TTI information in broadcast message for URLLC service type. For another example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE will select TTI information in broadcast message based on the service type indicated by the service indication. Preferably, the UE selects TTI information in broadcast message based on random access purpose (e.g. request broadcast message, paging, positioning, location update, control plane establishment, ...). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE. Preferably, the UE selects TTI information in broadcast message based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects TTI information in broadcast message for potential message size larger than the threshold. Preferably, the UE selects TTI information in broadcast message based on its DL measurement. Preferably, the UE selects TTI information in broadcast message based on connection establishment cause (e.g. emergency call, mo-data, mt-data, …). Preferably, the UE selects TTI information in broadcast message based on its current power ramping result. Preferably, the UE selects TTI information in broadcast message based on UE priority provided from network or UE subscription. Preferably, the UE selects TTI information in broadcast message based on Msg3 contents (e.g. which type control element will be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 will include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE will select TTI information in broadcast message related to the LC or RB based on the UE's configuration. For another example, if Msg3 will include a special control element / special message, the UE will select TTI information in broadcast message related to the special control element/message. Preferably, the UE selects TTI information in broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE will select TTI information in broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in broadcast message based on highest priority of logical channels having available data. Preferably, the UE selects TTI information in broadcast message based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message

In solution 4, a UE will derive TTI length for Msg3 transmission through dedicated message (e.g. RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple TTI information for Msg3 transmission are included in the dedicated message, a UE will select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in dedicated message based on its Msg1 transmission (e.g. preamble set, PRACH resource set, Msg1 length or format, ...). Preferably, the UE selects TTI information in dedicated message based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g. URLLC service type), then the UE will select TTI information in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field). Alternatively, the UE may understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). For another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE will select TTI information in dedicated message for URLLC service type. For another example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE will select TTI information in dedicated message based on the service type indicated by the service indication. Preferably, the UE selects TTI information in dedicated message based on random access purpose (e.g. request system information, paging, positioning, location update, control plane establishment, ...). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE. Preferably, the UE selects TTI information in dedicated message based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects TTI information in dedicated message for potential message size larger than the threshold. Preferably, the UE

selects TTI information in dedicated message based on its DL measurement. Preferably, the UE selects TTI information in dedicated message based on connection establishment cause (e.g. emergency call, mo-data, mt-data, …). Preferably, the UE selects TTI information in dedicated message based on its current power ramping result. Preferably, the UE selects TTI information in dedicated message based on UE priority provided from network or UE subscription. Preferably, the UE selects TTI information in dedicated message based on Msg3 contents (e.g. which type control element will be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 will include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE will select TTI information in dedicated message related to the LC or RB based on the UE's configuration. For another example, if Msg3 will include a special control element / special message, the UE will select TTI information in dedicated message related to the special control element/message. Preferably, the UE selects TTI information in dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE will select TTI information in dedicated message based on whether priority 2 is over a threshold or not. Preferably, the UE selects TTI information in dedicated message based on highest priority of logical channels having available data. Preferably, the UE selects TTI information in dedicated message based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 5 – implicitly derive from Msg2 transmission

In this solution, a UE will derive TTI length for Msg3 transmission based on implicit information of Msg2. In one embodiment, a UE derives TTI length based on TTI length used by Msg2. The TTI of Msg3 transmission may be N times of TTI of Msg2. N value can be integer or decimal. The N value may be obtained by a UE based on one or multiple solutions mentioned above. For example, the UE may obtain the N value through broadcast message from a network. And the UE will overwrite the N value provided in broadcast message, if the UE receives another N value in a dedicated message. In another embodiment, a UE derives TTI length based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different TTI lengths. The corresponding TTI information may be predefined and/or provided through system information and/or dedicated RRC message.

Msg3 start timing offset

In LTE, there is a fixed gap period between Msg2 reception and Msg3 transmission. The fixed gap period is designed for covering UE's Msg2/3 processing time (e.g. decode, (de-)multiplexing transport block). However, in NR, some possible methods can bring benefits to reduce such fixed gap period. For example, if short TTI is applied to both Msg2/Msg3 transmissions as figure 4.3.1-6, the minimum of the fixed gap between Msg2 and Msg3 can be set to short TTI. Otherwise, the minimum gap could only be set to normal sub-frame length like without short TTI case.

There are also many other ways for reducing processing time (e.g. provision TB size). These methods will bring not only the benefit, but also some limitations and/or complexity. As a conclusion, we think that it could be beneficial for network be capable to decide the length of gap period.

For achieving the concept, a UE will need to know the gap information (or called Msg3 start timing offset). The Msg3 start timing offset can be derived through the solution 1 to 5 mentioned above for Msg3 TTI or combination of those solutions, while Msg3 start timing offset and TTI length of Msg3 can apply the same or different solutions.

Some bullets of this invention are described below:

1. A method of a UE for performing random access procedure, comprising: [follow configuration]

   the UE receives a dedicated message from a network to set TTI of Msg3;

   the UE transmits a Msg1 to the network;

   the UE receives a Msg2 from the network for responding the Msg1;

   the UE transmits a Msg3 to the network according to the TTI of Msg3.

2. Based on bullet 1, further comprising: the UE decides TTI of Msg3 if there are multiple TTI of Msg3 in the dedicated message.

3. A method of a UE for performing random access procedure, comprising: [follow SI]

   the UE receives a broadcast message from a network to set TTI of Msg3;

   the UE transmits a Msg1 to the network;

   the UE receives a Msg2 from the network for responding the Msg1;

   the UE transmits a Msg3 to the network according to the TTI of Msg3.

4. Based on bullet 3, further comprising: the UE decides TTI of Msg3 if there are multiple TTI of Msg3 in the broadcast message.

5. A method of a UE for performing random access procedure, comprising: [follow RAR]

   the UE transmits a Msg1 to a network;

   the UE receives a Msg2 from the network for responding the Msg1, wherein the Msg2 contains TTI of Msg3;

   the UE transmits a Msg3 to the network according to the TTI of Msg3.

6. Based on bullet 5, further comprising: the UE decides TTI of Msg3 if there are multiple TTI of Msg3 in the Msg2.

7. Based on any of bullets 5 to 6, wherein the TTI of Msg3 is included in a RAR for responding the Msg1.

8. Based on any of bullets 5 to 6, wherein the TTI of Msg3 is included in a common field.

9. A method of a UE for performing random access procedure, comprising: [follow Msg2 TTI]

   The UE transmits a Msg1 to a network;

   The UE receives a Msg2 from the network for responding the Msg1;

   The UE transmits a Msg3 to the network according to a TTI, wherein the TTI is decided based on TTI of Msg2.

10.

[Msg3 start timing offset]

11. A method of a UE for performing random access procedure, comprising: [follow configuration]

    the UE receives a dedicated message from a network to set start timing offset for Msg3 transmission;

    the UE transmits a Msg1 to the network;

    the UE receives a Msg2 from the network for responding the Msg1;

    the UE transmits a Msg3 to the network after the start timing offset passes from the UE received the Msg2.

12. Based on bullet 11, further comprising: the UE decides TTI of Msg3 if there are multiple start timing offsets for Msg3 transmission in the dedicated message.

13. A method of a UE for performing random access procedure, comprising: [follow SI]

    the UE receives a broadcast message from a network to set start timing offset for Msg3

transmission;

the UE transmits a Msg1 to the network;

the UE receives a Msg2 from the network for responding the Msg1;

the UE transmits a Msg3 to the network after the start timing offset passes from the UE received the Msg2.

14. Based on bullet 13, further comprising: the UE decides TTI of Msg3 if there are multiple start timing offsets for Msg3 transmission in the broadcast message.

15. A method of a UE for performing random access procedure, comprising: [follow RAR]

the UE transmits a Msg1 to a network;

the UE receives a Msg2 from the network for responding the Msg1, wherein the Msg2 contains start timing offset for Msg3 transmission;

the UE transmits a Msg3 to the network after the start timing offset passes from the UE received the Msg2.

16. Based on bullet 15, further comprising: the UE decides TTI of Msg3 if there are multiple start timing offsets for Msg3 transmission in the Msg2.

17. Based on any of bullets 15 to 16, wherein the start timing offset for Msg3 transmission is included in a RAR for responding the Msg1.

18. Based on any of bullets 15 to 16, wherein the start timing offset for Msg3 transmission is included in a common field.

19. A communication device comprising:

a control circuit;

a processor installed in the control circuit;

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to perform the method step(s) as defined in anyone of the preceding bullets.

Advantage of the inventions

References:

[1] 3GPP TR 38.913 V0.3.0, Study on Scenarios and Requirements for Next Generation Access Technologies

[2] TR 36.300-d20

[3] 3GPP TS 36.913 V13.0.0 Requirements for further advancements for Evolved Universal Terrestrial Radio Access (E-UTRA)

[4] TS 36.331-d20

[5] TS 36.321-d10

[6] R2-163445, Scheduling Framework and Requirements Nokia, Alcatel-Lucent Shanghai Bell

Figures:

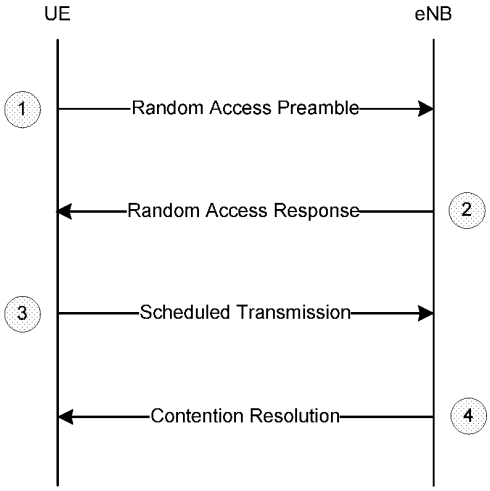


Figure 4.3.2-1: Contention based Random Access Procedure

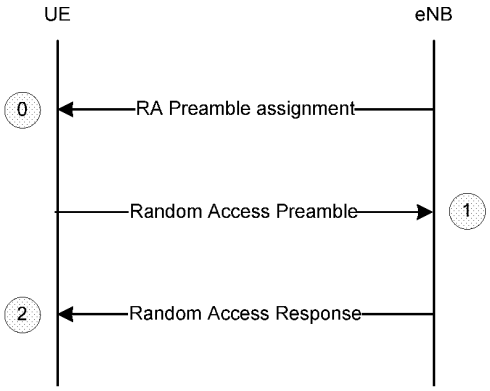


Figure 4.3.2-2: Non-contention based Random Access Procedure

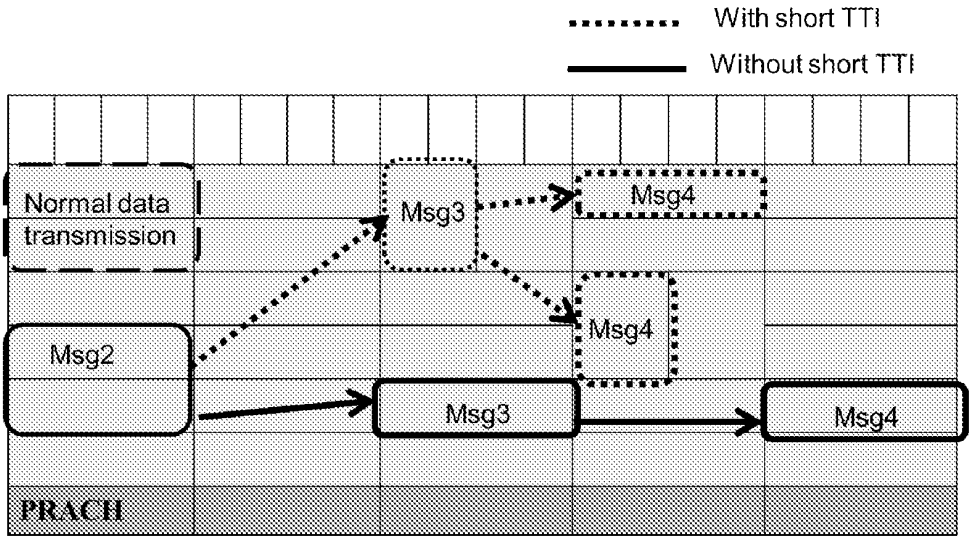


Figure 4.3.1-2 : Latency reduction owing to shorten TTI

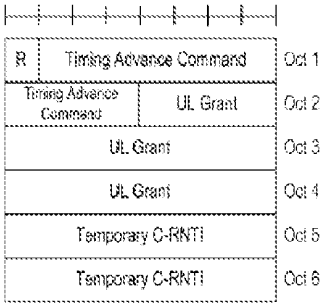


Figure 4.3.1-3: RAR format in LTE

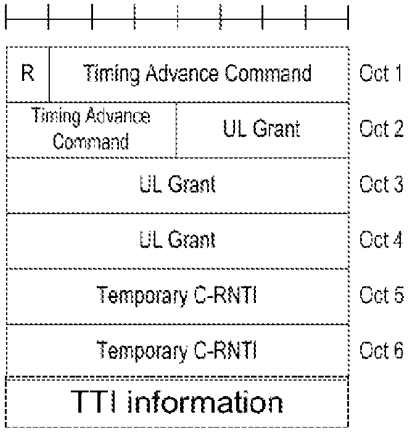


Figure 4.3.1-4: possible new RAR format in NR

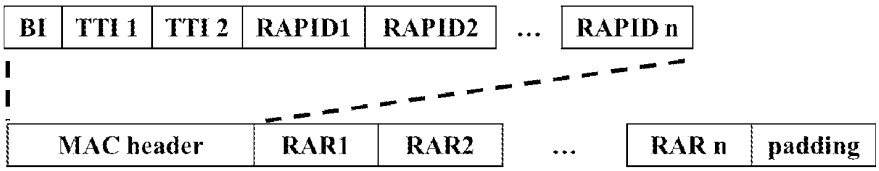


Figure 4.3.1-5: Possible new Msg2 for carrying TTI information of Msg3

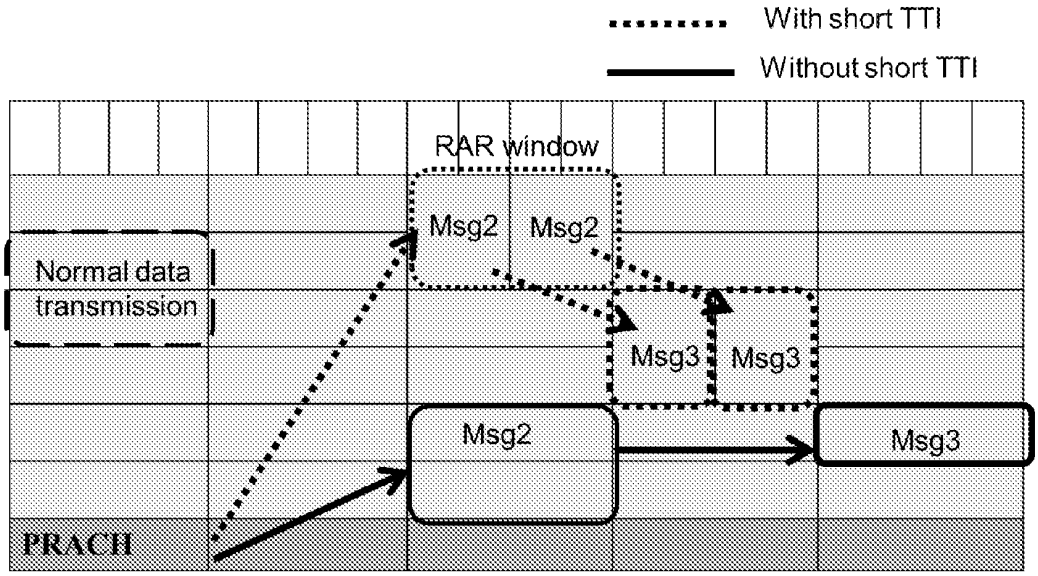


Figure 4.3.1-6: A case for reducing transmission gap between Msg2 and Msg3

Application and Implementation in Wireless Communication Systems and Devices

The invention(s) described above can be applied to or implemented in exemplary wireless communication systems and devices described below. In addition, the invention(s) is described mainly in the context of the 3GPP architecture reference model. However, it is understood that with the disclosed information, one skilled in the art could easily adapt for use and implement aspects of the invention in a 3GPP2 network architecture as well as in other network architectures.

The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A (Long Term Evolution Advanced) wireless access, 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

Figure A1 shows a multiple access wireless communication system according to one embodiment of the invention. An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In Figure A1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency than that used by reverse link 118.

Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage normally causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an eNodeB, or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

Figure A2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

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In one embodiment, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

Memory 232 may be used to temporarily store some buffered/computational data from 240 or 242 through Processor 230, store some buffed data from 212, or store some specific program codes. And Memory 272 may be used to temporarily store some buffered/computational data from 260 through

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Processor 270, store some buffed data from 236, or store some specific program codes.

Turning to Figure A3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in Figure A3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in Figure A1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly.

Figure A4 is a simplified block diagram of the program code 312 shown in Figure A3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

For LTE or LTE-A system, the Layer 2 portion 404 may include a Radio Link Control (RLC) layer and a Medium Access Control (MAC) layer. The Layer 3 portion 402 may include a Radio Resource Control (RRC) layer.

Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks,

modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

While the invention has been described in connection with various aspects, it will be understood that the invention is capable of further modifications. This application is intended to cover any variations, uses or adaptation of the invention following, in general, the principles of the invention, and including such departures from the present disclosure as come within the known and customary practice within the art to which the invention pertains.

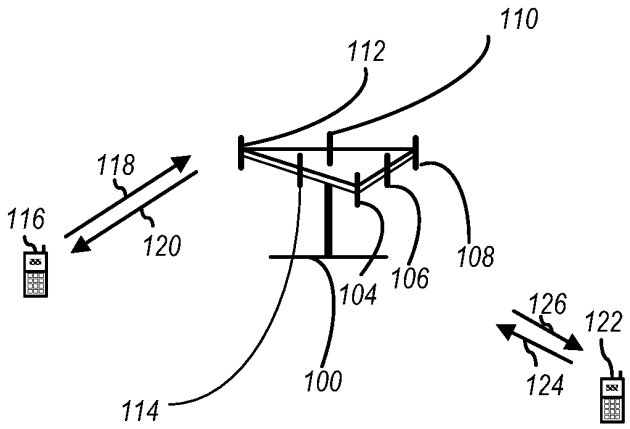


FIG. A1

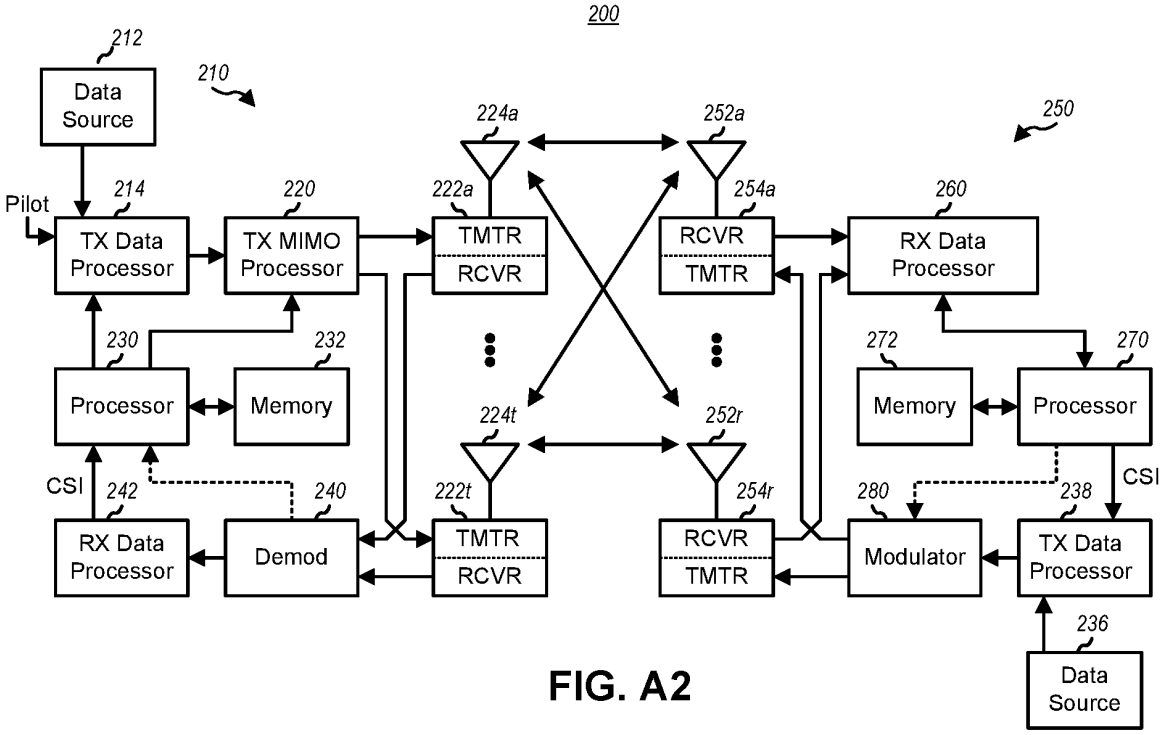

200
212
Data Source
210
224a
252a
250
Pilot
214
220
222a
254a
260
TX Data Processor
TX MIMO Processor
TMTR
RCVR
RCVR
TMTR
RX Data Processor
230
232
272
270
Processor
Memory
224t
252r
Memory
Processor
CSI
242
240
222t
254r
280
238
CSI
RX Data Processor
Demod
TMTR
RCVR
RCVR
TMTR
Modulator
TX Data Processor
236
Data Source

FIG. A2

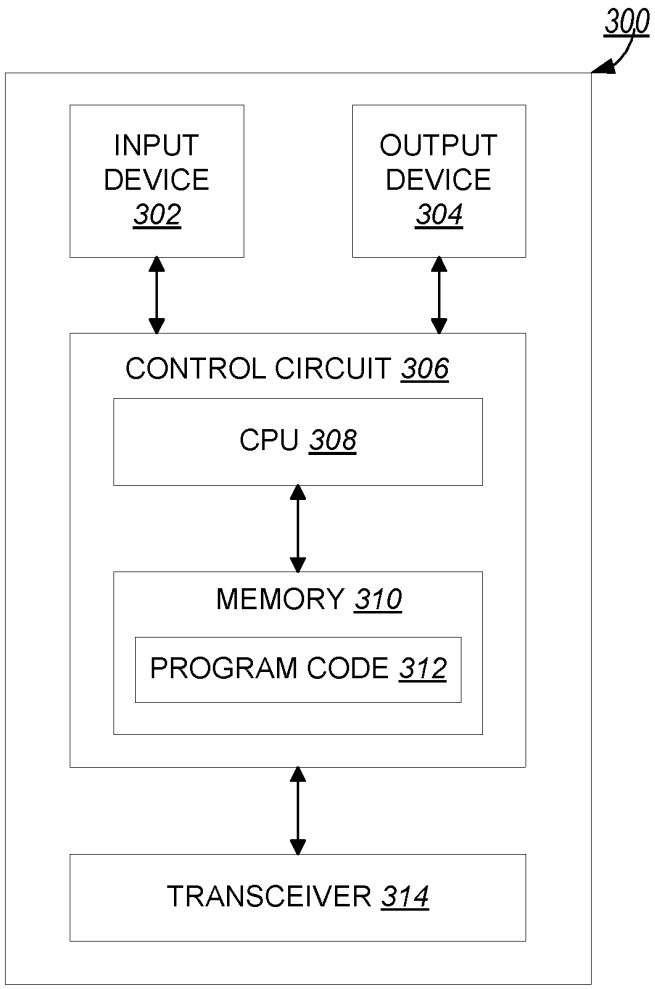

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. A3

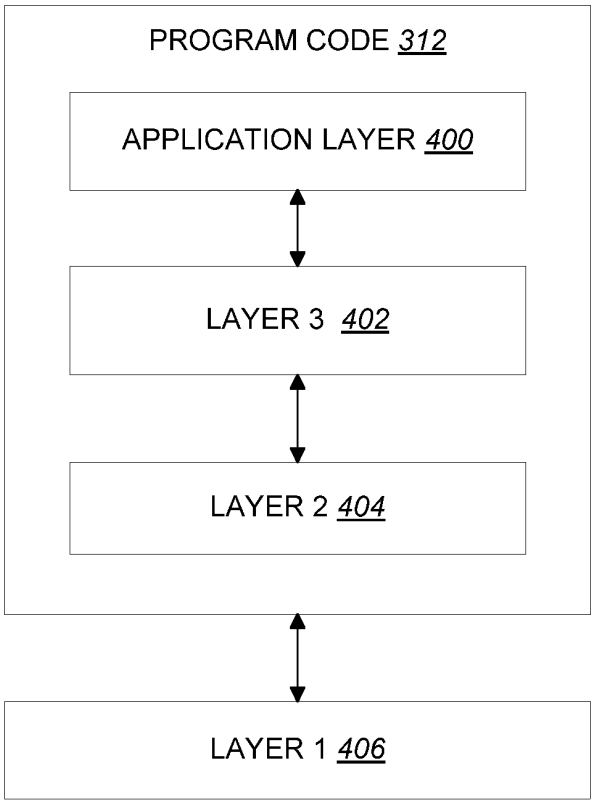

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. A4

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European Patent Office
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Hoefer & Partner Patentanwälte mbB
Pilgersheimer Straße 20
81543 München
ALLEMAGNE

Date
17.10.17

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1857
Applicant/Proprietor	
ASUSTek Computer Inc.	

Communication pursuant to the Decision of the President of the European Patent Office dated 9 August 2012 on the filing of priority documents (OJ EPO 2012, 492)

Please be informed that the priority document(s) listed below has (have) been included in the file of the above-mentioned European patent application (R. 53(2) EPC).

State:	Date of filing:	Application number:
US	28.07.16	USP201662367875

Receiving Section

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Samsung Exhibit 1008, Page 110 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

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Application No.: 17183827.9

The search has started on 21.11.17 (see Notice from the European Patent Office dated 03/2013, OJ EPO 2013, 153).

Receiving Section

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
EP 17 18 3827

TITLE: METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

APPLICANT: ASUSTek Computer Inc.

IPC CLASSIFICATION: H04W74/00, H04W74/08

EXAMINER: Andrés Muñoz, E

CONSULTED DATABASES: DOSYS, XP3GPP

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC:

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
5G, NR
Random access procedure
Short TTI, sTTI, shTTI
Message 3, Msg3, RAR response

EPO FORM P04A42

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 3827

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 2 680 651 A1 (HUAWEI TECH CO LTD [CN]) 1 January 2014 (2014-01-01) * figures 3A, 3B * * paragraph [0037] - paragraph [0056] * -----	1,2,7,8, 10,12-15 3-6,9,11	INV. H04W74/00 ADD. H04W74/08
Y	NOKIA ET AL: "Scheduling Framework and Requirements", 3GPP DRAFT; R2-163445 SCHEDULING FRAMEWORK, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Nanjing, China; 20160523 - 20160527 13 May 2016 (2016-05-13), XP051089702, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/ [retrieved on 2016-05-13]	3-6,9,11	
A	* section 2.1 Basic scheduler considerations * * section 2.2 Potential of using different TTI sizes * ----- -/--	1,2,7,8, 10,12-15	TECHNICAL FIELDS SEARCHED (IPC) H04W

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 November 2017	Andrés Muñoz, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Samsung Exhibit 1008, Page 113 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	HUAWEI ET AL: "Low latency and low overhead transmission for NR", 3GPP DRAFT; R2-162662 LOW LATENCY AND LOW OVERHEAD TRANSMISSION FOR NR, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; , vol. RAN WG2, no. Dubrovnik, Croatia; 20160411 - 20160415 1 April 2016 (2016-04-01), XP051082246, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_93bis/Docs/ [retrieved on 2016-04-01] * figures 1, 2, 3; tables 1, 2, 3 * -----	1-15	
A	ZTE: "Utilization of short TTI in higher layer", 3GPP DRAFT; R2-154172 UTILIZATION OF SHORT TTI IN HIGHER LAYER, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Malmo, Sweden; 20151005 - 20151009 25 September 2015 (2015-09-25), XP051023493, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_91bis/Docs/ [retrieved on 2015-09-25] * section 2.1 RACH * ----- -/--	1-15	TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 November 2017	Andrés Muñoz, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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& : member of the same patent family, corresponding document

1

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IPR2024-01036

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 3827

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	NTT DOCOMO ET AL: "Discussions on TTI shortening", 3GPP DRAFT; R1-163175, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG1, no. Busan, Korea; 20160411 - 20160415 1 April 2016 (2016-04-01), XP051079880, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_84b/Docs/ [retrieved on 2016-04-01] * section 2.1 Overhead increase * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 November 2017	Andrés Muñoz, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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& : member of the same patent family, corresponding document

1

EPO FORM 1503 03.82 (P04C01)

Samsung Exhibit 1008, Page 115 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 18 3827

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-11-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2680651 A1	01-01-2014	CN 102740468 A	17-10-2012
		EP 2680651 A1	01-01-2014
		JP 2014511080 A	01-05-2014
		WO 2012136130 A1	11-10-2012

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

The examination is being carried out on the **following application documents**

Description, Pages

1-33 as originally filed

Claims, Numbers

1-15 as originally filed

Drawings, Sheets

1/19-19/19 as originally filed

Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure.

D1 EP 2 680 651 A1 (HUAWEI TECH CO LTD [CN]) 1 January 2014 (2014-01-01)

D2 NOKIA ET AL: "Scheduling Framework and Requirements", 3GPP DRAFT; R2-163445 SCHEDULING FRAMEWORK, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE
,
vol. RAN WG2, no. Nanjing, China; 20160523 - 20160527 13 May 2016 (2016-05-13), XP051089702,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/
[retrieved on 2016-05-13]

Clarity - Art. 84 EPC

1 The application does not meet the requirements of Article 84 EPC, because claims 2 to 4 and 9 to 11 are not clear.

1.1 Claims 1 and 8 are allowable following Rule 43(2)(c) EPC, as they disclose alternative solutions to a particular problem.

1.1.1 But claims 1 and 8 disclose a single piece of TTI information of Msg3. However, claims 2 to 4 and 9 to 11 disclose multiple pieces of TTI information of Msg3, which is not clear (Art. 84 EPC). In fact, claims 2 to 4 and 9 to 11 should be also independent claims, as they do not disclose all the features of the independent claims on which they theoretically depend.

1.1.2 In addition, the computer program product claim 46 seems to imply that a single general purpose computer could implement any of the steps of the method claims 1 to 37. However, the applicant filed different apparatus claims for contending radio nodes and for recipient radio nodes, which seems to imply that different apparatuses are required to implement the steps of methods 1 and 7. This is unclear (Art. 84 EPC). There should be in consequence two different computer program product claims for, respectively, claims 1 to 6 and 12-37, and claims 7 to 37.

Novelty - Art. 54(1) and (2) EPC

2 Furthermore, notwithstanding the above-mentioned lack of clarity, the subject-matter of claims 1, 8, and 15 is not new within the meaning of Article 54(1) and (2) EPC, and the requirements of Article 52(1) EPC are therefore not met.

2.1 Regarding independent claim 1, document D1 discloses (the references in parentheses applying to this document):

A method of a User Equipment, in the following also referred to as UE, for performing random access procedure,

(figure 3A)

comprising:
the UE receives a message from a network, wherein the message includes a Transmission Time Interval, in the following also referred to as TTI, information of Msg3;

(paragraph [0037], line 1 - line 10; the TTI information is valid for all the steps in the random access procedure, including the step 3 message or Msg3)

the UE transmits a preamble to the network;

(paragraph [0039], line 1 - line 3, and line 6 - line 11)

the UE receives a Msg2 from the network for responding the preamble;

(paragraph [0041]; the second step message or Msg2 in a random access procedure is typically a response to the preamble and an allocation of resources, in this case a Common-EDCH resource)

and
the UE performs a Msg3 transmission to the network according to the TTI information of Msg3.

(paragraph [0042] - paragraph [0043]; the third step message or Msg3 in a random access procedure can take many forms; for example an uplink transmission)

2.2 Regarding independent claim 8, document D1 discloses (the references in parentheses applying to this document):

A method of a User Equipment, in the following also referred to as UE , for performing random access procedure,

(figure 3B)

comprising:
the UE transmits a Preamble to a network;

(paragraph [0049], line 1- line 2, and line 6 - line 11)

the UE receives a Msg2 from the network in response to the Preamble, wherein the Msg2 contains a Transmission Time Interval, in the following also referred to as TTI, information of Msg3;

(paragraph [0051], line 4 - line 12; paragraph [0052], line 2 - line 3; the second step message or Msg2 in a random access procedure can take many forms; for example a resource allocaiton. Please note that the UE selection of TTI can be denied by the Node B, see paragraph [0056], line 1 - line 2, which implies that at this step 2 of the random procedure, the UE receives information about the TTI for the step 3 of the random procedure, in spite of the initial selection by the UE)

and
the UE performs a Msg3 transmission to the network according to the TTI information of Msg3.

(paragraph [0053] - paragraph [0054])

2.3 The novelty objection under sections 2.1 and 2.2 above applies, mutatis mutandis, to the corresponding independent claim 15.

3 The supplementary features of dependent claims 2, 7, 10, 12, and 14 relate to minor implementation details which do not add anything new (Art. 54 EPC) to the subject-matter of the claim they refer to. In this respect, the following list indicates the passages where the features of dependent claims are disclosed in the prior art:

- claims 2, 7, and 10: D1 at paragraph [0039], line 6 - line 11; or paragraph [0049], line 6 - line 11. In both cases, the UE indicates to the network its TTI selection using a particular preamble or PRACH resource, which implies that the selection of TTI information for the third step of RACH is based on the associated PRACH resource or associated preamble (even if said preamble or PRACH resource was, in turn, previously selected by the UE).
- claim 12: paragraph [0051], line 4 - line 12; paragraph [0052], line 2 - line 3; the second step message or Msg2, which in this case is a resource allocation, is a response to the preamble.
- claim 14: D1 at paragraph [0047], line 4 - line 6.

Inventive Step - Art. 56 EPC

4 The supplementary features of dependent claims 3 to 6, 9, 11, and 13 relate to minor implementation details which do not add anything inventive (Art. 56 EPC) to the subject-matter of the claim they refer to.

4.1 D1 was cited against novelty of the independent claims. D1 pertains to TTI selection by the UE in HSUPA random access based on location on center or cell edge (i.e. based on coverage, reliability and transmission rate). But in fact D1 does not disclose a number of characteristics of the application, and said claims are not novel over D1 only because they are broad. If the applicant amended the independent claims with the subject-matter of some of the dependent claims cited below (for example TTI selection based on random access purpose), the claims would be certainly new over D1. However, they would not be inventive (Art. 56 EPC).

4.1.1 D1 is considered to be the prior art closest to the subject-matter of the application. The dependent claims cited below would be the distinguishing features over the disclosure of D1. However, the subject-matter of said features is already disclosed in the prior art, producing the same technical effect, and solving the same objective technical problems. Thus:

- claims 3, 4, 9, and 11: D2 at page 2, line 33 - line 38; the TTI is selected based on the purpose (e.g. URLLC, eMBB, mMTC). Therefore, a selection of TTI for msg3 in random access for such purposes is also based on said purposes. Besides, page 2, line 34, discloses that the URLLC service has priority over the other services.
- claims 5 and 6: D2 at page 2, line 33, discloses that the network support scheduling with different TTI sizes; D2 at page 1, line 22 - line 25, discloses that the scheduling is performed via downlink control information. It is implicit in a 3GPP system that said DCI is transmitted in a RRC message.

4.2 In addition, claim 13 is obvious the person skilled in the art (Art. 56 EPC).

General remarks

5 The general statement at page 33, line 3 - line 7, of the description, which implies that the extent of protection may be expanded in a vague and not precisely defined way ("principles"), does not meet the requirement following from Article 84 EPC (see Guidelines F-IV, 4.4), and in consequence, must be deleted.

6 Independent claims 1 and 8 are not in the two-part form in accordance with Rule 43(1) EPC, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

7 To meet the requirements of Rule 42(1)(b) EPC, D1 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.

8 The applicant is invited to file new claims which take account of the above comments.

8.1 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made, irrespective of whether they concern amendments by addition, replacement or deletion, and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1).

8.2 The attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC).

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81543 München
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Date
12.12.17

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1857
Applicant/Proprietor	
ASUSTek Computer Inc.	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the European search report (R. 61 EPC) or the partial European search report/ declaration of no search (R. 63 EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☑ 0 additional set(s) of copies of such documents is (are) enclosed as well.

The following have been approved:

☑ Abstract ☑ Title

☐ The Abstract was modified and the definitive text is attached to this communication.

The following figure(s) will be published together with the abstract: 12

Refund of search fee
If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued once the date of publication of the European search report has been mentioned in the European Patent Bulletin (R. 69(1), R. 70(2) EPC).

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ALLEMAGNE

Date
04.01.18

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1857 / 3277042
Applicant/Proprietor	
ASUSTek Computer Inc.	

Notification of European publication number and information on the application of Article 67(3) EPC

You are hereby informed that the technical preparations for the publication of the above-mentioned European patent application have been completed.

The application will be published on 31.01.18 with the European search report.
The publication number is: 3277042.
The publication will be mentioned in European Patent Bulletin number 2018/05.
(**http://bulletin.european-patent-office.org**).

Provisional protection under Article 67(1) and (2) EPC in the individual contracting states becomes effective when the conditions referred to in Article 67(3) EPC have been fulfilled. Provisional protection in the individual extension and validation states is governed by the national laws of the countries concerned. For more details, see Chapter III of the EPO brochure "National Law relating to the EPC" (**www.epo.org/law-practice/legal-texts/national-law.html**), which also contains information about the extension and validation system. Further information can also be found in the Official Journal of the European Patent Office.

The title of the invention in the three official languages of the European Patent Office is worded as follows:

VERFAHREN UND VORRICHTUNG ZUR VERBESSERUNG DER MSG3-ÜBERTRAGUNG EINES DIREKTZUGRIFFSVERFAHRENS IN EINEM DRAHTLOSKOMMUNIKATIONSSYSTEM
METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM
PROCÉDÉ ET APPAREIL PERMETTANT D'AMÉLIORER LA TRANSMISSION MSG3 D'UNE PROCÉDURE D'ACCÈS ALÉATOIRE DANS UN SYSTÈME DE COMMUNICATION SANS FIL

In all future communications to the EPO, please quote the application number as indicated above, i.e. including the final four figures (which identify the Directorate responsible for the subsequent procedure).

Remark
The publication can be downloaded, free of charge, from the EPO publication server **https://data.epo.org/publication-server/** or can be ordered from the Vienna sub-office upon payment of a fee (see Decision of the President of the EPO dated 12 July 2007 concerning the form of publication of European patent applications, European search reports and European patent specifications, Special edition No. 3, OJ EPO 2007, 97).

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IPR2024-01036

Note concerning renewal fees
Under Article 86 EPC renewal fees shall be paid to the EPO for the European patent application. These fees shall be due in respect of the third and each subsequent year, calculated from the date of filing. Due account should be taken that the EPO will not send invoices or reminders to pay any fees in due time.

Accelerated prosecution of European patent applications
Applicants wishing to accelerate proceedings before the EPO may file a request according to the programme for accelerated prosecution of European patent applications - "PACE" (OJ EPO 2010, 352). EPO Form 1005 is available on the EPO website (www.epo.org) for this purpose.

Receiving Section

Samsung Exhibit 1008, Page 125 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

Europäisches Patentamt
European Patent Office
Office européen des brevets

European Patent Office
80298 MUNICH
GERMANY

Questions about this communication ?
Contact Customer Services at www.epo.org/contact

Hoefer & Partner Patentanwälte mbB
Pilgersheimer Straße 20
81543 München
ALLEMAGNE

Date
05.02.18

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1215 / 3277042
Applicant/Proprietor	
ASUSTek Computer Inc.	

Communication pursuant to Rule 69 EPC - reminder concerning payment of the designation fee (Art. 79(2) EPC) and of the examination fee (Art. 94(1) EPC) - and invitation pursuant to Rule 70a(1) EPC

The date on which the European Patent Bulletin mentions the publication of the European search report for the above-mentioned European patent application is: 31.01.18.

Your attention is drawn to Article 79(2) and Rule 39(1) EPC as well as Article 94(1), Rule 70(1) and Rule 70a(1) EPC, according to which within **six months** of the above-mentioned publication date of the search report

- the designation fee must be paid,
- the request for examination must be filed and the examination fee must be paid,
- comments on the objections raised in the opinion accompanying the European search report and/or any amendments to the description, claims and drawings correcting any deficiencies noted in the opinion must be filed (R. 70a(1), 137(2) EPC; Guidelines for Examination in the EPO, B-XI, 8).

1. Payment of the designation fee and of the examination fee

The current amount of the flat-rate designation fee is: EUR 585,00

The current amount of the examination fee is: EUR 1635,00

If the written request for examination is filed in an admissible non-EPO language in accordance with Article 14(4) EPC, a reduction of the examination fee according to Rule 6(3) EPC applies.

For European patent applications filed on or after 01.04.2014, the reduction applies only if the applicant(s) has (have) declared to be an entity or a natural person within the meaning of Rule 6(4) EPC (Decision of the Administrative Council of 13 December 2013, OJ EPO 2014, A4).

If the designation fee and the examination fee are not paid within the period laid down in Rule 39(1) and Rule 70(1) EPC, the application **will be deemed to be withdrawn** (R. 39(2) and Art. 94(2) EPC).

Any extension or validation fees are also payable within the above-mentioned period.

Registered letter
EPO Form 1081 12.17 (NFS/RTB/ESOP01=N)

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
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2. Comments on the opinion accompanying the European search report and filing of amendments

Should the reply to the invitation pursuant to Rule 70a(1) EPC be filed in an admissible non-EPO language, a translation is to be submitted within one month of its filing (R. 6(2) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

Should you not comply with this invitation within the time limit, the application **will be deemed to be withdrawn** in accordance with Rule 70a(3) EPC.

Making payments
For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

Information concerning fee amounts
Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

Receiving Section

Samsung Exhibit 1008, Page 127 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

HOEFER & PARTNER

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Europäisches Patentamt

80298 München

Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-24/AH	April 13, 2018

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In reply to the Communication of February 5, 2018

Examination of the application is herewith requested. The payment of the **examination fee** is effected by debiting our account 2800 0600.

The payment of the **designation fee** is effected by debiting our account 2800 0600.

Enclosed is a **response** to the search report.

Hoefer & Partner Patentanwälte mbB

Encl.:
Response to the search report

Europäisches Patentamt
European Patent Office
Office européen des brevets

Letter accompanying subsequently filed items

Representative:

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17183827.9
Applicant's or representative's reference	ASU170707PEP

	Description of document	Original file name	Assigned file name
1	Letter relating to the search and examination procedure		EPLETT-1.pdf
2	Letter relating to the search and examination procedure		EPLETT-2.pdf
3	Amended description (clean copy)		DESCPAMD-1.pdf
4	Amended description with annotations		DESC-HWA-1.pdf

	Fees	Factor applied	Fee schedule	Amount to be paid
15-1	005e Designation fee - For all contracting States designated for applications filed on/after 01.04.2009	1	585.00	585.00
15-2	006 Examination fee - For applications filed on/after 01.07.2005	1	1 635.00	1 635.00
	Total:		**EUR**	**2 220.00**

	Payment	
1	Method of payment	Debit from deposit account
	Currency:	EUR
	The European Patent Office is hereby authorised, to debit from the deposit account with the EPO any fees and costs indicated on the fees page.	
	Deposit account number:	28000600
	Account holder:	Hoefer & Partner Patentanwälte mbB
2	Refund/Reimburserment	
	Reimbursement (if any) to be made to EPO deposit account:	28000600
	Account holder:	Hoefer & Partner Patentanwälte mbB

Signatures

Place:	**München**
Date:	**13 April 2018**
Signed by:	**Ingo Goerz 19384**
Association:	**Hoefer & Partner Patentanwälte mbB**
Representative name:	**Ingo Görz**
Capacity:	**(Representative)**

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IPR2024-01036

HOEFER & PARTNER

PATENTANWÄLTE / EUROPEAN PATENT TRADEMARK AND DESIGN ATTORNEYS
Hans-Werner Schmitz, Dipl.-Ing. Dipl.-Wirtsch.-Ing.
Dr. Joachim Weber, Dr.-Ing. Dipl.-Ing. (bis 2016)
Thomas J. Hager, Dipl.-Ing. (FH)
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Ingo Görz, Dipl.-Ing.
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Dr. Petra Traub, Dr. rer. nat. Dipl.-Biol.
Sebastian Schiller, Dipl.-Ing.
Benedikt Köstle, Dipl.-Ing.*

RECHTSANWÄLTE / LAWYERS
FACHANWÄLTE FÜR GEWERBLICHEN RECHTSSCHUTZ
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Europäisches Patentamt

80298 München

Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-60/LX	April 13, 2018

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In Response to the European Search Report of December 12, 2017:

1. New documents

- New description pages 1 and 33

The new documents are to replace, at least for the present, the respective documents currently pending. The remaining documents are presently maintained unchanged. The applicant preserves his right to file divisional applications for the subject matter of the original application.

2. Clarity

Referring to item 1.1.1 of the search opinion, it is the applicant's understanding that the present language of pending dependent claims 2 to 4 and 9 to 11 is clear and there is no inconsistency between independent claims 1, 8 and the above dependent claims. The reason is that although independent claims 1 and 8 define that a (single piece of) TTI information is included in the message, this definition does NOT exclude the possibility that more than one (single piece of) TTI information is included in the message, as it is **NOT** defined in claims 1 and 8 that **only** a (single piece of) TTI information is included in the message. The mentioned dependent claims 2 to 4 and 9 to 11 relate to such a special case in which multiple TTI information is included in the message. Therefore, the wording "if there are multiple TTI information of Msg3 in the message" in the mentioned dependent claims is not inconsistent

with the wording “a TTI information” in claim 1. Thus, the present claim language of the pending claims is clear. Therefore, it is asked to drop this objection.

Referring to item 1.1.2 of the search opinion, it is noted that there are only 15 pending claims in the present application and there is no computer program product claim 46 in the application. Moreover, it is not necessary to claim two device claims corresponding to the two pending method claim groups respectively, because pending claim 15 already clearly expresses that “the processor (of the claimed user equipment) is configured to execute a program code stored in the memory to perform the method steps in **any one** of the preceding claims”. In other words, the two parallel cases (a case in which the user equipment performs the method of the first claim group and a case in which the user equipment performs the method of the second claim group) are already clearly included in the present claim language of pending claim 15 as alternatives. The present claim language of claim 15 is clear and sufficient for a person skilled in the art to correctly understand and carry out the invention. So, there is no need to claim two different equipment claims for the two method claim groups respectively. It is asked to drop this objection.

3. Subject matter of the application

The invention concerns methods of a User Equipment (i.e. UE) for performing random access procedure and a corresponding user equipment.

It is an object underlying the present invention to provide methods of a UE for performing random access procedure and a corresponding UE, which can dynamically determine (control) the TTI length applied to Msg3.

The solution of this object is achieved by the features of the independent claims. The dependent claims contain advantageous embodiments of the present invention.

4. Novelty

None of the cited references discloses all the features of the pending independent claims.

It is alleged under item 2 of the search opinion that citation D1 (EP 2680651 A1) discloses all the features of pending independent claims 1, 8 and 15. Insofar, the applicant cannot agree to this view and asks the examiner to reconsider it in view of the following explanations:

According to claims 1 and 8, the invention concerns techniques of a UE for random access procedure. In particular, as claimed in the pending independent claims, the invention concerns the processes regarding the transmission/reception of Msg1, Msg2 and Msg3 during the random access procedure. In other words, the approach of the present invention refers to the whole random access procedure, but not only to a certain stage of the random access procedure.

Turning to D1, it relates to just channel resource allocation (see D1: [0003], [0004] and [0007]), which refers to only a stage of the random access procedure, but not the whole random access process. Besides, D1 does not relate to the transmission/reception of Msg1, Msg 2 and Msg 3 as claimed in the present invention.

Therefore, D1 and the invention are concerned with different technical problems and relate to different techniques. Thus, D1 cannot be used to and also does not anticipate the invention as claimed in the pending independent claims.

Accordingly, the pending independent claims are novel over D1.

D2 does also not disclose all the features of the pending independent claims. Therefore, the pending independent claims are novel over D2.

5. Inventive step

An invention is considered to involve an inventive step in case a person of ordinary skill cannot arrive at the teaching of the claim in an obvious manner.

The analysis of the cited references reveals that this pre-condition is doubtlessly given as even a combination of the cited references is not able to render the teaching of the independent claims obvious because both of the two references are silent on the claimed UE methods, in particular the claimed steps of receiving TTI information of Msg3 from the network and performing the Msg3 transmission according to the received TTI information. Thus, even D1 combined with D2 can also not render the claimed invention obvious.

Besides, as stated above, D1 is concerned with a different technical direction, i.e. channel resource allocation, but not relate to the whole random access procedure (in particular Msg1, Msg2, and Msg3 transmissions). So, nothing in D1 can direct the attention of a person skilled in the art to a direction towards the invention.

Further, as mentioned above, the claimed approach of the invention realizes applying dynamic TTI concept to Msg3. None of the cited references can achieve this technical effect of the invention. Thus, the claimed invention has a significant advantage as compared to the prior art.

Therefore, the pending independent claims are based on an inventive step.

6. Description / Formal requirements

In view of item 5 of the search opinion, the last paragraph on page 33 has been deleted.

Regarding item 6 of the search opinion, the independent claims are kept in the one-part form because as stated above, D1 (which is considered as the closest prior art document) does not concern the random access procedure, but rather the channel resource allocation. Thus, from the very beginning claims 1 and 8 are already different from the teaching of D1. So, it is asked to admit the present form of the pending independent claims.

In view of item 7 of the search opinion, D1 is identified and briefly discussed on new description page 1.

7. Requests

It is therefore respectfully requested to drop the objections against the patentability of the application, and to furnish an opportunity to adapt the specification if necessary.

In case of remaining minor amendments to the claims and/or description, it is respectfully requested to contact the applicant's representatives over the phone.

8. Oral proceedings (video-conference)

In case, however, the examining division should not agree to the patentability of the application, it is respectfully requested to issue an examination report in detail elucidating the reservations of the examining division. Auxiliary, it is requested to set a date for oral proceedings. If the oral proceedings are to be held in The Hague or Berlin, oral proceedings by **video-conference** (IP technology) are requested. If the request for video-conference cannot be granted, conventional oral proceedings are requested.

Hoefer & Partner Patentanwälte mbB

Encl.:
New pages 1 and 33
Markup version of the new pages

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system.

New pages 1, 33
Markup Version

aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

~~While the invention has been described in connection with various aspects, it could be understood that the invention is capable of further modifications. This application is intended to cover any variations, uses or adaptation of the invention following, in general, the principles of the invention, and including such departures from the present disclosure as come within the known and customary practice within the art to which the invention pertains.~~

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METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

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EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system.

New pages 1, 33
Clean Version

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
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aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

New pages 1, 33
Clean Version

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

Europäisches Patentamt
European Patent Office
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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	6230397
Application number	EP17183827.9
Date of receipt	13 April 2018
Receiving Office	European Patent Office, The Hague
Your reference	ASU170707PEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (2 p.) EPLETT-2.pdf (4 p.) DESC-HWA-1.pdf (2 p.) ep-sfd-request.xml EPLETT-1.pdf (1 p.) DESCPAMD-1.pdf (2 p.)
Submitted by	CN=Ingo Goerz 19384
Method of submission	Online
Date and time receipt generated	13 April 2018, 12:05 (CEST)
Message Digest	5F:BA:07:E1:EA:D7:03:C6:34:30:0C:71:FD:8F:A5:80:F7:F2:A2:7C

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

/European Patent Office/

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application No.: 17183827.9

Substantive examination has started on 07.08.18 (see Notice from the European Patent Office dated 29.01.2013, OJ EPO 2013, 153).

For the Examining Division

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Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

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Application No.	Ref.	Date
17 183 827.9 - 1215	ASU170707PEP	15.08.2018
Applicant ASUSTek Computer Inc.		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

In case you withdraw the application within the above-mentioned period, the examination fee will be refunded at a rate of 50% (Art. 11 (b) RFees).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter

Andrés Muñoz, E
Primary Examiner
For the Examining Division

Enclosure(s): 5 page/s reasons (Form 2906)

Registered letter
EPO Form 2001 11.16TRI

The examination is being carried out on the **following application documents**

Description, Pages

2-32	as originally filed	
1, 33	filed in electronic form on	13-04-2018

Claims, Numbers

1-15	as originally filed

Drawings, Sheets

1/19-19/19	as originally filed

Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure.

D1 EP 2 680 651 A1 (HUAWEI TECH CO LTD [CN]) 1 January 2014 (2014-01-01)

D2 NOKIA ET AL: "Scheduling Framework and Requirements", 3GPP DRAFT; R2-163445 SCHEDULING FRAMEWORK, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE
,
vol. RAN WG2, no. Nanjing, China; 20160523 - 20160527 13 May 2016 (2016-05-13), XP051089702,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/
[retrieved on 2016-05-13]

D3 HUAWEI ET AL: "Low latency and low overhead transmission for NR", 3GPP DRAFT; R2-162662 LOW LATENCY AND LOW OVERHEAD TRANSMISSION FOR NR, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ;
,

vol. RAN WG2, no. Dubrovnik, Croatia; 20160411 - 20160415 1 April 2016 (2016-04-01), XP051082246,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_93bis/Docs/
[retrieved on 2016-04-01]

D4 ZTE: "Utilization of short TTI in higher layer",
3GPP DRAFT; R2-154172 UTILIZATION OF SHORT TTI IN HIGHER LAYER, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE
,
vol. RAN WG2, no. Malmo, Sweden; 20151005 - 20151009 25 September 2015 (2015-09-25), XP051023493,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_91bis/Docs/
[retrieved on 2015-09-25]

D5 NTT DOCOMO ET AL: "Discussions on TTI shortening",
3GPP DRAFT; R1-163175, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE
,
vol. RAN WG1, no. Busan, Korea; 20160411 - 20160415 1 April 2016 (2016-04-01), XP051079880,
Retrieved from the Internet:
URL:http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_84b/Docs/
[retrieved on 2016-04-01]

The applicant's letter and amendments filed on 13/04/2018 have been carefully considered. However, said amendments fail to put the application in order for grant of a European Patent. The reasons are explained in the following paragraphs of this communication.

Patentability - Art. 52 EPC

1 The comments with respect to Article 52(1), in particular §2, §3, and §4 of the European Search Opinion, are maintained.

1.1 The applicant's arguments at the letter dated 13-04-2018 have been considered.

1.1.1 A first argument is that claims 1 and 8 pertain to a random access procedure, in particular to processes regarding Msg1, Msg2 and Msg3 during the random access procedure, while D1 would discuss one stage of the random access procedure, that would be the channel resource allocation.

1.1.1.1 This argument cannot be agreed. D1 discloses at paragraph [0003] that release 99 3GPP enhances the existing CELL FACH procedure with a enhanced random access, which includes a preamble access (i.e. Msg1) and resource allocation stage, a collision resolution stage (i.e. Msg2), an E-DCH data transmission stage (i.e. Msg3) and a resource release stage. Furthermore, paragraph [0024] discloses that the invention proposed by D1 consists in adding TTI length dynamic selection to said enhanced RACH procedure. Moreover, figure 3A, in which the argument of lack of novelty is based, discloses the mentioned steps of sending a preamble or Msg1 (step 303, and paragraph [0039], line 9), receiving a resource allocation message (step 306, and paragraph [0041]), which is the Msg2 in a random access procedure in the case of no collision, and sending a data transmission (step 308, paragraph [0043]), which is the Msg3 in a random access procedure in the case of no collision.

1.1.2 Another argument is that the independent claims are inventive over the combination of D1 and D2 because said documents are silent about the claimed UE methods.

1.1.2.1 However, as it has been explained above (see §1.1.1.1), the independent claims are actually not new over D1, so they are also not inventive over D1.

1.1.3 Another argument is that the invention realizes applying dynamic TTI concept to Msg3, which would not be disclosed by the cited documents.

1.1.3.1 However, as it has explained above (see §1.1.1.1), D1 discloses dynamic TTI concept applied to a data transmission in a random access procedure, which is a Msg3 in the case of no collision.

1.2 It is not at present apparent which part of the application could serve as a basis for a new, allowable claim. Should the applicant nevertheless regard some particular matter as patentable, an independent claim should be filed

taking account of Rule 43(1) EPC. The applicant should also indicate how the subject-matter of the new claim differs from the state of the art and the significance thereof.

Clarity - Art. 84 EPC

2 The application does not meet the requirements of Article 84 EPC, because the claims are not clear.

2.1 The objection under §1.1 of the European Search Opinion is maintained. The applicant's argument that the sentence "the message includes a TTI information of Msg3" does not exclude the possibility that more than one TTI information is included in the message cannot be agreed.

2.1.1 The applicant is recommended to amend the independent claims with "the message includes TTI information of Msg3", which would allow the possibilities of either one single piece of TTI information or multiple pieces of TTI information, and that would be supported by the application when read as a whole.

2.2 Regarding the objection under §1.1.2 of the European Search Opinion, this examiner apologizes for the mistake with the claims numbering. Besides said objection is **withdrawn**, as this examiner acknowledges the applicant's argument that a UE may contain program code to execute either the method of claim 1 or the method of claim 8 depending of the circumstances.

Further objections

3 It appears that part of the subject-matter of the description and/or drawings is not covered by the claims. However, if examples and technical descriptions of apparatuses, products and/or methods in the description and/or drawings which are not covered by the claims are presented not as embodiments of the invention but as background art or examples useful for understanding the invention, the retention of these examples may be allowed (Guidelines F-IV, 4.3iii).

4 Independent claims 1 and 8 are not in the two-part form in accordance with Rule 43(1) EPC, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

5 To meet the requirements of Rule 42(1)(b) EPC, D1 should be identified in the description and the relevant background art disclosed therein should be briefly discussed. The amended page 1 currently on file contains a very short description of D1 which fails to explain that D1 is about dynamic TTI selection for a random access procedure.

Procedure

6 The applicant is invited to file new claims which take account of the above comments.

6.1 The applicant is requested to bring the description into conformity with the amended claims; care should be taken during revision, especially of the introductory portion including any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

6.2 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made, irrespective of whether they concern amendments by addition, replacement or deletion, and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1).

6.3 The attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC).

6.4 In order to accelerate the examination procedure, it would be appreciated if the applicant provided with an argumentation based in the problem and solution approach, as defined in the Guidelines, G-VII, 2.5.

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Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-60/LX	December 11, 2018

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In Response to the Office Action of August 15, 2018:

1. New documents

- New claims 1 to 15
- New description page 1

The new documents are to replace, at least for the present, the respective documents currently pending. The remaining documents are presently maintained unchanged. The applicant preserves his right to file divisional applications for the subject matter of the original application.

2. Original disclosure of the new claims

New claim 1 is based on claim 1 as originally filed in which it is further clarified that the message which includes the TTI information of the Msg3 is a dedicated message. This amendment is supported by Figs. 12 and 16 and the "Solution 4" on page 24 of the description as originally filed. Besides, the former term "a TTI information" is amended to "TTI information". Further, an appropriate article is added before the term "Msg3". Since all these amendments made in claim 1 are either supported by the original disclosure of the invention or regarding to linguistic corrections which do not change the subject-matter of the claim, they are admissible.

New claims 2 to 4 are based on claims 2 to 4 as originally filed, respectively, in which a definite article “the” is added before the term “Msg3” in view of the linguistic amendments made in new claim 1 as stated above.

New claims 5 and 6 correspond to claims 5 and 6 as originally filed, respectively.

New claim 7 is based on claim 7 as originally filed, in which the same linguistic amendment as made in claims 2 to 4 is made.

New claim 8 is based on claim 8 as originally filed in which a feature as disclosed in claim 14 as originally filed is further incorporated. Besides, an appropriate article is added before the term “Msg3”. These amendments made in claim 8 are either supported by the original disclosure of the invention or regarding to linguistic corrections which do not change the subject-matter of the claim and are thus admissible.

New claims 9 to13 are based on claims 9 to 13 as originally filed, respectively, in which a definite article “the” is added before the term “Msg3” in view of the linguistic amendments made in new claim 8 as stated above.

New claim 14 is based on claim 14 as originally filed, in which its dependency is amended to be dependent on any one of claims 1 to 7 in view of the amendments made in claim 8 as stated above. Besides, similarly, a definite article “the” is added before the term “Msg3”.

New claim 15 corresponds to claim 15 as originally filed.

3. Clarity

Referring to item 2.1 of the office action, the indefinite article “a” of the term “a TTI information of Msg3” is deleted in the new claims in accordance with the recommendation of the examiner as stated in item 2.1.1 of the office action. Thus, this objection shall be overcome.

4. Subject matter of the application

The invention concerns methods of a user equipment for performing the random access procedure according to the pre-characterizing part of new claims 1 and 8, and a corresponding user equipment according to the pre-characterizing part of new claim 15.

Such methods and user equipment are known from D1, EP 2680651 A1.

In view of D1, it is an object underlying the present invention to enable a dynamic TTI adjustment dedicated to a specific UE during the random access procedure.

The solution of this object is achieved by the features of the independent claims. The dependent claims contain advantageous embodiments of the present invention.

5. Novelty

None of the cited references discloses all the features of new claim 1.

In particular, document D1 does not disclose the characterizing part of new claim 1.

According to D1, in particular Fig.3A and paragraphs [0037] and [0038], the TTI information is transmitted to the UE via a cell “broadcast” message. In contrast thereto, according to the invention, the message including the TTI information of the Msg3 is a “dedicated” message. In other words, the present invention uses a dedicated message to transmit the TTI information of the Msg3 to the UE, whereas D1 uses a broadcast message. Therefore, the invention as claimed in new claim 1 is different from the teaching of D1. Thus, new claim 1 is novel over D1.

Turning to new independent claim 8, it defines that the TTI information is to be included in the Msg2. However, according to document D1, in particular its Fig. 3A, the TTI information is transmitted in step 301 which is performed before step 304, i.e. the TTI information in D1 is received before the transmission of Msg1. So, document D1 does not teach transmitting the TTI information of the Msg3 via the Msg2 as claimed in the presently filed new claim 8. Therefore, the teaching of pending claim 8 is different from that of D1.

Further, the TTI information in the new independent claim 8 includes not only a TTI duration of the Msg3 but also a start timing offset of the Msg3. The start timing offset of the Msg3 is also not disclosed or hinted in D1 and shows the new claim 8 is for solving different technical issues.

Accordingly, new claim 8 is also novel over D1.

New independent claim 15 relates to a corresponding user equipment and is thus also novel over D1.

In view of the above, the presently filed new independent claims are novel over D1.

6. Inventive step

An invention is considered to involve an inventive step in case a person of ordinary skill cannot arrive at the teaching of the claim in an obvious manner.

The analysis of the cited references reveals that this pre-condition is doubtlessly given as even a combination of the cited references is not able to render the teaching of the independent claims obvious.

In particular, since none of the cited prior art documents discloses the characterizing parts of the new independent claims, even a combination of these documents can also not render the new independent claims obvious.

Therefore, the presently filed new claims are not only novel, but also based on an inventive step.

7. Description / Formal requirements

In view of item 4 of the office action, the new independent claims are drafted in the two-part form, with those features known in combination from D1 being placed in the pre-characterizing part and the remaining features being included in the characterizing part.

In view of item 5 of the office action, the description of D1 on description page 1 is amended to express that D1 refers to the dynamic TTI selection for a random access procedure.

8. Requests

It is therefore respectfully requested to drop the objections against the patentability of the application, and to furnish an opportunity to adapt the specification if necessary.

In case of remaining necessity for minor amendments to the claims and/or description, it is respectfully requested to contact the applicant's representatives over the phone.

9. Oral proceedings (videoconference)

In case, however, the examining division should not agree to the patentability of the application, it is respectfully requested to issue an examination report in detail elucidating the reservations of the examining division. Auxiliary, it is requested to set a date for oral proceedings. If the oral proceedings are to be held in The Hague or Berlin, oral proceedings by **v i d e o c o n f e r e n c e** are requested.

Videoconference studio Information: IP technology: SIP / H.323; Software: Polycom Real Presence Desktop; Transmission speed: 1920 kbps; Studio-telephone: +49 (0) 89 64 24 47 - 0; Studio-fax: +49 (0) 89 64 24 47 - 11; Contact: signing attorney.

If the request for videoconference cannot be granted, conventional oral proceedings are requested.

Hoefer & Partner Patentanwälte mbB

Encl.:
New claims 1 to 15
New page 1
Markup version of new claims
Markup version of new page

Europäisches Patentamt
European Patent Office
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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17183827.9
Applicant's or representative's reference	ASU170707PEP

	Description of document	Original file name	Assigned file name
1	Amended description (clean copy)		DESCPAMD-1.pdf
2	Amended claims (clean copy)		CLMSPAMD-1.pdf
3	Amended description with annotations		DESC-HWA-1.pdf
4	Amended claims with annotations		CLMS-HWA-1.pdf
5	Letter relating to the search and examination procedure		EPLETT-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**München**
Date:	**11 December 2018**
Signed by:	**Ingo Goerz 19384**
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METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system, according to which the UE could select a TTI for use according to its own requirement based on the received cell broadcast message in a random access procedure.

New claims 1 to 15
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE receives a message from a network, wherein the message includes Transmission Time Interval, in the following also referred to as TTI, information of a Msg3 (1205; 1305; 1605; 1705);

the UE transmits a preamble to the network (1210; 1310; 1610; 1710);

the UE receives a Msg2 from the network for responding the preamble (1215; 1315; 1615; 1715); and

the UE performs a Msg3 transmission to the network according to the TTI information of the Msg3 (1220; 1320; 1620; 1720),

characterized in that

the message which includes the TTI information of the Msg3 is a dedicated message.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on PRACH resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the message.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the message.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the message.

5. The method of any one of claims 1 to 4, wherein the message is a downlink control signal.

6. The method of any one of claims 1 to 5, wherein the message is a RRC message.

7. The method of any one of claims 1 to 6, further comprising:

the UE selects the TTI information of the Msg3 based on a random access configuration of the preamble transmission, if there are multiple TTI information of the Msg3 in the message.

8. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405; 1505; 1805; 1905);

the UE receives a Msg2 from the network in response to the Preamble (1410; 1510; 1810; 1910); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415; 1515; 1815; 1915) ,

characterized in that

the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

9. The method of claim 8, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

10. The method of claim 8 or 9, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

11. The method of any one of claims 8 to 10, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

12. The method of any one of claims 8 to 11, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

13. The method of any one of claims 8 to 11, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

14. The method of any one of claims 1 to 7, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 transmission, and/or a start timing offset of the Msg3 transmission.

15. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

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An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system, according to which the UE could select a TTI for use according to its own requirement based on the received cell broadcast message in a random access procedure.

New claims 1 to 15
Markup version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE receives a message from a network, wherein the message includes ~~a~~ Transmission Time Interval, in the following also referred to as TTI, information of a Msg3 (1205; 1305; 1605; 1705);

the UE transmits a preamble to the network (1210; 1310; 1610; 1710);

the UE receives a Msg2 from the network for responding the preamble (1215; 1315; 1615; 1715); and

the UE performs a Msg3 transmission to the network according to the TTI information of the Msg3 (1220; 1320; 1620; 1720),

characterized in that

the message which includes the TTI information of the Msg3 is a dedicated message.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on PRACH resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the message.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the message.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the message.

5. The method of any one of claims 1 to 4, wherein the message is a downlink control signal.

6. The method of any one of claims 1 to 5, wherein the message is a RRC message.

7. The method of any one of claims 1 to 6, further comprising:

the UE selects the TTI information of the Msg3 based on a random access configuration of the preamble transmission, if there are multiple TTI information of the Msg3 in the message.

8. A method of a User Equipment, in the following also referred to as UE-, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405; 1505; 1805; 1905);

the UE receives a Msg2 from the network in response to the Preamble~~, wherein the Msg2 contains a Transmission Time Interval, in the following also referred to as TTI, information of Msg3~~ (1410; 1510; 1810; 1910); and

the UE performs a Msg3 transmission to the network according to ~~the~~ TTI information of the Msg3 (1415; 1515; 1815; 1915) ,

characterized in that

the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

9. The method of claim 8, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

10. The method of claim 8 or 9, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

11. The method of any one of claims 8 to 10, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

12. The method of any one of claims 8 to 11, wherein the TTI information of the Msg3 is included in a Random Access Response-, in the following also referred to as RAR, for responding the Preamble.

13. The method of any one of claims 8 to 11, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

14. The method of any one of claims 1 to ~~13~~7, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 transmission, and/or a start timing offset of the Msg3 transmission.

15. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

~~wherein~~ characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	6994963
Application number	EP17183827.9
Date of receipt	11 December 2018
Receiving Office	European Patent Office, The Hague
Your reference	ASU170707PEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (1 p.) CLMSPAMD-1.pdf (3 p.) CLMS-HWA-1.pdf (3 p.) ep-sfd-request.xml DESCPAMD-1.pdf (1 p.) DESC-HWA-1.pdf (1 p.) EPLETT-1.pdf (4 p.)
Submitted by	CN=Ingo Goerz 19384
Method of submission	Online
Date and time receipt generated	11 December 2018, 11:48 (CET)
Message Digest	4C:22:D8:79:FD:89:44:3A:55:90:CF:9A:CC:C9:61:E3:60:24:2D:06

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

/European Patent Office/

Samsung Exhibit 1008, Page 161 of 357
Samsung Electronics Co., Ltd. v. Asus Technology Licensing Inc.
IPR2024-01036

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Application No.	Ref.	Date
17 183 827.9 - 1215	ASU170707PEP	07.01.2020
Applicant ASUSTek Computer Inc.		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter

Andrés Muñoz, E
Primary Examiner
For the Examining Division

Enclosure(s): 7 page/s reasons (Form 2906)
XP051053364, XP050133313

Registered letter
EPO Form 2001 11.16TRI

The examination is being carried out on the **following application documents**

Description, Pages

2-32	as originally filed	
33	filed in electronic form on	13-04-2018
1	filed in electronic form on	11-12-2018

Claims, Numbers

1-15	filed in electronic form on	11-12-2018

Drawings, Sheets

1/19-19/19	as originally filed

The following documents are cited by the Examiner. A copy of the documents is annexed to the communication and the numbering will be adhered to in the rest of the procedure.

D6 NOKIA NETWORKS: "Basic system design for UL NB-IoT", 3GPP DRAFT; R1-160041, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Budapest, HU; 20160118 - 20160120 17 January 2016 (2016-01-17), XP051053364, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/ [retrieved on 2016-01-17]

D7 QUALCOMM EUROPE: "RACH procedure", 3GPP DRAFT; R2-070212, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. Sorrento, Italy; 20070112, 12 January 2007 (2007-01-12), XP050133313, [retrieved on 2007-01-12]

Patentability - Art. 52(1) EPC

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1 The subject-matter of claims 1 and 15 is not new within the meaning of Article 54(1) and (2) EPC, and the requirements of Article 52(1) EPC are therefore not met.

1.1 Regarding independent claim 1, document D6 discloses (the references in parentheses applying to this document):

A method of a User Equipment, in the following also referred to as UE, for performing random access procedure,

(implicit)

comprising:
the UE receives a message from a network, wherein the message includes Transmission Time Interval, in the following also referred to as TTI, information of a Msg3;

(section 2.1 Resource scheduling discloses that "the UL access can be configured in terms of [...] Length of the time allocation (e.g. varying TTI length) [...]"; said passage also discloses that "Also when considering the Random Access Response, it would seem necessary to enable network to select between the numerologies to be used in response (e.g.Msg#3 and forward) [...]")

the UE transmits a preamble to the network;

(implicit in the random access procedure disclosed in section 2.1 Resource scheduling)

the UE receives a Msg2 from the network for responding the preamble;

(section 2.1 Resource scheduling, "Random Access Response")

and
the UE performs a Msg3 transmission to the network according to the TTI information of the Msg3,

(section 2.1 Resource scheduling discloses that "the UL access can be configured in terms of [...] Length of the time allocation (e.g. varying TTI length) [...]"; said passage also discloses that "Also when considering the Random Access Response, it would seem necessary to enable network to select between the numerologies to be used in response (e.g.Msg#3 and forward) [...]")

~~characterized in that~~
the message which includes the TTI information of the Msg3 is a dedicated message.

(section 2.1 Resource scheduling discloses that "being able to configuring the numerology more dynamically (e.g. through DCI) seems preferable but configuration through broadcast needs also be supported")

1.2 The novelty objection above applies, mutatis mutandis, to the corresponding independent claim 15.

1.3 It needs to be mentioned that claims 1 and 15 are also non-inventive (Art. 56 EPC) over the combination of D1 and D6. The distinguishing feature of claim 1 over D1, i.e. "the message which includes the TTI information of the Msg3 is a dedicated message", produces the technical effect of adapting the configuration of the TTI information in a dynamic way. It solves the problem of how to adapt the configuration of the network in a dynamic way. Such problem is always present in the art, and a skilled person would always be prompted to solve it. But transmitting the configuration information in a dedicated message is just an obvious selection for the skilled person among available solutions. For example, D6 discloses that same subject-matter, as explained above.

2 Furthermore, the subject-matter of independent claims 8 and 15 does not involve an inventive step within the meaning of Article 56 EPC, and the requirements of Article 52(1) EPC are therefore not met.

2.1 D1 is considered to be the prior art closest to the subject-matter of claim 8 and discloses (the references in parentheses applying to this document):

A method of a User Equipment, in the following also referred to as UE, for performing random access procedure,

(figure 3B)

comprising:
the UE transmits a Preamble to a network;

(paragraph [0049], line 1- line 2, and line 6 - line 11)

the UE receives a Msg2 from the network in response to the Preamble;

(paragraph [0051], line 4 - line 12)

and
the UE performs a Msg3 transmission to the network according to TTI information of the Msg3,

(paragraph [0053] – paragraph [0054])

~~characterized in that~~
the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3

(paragraph [0051], line 4 – line 12; paragraph [0052], line 2 – line 3; the second step message or Msg2 in a random access procedure can take many forms; for example a resource allocation. Please note that the UE selection of TTI can be denied by the Node B, see paragraph [0056], line 1 – line 2, which implies that at this step 2 of the random procedure, the UE receives information about the TTI for the step 3 of the random procedure, in spite of the initial selection by the UE)

~~and a start timing offset of the Msg3.~~

2.1.1 The subject-matter of claim 8 therefore differs from this known method in D1 in that the TTI information of the Msg3 contained in the Msg2 includes a start timing offset of the Msg3.

2.1.2 The technical effect provided by that difference is to adapt the point in time when msg3 should be transmitted to the distance to the base station.

2.1.3 The objective technical problem to be solved by the present invention may therefore be regarded as how to implement a correct timing advance in a random access procedure..

2.1.4 Said problem is a known one in the art, and a skilled person would always be faced with such problem. The known solution to that problem is to send a timing advance indication (i.e. a timing offset) in the msg2 of the random access procedure. As an example, document D7 (which is related to RA procedure in a network with short TTI, see section 2.3 Message 3, which discloses that "the size is dynamic due to the short TTI") discloses that same subject-matter, see section 2.2 Message 2, "The purpose of Message 2 is to at least: [...] Conveys ***timing adjustment*** in order to prevent un-synchronized transmission over ULSCH".

2.1.5 The person skilled in the art would therefore wish to combine the subject-matter of D1 and, for example, D7, and, in doing so, would arrive at the subject-matter of claim 8 of the application without having made an inventive step as defined in Articles 52(1) and 56 EPC.

2.2 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 15, which therefore are also considered not inventive (Articles 52(1) and 56 EPC).

3 The applicant's arguments have been considered.

3.1 A first argument is that D1 does not disclose the feature of "the message which includes the TTI information of the Msg3 is a dedicated message".

3.1.1 This argument is acknowledged. However, claim 1 is not new over D6. And claim 1 is also not inventive over the combination of D1 and D6. It has to be noted that the applicant has not provided with an inventive step argumentation based on the problem and solution approach (Guidelines, G-VII, 2.5).

3.2 Another argument is that D1 does not disclose that the TTI information is include in the Msg2.

3.2.1 This argument cannot be be agreed. D1 discloses that the UE selection of TTI can be denied by the Node B (see paragraph [0056], line 1 - line 2), which implies that at this step 2 of the random procedure, the UE receives information about the TTI for the step 3 of the random procedure, in spite of the initial selection by the UE.

3.3 Another argument is that D1 does not disclose a start timing offset of the Msg3.

3.3.1 This argument is acknowledged. However, such start timing offset is a known solution to a common problem in the art, as explained above, and does not involve an inventive step. Please note, in addition, that the applicant has not provided with an inventive step argumentation based on the problem and solution approach (Guidelines, G-VII, 2.5).

Further objections

4 It appears that part of the subject-matter of the description and/or drawings is not covered by the claims. However, the retention of these examples might be allowed if they are presented not as embodiments of the invention but as background art or examples useful for understanding the invention (Guidelines F-IV, 4.3iii).

5 The description fails to disclose the claimed invention as requested by Rule 42(1)(c) EPC. The Summary section at page 2 does not correspond to the present claim set.

6 Independent claims 1 and 8 are not in the two-part form in accordance with Rule 43(1) EPC. The characterizing part of claim 1 and part of the characterizing part of claim 8 belong to the preamble.

7 To meet the requirements of Rule 42(1)(b) EPC, D6 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.

Amendments - Art. 123(2) EPC

8 The amendments filed on 11-12-2018 comply with the requirements of Art. 123(2) EPC.

8.1 Thus, the amendment to claim 1 is supported, for example, by figure 12, step 1205 ("The UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or [...]").

8.2 Besides, the amendment to claim 8 is supported by originally filed claim 14, which has been accordingly amended to refer now only to claim 1 and its dependent claims.

Clarity - Art. 84 EPC

9 The clarity objection (Art. 84 EPC) in the communication dated 15-08-2018 has been rendered moot by the applicant's amendments.

Procedure

10 The applicant is invited to file new claims which take account of the above comments.

10.1 The applicant is requested to bring the description into conformity with the amended claims; care should be taken during revision, especially of the introductory portion including any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

10.2 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made, irrespective of whether they concern amendments by addition, replacement or deletion, and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1).

10.3 The attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC).

10.4 In order to accelerate the examination procedure, it would be appreciated if the applicant provided with an argumentation based in the problem and solution approach, as defined in the Guidelines, G-VII, 2.5.

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Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-60/LX	May 13, 2020

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In Response to the Office Action of January 7, 2020:

1. New documents

- New claims 1 to 7
- New description pages 1 to 3 and 27 to 29

The new documents are to replace, at least for the present, the respective documents currently pending. The remaining documents are presently maintained unchanged. The applicant preserves his right to file divisional applications for the subject matter of the original application.

2. Original disclosure of the new claims

New claims 1 to 7 correspond to claims 8 to 13 and 15 as filed on December 11, 2018, respectively.

3. Novelty

As the novelty of the presently filed new claims (i.e. independent claim 8 and its dependent claims as filed on December 11, 2018) has not been objected to, specific explanations with respect to this issue are presently not necessary.

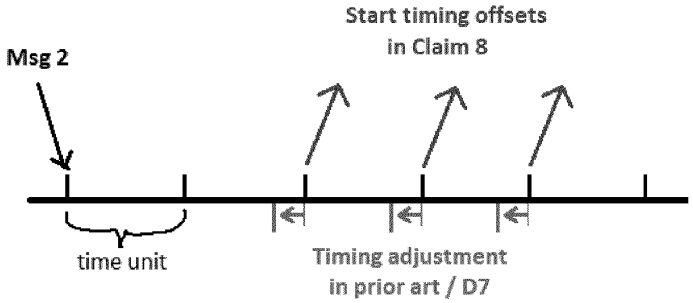
4. Inventive step

An invention is considered to involve an inventive step in case a person of ordinary skill cannot arrive at the teaching of the claim in an obvious manner.

The analysis of the cited references reveals that this pre-condition is doubtlessly given as even a combination of the cited references is not able to render the teaching of the independent claims obvious.

In particular, it is acknowledged in the referenced office action that claim 8 as filed on December 11, 2018 (i.e. the presently filed new claim 1) differs from the teaching of D1 in that the TTI information of the Msg3 contained in the Msg2 includes a start timing offset of the Msg3. However, the office action further indicates that this differing feature is known from D7 and said claim is thus not inventive over D1 in combination with D7. Insofar, the applicant does not agree to this view. The reasons are:

Section 2.2 of D7 indeed mentions sending a **timing adjustment** for the UL-SCH transmission in the Msg2. However, said "**timing adjustment**" of D7 cannot be deemed the same as the "**start timing offset**" as claimed in the presently filed new claim 1 of the present application. The reason is that the "start timing offset" of the invention is used for the UE to know at which time unit (e.g. slot, symbol, etc.) the Msg3 should be started to send, whereas the "timing adjustment" mentioned in section 2.2 of D7 is used for the UE to know how much small/tiny adjustment at a specific known time unit should be done for sending the Msg3. Below is an illustration for showing the difference between the two terms:



As shown in the above figure, the "start timing offset" as claimed in the invention is different from the "timing adjustment" as disclosed in section 2.2 of D7. Thus, from the teaching of D7 in respect to conveying a "timing adjustment" in the Msg2, the teaching of the invention in respect to including a "start timing offset" of the Msg3 in the Msg2 as claimed in the charactering part of the presently filed new claim 1 cannot unambiguously and doubtlessly be derived. Therefore, D7 is silent on the acknowledged differing feature of the invention as mentioned above.

In view of the above, the presently filed new claim 1 cannot be rendered obvious by D1 in combination with D7.

Moreover, actually, besides the above differing feature as acknowledged by the examiner in the office action, D1 does also not disclose containing a TTI duration of the Msg3 in the Msg2 as claimed in the characterizing part of the presently filed new claim 1.

In item 2.1 of the office action, the examiner argues that paragraph [0056] of D1 discloses that the UE selection of TTI can be denied by the Node B, which is considered to imply that at step 2 of the random procedure, the UE receives information about the TTI for step 3 of the random procedure in spite of the initial selection of the UE. Insofar, the applicant does not agree to this view. It is respectfully to be noted that first, paragraph [0056] of D1 only mentions that "a UE selecting the 2ms TTI" (i.e. the UE which selects the 2ms TTI) may be denied, but not the UE selection of TTI may be denied. Further, according to the last sentence of paragraph [0056] and the description in paragraphs [0057]-[0063] of D1, it is clear for the skilled person that if the above-said denial happens, according to the teaching of D1, a dynamic adjustment of resource subsets as described in paragraph [0060] of D1, but not a change/new selection of the TTI for the UE will be performed. Therefore, D1 does not teach or suggest that the Node B should deny or neglect the initial TTI selection of the UE. Thus, D1 does not imply that the UE needs to receive information about a (new) TTI via the Msg2.

Accordingly, D1 does not disclose containing a TTI duration of the Msg3 in the Msg2 as claimed in the characterizing part of the presently filed new claim 1.

As stated above, since D1 does not teach or suggest that the Node B should deny or neglect the initial TTI selection of the UE, nothing can prompt the skilled person to consider transmitting a new TTI duration to the UE via the Msg2 instead of the initial TTI selection of the UE so as to obtain the feature of the invention.

Further, said second differing feature is neither known from the other cited prior art documents nor common knowledge in the art. Thus, the presently filed new claim 1 cannot be rendered obvious by the cited prior art documents.

Therefore, the presently filed new claims are based on an inventive step.

5. Description / Formal requirements

In view of items 4 and 5 of the office action, the description is brought into conformity with the new claims.

Referring to item 6 of the office action, new claim 1 is drafted into the two-part form for a delimitation against the closest prior art document D1.

In view of item 7 of the office action, D6 is identified and briefly discussed on the presently filed new description page 1.

6. Requests

It is therefore respectfully requested to drop the objections against the patentability of the application, and to furnish an opportunity to adapt the specification if necessary.

In case of remaining necessity for minor amendments to the claims and/or description, it is respectfully requested to contact the applicant's representatives over the phone.

7. Oral proceedings (videoconference)

In case, however, the examining division should not agree to the patentability of the application, it is respectfully requested to issue an examination report in detail elucidating the reservations of the examining division. Auxiliary, it is requested to set a date for oral proceedings. If the oral proceedings are to be held in The Hague or Berlin, oral proceedings by **v i d e o c o n f e r e n c e** are requested.

Videoconference studio information:
IP technology: SIP / H.323;
Software: Polycom Real Presence Desktop; transmission speed: 1920 kbps;
Studio telephone: +49 (0) 89 64 24 47 - 0; Studio fax: +49 (0) 89 64 24 47 - 11;
E-mail: info@hoefer-pat.de;
Contact: signing attorney.

Please send communications containing information on the organisation of the videoconference to info@hoefer-pat.de.

If the request for videoconference cannot be granted, conventional oral proceedings are requested.

Hoefer & Partner Patentanwälte mbB

Encl.:
New claims 1 to 7
New pages 1 to 3 and 27 to 29
Markup version of new claims
Markup version of new page

Europäisches Patentamt
European Patent Office
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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17183827.9
Applicant's or representative's reference	ASU170707PEP

	Description of document	Original file name	Assigned file name
1	Amended description with annotations	DESC-HWA-2.pdf	DESC-HWA-2.pdf
2	Amended claims (clean copy)	CLMSPAMD-2.pdf	CLMSPAMD-2.pdf
3	Amended claims with annotations	CLMS-HWA-2.pdf	CLMS-HWA-2.pdf
4	Amended description (clean copy)	DESCPAMD-2.pdf	DESCPAMD-2.pdf
5	Letter relating to the search and examination procedure	EPLETT-2.pdf	EPLETT-2.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**München**
Date:	**13 May 2020**
Signed by:	**Ingo Goerz 19384**
Association:	**Hoefer & Partner Patentanwälte mbB**
Representative name:	**Ingo Görz**
Capacity:	**(Representative)**

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system, according to which the UE could select a TTI for use according to its own requirement based on the received cell broadcast message in a random access procedure.

3GPP document R1-160041 discloses the UL design for NB-IOT.

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SUMMARY

A method and apparatus, from the perspective of the UE, for performing random access procedure are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. The method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagram of a wireless communication system according to one exemplary embodiment.

FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE) according to one exemplary embodiment.

FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

FIG. 5 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0.

FIG. 6 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300 v13.2.0.

FIG. 7 is a diagram according to one exemplary embodiment.

FIG. 8 is a diagram according to one exemplary embodiment.

FIG. 9 is a diagram according to one exemplary embodiment.

FIG. 10 is a diagram according to one exemplary embodiment.

FIG. 11 is a diagram according to one exemplary embodiment.

FIG. 12 is a flow chart according to the related art.

FIG. 13 is a flow chart according to the related art.

FIG. 14 is a flow chart according to one exemplary embodiment.

FIG. 15 is a flow chart according to the related art.

FIG. 16 is a flow chart according to the related art.

FIG. 17 is a flow chart according to the related art.

FIG. 18 is a flow chart according to one exemplary embodiment.

FIG. 19 is a flow chart according to one exemplary embodiment.

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can apply the same or different solutions. The Msg3 start timing offset can be indicated in TTI duration, numerology, symbol, slot, microsecond, millisecond or N times of periodicity of periodic behavior. N value can be integer or decimal.

FIG. 12 is a flow chart 1200 according to the related art from the perspective of a UE. In step 1205, the UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission. In step 1210, the UE transmits a Msg1 to the network. In step 1215, the UE receives a Msg2 from the network in response to the Msg1. In step 1220, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 13 is a flow chart 1300 according to the related art from the perspective of a UE. In step 1305, the UE receives a broadcast message from a network to set TTI duration of Msg3. In step 1310, the UE transmits a Msg1 to the network. In step 1315, the UE receives a Msg2 from the network in response to the Msg1. In step 1320, the UE transmits a Msg3 to the network according to the TTI duration of Msg3.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set TTI duration of Msg3, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration of Msg3. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 14 is a flow chart 1400 according to one exemplary embodiment from the perspective of a UE. In step 1405, the UE transmits a Msg1 to a network. In step 1410, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration

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of Msg3 transmission and/or a start timing offset of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. Preferably, the start timing offset of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the start timing offset of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1415, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 15 is a flow chart 1500 according to the related art from the perspective of a UE. In step 1505, the UE transmits a Msg1 to a network. In step 1510, the UE receives a Msg2 from the network in response to the Msg1. In step 1515, the UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, and (iii) to transmit a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 16 is a flow chart 1600 according to the related art from the perspective of a UE. In step 1605, the UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission. In step 1610, the UE transmits a Msg1 to the network. In step 1615, the UE receives a Msg2 from the network in response to the Msg1. In step 1620, the

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UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 17 is a flow chart 1700 according to the related art from the perspective of a UE. In step 1705, the UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission. In step 1710, the UE transmits a Msg1 to the network. In step 1715, the UE receives a Msg2 from the network in response to the Msg1. In step 1720, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 18 is a flow chart 1800 according to one exemplary embodiment from the perspective of a UE. In step 1805, the UE transmits a Msg1 to the network. In step 1810, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission. In step 1815, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to the network, (iii) to receive a

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New claims 1 to 7
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405; 1505; 1805; 1905);

the UE receives a Msg2 from the network in response to the Preamble (1410; 1510; 1810; 1910); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415; 1515; 1815; 1915) ,

characterized in that

the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

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7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system, according to which the UE could select a TTI for use according to its own requirement based on the received cell broadcast message in a random access procedure.

3GPP document R1-160041 discloses the UL design for NB-IOT.

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SUMMARY

A method and apparatus, from the perspective of the UE, for performing random access procedure are disclosed ~~are disclosed~~ and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. ~~Preferably, the method includes the UE receiving a message from a network. The message includes a TTI information of Msg3. In addition,~~ Tthe method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagram of a wireless communication system according to one exemplary embodiment.

FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE) according to one exemplary embodiment.

FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

FIG. 5 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0.

FIG. 6 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300 v13.2.0.

FIG. 7 is a diagram according to one exemplary embodiment.

FIG. 8 is a diagram according to one exemplary embodiment.

FIG. 9 is a diagram according to one exemplary embodiment.

FIG. 10 is a diagram according to one exemplary embodiment.

FIG. 11 is a diagram according to one exemplary embodiment.

FIG. 12 is a flow chart according to the ~~one exemplary embodiment~~related art.

FIG. 13 is a flow chart according to the ~~one exemplary embodiment~~related art.

FIG. 14 is a flow chart according to one exemplary embodiment.

FIG. 15 is a flow chart according to the ~~one exemplary embodiment~~related art.

FIG. 16 is a flow chart according to the ~~one exemplary embodiment~~related art.

FIG. 17 is a flow chart according to the ~~one exemplary embodiment~~related art.

FIG. 18 is a flow chart according to one exemplary embodiment.

FIG. 19 is a flow chart according to one exemplary embodiment.

can apply the same or different solutions. The Msg3 start timing offset can be indicated in TTI duration, numerology, symbol, slot, microsecond, millisecond or N times of periodicity of periodic behavior. N value can be integer or decimal.

FIG. 12 is a flow chart 1200 according to the ~~one exemplary embodiment~~related art from the perspective of a UE. In step 1205, the UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission. In step 1210, the UE transmits a Msg1 to the network. In step 1215, the UE receives a Msg2 from the network in response to the Msg1. In step 1220, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in the ~~one exemplary embodiment~~related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 13 is a flow chart 1300 according to the ~~one exemplary embodiment~~related art from the perspective of a UE. In step 1305, the UE receives a broadcast message from a network to set TTI duration of Msg3. In step 1310, the UE transmits a Msg1 to the network. In step 1315, the UE receives a Msg2 from the network in response to the Msg1. In step 1320, the UE transmits a Msg3 to the network according to the TTI duration of Msg3.

Referring back to FIGS. 3 and 4, in the ~~one exemplary embodiment~~related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set TTI duration of Msg3, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration of Msg3. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 14 is a flow chart 1400 according to one exemplary embodiment from the perspective of a UE. In step 1405, the UE transmits a Msg1 to a network. In step 1410, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration

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of Msg3 transmission and/or a start timing offset of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. Preferably, the start timing offset of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the start timing offset of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1415, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 15 is a flow chart 1500 according to the ~~one exemplary embodiment~~related art from the perspective of a UE. In step 1505, the UE transmits a Msg1 to a network. In step 1510, the UE receives a Msg2 from the network in response to the Msg1. In step 1515, the UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2.

Referring back to FIGS. 3 and 4, in the ~~one exemplary embodiment~~related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, and (iii) to transmit a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 16 is a flow chart 1600 according to the ~~one exemplary embodiment~~related art from the perspective of a UE. In step 1605, the UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission. In step 1610, the UE transmits a Msg1 to the network. In step 1615, the UE receives a Msg2 from the network in response to the Msg1. In step 1620, the

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UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the ~~one exemplary embodiment~~related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 17 is a flow chart 1700 according to the ~~one exemplary embodiment~~related art from the perspective of a UE. In step 1705, the UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission. In step 1710, the UE transmits a Msg1 to the network. In step 1715, the UE receives a Msg2 from the network in response to the Msg1. In step 1720, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the ~~one exemplary embodiment~~related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 18 is a flow chart 1800 according to one exemplary embodiment from the perspective of a UE. In step 1805, the UE transmits a Msg1 to the network. In step 1810, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission. In step 1815, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to the network, (iii) to receive a

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New claims 1 to 7
Markup version

~~1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:~~

~~the UE receives a message from a network, wherein the message includes Transmission Time Interval, in the following also referred to as TTI, information of a Msg3 (1205; 1305; 1605; 1705);~~

~~the UE transmits a preamble to the network (1210; 1310; 1610; 1710);~~

~~the UE receives a Msg2 from the network for responding the preamble (1215; 1315; 1615; 1715); and~~

~~the UE performs a Msg3 transmission to the network according to the TTI information of the Msg3 (1220; 1320; 1620; 1720),~~

~~characterized in that~~

~~the message which includes the TTI information of the Msg3 is a dedicated message.~~

~~2. The method of claim 1, further comprising:~~

~~the UE selects the TTI information of the Msg3 based on PRACH resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the message.~~

~~3. The method of claim 1 or 2, further comprising:~~

~~the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the message.~~

~~4. The method of any one of claims 1 to 3, further comprising:~~

~~the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the message.~~

~~5. The method of any one of claims 1 to 4, wherein the message is a downlink control signal.~~

~~6. The method of any one of claims 1 to 5, wherein the message is a RRC message.~~

~~7. The method of any one of claims 1 to 6, further comprising:~~

~~the UE selects the TTI information of the Msg3 based on a random access configuration of the preamble transmission, if there are multiple TTI information of the Msg3 in the message.~~

~~8~~1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405; 1505; 1805; 1905);

the UE receives a Msg2 from the network in response to the Preamble (1410; 1510; 1810; 1910); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415; 1515; 1815; 1915) ,

characterized in that

the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 and a start timing offset of the Msg3.

~~9~~2. The method of claim ~~8~~1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

~~10~~3. The method of claim ~~8~~ 1 or ~~9~~2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

~~11~~4. The method of any one of claims ~~8~~ 1 to ~~10~~3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

~~12~~5. The method of any one of claims ~~8~~-1 to ~~11~~4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

~~13~~6. The method of any one of claims ~~8~~-1 to ~~11~~4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

~~14. The method of any one of claims 1 to 7, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3 transmission, and/or a start timing offset of the Msg3 transmission.~~

~~15~~7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

New claims 1 to 7
Markup version

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	8620168
Application number	EP17183827.9
Date of receipt	13 May 2020
Receiving Office	European Patent Office, The Hague
Your reference	ASU170707PEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (1 p.) CLMSPAMD-2.pdf\CLMSPAMD-2.pdf (2 p.) DESCPAMD-2.pdf\DESCPAMD-2.pdf (6 p.) ep-sfd-request.xml DESC-HWA-2.pdf\DESC-HWA-2.pdf (6 p.) CLMS-HWA-2.pdf\CLMS-HWA-2.pdf (3 p.) EPLETT-2.pdf\EPLETT-2.pdf (4 p.)
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Correction by the EPO of errors in debit instructions filed by eOLF

Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82, OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

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Application No. : 17 183 827.9

Consultation by telephone with the applicant / representative

Despatch with a time limit of 4 month(s)

Participants

Applicant:	ASUSTek Computer Inc.
Representative:	Xiaolu Li, Hoefer & Partner Patentanwälte mbB
Member(s) of the Examining Division:	Andrés Muñoz, E

Result of consultation

See Separate Sheet

16.09.2020
. . . . . .
Date

Andrés Muñoz, E
. . . . . .
Examiner

Enclosure(s):
EP17183827.9_new_claims (Clean version) - applicant's proposal (two pages)
EP17183827.9_new_claims (Markup version) - applicant's proposal (two pages)

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Application No.	Ref.	Date
17 183 827.9 - 1215	ASU170707PEP	25.09.2020
Applicant ASUSTek Computer Inc.		

Communication pursuant to Article 94(3) EPC

Examination of the above application has revealed that, for the reasons enclosed herewith which - at least partly - reflect the result of consultation by telephone on 16.09.2020 , it does not meet the requirements of the European Patent Convention. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to remedy the indicated deficiencies within a period

of 4 months

from notification of this invitation.

The time limit is calculated in accordance with the provisions of Rule 126(2), 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

Failure to reply to this invitation in due time will result in the European application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter

Andrés Muñoz, E
For the Examining Division

Enclosure(s): Copy of result of consultation (Form 2036)
EP17183827.9_new_claims (Clean version) - applicant's proposal (two pages)
EP17183827.9_new_claims (Markup version) - applicant's proposal (two pages)
XP051123185

Registered letter
EPO Form 2049B 11.17 TRI

Minutes of an e-mail discussion

From: Enrique Andrés Muñoz
Sent: 01 September 2020 10:40
To: Patentanwaelte Hoefer & Partner
Subject: Suggestion of amendments for application EP17183827.9 (your reference number ASU170707PEP-60/LX)

Dear all,

I would like to suggest amendments to the claims on file of application EP17183827.9 (your reference number ASU170707PEP-60/LX). Could you please forward this e-mail to the patent attorney in charge of this application?

First, I would like to discuss the applicant's arguments (points 1 and 2 below). Then, I would like to suggest amendments to overcome the standing objections (point 3 below):

The applicant's arguments and amendments filed on 13-05-2020 have been considered. However, they fail to put the application in order for grant of a European Patent.

1) The applicant argues that the "timing adjustment" disclosed in D7 is used for the UE to know how much small/tiny adjustment at a specific known time unit should be done for sending the Msg3, while the "start timing offset" of the invention is used for the UE to know at which time unit (e.g. slot, symbol, etc.) the Msg3 should be started to send.

But this argument cannot be agreed. Indeed, the "timing adjustment" disclosed in D7 relates to the timing advance parameter for the Msg3 which is transmitted in the RAR MAC format. This feature is common knowledge in the art as it is part of the 3GPP Technical Specification. TS 36.321 V13.2.0 on page 72, section 6.1.5, table 6.1.5-3, displays a MAC RAR format containing an UL Grant for a Msg3, in which a Timing Advance Command is also included. However, claim 1 on file just discloses "a start timing offset of the Msg3". This is a broad statement which also comprises the tiny adjustment of a timing advance command.

Nevertheless, a narrower disclosure of a UL delay field for the Msg3 in the RAR in a random access procedure is also common knowledge in the art, as it is part of the 3GPP Technical Specification. TS36.213 V13.2.0 on page 46, section 6.1.1, displays a UL delay field for a response to the transmitted preamble sequence (i.e. RAR) which determines whether transmitting the UL-SCH transport block (i.e. Msg3) in the first subframe $n+k_1$, $k_1>=6$, wherein $n+k_1$ is the first available UL subframe for UL transmission, or on the next available UL subframe after $n+k_1$.

In consequence, and starting from the disclosure of D1, the skilled person would not require an inventive step (Art. 56 EPC) to arrive of the disclosure of claim 1, because the distinguishing feature is part of the common knowledge in the art, as it is specified in TS36.213 V13.2.0.

2) Another applicant's argument is that D1 does not disclose that the Msg2 contains a TTI duration of the Msg3.

This argument cannot be agreed either. Paragraph [0050] - paragraph [0051] discloses that "[...] when allocating a resource, the Node B considers the TTI selected by the UE [...]" and that "[...] if the indication message of the UE indicates that the 2 ms TTI length is selected, the Node B selects a common E-DCH resource to be allocated to the UE from the resource subset with indexes of 0-15. If the indication message of the UE indicates that the 10 ms TTI length is selected, the Node B selects a common E-DCH resource to be allocated to the UE from the resource subset with indixes of 16-31". That is to say, D1 discloses an implicit TTI information of the Msg3 by the selection of a particular resource for the Msg3 transmission. Please note that the present disclosure of claim 1 comprises also the possibility of the UE selecting a TTI duration, and the network node confirming said information in the Msg2.

But even if the applicant would amend claim 1 to disclose that the network node decides the TTI duration of the Msg3 (assuming that said feature is disclosed in the original application), the subject-matter of D1 would still be comprised in claim 1. Thus, paragraph [0056] discloses that "when the UE notifies the Node B of the selected TTI, the selection may be denied [...]". That is to say, the selection may be denied, and not the "UE selection of the TTI" may be denied as argued by the applicant. That the selection of the TTI may be denied clearly implies, in combination with paragraph [0050] - paragraph [0051], that the Node B would select a common E-DCH resource corresponding to the other TTI.

The applicant further argues that the disclosure of paragraph [0056] - paragraph [0063] shows that if the denial happens, a dynamic adjustment of resource subsets take place. This is acknowledged, but that does not imply that the random access procedure is terminated without assigning resources for the Msg3. Rather, the disclosure of paragraph [0050] - paragraph [0056] would imply that the Node B simply signal a resource associated to a TTI different of the one selected by the UE.

3) The applicant is suggested to amend claim 1 as follows:

A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:
the UE transmits a Preamble to a network (1405~~; 1505; 1805; 1905~~);
the UE receives a Msg2 from the network in response to the Preamble (1410~~; 1510;~~

~~1810; 1910~~); and
the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415~~; 1515; 1815; 1915~~),

~~characterized in that~~
the TTI information of the Msg3 is contained in the Msg2,

~~wherein~~ characterized in that

the TTI information of the Msg3 includes a TTI duration of the Msg3 and a ~~start timing offset of the Msg3~~ minimum gap period between Msg2 reception and Msg3 transmission;

wherein the TTI duration of the Msg3 is set to a short TTI, and the minimum gap period is set to the short TTI.

This amendment is supported by the original description on page 20, line 13 - line 19.

The distinguishing feature is not disclosed in the cited prior art.

Said distinguishing feature would have the technical effect of reducing the gap between the Msg2 reception and the Msg3 transmission, which in the legacy 3GPP technical specification is fixed to at least $n+k_1$, $k_1>=6$ (i.e. several milliseconds). The objective technical problem could be expressed as how to reduce the latency in the random access procedure.

If the applicant agreed with the suggested amendment, the representative and this examiner could hold a telephone conference to discuss further steps. This examiner could perform himself the required amendments on the claims and description on file, if the applicant permits it.

Best regards,

Enrique Andrés Muñoz

From: Patentanwaelte Hoefer & Partner <info@hoefer-pat.de>
Sent: 08 September 2020 00:13
To: Enrique Andrés Muñoz <eandresmunoz@epo.org>
Subject: AW: Suggestion of amendments for application EP17183827.9 (your reference number ASU170707PEP-60/LX)

Dear Mr. Andrés Muñoz:

Thank you for your email of September 1, 2020, which provides your suggestion for claim amendments. The applicant's reply is given below .

First, the applicant truly appreciates your appraisement and suggestion as stated in your email. The applicant accepts part of the suggested amendments. However, the applicant disagrees with the last two features of claim 1 about setting the TTI duration as well as the gap period to the “short TTI”, and instead, the applicant wishes to add two other features for better reflecting the inventive concept of the invention as explained below in detail. Accordingly, the applicant wants to amend claim 1 as follows:

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

   the UE transmits a Preamble to a network (1405~~; 1505; 1805; 1905~~);

   the UE receives a Msg2 from the network in response to the Preamble (1410~~; 1510; 1810; 1910~~); and

   the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415~~; 1515; 1815; 1915~~) ,

   ~~characterized in that~~ wherein

   the TTI information of the Msg3 is contained in the Msg2,

   ~~wherein~~ characterized in that

   the TTI information of the Msg3 includes a TTI duration of the Msg3 and a ~~start timing offset of the Msg3~~ gap period between Msg2 reception and Msg3 transmission,

   wherein the TTI duration of the Msg3 is a first number of time units which are used to send the Msg3, and the gap period is a second number of time units.

Attached please also find a complete set of new claims as well as the markup version of the new claims.

The amendments made in above claim 1 are supported by page 20, lines 13-15 of the description as originally filed in combination with common knowledge in the art.

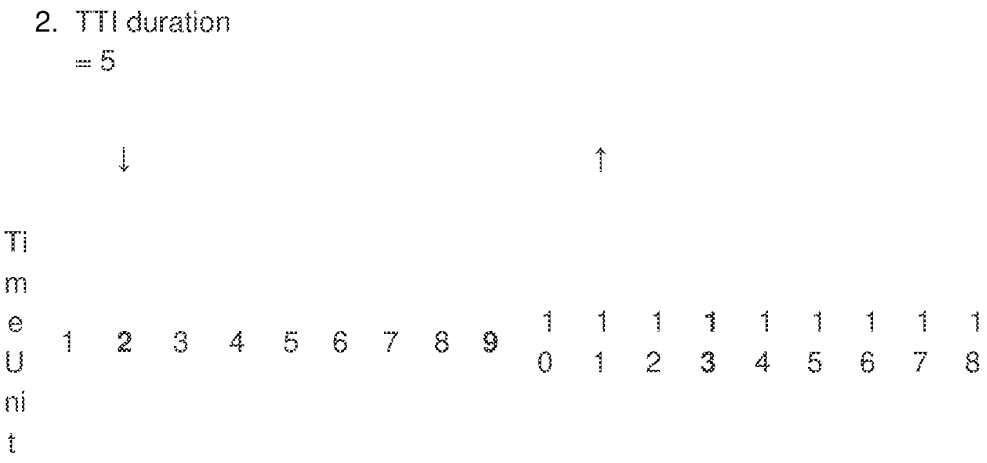
Generally, the inventive concept of the present invention is explicitly including the TTI duration of the Msg3, which is a first number of time units, and the gap period between Msg2 reception and Msg3 transmission, which is a second number of time units, in the Msg2. One example of the concept is illustrated as below:

Msg2

carries

1. Start timing offset = 7

Msg 3



In the above example, the UE receives the Msg2 at time unit 2 and the Msg2 carries TTI information of sending Msg3 (i.e. start timing offset = 7 and duration = 5). Based on the received TTI information, the UE starts sending the Msg3 at time unit 9 (i.e. 2+**7**) and ends at time unit 13 (i.e. 9, 10, 11, 12, 13 à **5** time units).

According to the invention, since the TTI duration of the Msg3 and the gap period between Msg2 reception and Msg3 transmission, which are two numbers of time units, are carried in the Msg2, which is received by UE from network, it's not proper and also not necessary for UE to "set" these two information.

It is the applicant's belief that the above new claim 1 is not disclosed in any of the cited prior art documents.

In particular, regarding point 1) in your previous email, first, the applicant agrees with the view stated in the first and second paragraphs of point 1). Thus, the applicant agrees to amend the term "a start timing offset of the Msg3" to "a gap period between Msg2 reception and Msg3 transmission". By this amendment, the teaching of the invention is clearly restricted from the teaching of D7 (i.e. the "timing adjustment" disclosed in D7).

Moreover, regarding the teaching in the 3GPP Technical Specification TS36.213 V13.2.0 as stated in the third paragraph of point 1), it is the applicant's understanding that according to the teaching of TS36.213 V13.2.0, the start timing of sending a Msg3 is dynamic after the "UL delay" since it may be "the first available UL subframe" or "the next available UL subframe" as quoted by the examiner. However, according to the above new claim 1, the start timing of sending the Msg3 is fixed based on the TTI information carried in the Msg2. For example, if the Msg2 is sent at time unit N and the Msg2 carries information of "start timing offset=20" for sending the Msg3, the Msg3

would be exactly sent at time unit N+20, which means that it's not allowed to send the Msg3 at time unit N+21, 23, 30, etc. Therefore, the above new claim 1 is different from the teaching of TS36.213 V13.2.0.

Therefore, none of the cited prior art documents teaches including the gap period between Msg2 reception and Msg3 transmission, which is a number of time units, in the Msg2 as claimed in the above-stated new claim 1.

Regarding point 2) in your previous email, it is respectfully to be noted that according to the wording of new claim 1, the TTI duration of the Msg3, which is a number of time units, is explicitly included in the Msg2 together with the starting timing offset of sending the Msg3. In contrast, D1 does not disclose that the TTI duration of the Msg3 per se (i.e. a number of time units) is included in the Msg2 and transmitted to the UE.

According to the teaching of D1, there are only two TTI lengths (i.e. 2 ms and 10 ms) for selection, i.e. the selection of the TTI lengths is restricted to a certain number of TTI lengths. However, according to the invention, the selection of the TTI duration of the Msg3 (i.e. the number of time units used for sending the Msg3) is not restricted.

Further, according to the teaching of D1, the UE must know the two candidate TTIs as well as the mapping between each TTI and each resource subset in advance and then it is possible for the UE to understand, via an information about the selected E-DCH resource received from the Node B, that a TTI different from the one selected by the UE should be used. In contrast, according to the invention, the UE does not need to know candidate TTIs or other related information in advance. The UE can know the TTI duration of the Msg3 directly from the received Msg2 alone.

Therefore, D1 does not disclose or suggest explicitly including the TTI duration of the Msg3, which is a number of time units, together with the gap period for sending the Msg3 in the Msg2 as claimed in the above new claim 1.

Based on the above, it is the applicant's belief that the patentability of the above-stated new claim 1 is given.

In case, however, the examiner should not agree to the patentability of the application, it is respectfully asked to give the applicant a further opportunity to comment on the examiner's opinion and/or make amendments.

Best regards,

Xiaolu Li

European Patent Attorney

Encls.:

Clean version of new claims 1 to 7

Markup version of new claims

From: Enrique Andrés Muñoz
Sent: 16 September 2020 10:00
To: Patentanwaelte Hoefer & Partner
Subject: Suggestion of amendments for application EP17183827.9 (your reference number ASU170707PEP-60/LX)

Dear Ms. Li,

Thank you very much for you detailed response. I apologize for taking so long to reply to your e-mail.

I fear that my position and that of the applicant are still far away. I have several objections to the applicant's proposal as contained in your e-mail dated 08-09-2020. In consequence, I consider that we should continue this procedure in writing.

I will issue a communication under Art. 94(3) EPC in the form of minutes of meeting, and with a standard time limit of four months. In said communication, I will paste the below e-mail exchange, and I will further comment the proposal for amendments in your e-mail dated 08-09-2020, as well as my objections to it. However, it must be noted the claim set that you attached to your e-mail dated 08-09-2020 has not been incorporated to the present file. The present claims on file are still the ones filed on 13-05-2020. If the applicant wishes to file the said claims from your e-mail (or even a further improved version), it can be done together with the reply to my communication.

Best regards

Enrique Andrés Muñoz

Communication under Art. 94(3) EPC

The examination is being carried out on the **following application documents**

Description, Pages

4-26, 30-32	as originally filed	
33	filed in electronic form on	13-04-2018

1-3, 27-29	filed in electronic form on	13-05-2020

Claims, Numbers

1-7	filed in electronic form on	13-05-2020

Drawings, Sheets

1/19-19/19	as originally filed

The following document is cited by the Examiner. A copy of the document is annexed to the communication and the numbering will be adhered to in the rest of the procedure.

D8 "3 Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 13)", 3GPP STANDARD; 3GPP TS 36.213, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. V13.2.0, 30 June 2016 (2016-06-30), pages 45-254, XP051123185, [retrieved on 2016-06-30]

The applicant's arguments discussed in the above e-mail exchange and the proposed amendments in said e-mail exchange (which are enclosed to this communication) have been carefully considered. However, they fail to put the application in order for grant of a European Patent. The reasons are explained in the following paragraphs.

Clarity - Art. 84 EPC

1 The proposed claim 1 in the e-mail dated 08-09-2020 is not clear (Art. 84 EPC).

1.1 The proposed amendment of:

<u>wherein the TTI duration of the Msg3 is a first number of time units which are used to send the Msg3, and the gap period is a second number of time units</u>.

is not concise (Art. 84 EPC).

1.1.1 Thus, it is common knowledge in the art that the TTI duration and the gap period are a number of time units (e.g. seconds, or milliseconds, or slots, or frames). In consequence, said sentence should belong to the preamble part of

the claim. But indeed, such statement does not limit the claim at all, as it is common knowledge, and it does not contribute to make said claim new or inventive. Therefore, its inclusion in the claim is not necessary and lacks conciseness.

Patentability - Art. 52(1) EPC

2 The subject-matter of independent claim 1 on file (as filed on 13-05-2020) does not involve an inventive step within the meaning of Article 56 EPC, and the requirements of Article 52(1) EPC are therefore not met.

2.1 D1 is considered to be the prior art closest to the subject-matter of claim 1 and discloses (the references in parentheses applying to this document):

A method of a User Equipment, in the following also referred to as UE, for performing random access procedure,

(figure 3B)

comprising:
the UE transmits a Preamble to a network;

(paragraph [0049], line 1- line 2, and line 6 - line 11)

the UE receives a Msg2 from the network in response to the Preamble;

(paragraph [0051], line 4 - line 12)

and
the UE performs a Msg3 transmission to the network according to TTI information of the Msg3,

(paragraph [0053] - paragraph [0054])

~~characterized in that~~
the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a TTI duration of the Msg3

(paragraph [0050] - paragraph [0051] discloses that "[...] when allocating a resource, the Node B considers the TTI selected by the UE [...]" and that "[...] if the indication message of the UE indicates that the 2 ms TTI length is selected, the Node B selects a common E-DCH resource to be allocated to the UE from the resource subset with indexes of 0-15. If the indication message of the UE indicates that the 10 ms TTI length is selected, the Node B selects a common

E-DCH resource to be allocated to the UE from the resource subset with indixes of 16-31". That is to say, D1 discloses an implicit TTI information of the Msg3 by the selection of a particular resource for the Msg3 transmission. Please note that the present disclosure of claim 1 comprises also the possibility of the UE selecting a TTI duration, and the network node confirming said information in the Msg2. Please note that a resource allocation in the second step of a random access message is implicitly a Msg2)

~~and a start timing offset of the Msg3.~~

2.1.1 Please note that even if the applicant would amend claim 1 to disclose that the network node decides the TTI duration of the Msg3 (assuming that said feature is disclosed in the original application), the subject-matter of D1 would still be comprised in claim 1. Thus, paragraph [0056] discloses that "when the UE notifies the Node B of the selected TTI, the selection may be denied [...]". That is to say, the selection may be denied, and not the "UE selection of the TTI" may be denied as argued by the applicant. That the selection of the TTI may be denied clearly implies, in combination with paragraph [0050] - paragraph [0051], that the Node B would select a common E-DCH resource corresponding to the other TTI.

2.1.2 The subject-matter of claim 1 on file therefore differs from this known method in D1 in that the TTI information of the Msg3 includes a start timing offset of the Msg3.

2.1.2.1 Said term "start timing offset of the Msg3" is broad and it could be interpreted as a timing advance parameter. However, for the sake of discussion, said term would be interpreted in the following as "a gap period between Msg2 reception and Msg3 transmission", as supported by the original description in page 20, line 13 - line 15.

2.1.2.2 The applicant is recommended to amend claim 1 accordingly. In fact, said amendment is already present in the proposal of claim 1 in the e-mail dated 08-09-2020.

2.1.3 However, there is no apparent technical effect provided by the distinguishing feature, as actually the setting of a gap period between Msg2 reception and Msg3 transmission is common knowledge in the art. Thus, 3GPP TS36.213 V13.2.0 (i.e., D8), displays on page 46, section 6.1.1, a UL delay field for a response to the transmitted preamble sequence (i.e. RAR) which determines whether transmitting the UL-SCH transport block (i.e. Msg3) in the first subframe $n+k_1$, $k_1>=6$, wherein $n+k_1$ is the first available UL subframe for UL transmission, or on the next available UL subframe after $n+k_1$.

2.1.3.1 In consequence, the indication of a gap period between Msg2 reception and Msg3 transmission does not appear to solve any underlying technical problem or to produce some improvement or advantage (see Guidelines G-VII, 12, and G-VII, Annex 3). Therefore, the distinctive feature does not involve an inventive step (Art. 52(1) and 56 EPC).

2.2 The subject-matter of the proposed claim 1 in the e-mail dated 08-09-2020 does not involve an inventive step within the meaning of Article 56 EPC, and the requirements of Article 52(1) EPC are therefore not met.

2.2.1 Said proposal incorporates the additional feature of:

wherein the TTI duration of the Msg3 is a first number of time units which are used to send the Msg3, and the gap period is a second number of time units.

2.2.2 But said feature appears to be trivial, as it is common knowledge in the art that the TTI duration and the gap period are a number of time units (e.g. seconds, or milliseconds, or slots, or frames). The fact that they may be measured by a first and a second numbers of time units is also trivial, as those numbers may be the same number, according to the present disclosure of the claim. Please note that claim 1 does not disclose that the TTI information ***indicates*** a first and a second number, but that the TTI duration ***is*** a first number, and the gap period ***is*** a second number.

2.2.3 In consequence, the argument above in relation to the claim 1 on file is also applicable to the proposed claim 1 in the e-mail dated 08-09-2020.

2.3 The applicant's arguments, listed below, have been considered.

2.3.1 a) Claim 1 pertains to a gap period between Msg2 reception and Msg3 transmission, and not to timing advance (letter filed on 13-05-2020).

2.3.1.1 This argument has been discussed in the e-mail exchange (see above).

2.3.2 b) D1 does not disclose that the Msg2 contains a TTI duration of the Msg3 (letter filed on 13-05-2020).

2.3.2.1 This argument has been discussed in the e-mail exchange (see above).

2.3.3 c) The inventive concept of the present invention is explicitly including the TTI duration of the Msg3, which is a first number of time units, and the gap period between Msg2 reception and Msg3 transmission, which is a second number of time units, in the Msg2 (e-mail dated 08-09-2020).

2.3.3.1 However, this argument cannot be agreed. Said feature is explicitly not disclosed in the original application. However, it is acknowledged that it may be derived directly and unambiguously from the original application by using common general knowledge (Guidelines H-IV, 2.2). Still, said feature is a trivial common knowledge in the art, as explained above under §2.2.2, and it cannot support per se an inventive step.

2.3.4 d) According to the invention, since the TTI duration of the Msg3 and the gap period between Msg2 reception and Msg3 transmission [...] are carried in the Msg2, which is received by UE from network, it's not proper and also not necessary for UE to "set" these two information (e-mail dated 08-09-2020).

2.3.4.1 However, those two separate technical effects are known in the art. As discussed above, an indication of the TTI duration is disclosed by D1, and an indication of the gap period between Msg2 reception and Msg3 transmission is disclosed by D8. It would be obvious for the skilled person to combine both of these known features.

2.3.5 e) According to the teaching of TS36.213 V13.2.0, the start timing of sending a Msg3 is dynamic after the "UL delay" since it may be "the first available UL subframe" or "the next available UL subframe" as quoted by the examiner. However, according to the above new claim 1, the start timing of sending the Msg3 is fixed based on the TTI information carried in the Msg2 (e-mail dated 08-09-2020).

2.3.5.1 This argument cannot be agreed. Neither the present claim 1 on file ("start timing offset of the Msg3") nor the proposed claim 1 in the e-mail dated 08-09-2020 (a gap period between Msg2 reception and Msg3 transmission) specify that such period is fixed in contraposition to the disclosure of D8 (TS36.213 V13.2.0). Indeed, the scope of the disclosure of both versions of the claims may comprise that of D8.

2.3.5.2 Besides, even if the applicant further amended claim 1 with a term similar to "a fixed gap duration", said term does not seem to be supported by the original application.

2.3.6 f) D1 does not disclose that the TTI duration of the Msg3 per se (i.e. a number of time units) is included in the Msg2 and transmitted to the UE (e-mail dated 08-09-2020).

2.3.6.1 It is acknowledged that D1 just discloses an indication of the TTI duration, and not an indication of a numeric value of said duration. However, the proposed claim 1 in the e-mail dated 08-09-2020 does not disclose either an ***indication*** of a numeric value of said duration. It just discloses that the duration ***is*** a number of time units, which is trivial.

2.3.7 g) According to the teaching of D1, there are only two TTI lengths (i.e. 2 ms and 10 ms) for selection, i.e. the selection of the TTI lengths is restricted to a certain number of TTI lengths. However, according to the invention, the selection of the TTI duration of the Msg3 (i.e. the number of time units used for sending the Msg3) is not restricted.

2.3.7.1 This argument cannot be agreed. Neither the present claim 1 on file nor the proposed claim 1 in the e-mail dated 08-09-2020 seem to relate to unrestricted selection of the TTI duration.

2.3.7.2 Moreover, it does seems that the subject-matter of unrestricted selection of the TTI duration is supported by the original application. The description teaches in several passages (for example on page 13, line 29 - line 30) about indicating multiple possibilities of TTI length. But looking through solutions 1 to 5, it appears to be implicit that said multiple TTI lengths (it is not specified if that means two, or if that means more than two) are limited to a certain number of TTI lengths.

2.3.8 h) According to the teaching of D1, the UE must know the two candidate TTIs as well as the mapping between each TTI and each resource subset in advance [...]. In contrast, according to the invention, the UE [...] can know the TTI duration of the Msg3 directly from the received Msg2 alone.

2.3.8.1 Although it is acknowledged that in D1, the UE must know the mapping between each TTI and each resource subset in advance, it cannot be agreed that claim 1 discloses that the UE can know the TTI duration of the Msg3 directly from the received Msg2 alone. The scope of both present claim 1 on file and the proposed claim 1 in the e-mail dated 08-09-2020 are broad enough to comprise also a method such as the one in D1.

2.4 The applicant stated in page 12, line 22 - line 24 of the original description that "it would be better to reduce possible transmission and processing latency as much as possible. As discussed below, the present application first focuses on random access latency". This examiner has proposed an amendment based on page 20, line 13 - line 19, which would address said problem:

~~wherein~~ characterized in that

the TTI information of the Msg3 includes a TTI duration of the Msg3 and a ~~start timing offset of the Msg3~~ minimum gap period between Msg2 reception and Msg3 transmission;

wherein the TTI duration of the Msg3 is set to a short TTI, and the minimum gap period is set to the short TTI.

2.4.1 The distinguishing features are not disclosed in the cited prior art.

2.4.2 Said distinguishing features would have the technical effect of reducing the gap between the Msg2 reception and the Msg3 transmission, which in the legacy 3GPP technical specification is fixed to at least $n+k_1$, $k_1>=6$ (i.e. several milliseconds). The objective technical problem could be expressed as how to reduce the latency in the random access procedure.

2.4.3 It is noted that this suggestion is only for assisting the applicant in his decision on how to proceed. It in no way precludes consideration of alternative solutions submitted by the applicant. The responsibility for determining the text of the application (Article 113(2) EPC) and in particular for defining the subject-matter for which protection is sought remains with the applicant.

Further objections

3 Following further objections should be considered by the applicant:

3.1 In case the applicant accepts the suggestion of the examiner for an acceptable form of amendments to the claims overcoming the objections raised, the applicant should also submit an adapted description together with the amended claims.

3.1.1 The applicant should amend the description as needed to fulfil the following requirements:

– The summary of the invention (Rule 42(1)(c) and GL F-II.4.5) must correspond to the amended set of claims. If appropriate, statements such as “The invention is set out in the appended set of claims“ or "The invention is as defined in claim X" can be applied instead of repeating the claims verbatim.

– All embodiments which are not covered by the claims anymore must be deleted, unless these embodiments can reasonably be considered to be useful for highlighting specific aspects of the amended subject-matter. In such case, they must be prominently marked as not being part of the present invention (T 1808/06).

– All technical features of the independent claims shall not be presented as optional in the description. Terms such as “for example“, “may“, “can”, “exemplary“, “optionally“, “preferably“ and the like should be removed when preceding a feature of an independent claim.

Procedure

4 The applicant is invited to file new claims which take account of the above comments.

4.1 The applicant is requested to bring the description into conformity with the amended claims; care should be taken during revision, especially of the introductory portion including any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

4.2 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made, irrespective of whether they concern amendments by addition, replacement or deletion, and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1).

4.3 The attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC).

4.4 In order to accelerate the examination procedure, it would be appreciated if the applicant provided with an argumentation based in the problem and solution approach, as defined in the Guidelines, G-VII, 2.5.

New claims 1 to 7
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405);

the UE receives a Msg2 from the network in response to the Preamble (1410); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415) ,

wherein the TTI information of the Msg3 is contained in the Msg2,

characterized in that

the TTI information of the Msg3 includes a TTI duration of the Msg3 and a gap period between Msg2 reception and Msg3 transmission,

wherein the TTI duration of the Msg3 is a first number of time units which are used to send the Msg3, and the gap period is a second number of time units.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

New claims 1 to 7
Markup version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405~~; 1505; 1805; 1905~~);

the UE receives a Msg2 from the network in response to the Preamble (1410~~; 1510; 1810; 1910~~); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415~~; 1515; 1815; 1915~~) ,

~~characterized in that~~wherein

the TTI information of the Msg3 is contained in the Msg2,

~~wherein~~ characterized in that

the TTI information of the Msg3 includes a TTI duration of the Msg3 and a ~~start timing offset of the Msg3~~gap period between Msg2 reception and Msg3 transmission,

wherein the TTI duration of the Msg3 is a first number of time units which are used to send the Msg3, and the gap period is a second number of time units.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

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6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

New claims 1 to 7
Markup version

HOEFER & PARTNER

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Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-60/LX	January 20, 2021

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In Response to the Office Action of September 25, 2020:

1. New documents

- New claims 1 to 7
- New description page 2

The new documents are to replace, at least for the present, the respective documents currently pending. The remaining documents are presently maintained unchanged. The applicant preserves his right to file divisional applications for the subject matter of the original application.

2. Original disclosure of the new claims

New claim 1 is based on pending claim 1 (in this submission pending claims mean the claims as filed on May 13, 2020), in which the last feature is amended to read "*the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a gap period between Msg2 reception and Msg3 transmission, respectively*". The original disclosure of the wording "the TTI information includes a first number of time units for indicating a TTI of the Msg3" is Fig.10, lines 3-4 and 15-16 on page 10 of the description as originally filed, and the last paragraph on page 27 to the second paragraph on page 28 of the description as originally filed. From the above-said original disclosure in combination with common knowledge in the art, it can directly and

doubtlessly be derived by a person skilled in the art that according to the invention, the TTI duration of the Msg3 itself (i.e. a first number of time units) may be directly included in the Msg2 as a part of the TTI information. Thus, the wording "the TTI information includes a first number of time units for indicating a TTI of the Msg3" in new claim 1 is supported by the original description of the invention.

The original discourse of the above wording "the TTI information includes a second number of time units for indicating a gap period between Msg2 reception and Msg3 transmission" in new claim 1 is lines 1-3 on page 27 and the last paragraph on page 27 to the second paragraph on page 28 of the description as originally filed. From the above-said original disclosure in combination with common knowledge in the art, it can directly and doubtlessly be derived by a person skilled in the art that according to the invention, the gap period itself (i.e. a second number of time units) may be directly included in the Msg2 as a part of the TTI information. Thus, the above wording in new claim 1 is also supported by the original description of the invention.

Moreover, in the last feature of claim 1, the former term "a start timing offset of the Msg3" is amended to "a gap period between Msg2 reception and Msg3 transmission" as suggested by the examiner in his email of September 1, 2020. This amendment is supported by page 20, lines 13-15 of the description as originally filed.

Therefore, all amendments in claim 1 are supported by the original disclosure of the application.

New claims 2 to 7 correspond to pending claims 2 to 7, respectively.

3. Clarity

In the currently filed new claim 1, by the amendments it is clarified that the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating the TTI duration of the Msg3 and the gap period between Msg2 reception and Msg3 transmission, respectively, i.e. the first number of time units and the second number of time units are directly indicated in the TTI information. It is the applicant's belief that after the amendments, the clarity objection as stated in item 1 of the above-identified office action is overcome.

4. Novelty and inventive step

According to the currently filed new claim 1, as stated above, the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating the TTI duration of the Msg3 and the gap period between Msg2 reception and Msg3 transmission, respectively. In other words, according to the present invention, two numeric values of time durations (i.e. the first number of time units and the second number of time units) are directly indicated in the TTI information for indicating the TTI duration of the Msg3 and the gap period between the Msg2 reception and the Msg3 transmission, respectively.

As already stated in our email of September 8, 2020 and also acknowledged by the examiner in item 2.3.6.1 of the above-identified office action, D1 does not disclose including an

indication of a numeric value of the TTI duration of the Msg3 in the Msg2. Therefore, D1 is silent on the characterizing part of new claim 1.

According to the solution of the present invention, the UE can directly and easily know the TTI duration of the Msg3 directly from the received Msg2 alone by reading the first number of time units and the second number of time units contained in the Msg2 without other additional information or processing. In contrast, as acknowledged by the examiner in item 2.3.8.1 of the office action, according to the teaching of D1, for determining the TTI duration of the Msg3, the UE must know the mapping between each TTI and each resource subset in advance. Therefore, D1 cannot obtain the same technical effect as that of the present invention.

In view of the above, it is the applicant's belief that the presently filed new claims are not only novel, but also based on an inventive step.

5. Description / Formal requirements

On the filed new description page 2, the description is adapted to the filed new claims.

6. Requests

It is therefore respectfully requested to drop the objections against the patentability of the application, and to furnish an opportunity to adapt the specification if necessary.

In case of remaining necessity for minor amendments to the claims and/or description, it is respectfully requested to contact the applicant's representatives over the phone.

7. Oral proceedings (videoconference)

In case, however, the examining division should not agree to the patentability of the application, it is respectfully requested to issue an examination report in detail elucidating the reservations of the examining division. Auxiliary, it is requested to set a date for **oral proceedings**. According to the decision of the President of the European Patent Office dated April 1, 2020, the oral proceedings are to be held by videoconference.

Please send communications containing information on the organization of the videoconference to:

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Videoconference studio information:

Software: Skype for Business Web App or SIP/H.323 (Polycom Real Presence Desktop)
Studio phone: +49 89 642 447-0
Studio fax: +49 89 642 447-11

If there are serious reasons against holding the oral proceedings by videoconference, oral proceedings may be held on the premises of the European Patent Office.

Hoefer & Partner Patentanwälte mbB

Encl.:
New claims 1 to 7
New page 2
Markup version of new claims
Markup version of new page

Europäisches Patentamt
European Patent Office
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Letter accompanying subsequently filed items

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Tel. +49(0)30 25901-0 | Fax -840

The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17183827.9
Applicant's or representative's reference	ASU170707PEP

	Description of document	Original file name	Assigned file name
1	Amended description (clean copy)	DESCPAMD-1.pdf	DESCPAMD-1.pdf
2	Amended claims (clean copy)	CLMSPAMD-1.pdf	CLMSPAMD-1.pdf
3	Amended description with annotations	DESC-HWA-1.pdf	DESC-HWA-1.pdf
4	Amended claims with annotations	CLMS-HWA-1.pdf	CLMS-HWA-1.pdf
5	Letter relating to the search and examination procedure	EPLETT-1.pdf	EPLETT-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**München**
Date:	**20 January 2021**
Signed by:	**Ingo Goerz 19384**
Association:	**Hoefer & Partner Patentanwälte mbB**
Representative name:	**Ingo Görz**
Capacity:	**(Representative)**

SUMMARY

A method and apparatus, from the perspective of the UE, for performing random access procedure are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. The method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a start timing offset of the Msg3, respectively.

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New claims 1 to 7
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405);

the UE receives a Msg2 from the network in response to the Preamble (1410); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415) ,

whereinthe TTI information of the Msg3 is contained in the Msg2,

characterized in that

the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a gap period between Msg2 reception and Msg3 transmission, respectively.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

SUMMARY

A method and apparatus, from the perspective of the UE, for performing random access procedure are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. The method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a start timing offset of the Msg3, respectively.

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New claims 1 to 7
Markup version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405~~; 1505; 1805; 1905~~);

the UE receives a Msg2 from the network in response to the Preamble (1410~~; 1510; 1810; 1910~~); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415~~; 1515; 1815; 1915~~) ,

~~characterized in that~~wherein

the TTI information of the Msg3 is contained in the Msg2,

~~wherein~~ characterized in that

the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a ~~start timing offset of the Msg3~~gap period between Msg2 reception and Msg3 transmission, respectively.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble.

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

New claims 1 to 7
Markup version

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	9418060
Application number	EP17183827.9
Date of receipt	20 January 2021
Receiving Office	European Patent Office, The Hague
Your reference	ASU170707PEP
Applicant	All applicants as on file

Documents submitted	
package-data.xml	ep-sfd-request.xml
epf1038.pdf (1 p.)	DESCPAMD-1.pdf\DESCPAMD-1.pdf (1 p.)
CLMSPAMD-1.pdf\CLMSPAMD-1.pdf (2 p.)	DESC-HWA-1.pdf\DESC-HWA-1.pdf (1 p.)
CLMS-HWA-1.pdf\CLMS-HWA-1.pdf (2 p.)	EPLETT-1.pdf\EPLETT-1.pdf (4 p.)

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/European Patent Office/

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May 13, 2020

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

2 EP 2680651 A1 discloses a method for flexibly selecting either 2ms TTI or 10 ms TTI for the messages of a random access procedure in UMTS. The UE notifies the Node B of the selected TTI by using different preamble codes in the first message. The Node B may deny the UE selection. ¶

¶

3GPP Technical Specification TS 36.213, V13.2.0, discloses a UL delay field for a response to the transmitted preamble sequence which determines whether transmitting the UL-SCH transport block on the first subframe n+k, or on the next available UL subframe after n+k. 2

~~EP 2680651 A1 discloses a method and corresponding base station device, terminal device for channel resource allocation in a communication system, according to which the UE could select a TTI for use according to its own requirement based on the received cell broadcast message in a random access procedure.~~

3GPP document R1-160041 discloses the UL design for NB-IOT.

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SUMMARY

2 A method from the perspective of a user equipment, and a user equipment, 2 ~~A method and apparatus, from the perspective of the UE,~~ for performing random access procedure are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. The method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a start timing offset of the Msg3, respectively.

New page 2
Clean version

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagram of a wireless communication ƨ ▛ system. ▟ ƨ

~~system according to one exemplary embodiment.~~

FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or ƨ ▛ UE). ▟ ƨ

~~UE) according to one exemplary embodiment.~~

FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

FIG. 5 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0.

FIG. 6 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300 v13.2.0.

ƨ ▛ FIGS. 7 to 11 are diagrams. ▟ ƨ

~~FIG. 7 is a diagram according to one exemplary embodiment.~~

~~FIG. 8 is a diagram according to one exemplary embodiment.~~

~~FIG. 9 is a diagram according to one exemplary embodiment.~~

~~FIG. 10 is a diagram according to one exemplary embodiment.~~

~~FIG. 11 is a diagram according to one exemplary embodiment.~~

ƨ ▛ FIGS. 12 and 13 are flow charts. ▟ ƨ

~~FIG. 12 is a flow chart according to the related art.~~

~~FIG. 13 is a flow chart according to the related art.~~

FIG. 14 is a flow chart according to one exemplary embodiment.

ƨ ▛ FIGS. 15 to 19 are flow charts. ▟ ƨ ~~FIG. 15 is a flow chart according to the related art.~~

~~FIG. 16 is a flow chart according to the related art.~~

~~FIG. 17 is a flow chart according to the related art.~~

~~FIG. 18 is a flow chart according to one exemplary embodiment.~~

~~FIG. 19 is a flow chart according to one exemplary embodiment.~~

DETAILED DESCRIPTION

The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A or LTE-Advanced (Long Term Evolution Advanced), 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

In particular, the exemplary wireless communication systems devices described below may be designed to support one or more standards such as the standard offered by a consortium named "3rd Generation Partnership Project" referred to herein as 3GPP, including: TR 38.913 v0.3.0, "Study on Scenarios and Requirements for Next Generation Access Technologies"; TS 36.300 v13.2.0, "Overall Description; Stage 2"; TS 36.913, v13.0.0, "Requirements for further advancements for Evolved Universal Terrestrial Radio Access (E-UTRA)"; TS 36.331 v13.2.0, "Radio Resource Control (RRC); Protocol specification"; TS 36.321 v13.1.0, "Medium Access Control (MAC) protocol specification"; and R2-163445, "Scheduling Framework and Requirements", Nokia and Alcatel-Lucent Shanghai Bell.

FIG. 1 shows a multiple access wireless communication 2 system, which does not fall within the scope of the claims. 2 ~~system according to one embodiment of the invention.~~ An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In FIG. 1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency then that used by reverse link 118.

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Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an evolved Node B (eNB), or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

FIG. 2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

Preferably, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

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The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and

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processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

Turning to FIG. 3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in FIG. 3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in FIG. 1 or the base station (or AN) 100 in FIG. 1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly. The communication device 300 in a wireless communication system can also be utilized for realizing the AN 100 in FIG. 1.

FIG. 4 is a simplified block diagram of the program code 312 shown in FIG. 3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

One of the general objectives of the present application is to study the frame structure used in New RAT (NR) for 5G, to accommodate various type of requirement (discussed in 3GPP TR 38.913) for time and frequency resource, e.g., from ultra-low latency (~0.5 ms) to expected longer TTI (Transmission Time Interval) for MTC (Machine Type Communication), from high peak rate for eMBB (enhanced Mobile Broadband) to very low data rate for MTC. An important focus is low latency aspect, while other aspect of mixing/adapting different TTIs can also be considered in the study. In addition to diverse services and requirements, forward compatibility is an important consideration in initial NR frame structure design as not all features of NR would be included in the beginning phase/release.

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[0001] 3GPP TS 36.300 includes the following random access (RA) procedure related description:

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;

The random access procedure is performed for the following events related to the PCell:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- Handover;
- DL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised".
- UL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised" or there are no PUCCH resources for SR available.
- For positioning purpose during RRC_CONNECTED requiring random access procedure;
  - E.g. when timing advance is needed for UE positioning.

The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG.

In DC, the random access procedure is also performed on at least PSCell upon SCG addition/modification, if instructed, or upon DL/UL data arrival during RRC_CONNECTED requiring random access procedure. The UE initiated random access procedure is performed only on PSCell for SCG.

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).

Normal DL/UL transmission can take place after the random access procedure.

An RN supports both contention-based and non-contention-based random access. When an RN performs the random access procedure, it suspends any current RN subframe

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configuration, meaning it temporarily disregards the RN subframe configuration. The RN subframe configuration is resumed at successful random access procedure completion.

10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

[Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 5]

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:
   - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.
2) Random Access Response generated by MAC on DL-SCH:
   - Semi-synchronous (within a flexible window of which the size is one or more TTI) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least RA-preamble identifier, Timing Alignment information for the pTAG, initial UL grant and assignment of Temporary C-RNTI (which may or may not be made permanent upon Contention Resolution);
   - Intended for a variable number of UEs in one DL-SCH message.
3) First scheduled UL transmission on UL-SCH:
   - Uses HARQ;
   - Size of the transport blocks depends on the UL grant conveyed in step 2.
   - For initial access:
     - Conveys the RRC Connection Request generated by the RRC layer and transmitted via CCCH;
     - Conveys at least NAS UE identifier but no NAS message;

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- RLC TM: no segmentation.

- For RRC Connection Re-establishment procedure:
  - Conveys the RRC Connection Re-establishment Request generated by the RRC layer and transmitted via CCCH;
  - RLC TM: no segmentation;
  - Does not contain any NAS message.
- After handover, in the target cell:
  - Conveys the ciphered and integrity protected RRC Handover Confirm generated by the RRC layer and transmitted via DCCH;
  - Conveys the C-RNTI of the UE (which was allocated via the Handover Command);
  - Includes an uplink Buffer Status Report when possible.
- For other events:
  - Conveys at least the C-RNTI of the UE.

4) Contention Resolution on DL:
   - Early contention resolution shall be used i.e. eNB does not wait for NAS reply before resolving contention;
   - Not synchronised with message 3;
   - HARQ is supported;
   - Addressed to:
     - The Temporary C-RNTI on PDCCH for initial access and after radio link failure;
     - The C-RNTI on PDCCH for UE in RRC_CONNECTED.
   - HARQ feedback is transmitted only by the UE which detects its own UE identity, as provided in message 3, echoed in the Contention Resolution message;
   - For initial access and RRC Connection Re-establishment procedure, no segmentation is used (RLC-TM).

The Temporary C-RNTI is promoted to C-RNTI for a UE which detects RA success and does not already have a C-RNTI; it is dropped by others. A UE which detects RA success and already has a C-RNTI, resumes using its C-RNTI.

When CA is configured, the first three steps of the contention based random access procedures occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell.

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When DC is configured, the first three steps of the contention based random access procedures occur on the PCell in MCG and PSCell in SCG. When CA is configured in SCG, the first three steps of the contention based random access procedures occur on the PSCell while contention resolution (step 4) can be cross-scheduled by the PSCell.

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 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 6]

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-

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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.

When performing non-contention based random access on the PCell or PSCell while DC 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 corresponding cell. 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 not including PSCell. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell for MCG and PSCell for SCG.

Details of each random access step and related control element are described in Sections 5.1, 5.4, 6, and 7 of 3GPP TS 36.321. Furthermore, some configurations for random access and obtaining procedure are discussed in 3GPP 36.331.

One NR requirement listed in 3GPP TR 38.913 lists the following NR requirement: "*Control plane latency refers to the time to move from a battery efficient state (e.g., IDLE) to start of continuous data transfer (e.g., ACTIVE). The target for control plane latency should be **10ms***." Regarding similar requirement in LTE, the control plane latency requirement is set to 50ms (as discussed in 3GPP TS 36.913). There is a huge gap between latency requirement of LTE and latency requirement of NR. Therefore, it would be better to reduce possible transmission and processing latency as much as possible. As discussed below, the present application first focuses on random access latency.

In LTE, there are two kinds of random access procedure, contention and non-contention. The contention random access procedure consists of 4 steps, including: Msg1, Msg2, Msg3, and Msg4. FIG. 5 is an exemplary embodiment for the contention random access. The Msg1 and Msg3 are transmitted from a UE to a network. And the resource for performing Msg1 transmission and Msg3 transmission are contention resource. If the network can successfully receive a Msg3, the network could identify the UE based on contents in Msg3, and transmit a Msg4 to the UE for finishing the contention.

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On the other hand, a dynamic TTI adjusting concept is discussed in 3GPP R2-163445, which proposes to set the TTI size per scheduling grant for optimizing TCP(Transmission Control Protocol) transmission case. In particular, short TTI can be used to accelerate TCP slow start process, and long TTI can be used in steady transmission rate state for reduce control signaling overhead.

Considering such dynamic TTI concept, the present application further discusses whether it can also be used to accelerate random access procedure and how to achieve dynamic TTI change in random access. The following discussion mainly focuses on the Msg3 transmission step in a random access procedure. In addition, the discussion below does not include UE's RF/Baseband capability differentiation (e.g., differentiation between normal cell phone in LTE and NB-IoT devices in LTE) case.

In LTE, there could be three different random access configurations in LTE system. The first configuration is generally for normal UEs with enough RF/Baseband capability to monitor whole system bandwidth (e.g., cell phones, high end MTC devices). The second configuration is generally for low-end MTC devices and normal UEs with enough RF/Baseband capability but worked in power limited condition. The third configuration is generally for NB-IoT (Narrow Band-Internet of Thing) UEs which pool RF/Baseband capability and can only perform transmission/reception on a narrow band (e.g., 1.4MHz). The last configuration is generally defined as a new RAT (Radio Access Technology). Normally, low-end MTC devices will only worked on the second configuration, and NB-IoT devices will work only on the third configuration. For a normal UE with enough RF/Baseband capability, the UE will only change RA configuration when it enters the power limited state (e.g., cell edge or even far away).

If short TTI applies to Msg3 transmission, the average random access latency could be reduced due to early start to monitor Msg4. A possible case for such benefit is shown in FIG. 7. As shown in FIG. 7, although the processing delay is a fixed period, the UE could start to receive Msg4 earlier owing to early Msg3 transmission. Moreover, two possibilities for monitoring Msg4 are shown in FIG. 7. The UE may expect either TTI format if the TTI length information is not be carried in scheduling control signal. Otherwise, the UE may expect multiple possibilities of TTI length.

Another possible benefit may be improving resource efficiency. If the dynamic TTI concept is applied to Msg3, the network can more flexibly adjust resource allocation. In LTE, the TTI

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length for Msg3 is fixed. In the same modulation scheme condition, LTE system could only schedule radio resource in PRB level, while NR may be able to schedule in symbol level.

To achieve dynamic TTI concept, a UE needs to derive TTI information (e.g., TTI length, numerology) for transmitting Msg3 on air interface. In this aspect, possible candidates for the UE are proposed to obtain such information. One or multiple solutions can be applied in a NR system.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional TTI information is added into RAR for scheduling Msg3. Preferably, the new TTI information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field. A possible exemplary embodiment is shown in FIG. 9.

Solution 2 – Common field in Msg2. In Solution 2, the TTI information is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI length has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry TTI information. A possible example is shown in FIG. 10. The TTI information 1 could be provided to preamble set 1 (e.g., rapid 0~20), and the TTI information 2 could be provided to preamble set 2 (e.g., rapid 21~40).

The TTI information carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g., PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access

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configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, ...) performing the random access.

Solution 3 – Broadcast Information. In Solution 2 3, which does not fall within the scope of the claims, 2 ~~3,~~ a UE could derive TTI information for

Msg3 transmission through a broadcast message (e.g., system information(s), MIB, etc) from a network (e.g. gNB, base station, TRP, etc). If multiple TTI information for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol

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type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects TTI information in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the broadcast message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select TTI information in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the broadcast message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to

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radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 2 4, which does not fall within the scope of the claims, 2 4, a UE could derive TTI information for

Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple TTI information for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the dedicated message based on the service type indicated by the service indication.

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Preferably, the UE selects TTI information in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select TTI information in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the dedicated message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

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Solution 5 – Implicitly derive from Msg2 Transmission. In this 2 solution, which does not fall within the scope of the claims, 2 ~~solution,~~ a UE could derive TTI information for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives TTI information for Msg3 based on TTI information used by Msg2. For example, the TTI duration of Msg3 transmission may be N times of TTI duration of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives TTI information for Msg3 based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different TTI informations. The corresponding TTI information may be predefined and/or provided through system information and/or provided through dedicated RRC message.

Msg3 start timing offset - In LTE, there is a fixed gap period between Msg2 reception and Msg3 transmission. The fixed gap period is designed for covering UE's Msg2/3 processing time (e.g., decode, (de-)multiplexing transport block). However, in NR, some possible methods can bring benefits to reduce such fixed gap period. For example, if short TTI is applied to both Msg2/Msg3 transmissions as FIG. 11, the minimum of the fixed gap between Msg2 and Msg3 can be set to short TTI. Otherwise, the minimum gap could only be set to normal sub-frame length like without short TTI case.

There are also many other ways for reducing processing time (e.g. provision TB size). These methods will bring not only the benefit, but also some limitations and/or complexity. As a conclusion, we think that it could be beneficial for network be capable to decide the length of gap period. For achieving the concept, a UE will need to know the gap information (or called Msg3 start timing offset) by information provided from network. The possible solutions are listed below.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional information is added into RAR for adjusting Msg3 start timing offset. Preferably, the additional information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field.

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Solution 2 – Common field in Msg2. In Solution 2, the Msg3 start timing offset is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And MAC sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI information has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry Msg3 start timing offset.

The Msg3 start timing offset carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g. PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

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Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 3 – Broadcast Information. In Solution 2 [redacted] 3, which does not fall within the scope of the claims, [redacted] 2 ~~3~~ a UE could derive Msg3 start timing offset for Msg3 transmission through a broadcast message (e.g., system information(s), MIB,

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etc) from a network (e.g. gNB, base station, TRP, etc). If multiple Msg3 start timing offsets for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offsets in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the broadcast message for potential message size larger than the threshold.

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Preferably, the UE selects Msg3 start timing offset in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the broadcast message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 2 ▛ 4, which does not fall within the scope of the claims, ▟ 2 ~~4,~~ a UE could derive Msg3 start timing offset

for Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple Msg3 start timing offsets for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offset in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the dedicated message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock,

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data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the dedicated message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 5 – Implicitly derive from Msg2 Transmission. In this 2 solution, which does not fall within the scope of the claims, 2 ~~solution,~~ a UE could

derive Msg3 start timing offset for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives Msg3 start timing offset based on start timing offset used by Msg2. For example, the Msg3 start timing offset of Msg3 transmission may be N times of start timing offset of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives Msg3 start timing offset based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different Msg3 start timing offsets. The corresponding Msg3 start timing offset may be predefined and/or provided through system information and/or provided through dedicated RRC message.

The Msg3 start timing offset can be derived through the solution 1 to 5 mentioned above or combination of those solutions, while Msg3 start timing offset and TTI information of Msg3

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can apply the same or different solutions. The Msg3 start timing offset can be indicated in TTI duration, numerology, symbol, slot, microsecond, millisecond or N times of periodicity of periodic behavior. N value can be integer or decimal.

FIG. 12 is a flow chart 1200, which does not fall within the scope of the claims, ~~1200 according to the related art~~ from the perspective of a UE. In step 1205, the UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission. In step 1210, the UE transmits a Msg1 to the network. In step 1215, the UE receives a Msg2 from the network in response to the Msg1. In step 1220, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 13 is a flow chart 1300, which does not fall within the scope of the claims, ~~1300 according to the related art~~ from the perspective of a UE. In step 1305, the UE receives a broadcast message from a network to set TTI duration of Msg3. In step 1310, the UE transmits a Msg1 to the network. In step 1315, the UE receives a Msg2 from the network in response to the Msg1. In step 1320, the UE transmits a Msg3 to the network according to the TTI duration of Msg3.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set TTI duration of Msg3, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration of Msg3. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 14 is a flow chart 1400 according to one exemplary embodiment from the perspective of a UE. In step 1405, the UE transmits a Msg1 to a network. In step 1410, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration

of Msg3 transmission ~~and/or~~ a start timing offset of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. Preferably, the start timing offset of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the start timing offset of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1415, the UE transmits a Msg3 to the network according to the TTI duration ~~and/or~~ the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 ~~could~~ execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission ~~and/or~~ a start timing offset of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration ~~and/or~~ the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 15 is a flow chart ~~1500 according to the related art~~ 1500, which does not fall within the scope of the claims, from the perspective of a UE. In step 1505, the UE transmits a Msg1 to a network. In step 1510, the UE receives a Msg2 from the network in response to the Msg1. In step 1515, the UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, and (iii) to transmit a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 16 is a flow chart ~~1600 according to the related art~~ 1600, which does not fall within the scope of the claims, from the perspective of a UE. In step 1605, the UE receives a dedicated message from a network to set a start timing offset for

Msg3 transmission. In step 1610, the UE transmits a Msg1 to the network. In step 1615, the UE receives a Msg2 from the network in response to the Msg1. In step 1620, the

UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 17 is a flow chart ~~2~~ 1700, which does not fall within the scope of the claims, ~~2 1700 according to the related art~~ from the perspective of a UE. In step 1705, the UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission. In step 1710, the UE transmits a Msg1 to the network. In step 1715, the UE receives a Msg2 from the network in response to the Msg1. In step 1720, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 18 is a flow chart ~~2~~ 1800, which does not fall within the scope of the claims, ~~2 1800 according to one exemplary embodiment~~ from the perspective of a UE. In step 1805, the UE transmits a Msg1 to the network. In step 1810, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission. In step 1815, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to the network, (iii) to receive a

Msg2 from the network in response to the Msg1, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission, and (iii) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 19 is a flow chart 1900, which does not fall within the scope of the claims, ~~1900 according to one exemplary embodiment~~ from the perspective of a UE. In step 1905, the UE transmits a Msg1 to a network. In step 1910, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1915, the UE transmits a Msg3 to the network according to the TTI duration.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

With respect to the embodiments illustrated in FIGS. 12 through 19 and discussed above, preferably, the UE selects a TTI duration of Msg3 if there are multiple TTI durations of Msg3 in the dedicated message, the broadcast message, or the Msg2. Furthermore, the TTI duration of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Preferably, the UE selects a TTI duration of Msg3 if there are multiple start timing offsets for Msg3 transmission in the dedicated message, the broadcast message, or the Msg2. Furthermore, the start timing offset of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings

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herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an

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integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the

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aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

New claims 1 to 7
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405);

the UE receives a Msg2 from the network in response to the Preamble (1410); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415) ,

wherein the ~~wherein the~~ TTI information of the Msg3 is contained in the Msg2,

characterized in that

the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a gap period between Msg2 reception and Msg3 transmission, respectively.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble, wherein the RAR is included in the Msg2. ~~Preamble.~~

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

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7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

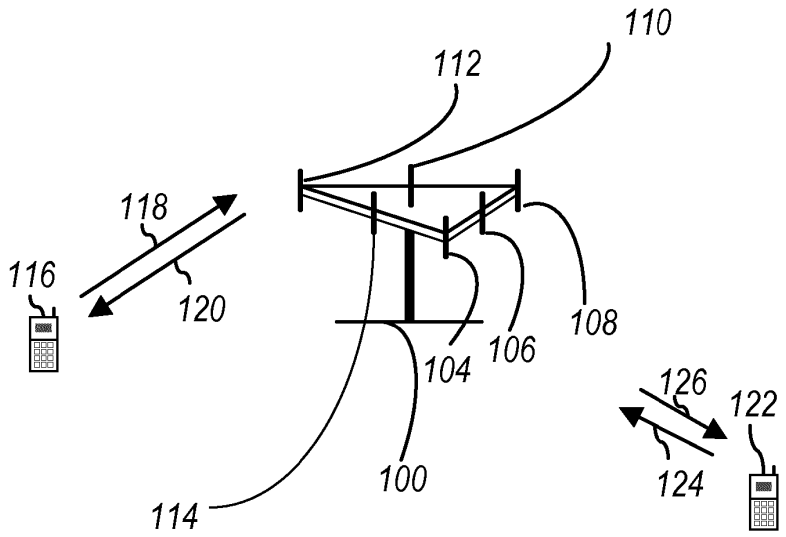


FIG. 1

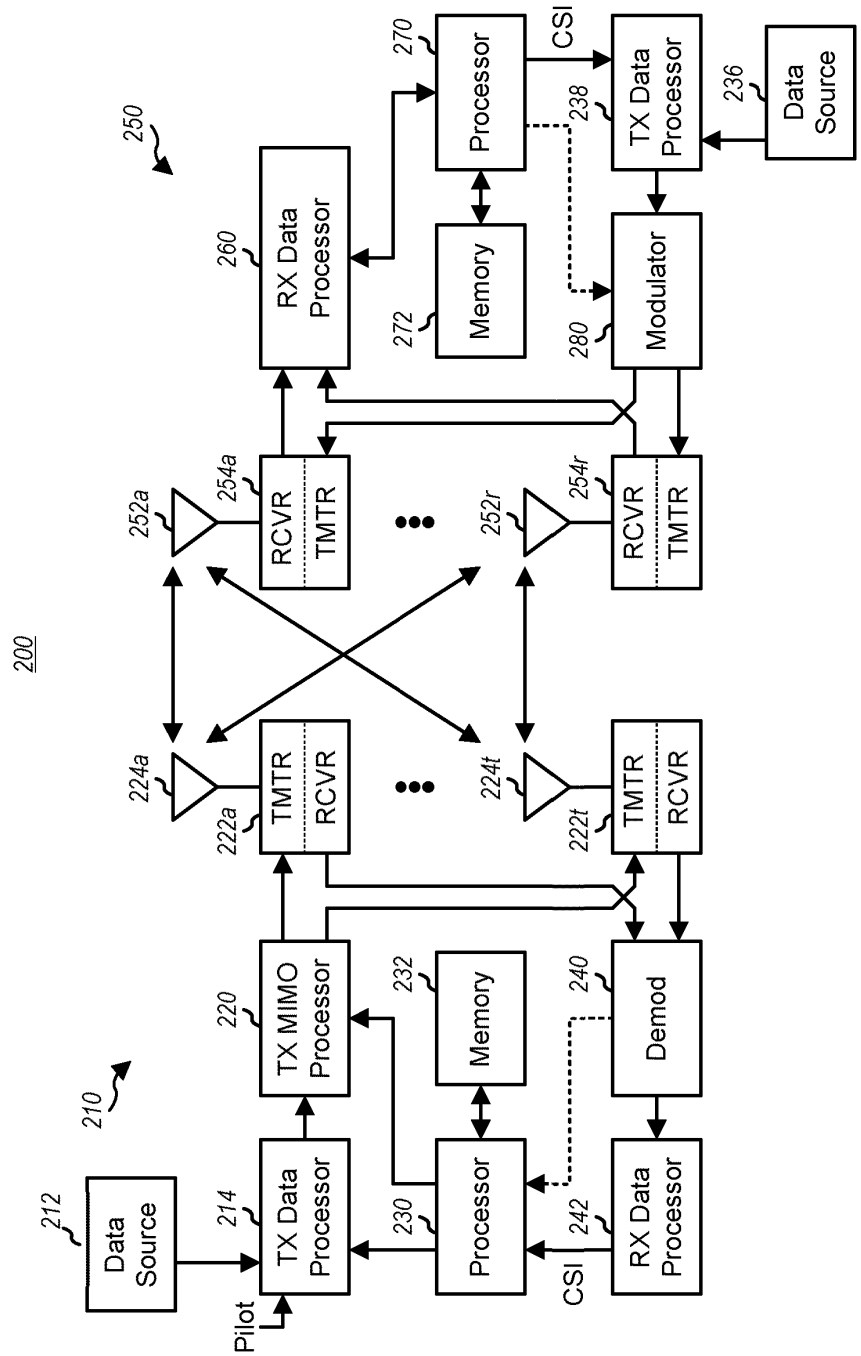

200
210
212
Data Source
214
TX Data Processor
Pilot
220
TX MIMO Processor
222a
TMTR
RCVR
224a
224t
222t
230
Processor
232
Memory
240
Demod
242
RX Data Processor
CSI
250
252a
254a
RCVR
TMTR
252r
254r
260
RX Data Processor
270
Processor
272
Memory
CSI
238
TX Data Processor
236
Data Source
280
Modulator

FIG. 2

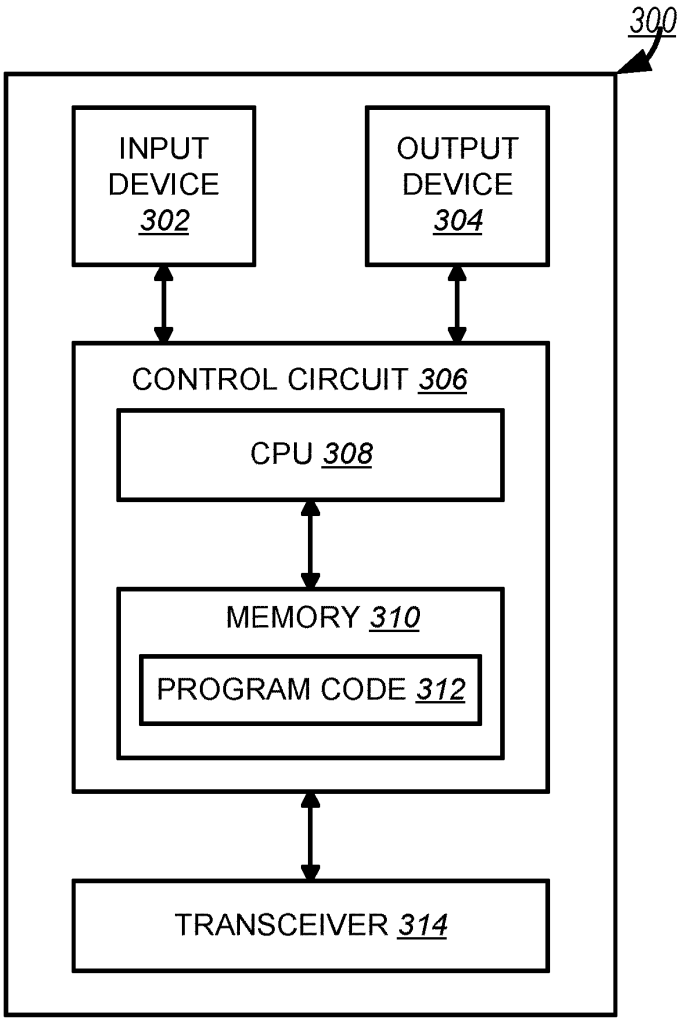

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. 3

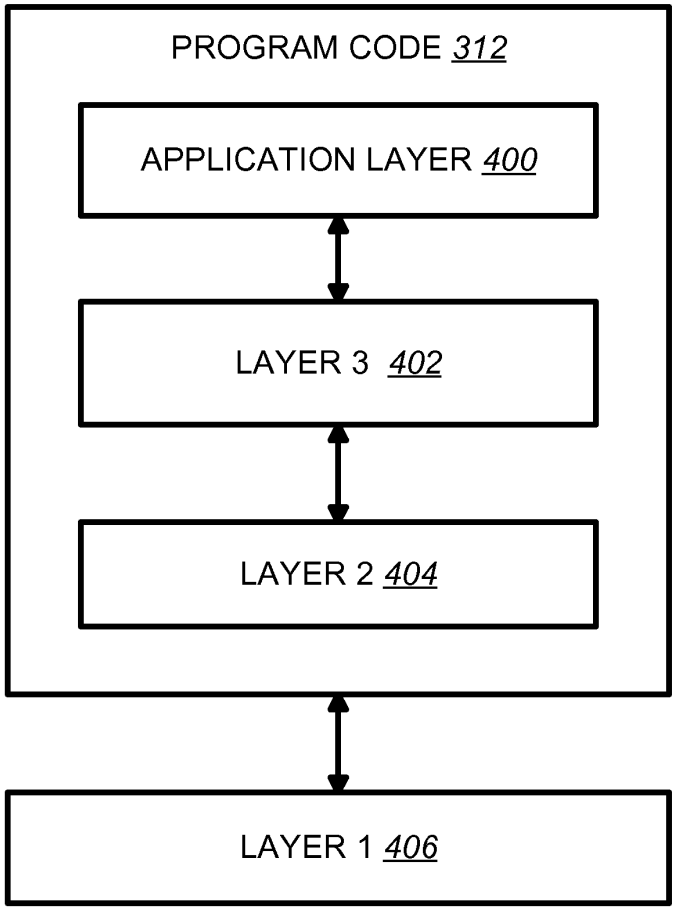

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. 4

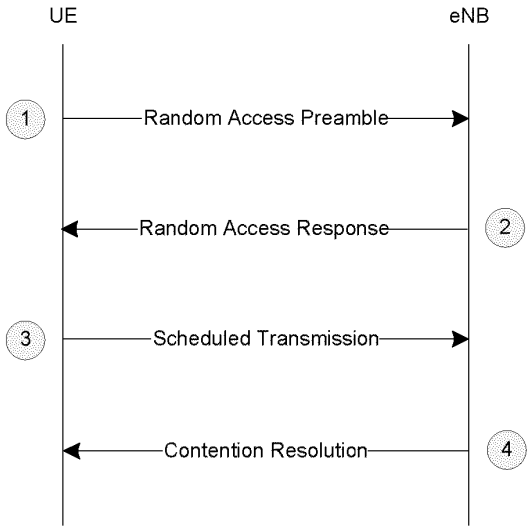

UE
eNB
1
Random Access Preamble
Random Access Response
2
3
Scheduled Transmission
Contention Resolution
4

FIG. 5

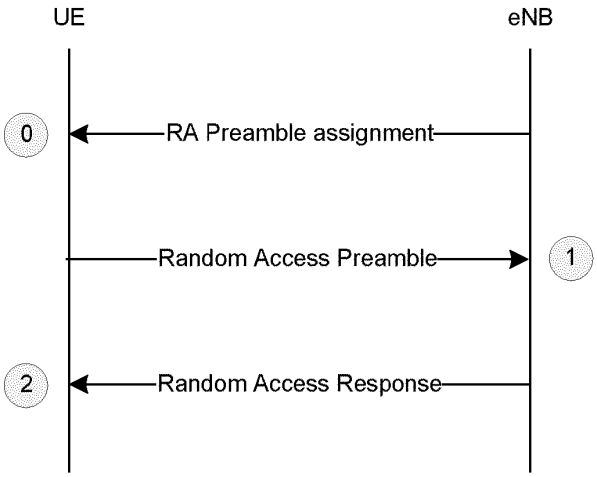

UE
eNB
0
RA Preamble assignment
Random Access Preamble
1
2
Random Access Response

FIG. 6

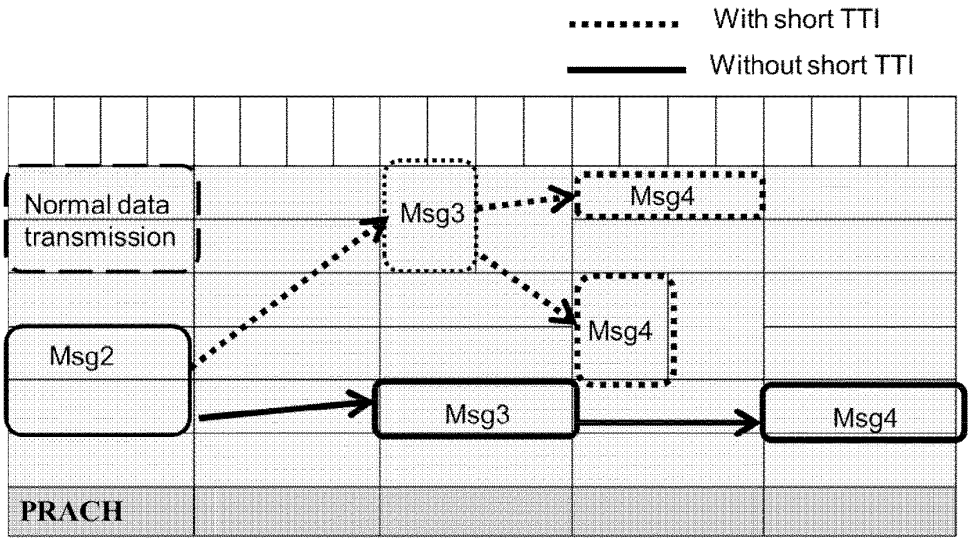

With short TTI
Without short TTI
Normal data transmission
Msg3
Msg4
Msg4
Msg2
Msg3
Msg4
PRACH

FIG. 7

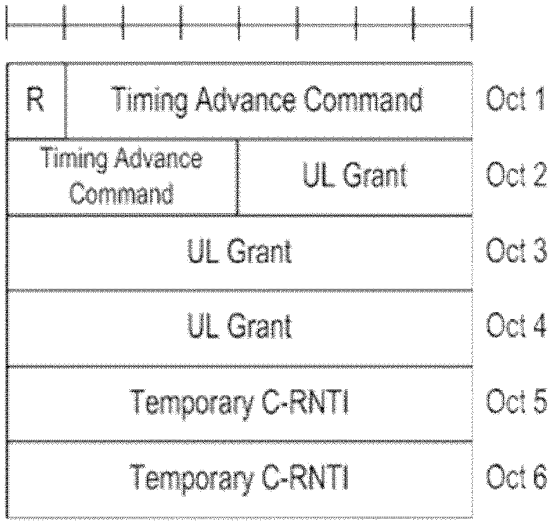

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6

FIG. 8

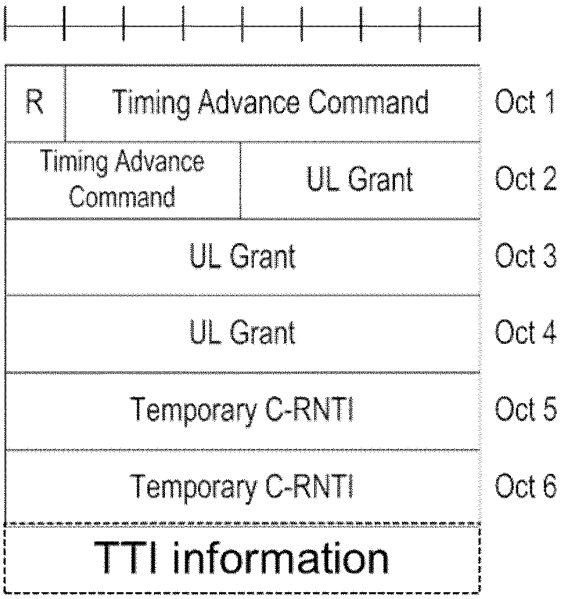

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6
TTI information

FIG. 9

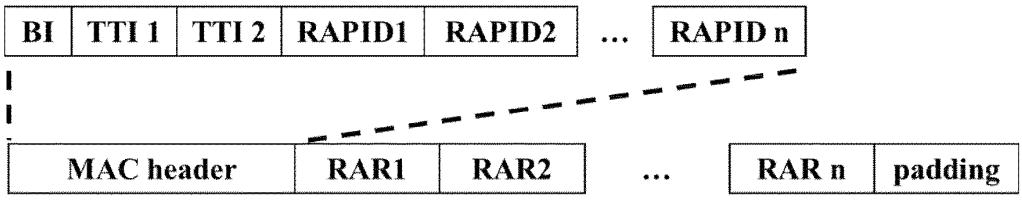

BI
TTI 1
TTI 2
RAPID1
RAPID2
…
RAPID n
MAC header
RAR1
RAR2
…
RAR n
padding

FIG. 10

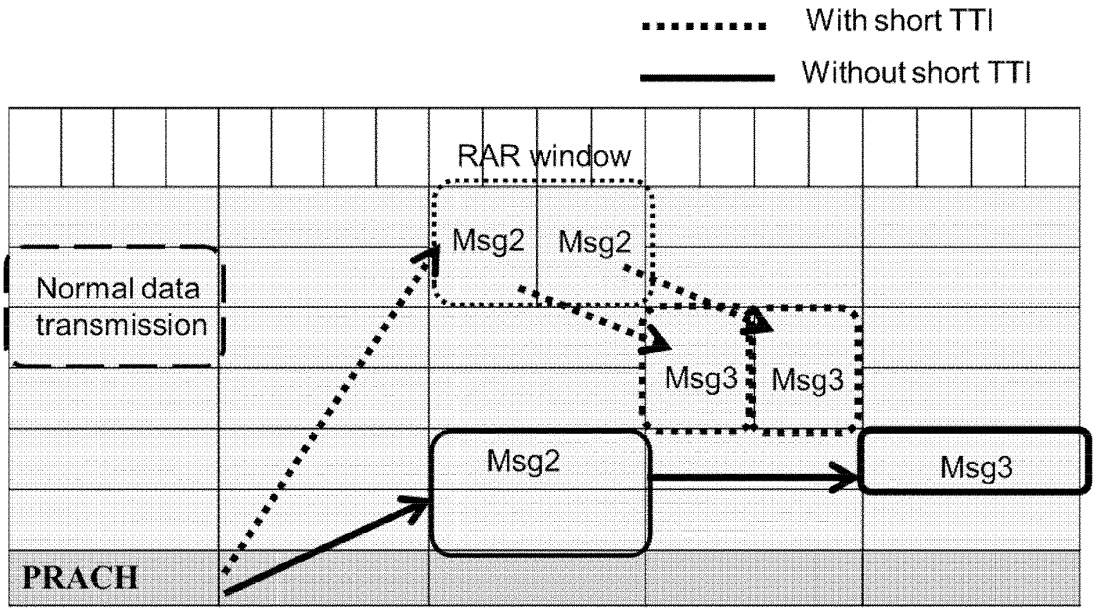

With short TTI
Without short TTI
RAR window
Msg2
Msg2
Normal data transmission
Msg3
Msg3
Msg2
Msg3
PRACH

FIG. 11

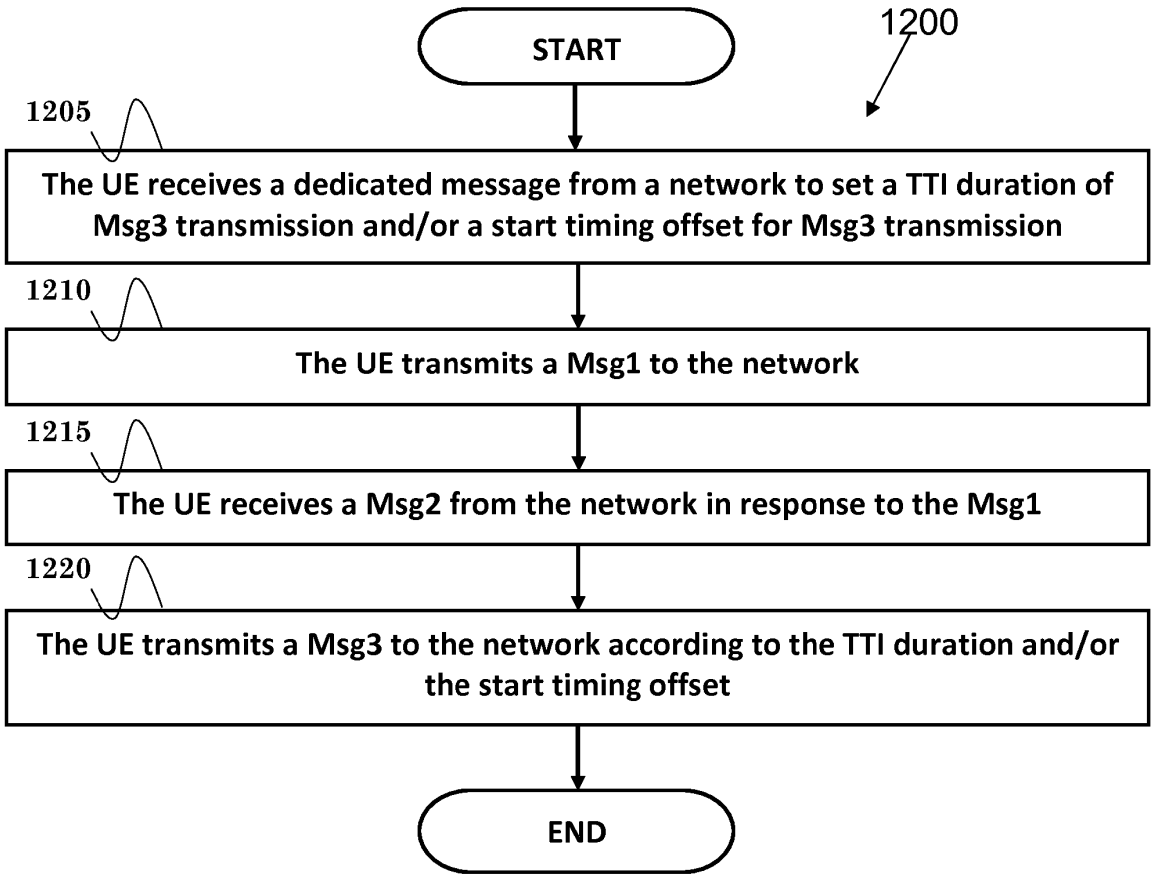

START
1200
1205
The UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission
1210
The UE transmits a Msg1 to the network
1215
The UE receives a Msg2 from the network in response to the Msg1
1220
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 12

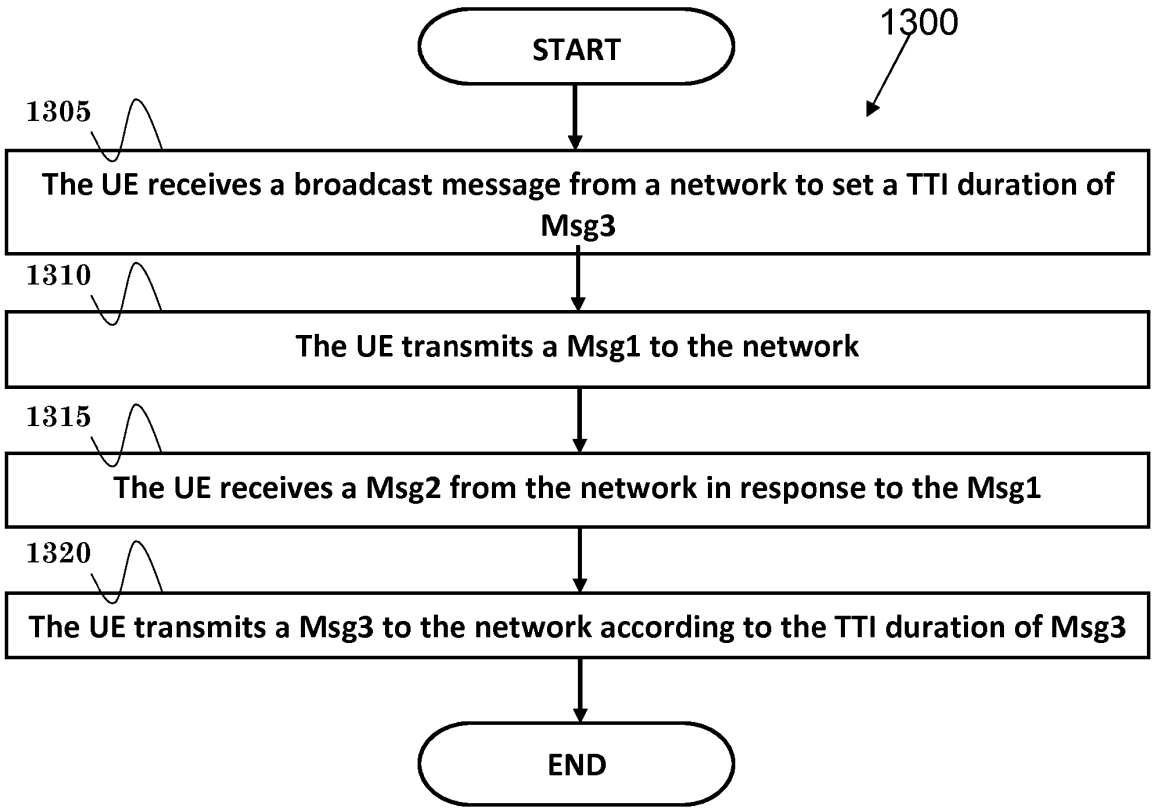

1300
START
1305
The UE receives a broadcast message from a network to set a TTI duration of Msg3
1310
The UE transmits a Msg1 to the network
1315
The UE receives a Msg2 from the network in response to the Msg1
1320
The UE transmits a Msg3 to the network according to the TTI duration of Msg3
END

FIG. 13

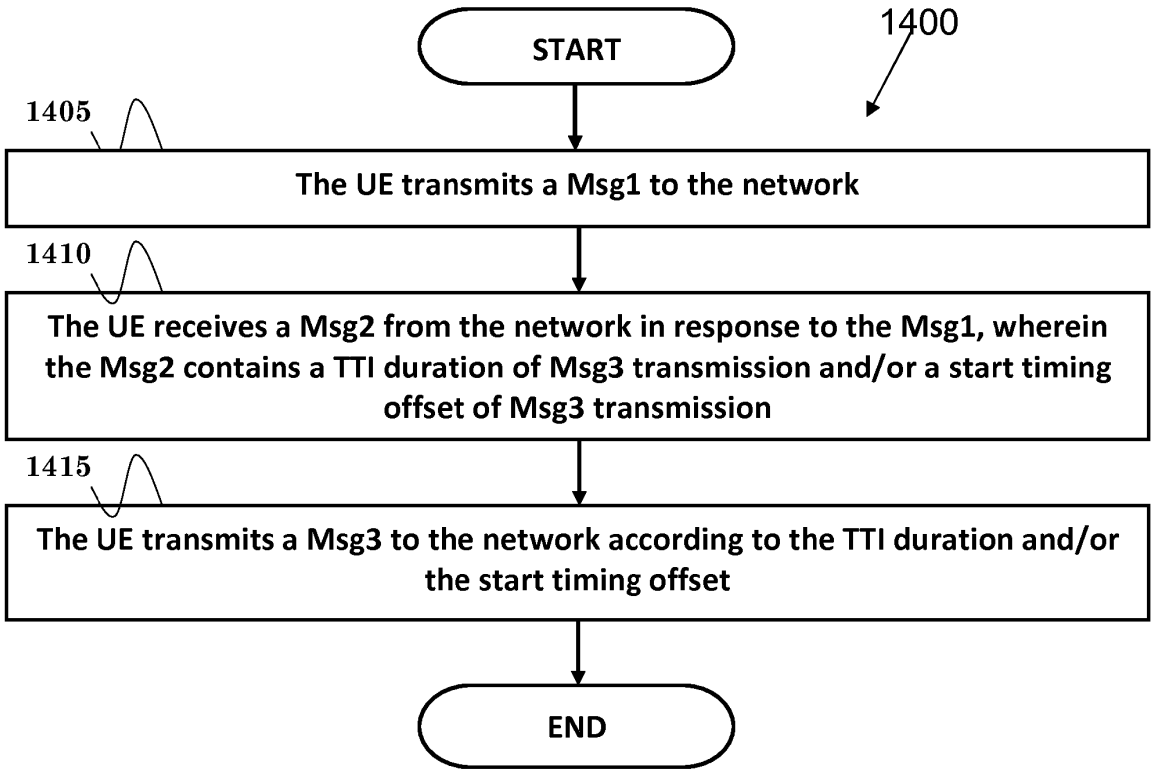

START
1400
1405
The UE transmits a Msg1 to the network
1410
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission
1415
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 14

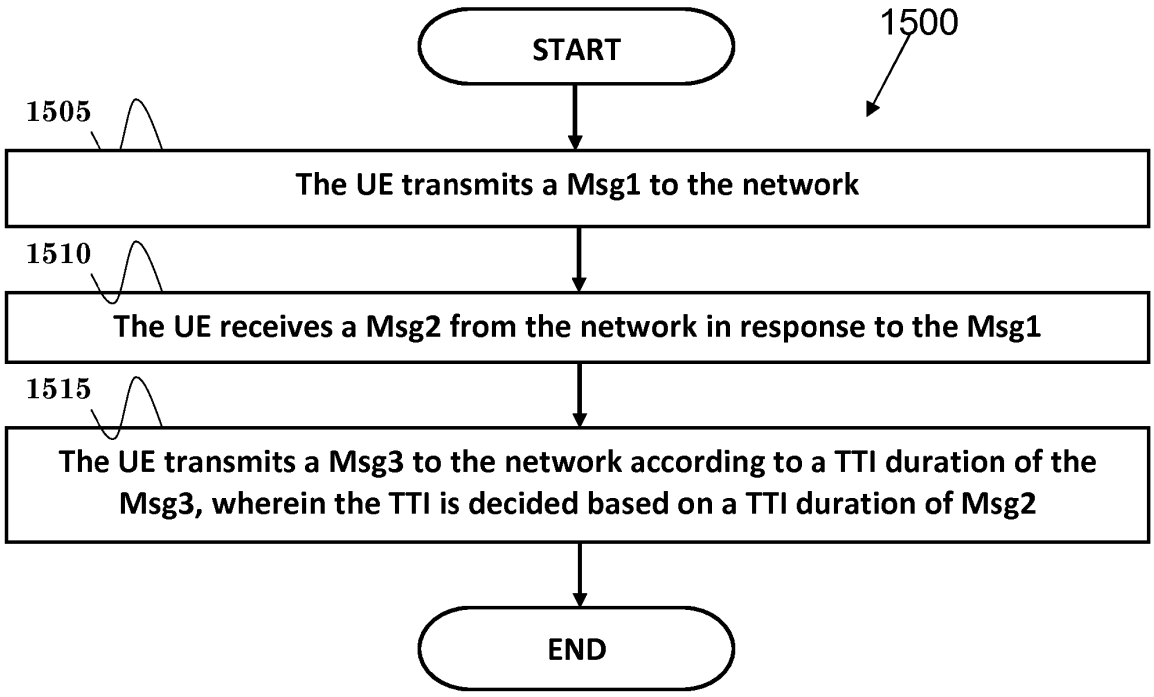

START
1500
1505
The UE transmits a Msg1 to the network
1510
The UE receives a Msg2 from the network in response to the Msg1
1515
The UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI is decided based on a TTI duration of Msg2
END

FIG. 15

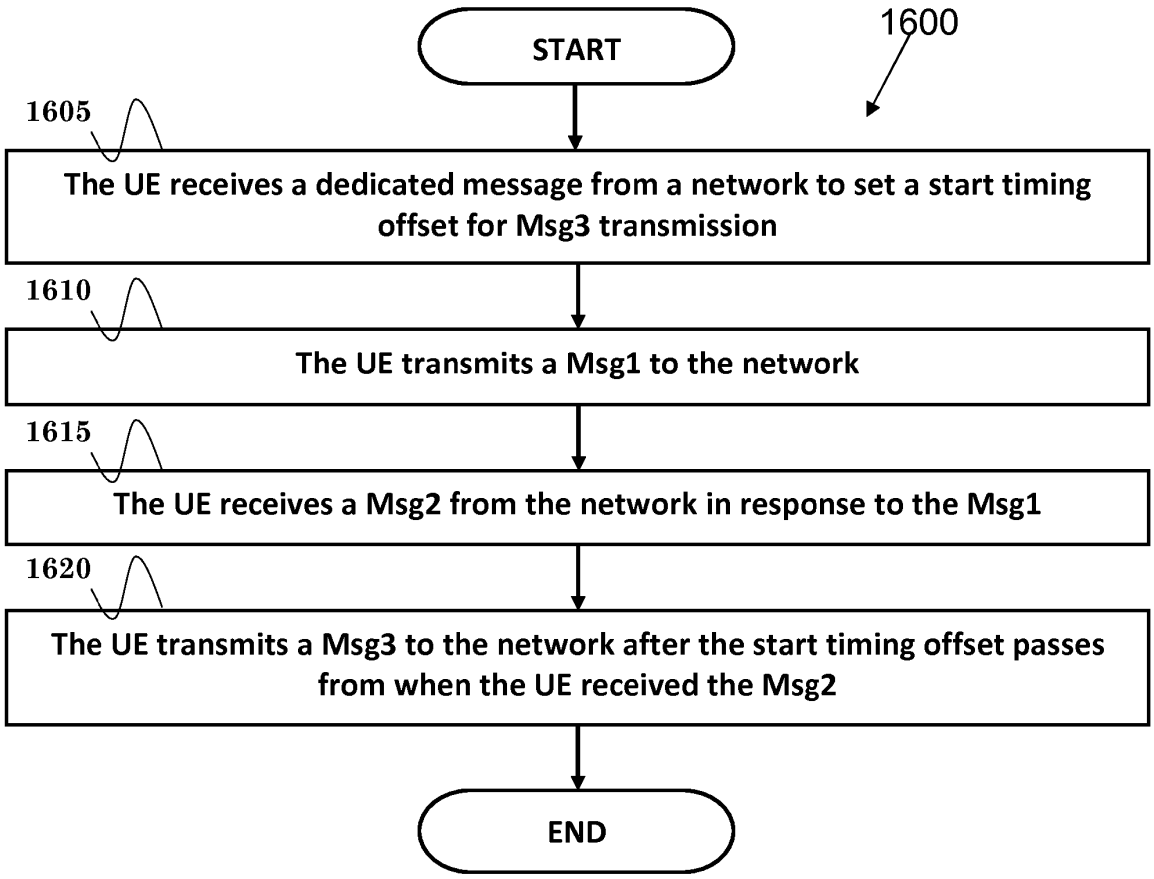

START
1600
1605
The UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission
1610
The UE transmits a Msg1 to the network
1615
The UE receives a Msg2 from the network in response to the Msg1
1620
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 16

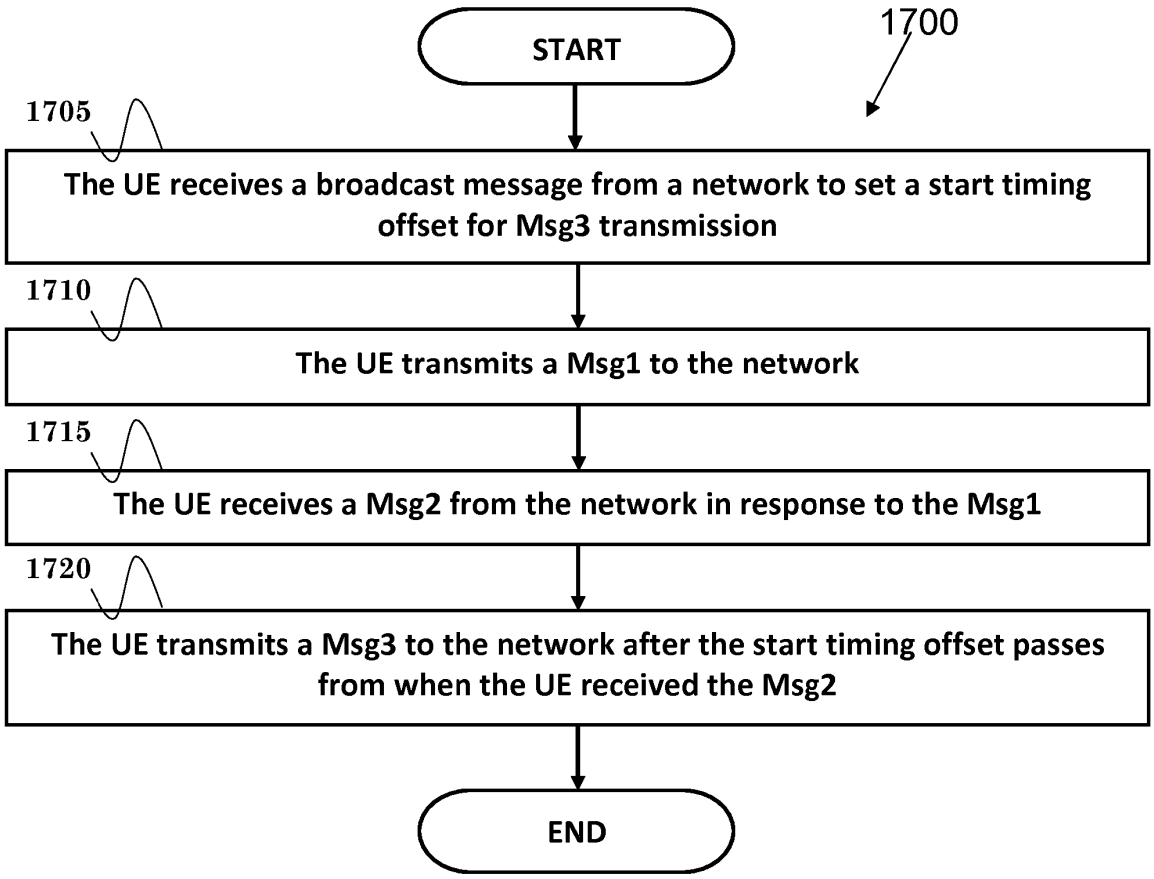

1700
START
1705
The UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission
1710
The UE transmits a Msg1 to the network
1715
The UE receives a Msg2 from the network in response to the Msg1
1720
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 17

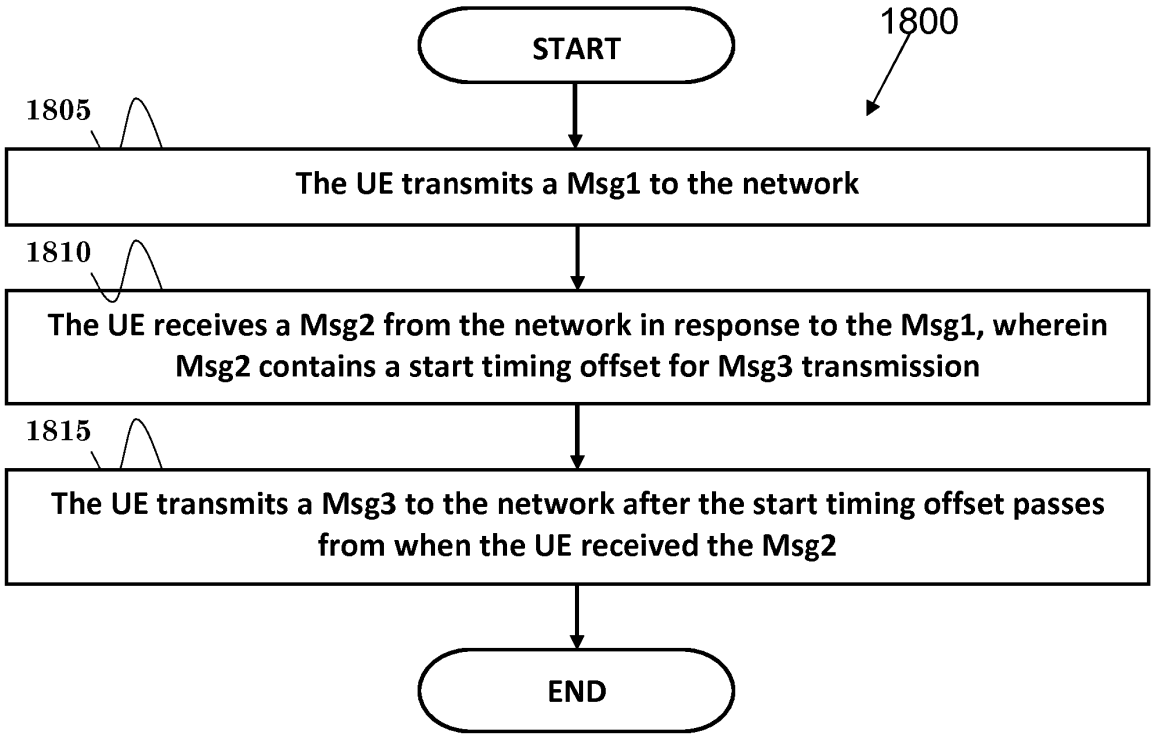

START
1800
1805
The UE transmits a Msg1 to the network
1810
The UE receives a Msg2 from the network in response to the Msg1, wherein Msg2 contains a start timing offset for Msg3 transmission
1815
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 18

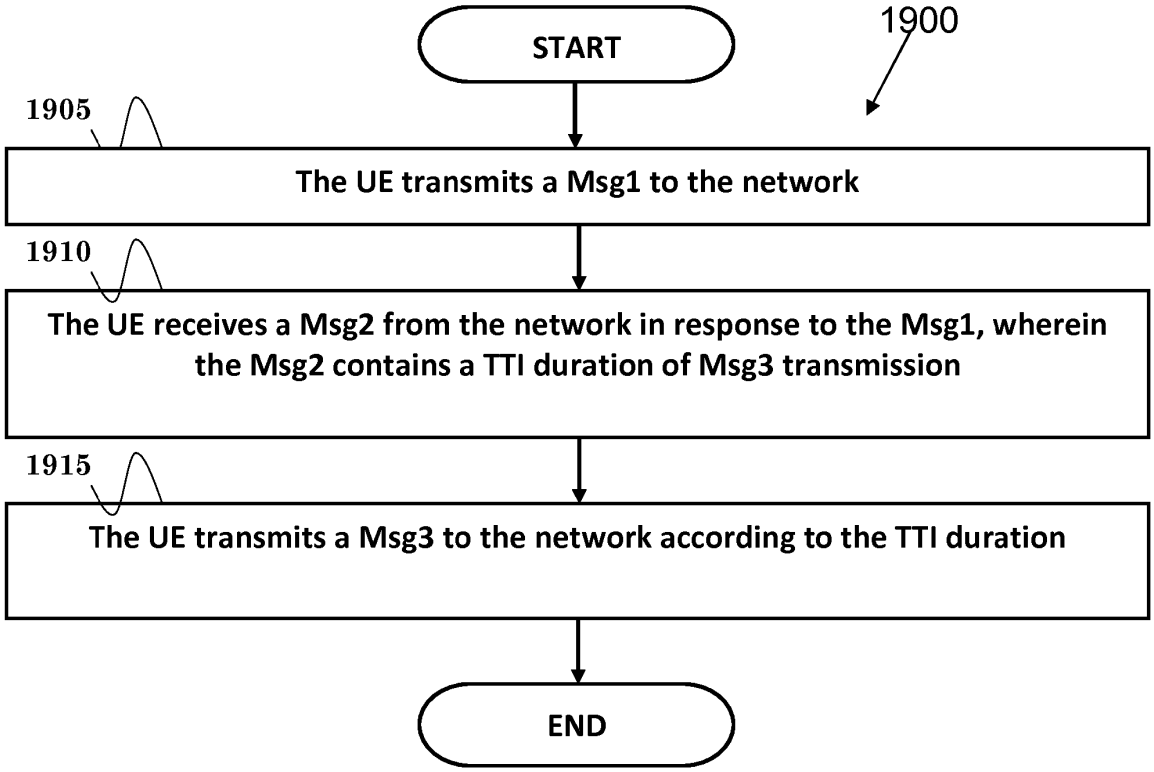

1900
START
1905
The UE transmits a Msg1 to the network
1910
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission
1915
The UE transmits a Msg3 to the network according to the TTI duration
END

FIG. 19

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ASU170707PEP-60/LX
May 13, 2020

METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM

This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for improving Msg3 transmission of random access procedure in a wireless communication system.

With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

EP 2680651 A1 discloses a method for flexibly selecting either 2ms TTI or 10 ms TTI for the messages of a random access procedure in UMTS. The UE notifies the Node B of the selected TTI by using different preamble codes in the first message. The Node B may deny the UE selection.

3GPP Technical Specification TS 36.213, V13.2.0, discloses a UL delay field for a response to the transmitted preamble sequence which determines whether transmitting the UL-SCH transport block on the first subframe n+k, or on the next available UL subframe after n+k.

3GPP document R1-160041 discloses the UL design for NB-IOT.

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ASU170707PEP-60/LX
January 20, 2021

SUMMARY

A method from the perspective of a user equipment, and a user equipment, for performing random access procedure are disclosed and defined in independent claims, respectively. Preferred embodiments thereof are defined in the dependent claims. The method includes the UE transmitting a Preamble to the network. The method also includes the UE receiving a Msg2 from the network for responding the Preamble. The method further includes the UE performing a Msg3 transmission to the network according to the TTI information of Msg3. In addition, the TTI information of the Msg3 is contained in the Msg2, wherein the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a start timing offset of the Msg3, respectively.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagram of a wireless communication system.

FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE).

FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

FIG. 5 is a reproduction of Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0.

FIG. 6 is a reproduction of Figure 10.1.5.2-1 of 3GPP TS 36.300 v13.2.0.

FIGS. 7 to 11 are diagrams.

FIGS. 12 and 13 are flow charts.

FIG. 14 is a flow chart according to one exemplary embodiment.

FIGS. 15 to 19 are flow charts.

DETAILED DESCRIPTION

The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A or LTE-Advanced (Long Term Evolution Advanced), 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

In particular, the exemplary wireless communication systems devices described below may be designed to support one or more standards such as the standard offered by a consortium named "3rd Generation Partnership Project" referred to herein as 3GPP, including: TR 38.913 v0.3.0, "Study on Scenarios and Requirements for Next Generation Access Technologies"; TS 36.300 v13.2.0, "Overall Description; Stage 2"; TS 36.913, v13.0.0, "Requirements for further advancements for Evolved Universal Terrestrial Radio Access (E-UTRA)"; TS 36.331 v13.2.0, "Radio Resource Control (RRC); Protocol specification"; TS 36.321 v13.1.0, "Medium Access Control (MAC) protocol specification"; and R2-163445, "Scheduling Framework and Requirements", Nokia and Alcatel-Lucent Shanghai Bell.

FIG. 1 shows a multiple access wireless communication system, which does not fall within the scope of the claims.

An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In FIG. 1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency then that used by reverse link 118.

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Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an evolved Node B (eNB), or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

FIG. 2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

Preferably, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

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The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and

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processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

Turning to FIG. 3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in FIG. 3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in FIG. 1 or the base station (or AN) 100 in FIG. 1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly. The communication device 300 in a wireless communication system can also be utilized for realizing the AN 100 in FIG. 1.

FIG. 4 is a simplified block diagram of the program code 312 shown in FIG. 3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

One of the general objectives of the present application is to study the frame structure used in New RAT (NR) for 5G, to accommodate various type of requirement (discussed in 3GPP TR 38.913) for time and frequency resource, e.g., from ultra-low latency (~0.5 ms) to expected longer TTI (Transmission Time Interval) for MTC (Machine Type Communication), from high peak rate for eMBB (enhanced Mobile Broadband) to very low data rate for MTC. An important focus is low latency aspect, while other aspect of mixing/adapting different TTIs can also be considered in the study. In addition to diverse services and requirements, forward compatibility is an important consideration in initial NR frame structure design as not all features of NR would be included in the beginning phase/release.

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[0001] 3GPP TS 36.300 includes the following random access (RA) procedure related description:

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;

The random access procedure is performed for the following events related to the PCell:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- Handover;
- DL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised".
- UL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised" or there are no PUCCH resources for SR available.
- For positioning purpose during RRC_CONNECTED requiring random access procedure;
  - E.g. when timing advance is needed for UE positioning.

The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG.

In DC, the random access procedure is also performed on at least PSCell upon SCG addition/modification, if instructed, or upon DL/UL data arrival during RRC_CONNECTED requiring random access procedure. The UE initiated random access procedure is performed only on PSCell for SCG.

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).

Normal DL/UL transmission can take place after the random access procedure.

An RN supports both contention-based and non-contention-based random access. When an RN performs the random access procedure, it suspends any current RN subframe

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configuration, meaning it temporarily disregards the RN subframe configuration. The RN subframe configuration is resumed at successful random access procedure completion.

10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

[Figure 10.1.5.1-1 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 5]

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:
   - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.
2) Random Access Response generated by MAC on DL-SCH:
   - Semi-synchronous (within a flexible window of which the size is one or more TTI) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least RA-preamble identifier, Timing Alignment information for the pTAG, initial UL grant and assignment of Temporary C-RNTI (which may or may not be made permanent upon Contention Resolution);
   - Intended for a variable number of UEs in one DL-SCH message.
3) First scheduled UL transmission on UL-SCH:
   - Uses HARQ;
   - Size of the transport blocks depends on the UL grant conveyed in step 2.
   - For initial access:
     - Conveys the RRC Connection Request generated by the RRC layer and transmitted via CCCH;
     - Conveys at least NAS UE identifier but no NAS message;

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- RLC TM: no segmentation.

- For RRC Connection Re-establishment procedure:
  - Conveys the RRC Connection Re-establishment Request generated by the RRC layer and transmitted via CCCH;
  - RLC TM: no segmentation;
  - Does not contain any NAS message.
- After handover, in the target cell:
  - Conveys the ciphered and integrity protected RRC Handover Confirm generated by the RRC layer and transmitted via DCCH;
  - Conveys the C-RNTI of the UE (which was allocated via the Handover Command);
  - Includes an uplink Buffer Status Report when possible.
- For other events:
  - Conveys at least the C-RNTI of the UE.

4) Contention Resolution on DL:
   - Early contention resolution shall be used i.e. eNB does not wait for NAS reply before resolving contention;
   - Not synchronised with message 3;
   - HARQ is supported;
   - Addressed to:
     - The Temporary C-RNTI on PDCCH for initial access and after radio link failure;
     - The C-RNTI on PDCCH for UE in RRC_CONNECTED.
   - HARQ feedback is transmitted only by the UE which detects its own UE identity, as provided in message 3, echoed in the Contention Resolution message;
   - For initial access and RRC Connection Re-establishment procedure, no segmentation is used (RLC-TM).

The Temporary C-RNTI is promoted to C-RNTI for a UE which detects RA success and does not already have a C-RNTI; it is dropped by others. A UE which detects RA success and already has a C-RNTI, resumes using its C-RNTI.

When CA is configured, the first three steps of the contention based random access procedures occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell.

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When DC is configured, the first three steps of the contention based random access procedures occur on the PCell in MCG and PSCell in SCG. When CA is configured in SCG, the first three steps of the contention based random access procedures occur on the PSCell while contention resolution (step 4) can be cross-scheduled by the PSCell.

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 of 3GPP TS 36.300 v13.2.0 is reproduced as FIG. 6]

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-

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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.

When performing non-contention based random access on the PCell or PSCell while DC 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 corresponding cell. 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 not including PSCell. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell for MCG and PSCell for SCG.

Details of each random access step and related control element are described in Sections 5.1, 5.4, 6, and 7 of 3GPP TS 36.321. Furthermore, some configurations for random access and obtaining procedure are discussed in 3GPP 36.331.

One NR requirement listed in 3GPP TR 38.913 lists the following NR requirement: "*Control plane latency refers to the time to move from a battery efficient state (e.g., IDLE) to start of continuous data transfer (e.g., ACTIVE). The target for control plane latency should be **10ms***." Regarding similar requirement in LTE, the control plane latency requirement is set to 50ms (as discussed in 3GPP TS 36.913). There is a huge gap between latency requirement of LTE and latency requirement of NR. Therefore, it would be better to reduce possible transmission and processing latency as much as possible. As discussed below, the present application first focuses on random access latency.

In LTE, there are two kinds of random access procedure, contention and non-contention. The contention random access procedure consists of 4 steps, including: Msg1, Msg2, Msg3, and Msg4. FIG. 5 is an exemplary embodiment for the contention random access. The Msg1 and Msg3 are transmitted from a UE to a network. And the resource for performing Msg1 transmission and Msg3 transmission are contention resource. If the network can successfully receive a Msg3, the network could identify the UE based on contents in Msg3, and transmit a Msg4 to the UE for finishing the contention.

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On the other hand, a dynamic TTI adjusting concept is discussed in 3GPP R2-163445, which proposes to set the TTI size per scheduling grant for optimizing TCP(Transmission Control Protocol) transmission case. In particular, short TTI can be used to accelerate TCP slow start process, and long TTI can be used in steady transmission rate state for reduce control signaling overhead.

Considering such dynamic TTI concept, the present application further discusses whether it can also be used to accelerate random access procedure and how to achieve dynamic TTI change in random access. The following discussion mainly focuses on the Msg3 transmission step in a random access procedure. In addition, the discussion below does not include UE's RF/Baseband capability differentiation (e.g., differentiation between normal cell phone in LTE and NB-IoT devices in LTE) case.

In LTE, there could be three different random access configurations in LTE system. The first configuration is generally for normal UEs with enough RF/Baseband capability to monitor whole system bandwidth (e.g., cell phones, high end MTC devices). The second configuration is generally for low-end MTC devices and normal UEs with enough RF/Baseband capability but worked in power limited condition. The third configuration is generally for NB-IoT (Narrow Band-Internet of Thing) UEs which pool RF/Baseband capability and can only perform transmission/reception on a narrow band (e.g., 1.4MHz). The last configuration is generally defined as a new RAT (Radio Access Technology). Normally, low-end MTC devices will only worked on the second configuration, and NB-IoT devices will work only on the third configuration. For a normal UE with enough RF/Baseband capability, the UE will only change RA configuration when it enters the power limited state (e.g., cell edge or even far away).

If short TTI applies to Msg3 transmission, the average random access latency could be reduced due to early start to monitor Msg4. A possible case for such benefit is shown in FIG. 7. As shown in FIG. 7, although the processing delay is a fixed period, the UE could start to receive Msg4 earlier owing to early Msg3 transmission. Moreover, two possibilities for monitoring Msg4 are shown in FIG. 7. The UE may expect either TTI format if the TTI length information is not be carried in scheduling control signal. Otherwise, the UE may expect multiple possibilities of TTI length.

Another possible benefit may be improving resource efficiency. If the dynamic TTI concept is applied to Msg3, the network can more flexibly adjust resource allocation. In LTE, the TTI

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length for Msg3 is fixed. In the same modulation scheme condition, LTE system could only schedule radio resource in PRB level, while NR may be able to schedule in symbol level.

To achieve dynamic TTI concept, a UE needs to derive TTI information (e.g., TTI length, numerology) for transmitting Msg3 on air interface. In this aspect, possible candidates for the UE are proposed to obtain such information. One or multiple solutions can be applied in a NR system.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional TTI information is added into RAR for scheduling Msg3. Preferably, the new TTI information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field. A possible exemplary embodiment is shown in FIG. 9.

Solution 2 – Common field in Msg2. In Solution 2, the TTI information is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI length has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry TTI information. A possible example is shown in FIG. 10. The TTI information 1 could be provided to preamble set 1 (e.g., rapid 0~20), and the TTI information 2 could be provided to preamble set 2 (e.g., rapid 21~40).

The TTI information carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g., PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access

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configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, ...) performing the random access.

Solution 3 – Broadcast Information. In Solution 3, which does not fall within the scope of the claims, a UE could derive TTI information for

Msg3 transmission through a broadcast message (e.g., system information(s), MIB, etc) from a network (e.g. gNB, base station, TRP, etc). If multiple TTI information for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol

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type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects TTI information in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the broadcast message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select TTI information in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the broadcast message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to

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radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 4, which does not fall within the scope of the claims, a UE could derive TTI information for

Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple TTI information for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects TTI information in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select TTI information in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select TTI information in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select TTI information in the dedicated message based on the service type indicated by the service indication.

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Preferably, the UE selects TTI information in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects TTI information in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects TTI information in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects TTI information in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and TTI information), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select TTI information in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select TTI information in the dedicated message related to the special control element/message. Preferably, the UE will select another TTI information if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects TTI information in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select TTI information in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects TTI information in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

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Solution 5 – Implicitly derive from Msg2 Transmission. In this solution, which does not fall within the scope of the claims, a UE could derive TTI information for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives TTI information for Msg3 based on TTI information used by Msg2. For example, the TTI duration of Msg3 transmission may be N times of TTI duration of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives TTI information for Msg3 based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different TTI informations. The corresponding TTI information may be predefined and/or provided through system information and/or provided through dedicated RRC message.

Msg3 start timing offset - In LTE, there is a fixed gap period between Msg2 reception and Msg3 transmission. The fixed gap period is designed for covering UE's Msg2/3 processing time (e.g., decode, (de-)multiplexing transport block). However, in NR, some possible methods can bring benefits to reduce such fixed gap period. For example, if short TTI is applied to both Msg2/Msg3 transmissions as FIG. 11, the minimum of the fixed gap between Msg2 and Msg3 can be set to short TTI. Otherwise, the minimum gap could only be set to normal sub-frame length like without short TTI case.

There are also many other ways for reducing processing time (e.g. provision TB size). These methods will bring not only the benefit, but also some limitations and/or complexity. As a conclusion, we think that it could be beneficial for network be capable to decide the length of gap period. For achieving the concept, a UE will need to know the gap information (or called Msg3 start timing offset) by information provided from network. The possible solutions are listed below.

Solution 1 – RAR (Random Access Response). In LTE, Msg3 transmission is scheduled by UL grant field in RAR. A RAR is a response for a preamble transmitted at a Msg1 transmission opportunity from UE(s). The format of RAR in LTE is shown in FIG. 8.

The Msg3 transmission is scheduled according to UL (Uplink) grant field in the RAR. In this solution, additional information is added into RAR for adjusting Msg3 start timing offset. Preferably, the additional information can be a new field in RAR or a new field in Msg2 for a specific preamble or added into UL grant field.

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Solution 2 – Common field in Msg2. In Solution 2, the Msg3 start timing offset is also carried in Msg2 similar to Solution 1. The Msg2 may include multiple RARs. And MAC sub-header of a RAR will indicate the RAR is for which preamble. However, since the TTI information has limited choices, there may be no need to repeatedly include the redundant information. Hence, it is proposed to use common field(s) in Msg2 to carry Msg3 start timing offset.

The Msg3 start timing offset carried in a common field will be applied to UEs performed different Msg1 transmission (e.g., different preamble). The different Msg1 transmissions are differentiable by receiving side in Code domain and/or Time domain and/or Frequency domain. Preferably, the common field(s) may be carried as control element. Alternatively, the common field(s) may be carried as part of MAC (sub-)header, as data (e.g., RRC configuration), or in control signal (e.g. PDCCH signal) for scheduling Msg2.

If multiple common fields are included in a Msg2, a UE could select one of them to apply to Msg3 transmission. Preferably, the UE could select common field based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc). The UE could also select common field based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select common field for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field), or based on delivering user plane protocol type/category (e.g., category 1 maps to URLLC). As an example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select common field for URLLC service type. As another example, if higher layer (e.g., NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select common field based on the service type indicated by the service indication.

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Preferably, the UE selects common field based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g. NAS, RRC, application layer) in the UE.

Preferably, the UE selects common field based on potential Msg3 size. For example, if the pending available data in a UE larger than a threshold when a UE is performing RA, the UE selects common field for potential message size larger than the threshold.

Preferably, the UE selects common field based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority (e.g. access class, etc) provided from network or UE subscription, or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select common field related to the LC or RB based on the UE's configuration (e.g. association between LC/RB and random access configuration, association between LC/RB and service configuration, association between LC/RB and transport channel configuration, etc). As another example, if Msg3 could include a special control element / special message, the UE could select common field related to the special control element/message. Preferably, the UE will select another common field if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects common field based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select common field based on whether priority 2 is over a threshold or not.

Preferably, the UE selects common field based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g. URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 3 – Broadcast Information. In Solution 3, which does not fall within the scope of the claims, a UE could derive Msg3 start timing

offset for Msg3 transmission through a broadcast message (e.g., system information(s), MIB,

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etc) from a network (e.g. gNB, base station, TRP, etc). If multiple Msg3 start timing offsets for Msg3 transmission are included in the broadcast message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offsets in the broadcast message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by Msg1, etc), or based on service types (e.g., URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in the broadcast message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data.

The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g., RLC header field, PDCP field). The UE may also understand the data belonging to which service type based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC). As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the broadcast message for URLLC service type. As a further example, if higher layer (e.g. NAS layer, application layer, RRC layer) in a UE sends a service indication to lower layer(e.g. MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the broadcast message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on random access purpose (e.g., request broadcast message, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the broadcast message for potential message size larger than the threshold.

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Preferably, the UE selects Msg3 start timing offset in the broadcast message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock, data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific or a set of LC or RB (e.g., URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in the broadcast message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the broadcast message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in the broadcast message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the broadcast message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 4 – Dedicated message. In Solution 4, which does not fall within the scope of the claims, a UE could derive Msg3 start timing offset

for Msg3 transmission through a dedicated message (e.g., RRC reconfiguration message, paging message, PDCCH for initiating RA, …) from a network. If multiple Msg3 start timing offsets for Msg3 transmission are (implicitly or explicitly) included in the dedicated message, a UE could select one of them to apply to Msg3 transmission.

Preferably, the UE selects Msg3 start timing offset in dedicated message based on its Msg1 transmission (e.g., preamble group set in RA configuration used by Msg1, PRACH resource set in RA configuration used by Msg1, Msg1 length or format, RA configuration used by

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Msg1, etc), or based on service types (e.g. URLLC, eMBB, delay sensitive, ...). For example, if the UE triggers RA for transmitting a specific service type data (e.g., URLLC service type), then the UE could select Msg3 start timing offset in dedicated message for the specific service type. Moreover, the UE may understand the data belonging to which service type based on a service type indication (similar to logical channel priority) in configuration of logical channel/RB having available data. The service type indication may be used in multiplexing procedure. For instance, the UE may not multiplex data with different service type indications into a TB for transmission. Alternatively, the UE may understand the data belonging to which service type based on header field of the data (e.g. RLC header field, PDCP field)), or based on delivering user plane protocol type/category (e.g. category 1 maps to URLLC).

As another example, if the UE triggers RA when the UE has registered/authorized for URLLC service type, the UE could select Msg3 start timing offset in the dedicated message for URLLC service type. As a further example, if higher layer (e.g., NAS layer, application layer, RRC layer) in the UE sends a service indication to lower layer(e.g., MAC, PHY) in the UE when the UE triggers and/or performs RA, the UE could select Msg3 start timing offset in the dedicated message based on the service type indicated by the service indication.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on random access purpose (e.g., request system information, paging, positioning, location update, control plane establishment, beam recovery, etc). And the random access purpose may be indicated by higher layer (e.g., NAS, RRC, application layer) in the UE.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on potential Msg3 size. For example, if the pending available data in the UE larger than a threshold when the UE is performing RA, the UE selects Msg3 start timing offset in the dedicated message for potential message size larger than the threshold.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on its DL measurement, based on connection establishment cause (e.g., emergency call, mo-data, mt-data, …), based on its current power ramping result (e.g. ramping over threshold times or threshold power, changing based on mapping table between ramping steps and Msg3 start timing offset), based on UE priority provided from network or UE subscription (e.g. access class, etc), or based on Msg3 contents (e.g., which type control element could be included, BSR reporting for which LCG or which RB/LC, data from which user plane protocol stock,

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data from which radio bearer, data from which logical channel, …). For example, if Msg3 could include data from a specific (set of) LC or RB (e.g. URLLC type RB, CCCH, …), the UE could select Msg3 start timing offset in dedicated message related to the LC or RB based on the UE's configuration. As another example, if Msg3 could include a special control element / special message, the UE could select Msg3 start timing offset in the dedicated message related to the special control element/message. Preferably, the UE will select another Msg3 start timing offset if the Msg3 doesn't include the special control element and/or the special message (e.g. RRC message).

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of radio bearers having available data. For example, the UE has available data belonging to radio bearer with priority 2 and priority 8 when the UE is performing RA. The UE could select Msg3 start timing offset in dedicated message based on whether priority 2 is over a threshold or not.

Preferably, the UE selects Msg3 start timing offset in the dedicated message based on highest priority of logical channels having available data, or based on which user plane protocol stock (e.g., URLLC or eMBB type user plane protocol, protocol stock category/index 1 or 2, …) performing the random access.

Solution 5 – Implicitly derive from Msg2 Transmission. In this solution, which does not fall within the scope of the claims, a UE could derive Msg3 start timing offset for Msg3 transmission based on implicit information of Msg2. Preferably, a UE derives Msg3 start timing offset based on start timing offset used by Msg2. For example, the Msg3 start timing offset of Msg3 transmission may be N times of start timing offset of Msg2. N value can be integer or decimal. The N value may be obtained by the UE based on one or multiple solutions mentioned above. The UE may obtain the N value through the broadcast message from a network. And the UE could overwrite the N value provided in the broadcast message, if the UE receives another N value in a dedicated message.

Alternatively preferably, a UE derives Msg3 start timing offset based on frequency carrier used by Msg2. Each frequency carrier may have corresponding different Msg3 start timing offsets. The corresponding Msg3 start timing offset may be predefined and/or provided through system information and/or provided through dedicated RRC message.

The Msg3 start timing offset can be derived through the solution 1 to 5 mentioned above or combination of those solutions, while Msg3 start timing offset and TTI information of Msg3

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can apply the same or different solutions. The Msg3 start timing offset can be indicated in TTI duration, numerology, symbol, slot, microsecond, millisecond or N times of periodicity of periodic behavior. N value can be integer or decimal.

FIG. 12 is a flow chart 1200, which does not fall within the scope of the claims, from the perspective of a UE. In step 1205, the UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission. In step 1210, the UE transmits a Msg1 to the network. In step 1215, the UE receives a Msg2 from the network in response to the Msg1. In step 1220, the UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration and/or the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 13 is a flow chart 1300, which does not fall within the scope of the claims, from the perspective of a UE. In step 1305, the UE receives a broadcast message from a network to set TTI duration of Msg3. In step 1310, the UE transmits a Msg1 to the network. In step 1315, the UE receives a Msg2 from the network in response to the Msg1. In step 1320, the UE transmits a Msg3 to the network according to the TTI duration of Msg3.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set TTI duration of Msg3, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network according to the TTI duration of Msg3. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 14 is a flow chart 1400 according to one exemplary embodiment from the perspective of a UE. In step 1405, the UE transmits a Msg1 to a network. In step 1410, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration

of Msg3 transmission and a start timing offset of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. Preferably, the start timing offset of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the start timing offset of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1415, the UE transmits a Msg3 to the network according to the TTI duration and the start timing offset.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 is configured to execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and a start timing offset of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration and the start timing offset. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 15 is a flow chart 1500, which does not fall within the scope of the claims, from the perspective of a UE. In step 1505, the UE transmits a Msg1 to a network. In step 1510, the UE receives a Msg2 from the network in response to the Msg1. In step 1515, the UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, and (iii) to transmit a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI duration of the Msg3 is decided based on a TTI duration of Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 16 is a flow chart 1600, which does not fall within the scope of the claims, from the perspective of a UE. In step 1605, the UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission. In step 1610, the UE transmits a Msg1 to the network. In step 1615, the UE receives a Msg2 from the network in response to the Msg1. In step 1620, the

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UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a dedicated message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 17 is a flow chart 1700, which does not fall within the scope of the claims, from the perspective of a UE. In step 1705, the UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission. In step 1710, the UE transmits a Msg1 to the network. In step 1715, the UE receives a Msg2 from the network in response to the Msg1. In step 1720, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in the related art of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a broadcast message from a network to set a start timing offset for Msg3 transmission, (ii) to transmit a Msg1 to the network, (iii) to receive a Msg2 from the network in response to the Msg1, and (iv) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 18 is a flow chart 1800, which does not fall within the scope of the claims, from the perspective of a UE. In step 1805, the UE transmits a Msg1 to the network. In step 1810, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission. In step 1815, the UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to the network, (iii) to receive a

Msg2 from the network in response to the Msg1, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a start timing offset for Msg3 transmission, and (iii) to transmit a Msg3 to the network after the start timing offset passes from when the UE received the Msg2. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

FIG. 19 is a flow chart 1900, which does not fall within the scope of the claims, from the perspective of a UE. In step 1905, the UE transmits a Msg1 to a network. In step 1910, the UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission. Preferably, the TTI duration of Msg3 transmission is indicated in a common field for multiple RARs in the Msg2. Alternatively or additionally preferably, the TTI duration of Msg3 transmission is indicated in a RAR in response to the Msg1 transmission. In step 1915, the UE transmits a Msg3 to the network according to the TTI duration.

Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to transmit a Msg1 to a network, (ii) to receive a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission, and (iii) to transmit a Msg3 to the network according to the TTI duration. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

With respect to the embodiments illustrated in FIGS. 12 through 19 and discussed above, preferably, the UE selects a TTI duration of Msg3 if there are multiple TTI durations of Msg3 in the dedicated message, the broadcast message, or the Msg2. Furthermore, the TTI duration of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Preferably, the UE selects a TTI duration of Msg3 if there are multiple start timing offsets for Msg3 transmission in the dedicated message, the broadcast message, or the Msg2. Furthermore, the start timing offset of Msg3 could be included in a RAR in response to Msg1 or in a common field for multiple RARs in a Msg2.

Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings

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herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an

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integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the

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aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

New claims 1 to 7
Clean version

1. A method of a User Equipment, in the following also referred to as UE, for performing random access procedure, comprising:

the UE transmits a Preamble to a network (1405);

the UE receives a Msg2 from the network in response to the Preamble (1410); and

the UE performs a Msg3 transmission to the network according to TTI information of the Msg3 (1415) ,

wherein the TTI information of the Msg3 is contained in the Msg2,

characterized in that

the TTI information of the Msg3 includes a first number of time units and a second number of time units for indicating a TTI duration of the Msg3 and a gap period between Msg2 reception and Msg3 transmission, respectively.

2. The method of claim 1, further comprising:

the UE selects the TTI information of the Msg3 based on random access purpose, if there are multiple TTI information of the Msg3 in the Msg2.

3. The method of claim 1 or 2, further comprising:

the UE selects the TTI information of the Msg3 based on Physical Random Access Channel resource set of the Preamble transmission or preamble set of the Preamble transmission, if there are multiple TTI information of the Msg3 in the Msg2.

4. The method of any one of claims 1 to 3, further comprising:

the UE selects the TTI information of the Msg3 based on highest priority of logical channel having data available for transmission, if there are multiple TTI information of the Msg3 in the Msg2.

5. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a Random Access Response, in the following also referred to as RAR, for responding the Preamble, wherein the RAR is included in the Msg2.

6. The method of any one of claims 1 to 4, wherein the TTI information of the Msg3 is included in a common field for multiple RARs in the Msg2.

New claims 1 to 7
Clean version

7. A User Equipment, in the following also referred to as UE, comprising:

a control circuit (306);

a processor (308) installed in the control circuit (306); and

a memory (310) installed in the control circuit (306) and operatively coupled to the processor (308);

characterized in that the processor (308) is configured to execute a program code (312) stored in the memory (310) to perform the method steps as defined in any one of the preceding claims.

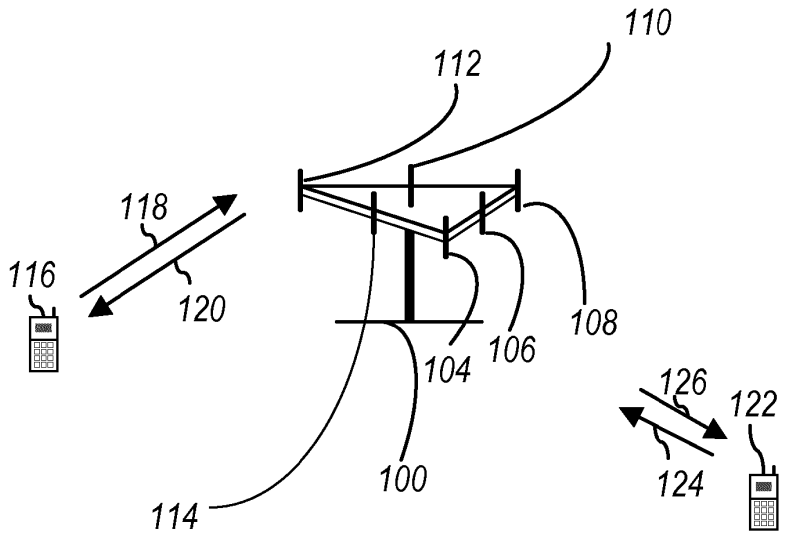


FIG. 1

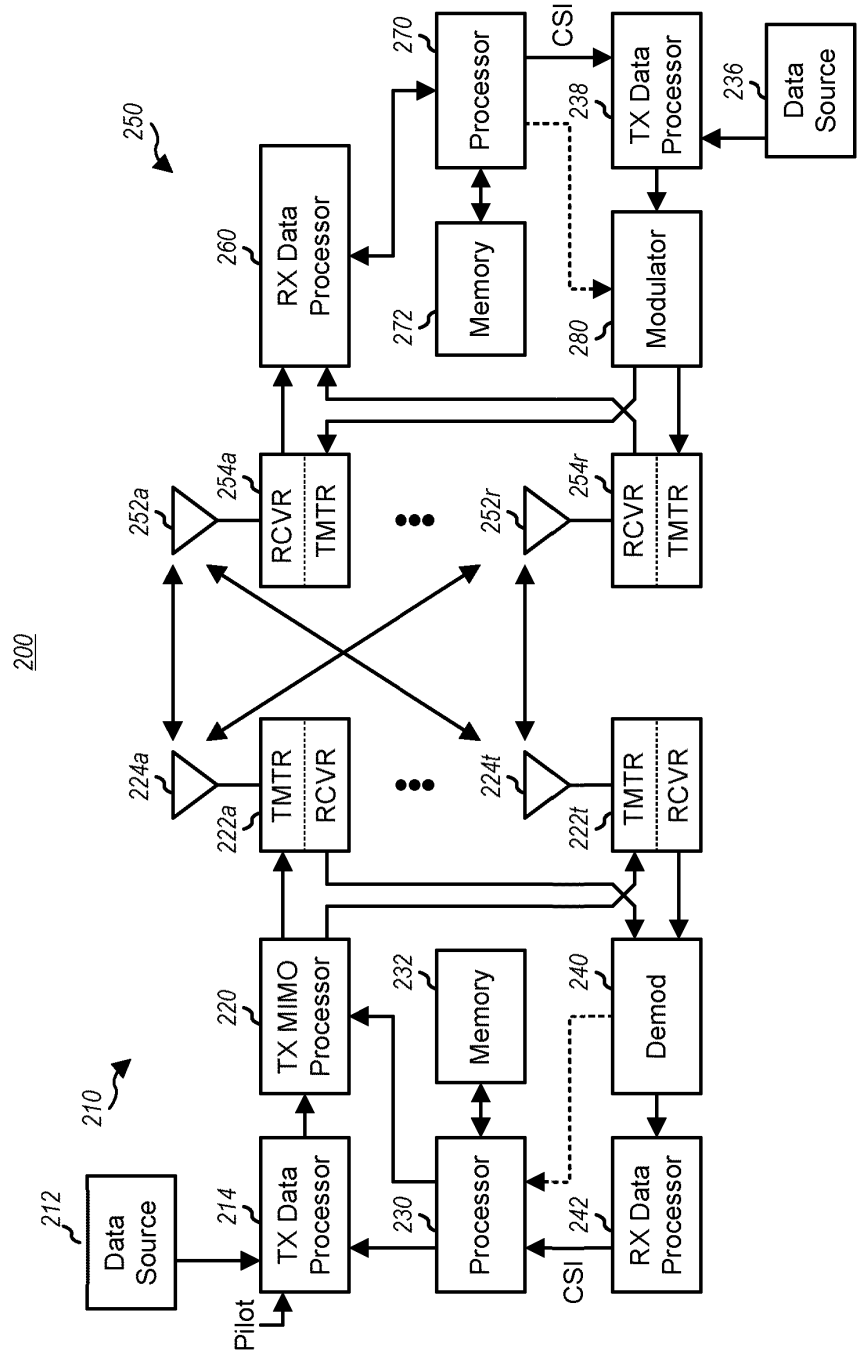

200
210
212
Data Source
214
TX Data Processor
Pilot
220
TX MIMO Processor
222a
TMTR
RCVR
224a
224t
222t
230
Processor
232
Memory
240
Demod
242
RX Data Processor
CSI
250
252a
254a
RCVR
TMTR
252r
254r
260
RX Data Processor
270
Processor
272
Memory
CSI
238
280
Modulator
TX Data Processor
236
Data Source

FIG. 2

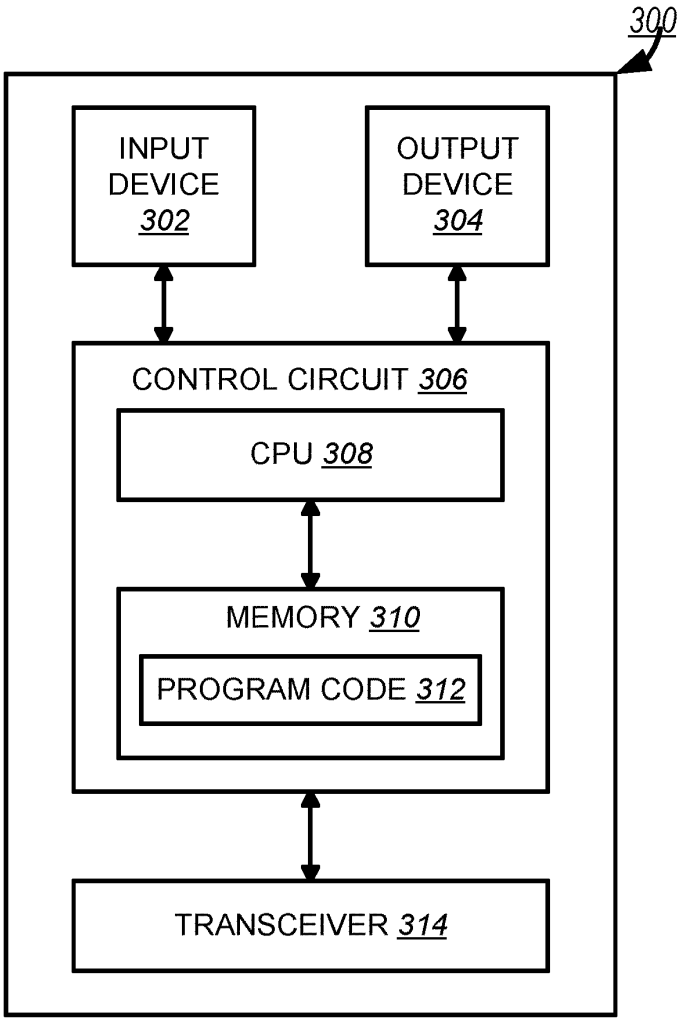

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. 3

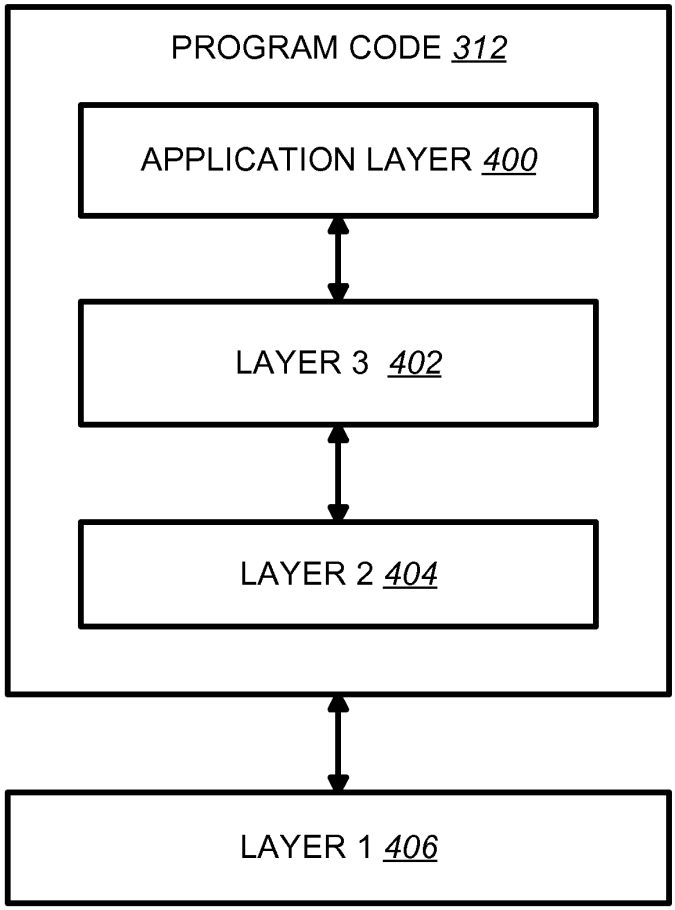

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. 4

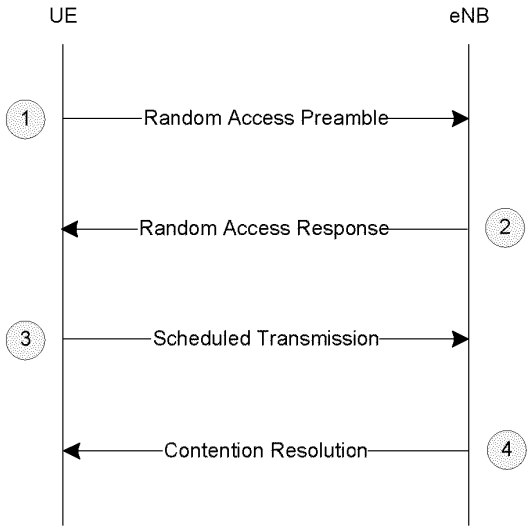

UE
eNB
1
Random Access Preamble
Random Access Response
2
3
Scheduled Transmission
Contention Resolution
4

FIG. 5

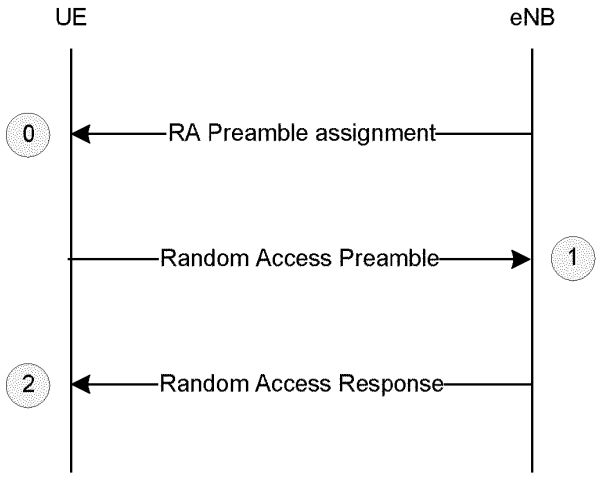

UE
eNB
0
RA Preamble assignment
Random Access Preamble
1
2
Random Access Response

FIG. 6

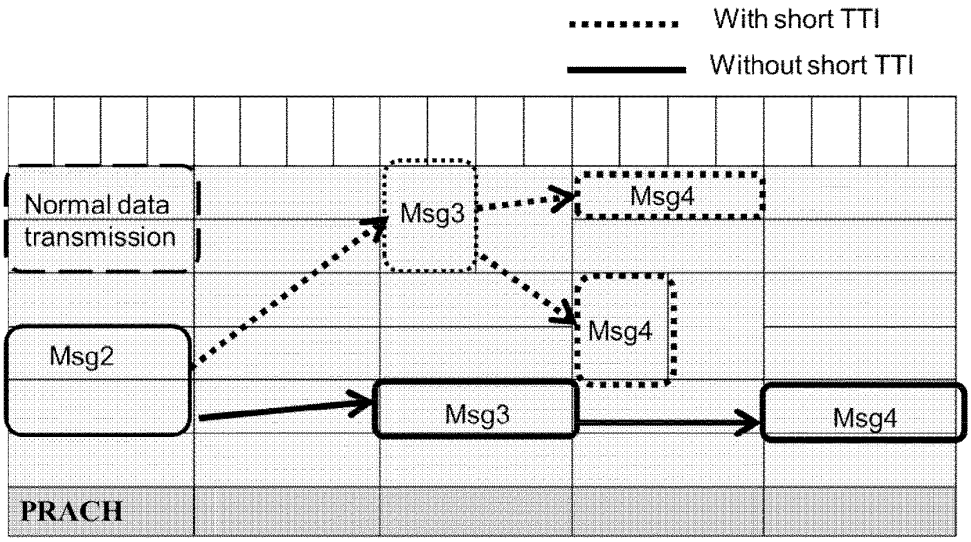

With short TTI
Without short TTI
Normal data transmission
Msg3
Msg4
Msg4
Msg2
Msg3
Msg4
PRACH

FIG. 7

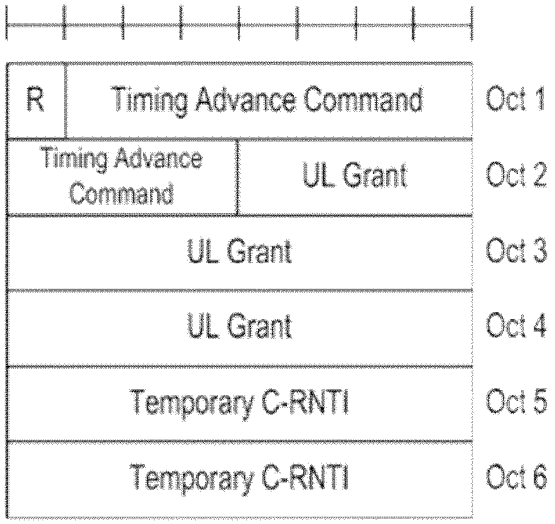

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6

FIG. 8

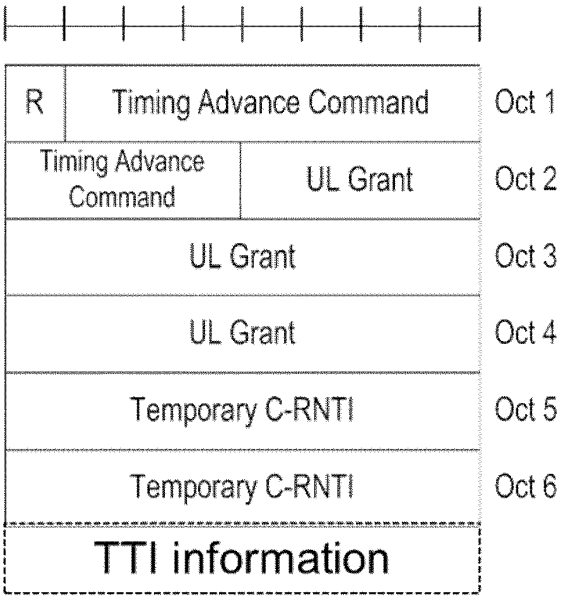

R
Timing Advance Command
Oct 1
Timing Advance Command
UL Grant
Oct 2
UL Grant
Oct 3
UL Grant
Oct 4
Temporary C-RNTI
Oct 5
Temporary C-RNTI
Oct 6
TTI information

FIG. 9

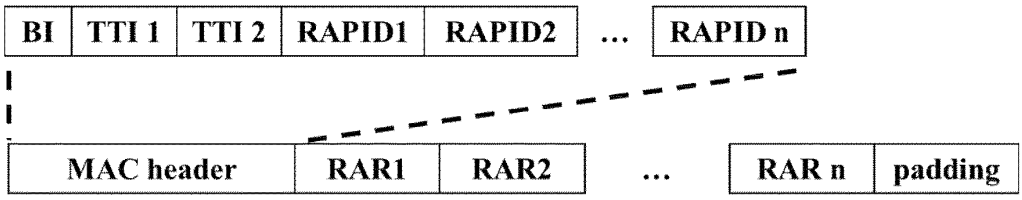

BI
TTI 1
TTI 2
RAPID1
RAPID2
…
RAPID n
MAC header
RAR1
RAR2
…
RAR n
padding

FIG. 10

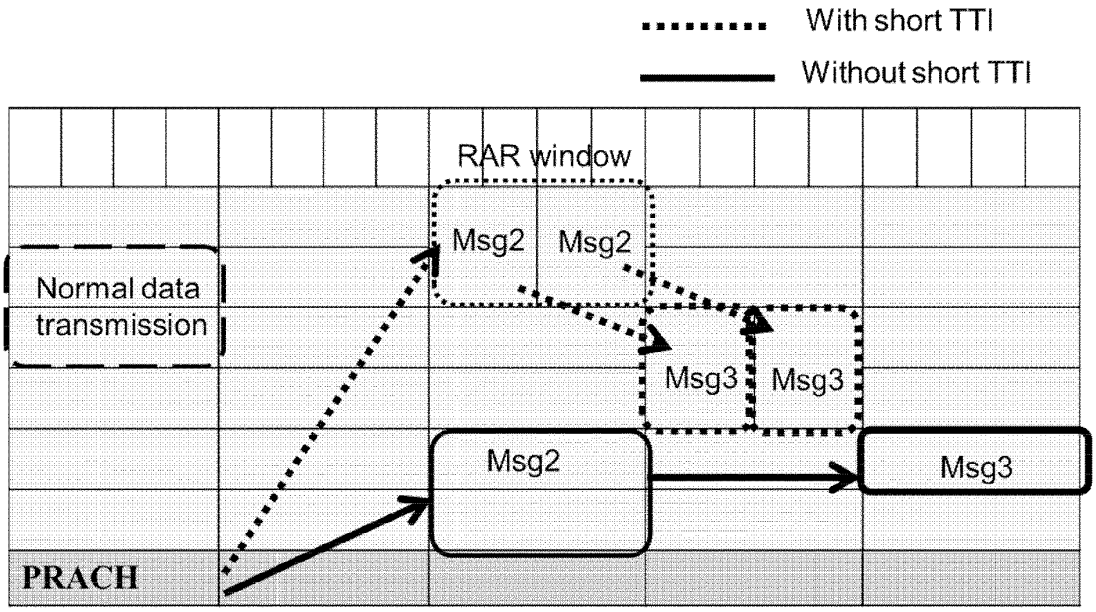

With short TTI
Without short TTI
RAR window
Msg2
Msg2
Normal data transmission
Msg3
Msg3
Msg2
Msg3
PRACH

FIG. 11

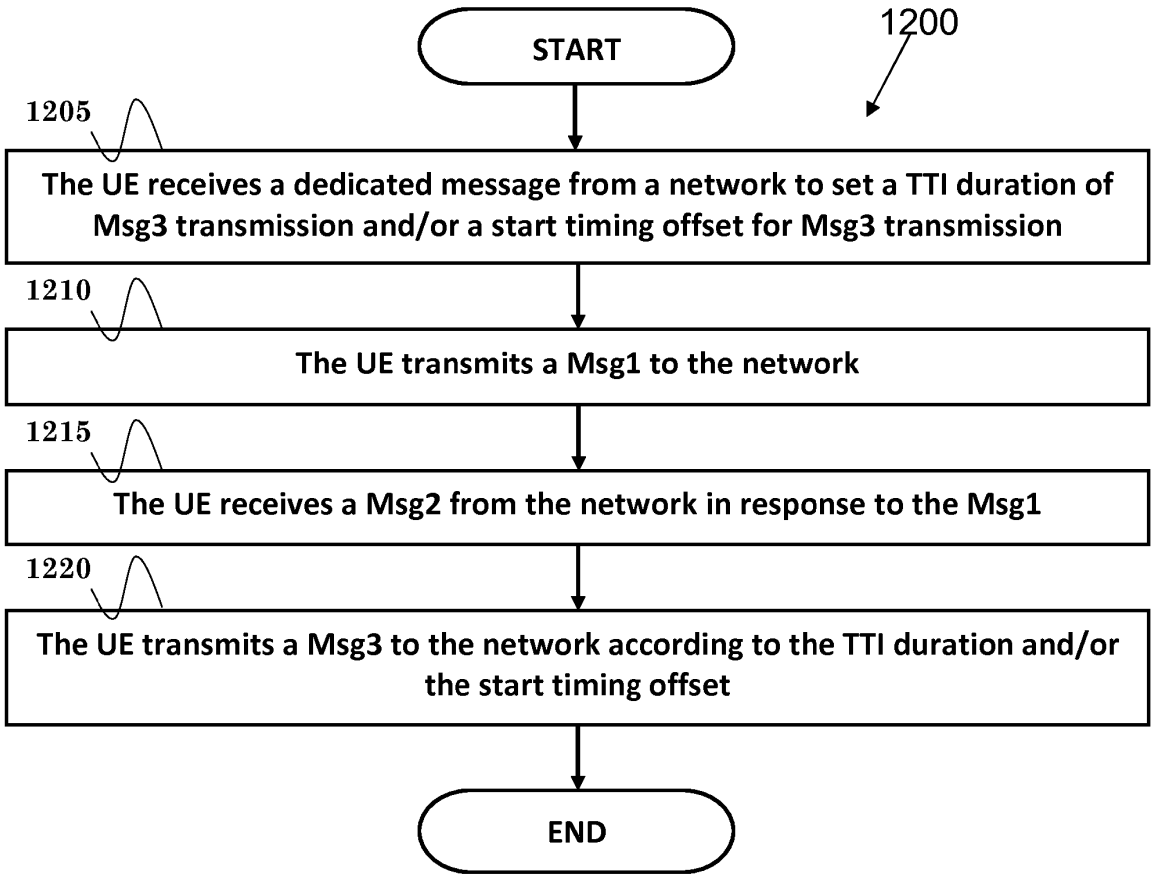

START
1200
1205
The UE receives a dedicated message from a network to set a TTI duration of Msg3 transmission and/or a start timing offset for Msg3 transmission
1210
The UE transmits a Msg1 to the network
1215
The UE receives a Msg2 from the network in response to the Msg1
1220
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 12

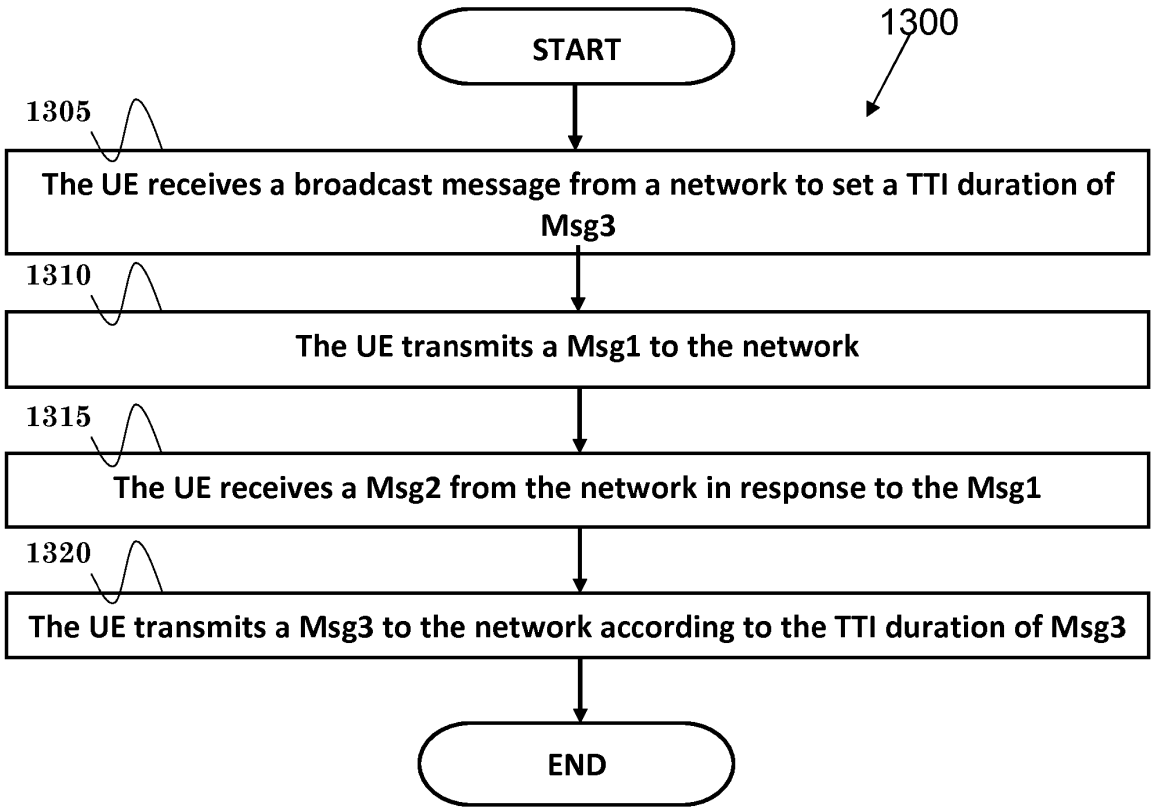

START
1300
1305
The UE receives a broadcast message from a network to set a TTI duration of Msg3
1310
The UE transmits a Msg1 to the network
1315
The UE receives a Msg2 from the network in response to the Msg1
1320
The UE transmits a Msg3 to the network according to the TTI duration of Msg3
END

FIG. 13

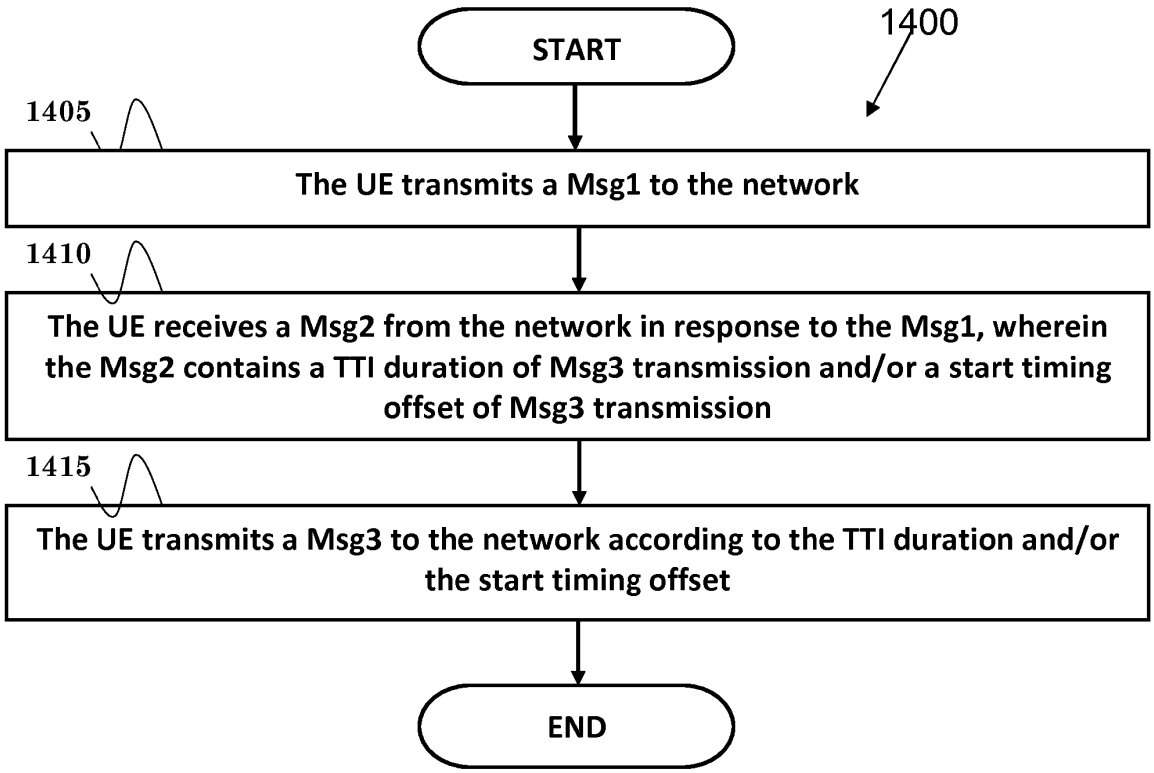

START
1400
1405
The UE transmits a Msg1 to the network
1410
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission and/or a start timing offset of Msg3 transmission
1415
The UE transmits a Msg3 to the network according to the TTI duration and/or the start timing offset
END

FIG. 14

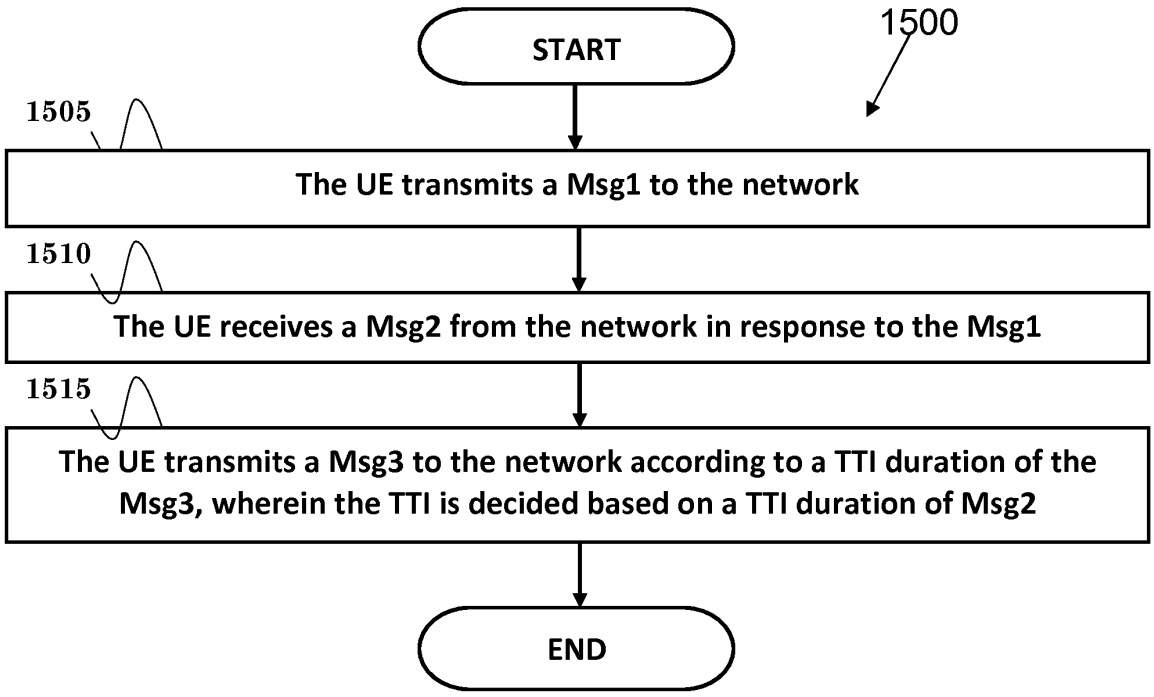

START
1500
1505
The UE transmits a Msg1 to the network
1510
The UE receives a Msg2 from the network in response to the Msg1
1515
The UE transmits a Msg3 to the network according to a TTI duration of the Msg3, wherein the TTI is decided based on a TTI duration of Msg2
END

FIG. 15

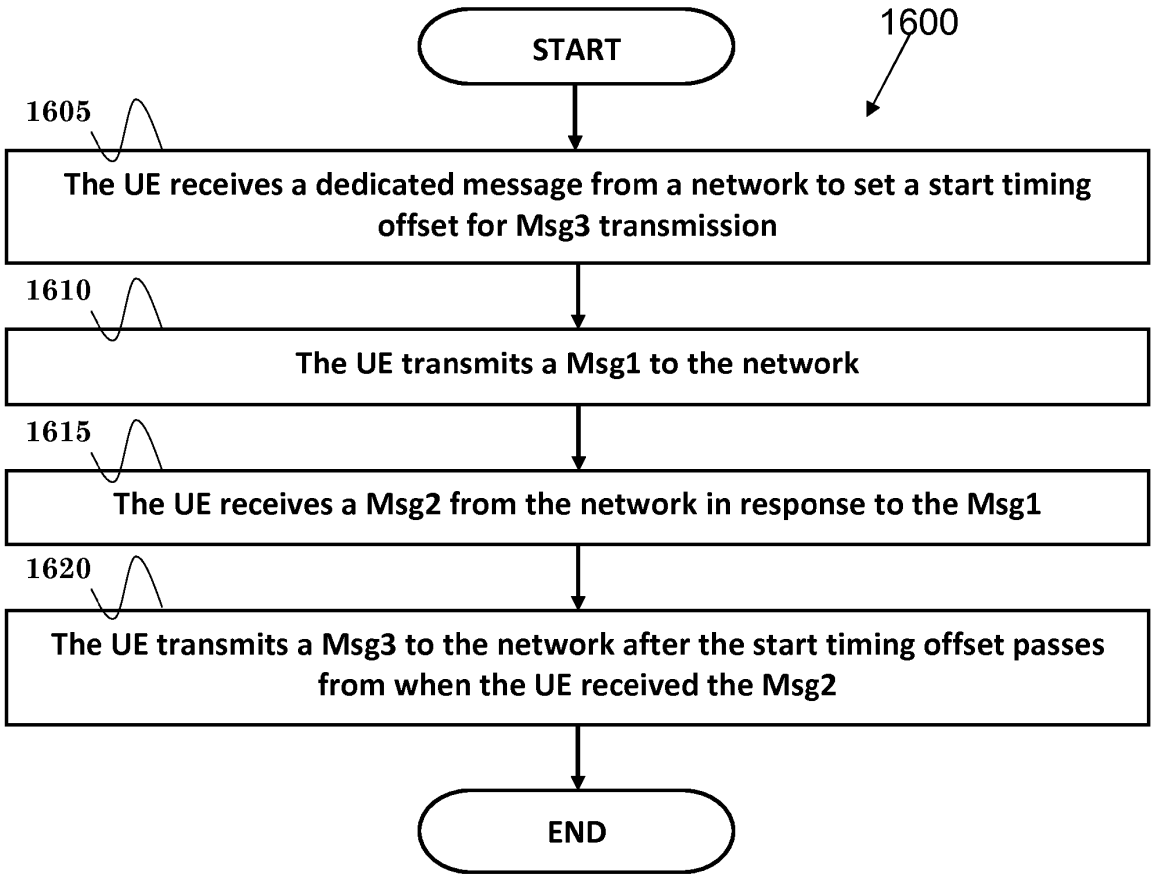

START
1600
1605
The UE receives a dedicated message from a network to set a start timing offset for Msg3 transmission
1610
The UE transmits a Msg1 to the network
1615
The UE receives a Msg2 from the network in response to the Msg1
1620
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 16

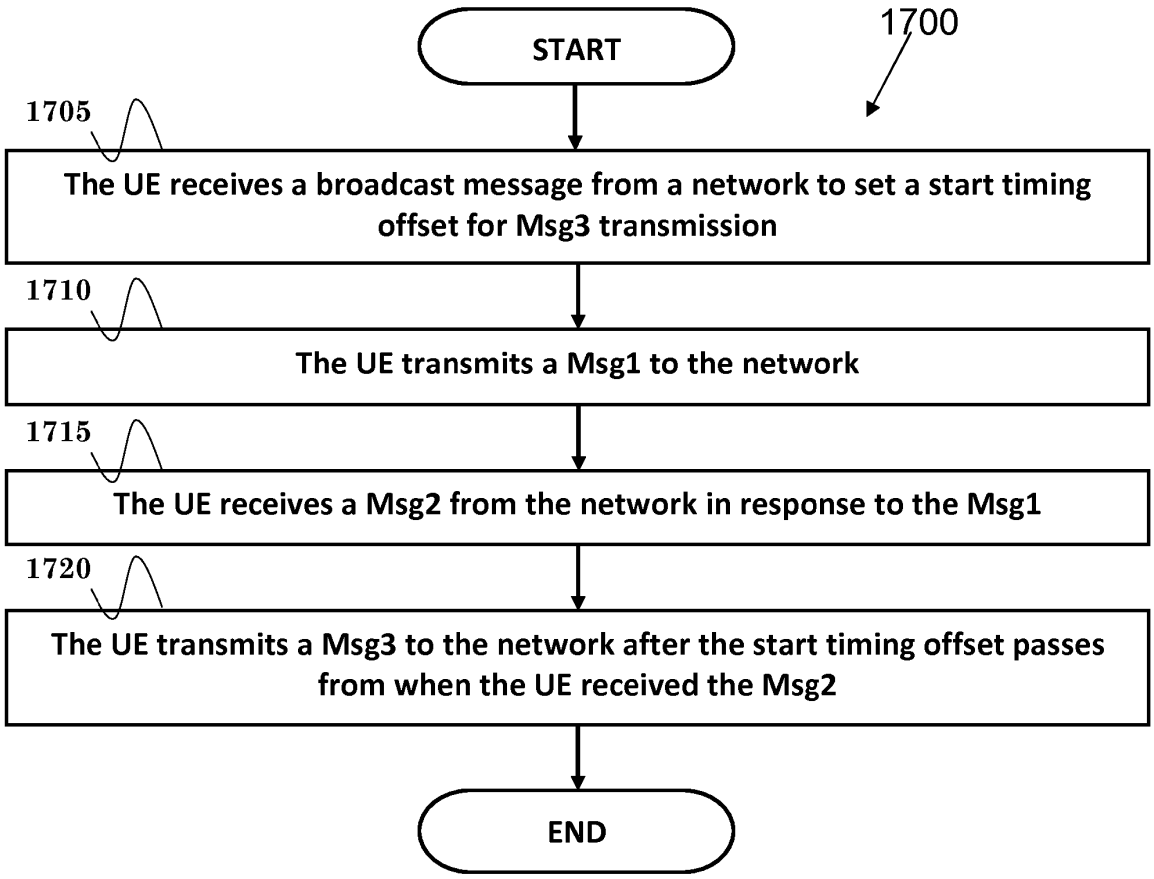

1700
START
1705
The UE receives a broadcast message from a network to set a start timing offset for Msg3 transmission
1710
The UE transmits a Msg1 to the network
1715
The UE receives a Msg2 from the network in response to the Msg1
1720
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 17

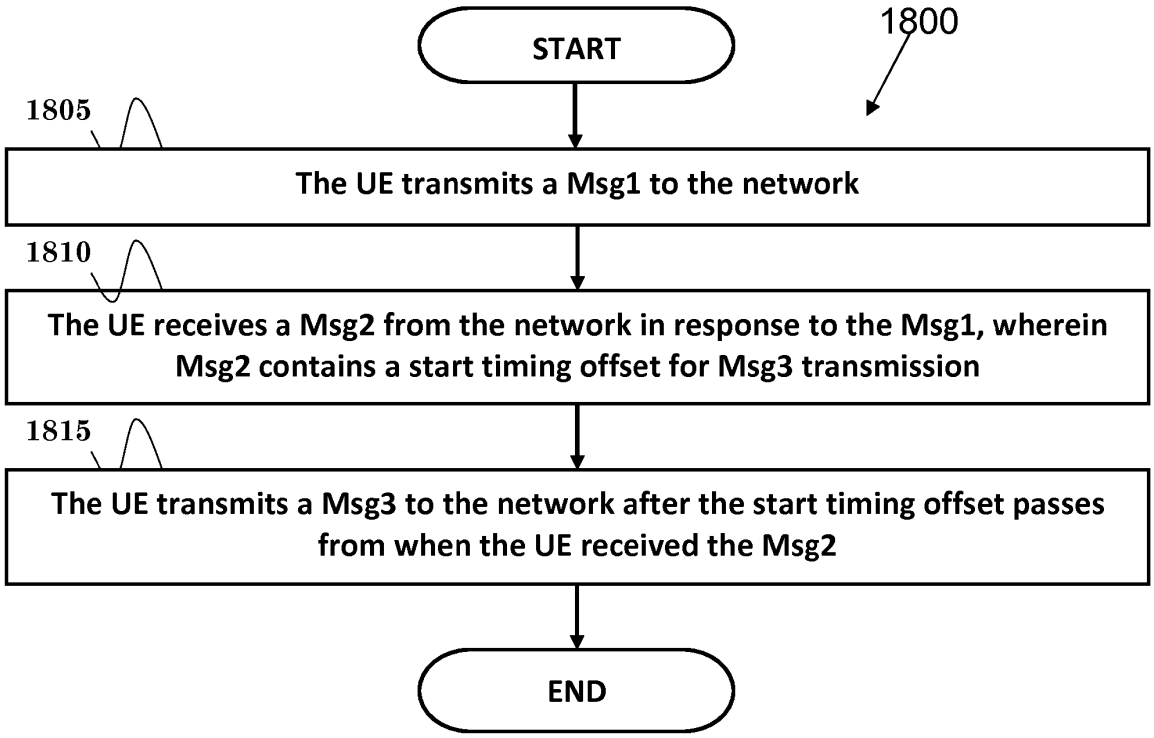

START
1800
1805
The UE transmits a Msg1 to the network
1810
The UE receives a Msg2 from the network in response to the Msg1, wherein Msg2 contains a start timing offset for Msg3 transmission
1815
The UE transmits a Msg3 to the network after the start timing offset passes from when the UE received the Msg2
END

FIG. 18

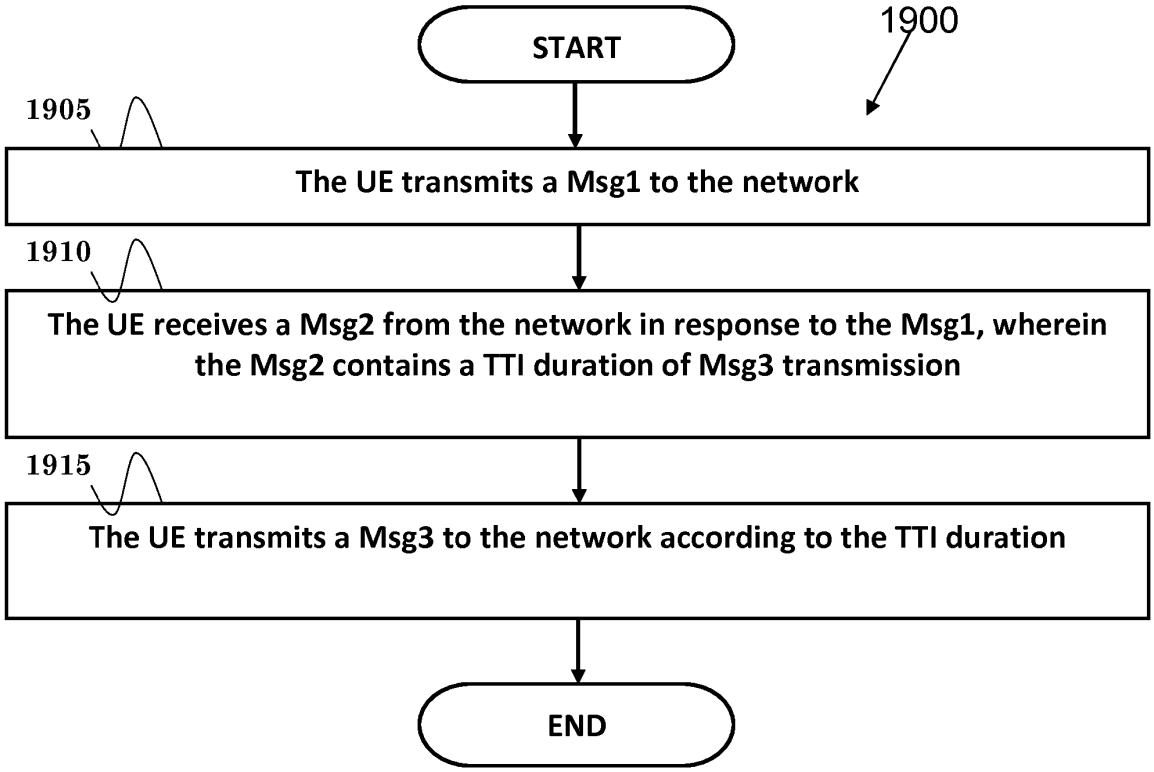

1900
START
1905
The UE transmits a Msg1 to the network
1910
The UE receives a Msg2 from the network in response to the Msg1, wherein the Msg2 contains a TTI duration of Msg3 transmission
1915
The UE transmits a Msg3 to the network according to the TTI duration
END

FIG. 19

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application No.: EP17183827

Intention to grant a European patent

Electronically authenticated

04.03.2022

Date

Adam Lebiedowski	Enrique Andrés Muñoz	Federico Iavarone
Chairperson	1st examiner	2nd examiner

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IPR2024-01036

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Application No.	Ref.	Date
17 183 827.9 - 1215	ASU170707PEP	04.03.2022
Applicant ASUSTek Computer Inc.		

Communication under Rule 71(3) EPC

1. Intention to grant

You are informed that the examining division intends to grant a European patent on the basis of the above application, with the text and drawings and the related bibliographic data as indicated below.

A copy of the relevant documents is enclosed.

1.1 In the text for the Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Description, Pages

4-26, 30-32	as originally filed	
33	filed in electronic form on	13-04-2018
1, 3, 27-29	filed in electronic form on	13-05-2020
2	filed in electronic form on	20-01-2021

Claims, Numbers

1-7	filed in electronic form on	20-01-2021

Drawings, Sheets

1/19-19/19	as originally filed

With the following amendments to the above-mentioned documents proposed by the division

Description, Pages	1-4, 16, 18, 20, 22, 24, 26-30

Registered letter
EPO Form 2004C 07.20CXP

Claims, Numbers 1, 5

Comments

DESCRIPTION
Page 1: Mention of relevant prior art in the description (Rule 42(1) EPC)
Pages 2-4, 16, 18, 20, 22, 24, 26-30: Description adapted to amended claims (Art. 84 EPC)
CLAIMS
Page 1, Claim 1: Error(s) in spelling, grammar, typography corrected
Page 1, Claim 5: Scope of claim unclear - clarified (Art. 84 EPC); based on the original description on page 14, line 7 - line 16. Otherwise, claim 5 would appear to be an independent claim.

1.2 Bibliographic data

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated contracting states, the registered name(s) of the applicant(s) and the other bibliographic data are shown on **EPO Form 2056** (enclosed).

2. Invitation

You are invited, **within a non-extendable period of four months** of notification of this communication,

2.1 to EITHER approve the text communicated above and verify the bibliographic data (Rule 71(5) EPC)

(1) by filing a translation of the claim(s) in the other two official languages of the EPO

		Fee code	EUR
(2a)	by paying the fee for grant including the fee for publication:	**007**	960.00
	minus any amount already paid (Rule 71a(5) EPC):		0.00
		Total amount:	960.00
(3)	by paying additional claims fees under Rule 71(4) EPC; number of claims fees payable: 0	**016**	0.00
	minus any amount already paid (Rule 71a(5) EPC):		0.00
		Total amount:	0.00

Important: If the translations of the claims and fees have already been filed and paid respectively in reply to a previous communication under Rule 71(3) EPC, e.g. in the case of resumption of examination after approval (see Guidelines C-V, 6), **agreement as to the text to be granted** (Rule 71a(1) EPC) must be expressed within the same time limit (e.g. by approving the text and verifying the bibliographic data, by confirming that grant proceedings can go ahead with the documents on file and/or by stating which translations of the claims already on file are to be used).

Note 1: See "Notes concerning fee payments" below.
Note 2: Any overpaid "minus" amounts will be refunded when the decision to grant (EPO Form 2006A) has been issued.
Note 3: For the calculation of the grant fee under Article 2(2), No. 7, RFees (old fee structure), the number of pages is determined on the basis of a clean copy of the application documents, in which text deleted as a result of any amendments by the examining division is not shown.

Such clean copy is made available via on-line file inspection only.

2.2 OR, in the case of disapproval, to request reasoned amendments or corrections to the text communicated above or keep to the latest text submitted by you (Rule 71(6) EPC).

In this case the translations of the claims and fee payments mentioned under point 2.1 above are NOT due.

The terms "amendment(s)" and "correction(s)" refer only to amendments or corrections of the application documents and not of other documents (e.g. bibliographic data, the designation of the inventor, etc.).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the examining division requesting that you correct this deficiency (Rule 137(4) EPC).

2.3 Bibliographic data

Where you request a change or correction of bibliographic data in response to the Rule 71(3) communication, this will **not** cause the sending of a further communication under Rule 71(3) EPC. You will still have to pay the fees and file translations in reply to the Rule 71(3) communication in the case of 2.1 above, unless you also file a reasoned request for amendments or corrections in response to the Rule 71(3) communication (see case 2.2 above).

3. Loss of rights

If neither of the two possible actions above (see points 2.1 or 2.2) is performed in due time, the European patent application will be deemed to be withdrawn (Rule 71(7) EPC).

4. Further procedure

4.1 In the case of point 2.1 above

4.1.1 The decision to grant the European patent will be issued, and the **mention of the grant** of the patent will be published in the European Patent Bulletin, if the requirements concerning the translation of the claims and the payment of all fees are fulfilled and there is agreement as to the text to be granted (Rule 71a(1) EPC).

Note on payment of the renewal fee:
If a renewal fee becomes due before the next possible date for publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (Rule 71a(4) EPC).

Under Article 86(2) EPC, the obligation to pay renewal fees to the European Patent Office terminates with the payment of the renewal fee due in respect of the year in which the mention of the grant of the European patent is published.

Note on payment of the designation fee(s):
If the designation fee(s) become(s) due after the communication under Rule 71(3) EPC, the mention of the grant of the European patent will not be published until these fees have been paid (Rule 71a(3) EPC).

4.1.2 After publication, the **European patent specification** can be downloaded free of charge from the EPO publication server https://data.epo.org/publication-server.

4.1.3 Filing of translations in the contracting states

As regards translation requirements prescribed by the contracting states under Article 65(1) EPC, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC
www.epo.org ➞Law & practice ➞All Legal texts ➞London Agreement

In the case of a valid extension or validation

As regards translation requirements prescribed by the extension or validation states, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC

Failure to supply a prescribed translation in a contracting state, or in an extension or validation state may result in the patent being deemed to be void *ab initio* in the state concerned (Art. 65(3) EPC).

4.2 In the case of 2.2 above

If the present communication under Rule 71(3) EPC is based on an auxiliary request and, within the time limit, you maintain the main request or a higher ranking request which is not allowable, the application will be refused (Art. 97(2) EPC).

If the examining division gives its consent to the requested amendments or corrections, it will issue a new communication under Rule 71(3) EPC; otherwise, it shall resume the examination proceedings (Rule 71(6) EPC).

5. Filing of a divisional application

Any divisional application relating to this European patent application must be filed directly with the European Patent Office in Munich, The Hague or Berlin and will be in the language of the proceedings for the present application, or if the latter was not in an official language of the EPO, the divisional application may be filed in the language of the present application as filed (see Article 76(1) and Rule 36(2) EPC). Any such divisional application must be filed while the present application is still pending (Rule 36(1) EPC; Guidelines A-IV, 1.1.1).

6. Notes concerning fee payments

6.1 Making payments

For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

6.2 Information concerning fee amounts

Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

6.3 Note to users of the automatic debiting procedure

The fee for grant, including the fee for publication, and any additional claims fees due under Rule 71(4) EPC will be debited automatically on the date of filing of the translations of the claims, or on the last day of the period of this communication. However, if the designation fee(s) become(s) due as set out in Rule 71a(3) EPC and/or a renewal fee becomes due as set out in Rule 71a(4) EPC, these should be paid separately by another permitted way of payment in order not to delay the publication of the mention of the grant. The same applies in these circumstances to the payment of extension and validation fees. The same applies in these circumstances to the payment of extension and validation fees.

Examining Division:

Chairman: Lebiedowski, Adam
2nd Examiner: Iavarone, Federico
1st Examiner: Andrés Muñoz, E

Martenson, Birgit
For the Examining Division
Tel. No.: +31 70 340 - 2365 **Branch at The Hague**

Enclosures: Text intended for grant

EPO Form 2056

Registered letter
EPO Form 2004C 07.20CXP

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Annex to EPO Form 2004, Communication pursuant to Rule 71(3) EPC

Bibliographical data of European patent application No. 17 183 827.9

For the intended grant of the European patent, the bibliographical data are set out below, for information:

Title of invention:	- VERFAHREN UND VORRICHTUNG ZUR VERBESSERUNG DER MSG3-ÜBERTRAGUNG EINES DIREKTZUGRIFFSVERFAHRENS IN EINEM DRAHTLOSKOMMUNIKATIONSSYSTEM - METHOD AND APPARATUS FOR IMPROVING MSG3 TRANSMISSION OF RANDOM ACCESS PROCEDURE IN A WIRELESS COMMUNICATION SYSTEM - PROCÉDÉ ET APPAREIL PERMETTANT D'AMÉLIORER LA TRANSMISSION MSG3 D'UNE PROCÉDURE D'ACCÈS ALÉATOIRE DANS UN SYSTÈME DE COMMUNICATION SANS FIL
Classification:	INV. H04W74/00 ADD. H04W74/08
Date of filing:	28.07.2017
Priority claimed:	US / 28.07.2016 / USP201662367875
Contracting States* for which fees have been paid:	AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Extension States* for which fees have been paid:	
Validation States* for which fees have been paid:	
Applicant(s):**	ASUSTek Computer Inc. No. 15, Lite Rd., Peitou Dist. Taipei City 112 TW
Inventor(s):	CHEN, Wei-Yu c/o ASUSTek Computer Inc. No.15, Lite Rd., Peitou Dist. Taipei City 112 TW TSENG, Li-Chih c/o ASUSTek Computer Inc. No.15, Lite Rd., Peitou Dist. Taipei City 112 TW

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*)	If the time limit for the payment of designation fees according to Rule 39(1) EPC has not yet expired and the applicant has not withdrawn any designation, **all Contracting States/Extension States/Validation States** are currently still deemed to be designated. See also Rule 71a(3) EPC and, if applicable, the above Note to users of the automatic debiting procedure.
**)	If two or more applicants have designated different Contracting States, this is indicated here.

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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	17183827.9
Applicant's or representative's reference	ASU170707PEP

	Description of document	Original file name	Assigned file name
1	Reply to the communication under rule 71(3) EPC	IGRA-1.pdf	IGRA-1.pdf
2	French translations of the claims	EPLETT-1.pdf	CLMSTRAN-FR-1.pdf
3	German translations of the claims	EPLETT-2.pdf	CLMSTRAN-DE-1.pdf

	Fees	Factor applied	Fee schedule	Amount to be paid
15-1	007 Fee for grant, including fee for publication of the European patent specification (R71(3))	1	990.00	990.00
	Total:		**EUR**	**990.00**

	Payment	
1	Method of payment	Debit from deposit account
	Currency:	EUR
	The European Patent Office is hereby authorised, to debit from the deposit account with the EPO any fees and costs indicated on the fees page.	
	Deposit account number:	28000600
	Account holder:	Hoefer & Partner Patentanwälte mbB
2	Refund/Reimburserment	
	Reimbursement (if any) to be made to EPO deposit account:	28000600
	Account holder:	Hoefer & Partner Patentanwälte mbB

Signatures

Place: **München**

Date: **19 April 2022**

Signed by: **Ingo Goerz 19384**

Association:	**Hoefer & Partner Patentanwälte mbB**
Representative name:	**Ingo Görz**
Capacity:	**(Representative)**

ASU170707PEP

Ansprüche

1. Verfahren einer Teilnehmerausrüstung, im Folgenden auch als UE bezeichnet, zum Ausführen einer Zufallszugriffsprozedur, umfassend:

die UE sendet eine Präambel an ein Netzwerk (1405);

die UE empfängt eine Msg2 von dem Netzwerk als Reaktion auf die Präambel (1410); und

die UE führt eine Msg3-Übertragung an das Netzwerk gemäß TTI-Informationen der Msg3 aus (1415),

wobei die TTI-Informationen der Msg3 in der Msg2 enthalten sind,

dadurch gekennzeichnet, dass

die TTI-Informationen der Msg3 eine erste Anzahl von Zeiteinheiten und eine zweite Anzahl von Zeiteinheiten jeweils zum Anzeigen einer TTI-Dauer der Msg3 und eines Lückenzeitraums zwischen einem Msg2-Empfang und einer Msg3-Übertragen umfassen.

2. Verfahren gemäß Anspruch 1, weiter umfassend:

die UE wählt die TTI-Informationen der Msg3 basierend auf einem Zufallszugriffszweck aus, wenn es mehrere TTI-Informationen der Msg3 in der Msg2 gibt.

3. Verfahren gemäß Anspruch 1 oder 2, weiter umfassend:

die UE wählt die TTI-Informationen der Msg3 basierend auf einem Physical-Random-Access-Channel-Ressourcensatz der Präambelübertragung oder einem Präambelsatz der Präambelübertragung aus, wenn es mehrere TTI-Informationen der Msg3 in der Msg2 gibt.

4. Verfahren gemäß einem der Ansprüche 1 bis 3, weiter umfassend:

die UE wählt die TTI-Informationen der Msg3 basierend auf einer höchsten Priorität eines logischen Kanals aus, der Daten für eine Übertragung verfügbar hat, wenn es mehrere TTI-Informationen der Msg3 in der Msg2 gibt.

5. Verfahren gemäß einem der Ansprüche 1 bis 4, wobei die TTI-Informationen der Msg3 zum Beantworten der Präambel in einer Zufallszugriffsantwort, im Folgenden auch als RAR bezeichnet, enthalten sind, wobei die RAR in der Msg2 enthalten ist.

6. Verfahren gemäß einem der Ansprüche 1 bis 4, wobei die TTI-Informationen der Msg3 in einem gemeinsamen Feld für mehrere RARs in der Msg2 enthalten sind.

7. Teilnehmerausrüstung, im Folgenden auch als UE bezeichnet, aufweisend:

eine Steuerungsschaltung (306);

einen Prozessor (308), der in der Steuerungsschaltung (306) installiert ist; und

einen Speicher (310), der in der Steuerungsschaltung (306) installiert und betriebsfähig mit dem Prozessor (308) verbunden ist;

dadurch gekennzeichnet, dass der Prozessor (308) eingerichtet ist, einen Programm-Code (312), der in dem Speicher (310) gespeichert ist, auszuführen, um die in einem der vorstehenden Ansprüche definierten Verfahrensschritte auszuführen.

REVENDICATIONS

1. Procédé d'un Équipement Utilisateur, ci-après également appelé UE, pour exécuter une procédure d'accès aléatoire, comprenant :

la transmission par l'UE d'un Préambule à un réseau (1405) :

la réception par l'UE d'un Msg2 du réseau en réponse au Préambule (1410) ; et

l'exécution par l'UE d'une transmission de Msg3 au réseau selon les informations TTI du Msg3 (1415),

dans lequel les informations TTI du Msg3 sont contenues dans le Msg2,

caractérisé en ce que

les informations TTI du Msg3 comprennent un premier nombre d'unités de temps et un deuxième nombre d'unités de temps pour indiquer une durée TTI du Msg3 et un temps de silence entre la réception de Msg2 et la transmission de Msg3, respectivement.

2. Procédé de la revendication 1, comprenant en outre :

la sélection par l'UE des informations TTI du Msg3 sur la base d'un objectif d'accès aléatoire, s'il existe plusieurs informations TTI du Msg3 dans le Msg2.

3. Procédé de la revendication 1 ou 2, comprenant en outre :

la sélection par l'UE des informations TTI du Msg3 sur la base d'un ensemble de ressources de Canal d'Accès Aléatoire Physique de la transmission de Préambule ou d'un ensemble de préambule de la transmission de Préambule, s'il existe plusieurs informations TTI du Msg3 dans le Msg2.

4. Procédé de l'une quelconque des revendications 1 à 3, comprenant en outre :

la sélection par l'UE des informations TTI du Msg3 sur la base de la priorité la plus élevée du canal logique ayant des données disponibles pour la transmission, s'il existe plusieurs informations TTI du Msg3 dans le Msg2.

5. Procédé de l'une quelconque des revendications 1 à 4, dans lequel les informations TTI du Msg3 sont incluses dans une Réponse d'Accès Aléatoire, ci-après également appelée RAR, pour répondre au Préambule, dans lequel la RAR est incluse dans le Msg2.

6. Procédé de l'une quelconque des revendications 1 à 4, dans lequel les informations TTI du Msg3 sont incluses dans un champ commun pour plusieurs RAR dans le Msg2.

7. Équipement Utilisateur, ci-après également appelé UE, comprenant :

un circuit de commande (306) ;

un processeur (308) installé dans le circuit de commande (306) ; et

une mémoire (310) installée dans le circuit de commande (306) et fonctionnellement couplée au processeur (308) ;

caractérisé en ce que le processeur (308) est configuré pour exécuter un code de programme (312) stocké dans la mémoire (310) pour mettre en œuvre les étapes de procédé selon l'une quelconque des revendications précédentes.

HOEFER & PARTNER

PATENTANWÄLTE / EUROPEAN PATENT TRADEMARK AND DESIGN ATTORNEYS

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Pilgersheimer Str. 20 · 81543 München / Germany

Europäisches Patentamt

80298 München

Ihr Zeichen / your ref	Unser Zeichen / our ref	Datum / date
	ASU170707PEP-24/RS	April 19, 2022

Official No.: 17183827.9
Applicant: ASUSTek Computer Inc.

In Reply to the Communication under Rule 71(3) EPC of March 4, 2022

It is herewith stated that the applicant approves the text specified in the Communication under Rule 71(3) EPC.

The German and French translation of the claims are filed herewith.

Furthermore, the fee for grant and the publication fee are paid by debiting our deposit account 2800 0600.

Hoefer & Partner Patentanwälte mbB

Encl.:
French translation of the claims
German translation of the claims

100 YEARS OF EXCELLENCE

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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	10866511
Application number	EP17183827.9
Date of receipt	19 April 2022
Receiving Office	European Patent Office, The Hague
Your reference	ASU170707PEP
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (2 p.) CLMSTRAN-FR-1.pdf\EPLETT-1.pdf (2 p.) ep-sfd-request.xml IGRA-1.pdf\IGRA-1.pdf (1 p.) CLMSTRAN-DE-1.pdf\EPLETT-2.pdf (1 p.)
Submitted by	CN=Ingo Goerz 19384
Method of submission	Online
Date and time receipt generated	19 April 2022, 17:18 (CEST)
Message Digest	AD:F1:68:21:26:2F:24:34:32:73:32:58:51:2F:13:06:4B:94:E3:B3

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IPR2024-01036

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ALLEMAGNE

Date
29.04.2022

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1215 / 3277042
Applicant/Proprietor	
ASUSTek Computer Inc.	

Decision to grant a European patent pursuant to Article 97(1) EPC

Following examination of European patent application No. 17183827.9 a European patent with the title and the supporting documents indicated in the communication pursuant to Rule 71(3) EPC (EPO Form 2004C) or in the information (EPO Form 2004W, cf. Notice from the EPO dated 8 June 2015, OJ EPO 2015, A52) dated 04.03.22 is hereby granted in respect of the designated Contracting States.

Patent No. : 3277042
Date of filing : 28.07.17
Priority claimed : 28.07.16/USP201662367875
Designated Contracting States and Proprietor(s) : AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
ASUSTek Computer Inc.
No. 15, Lite Rd., Peitou Dist.
Taipei City 112/TW

This decision will take effect on the date on which the European Patent Bulletin mentions the grant (Art. 97(3) EPC).

The mention of the grant will be published in European Patent Bulletin 22/21 of 25.05.22.

Examining Division

Andrés Muñoz, Enriqu Iavarone, Federico Lebiedowski, Adam

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Registered Letter
EPO Form 2006A 07.15 (21/04/22)

to EPO postal service: 22.04.22

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IPR2024-01036

ANMERKUNG ZUR ENTSCHEIDUNG ÜBER DIE ERTEILUNG
EINES EUROPÄISCHEN PATENTS (EPA Form 2006)

1. **EPA Informationsbroschüre "Nationales Recht zum EPÜ"**
Diese Broschüre enthält nützliche Informationen zu den formalen Erfordernissen und den Handlungen, die vor den Patentbehörden der Vertragsstaaten vorzunehmen sind, um Rechte in diesen Staaten zu erlangen. Da diese Handlungen einem ständigen Wandel unterworfen sind, sollte immer nur die neueste Ausgabe der Broschüre benutzt werden. Nachträgliche Informationen werden im Amtsblatt veröffentlicht.

2. **Übersetzung der europäischen Patentschrift nach Artikel 65 (1) des Europäischen Patentübereinkommens**
Sie werden erneut darauf hingewiesen, dass bestimmte Vertragsstaaten nach Artikel 65 (1) EPÜ eine Übersetzung der europäischen Patentschrift verlangen; hierauf wird in der Mitteilung gemäß Regel 71 (5) EPÜ verwiesen. Die Nichteinreichung dieser Übersetzung kann zur Folge haben, dass das Patent in dem betreffenden Staat/in den betreffenden Staaten als von Anfang an nicht eingetreten gilt. Weitere Einzelheiten entnehmen Sie bitte der oben genannten Broschüre.

3. **Zahlung von Jahresgebühren für europäische Patente**
Nach Artikel 141 EPÜ können "nationale" Jahresgebühren für das europäische Patent für die Jahre erhoben werden, die an das Jahr anschließen, in dem der Hinweis auf die Erteilung des europäischen Patents im "Europäischen Patentblatt" bekanntgemacht wird. Weitere Einzelheiten entnehmen Sie bitte der oben genannten Broschüre.

NOTE RELATING TO THE DECISION TO GRANT A
EUROPEAN PATENT (EPO Form 2006)

1. **EPO Information Brochure "National law relating to the EPC"**
This brochure provides useful information regarding formal requirements and the steps to be taken before the patent authorities of the Contracting States in order to acquire rights in those states. Since the necessary steps are subject to change the latest edition of the brochure should always be used. Subsequent information is published in the Official Journal.

2. **Translation of the European patent application under Article 65(1) of the European Patent Convention**
Your attention is again drawn to the requirements regarding translation of the European patent specification laid down by a number of Contracting States under Article 65(1) EPC, to which reference is made in the communication under Rule 71(5) EPC. Failure to supply such translation(s) may result in the patent being deemed to be void "ab initio" in the State(s) in question. For further details you are recommended to consult the above-mentioned brochure.

3. **Payment of renewal fees for European patents**
Under Article 141 EPC "national" renewal fees in respect of a European patent may be imposed for the years which follow that in which the mention of the grant of the European patent is published in the "European Patent Bulletin". For further details you are recommended to consult the above-mentioned brochure.

REMARQUE RELATIVE A LA DECISION DE DELIVRANCE
D'UN BREVET EUROPEEN (OEB Form 2006)

1. **Brochure d'information de l'OEB "Droit national relatif à la CBE"**
Cette brochure fournit d'utiles renseignements sur les conditions de forme requises et sur les actes à accomplir auprès des offices de brevet des Etats contractants aux fins d'obtenir des droits dans les Etats contractants. Etant donné que les actes indispensables sont susceptibles de modifications, il serait bon de toujours consulter la dernière édition de la brochure. Toute information ultérieure est publiée au Journal Officiel.

2. **Traduction du fascicule du brevet européen en vertu de l'article 65(1) de la Convention sur le brevet européen**
Votre attention est de nouveau attirée sur l'obligation faite par certains Etats contractants, en vertu de l'article 65(1) CBE, de fournir une traduction du fascicule du brevet européen, à laquelle il est fait référence dans la notification établie conformément à la règle 71(5) CBE. Si la(les) traduction(s) n'est(ne sont) pas fournie(s), le brevet européen peut, dès l'origine, être réputé sans effet dans cet(ces) Etat(s). Pour plus de détails, nous vous renvoyons à la brochure susmentionnée.

3. **Paiement des taxes annuelles pour le brevet européen**
Conformément à l'article 141 CBE des taxes annuelles "nationales" dues au titre du brevet européen peuvent être perçues pour les années suivant celle au cours de laquelle la mention de la délivrance du brevet européen est publiée au "Bulletin européen des brevets. Pour plus de détails, nous vous renvoyons à la brochure susmentionnée.

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Hoefer & Partner Patentanwälte mbB
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81543 München
ALLEMAGNE

Date
08.06.2022

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1215 / 3277042
Applicant/Proprietor ASUSTek Computer Inc.	

Transmission of the certificate for a European patent pursuant to Rule 74 EPC

The certificate for a European patent is herewith transmitted.

The European patent specification can be downloaded from the EPO publication server **https://data.epo.org/publication-server/** (see OJ EPO 2005, 126).

Note:
A corrected title page of the European patent specification will be published, if the bibliographic data have been changed after completion of the technical preparations.

For the Examining Division

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IPR2024-01036

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Date
03.04.2023

Reference	Application No./Patent No.
ASU170707PEP	17183827.9 - 1215 / 3277042
Applicant/Proprietor ASUSTek Computer Inc.	

Communication regarding the expiry of the time limit within which notice of opposition may be filed

You are hereby informed that on expiry of the nine-month time limit from the publication of the mention of the grant of European patent No. 3277042 no notice of opposition had reached the files.

The entry in the Register of European Patents will be automatically generated by the electronic data processing system.

For the Examining Division

Europäisches Patentamt • European Patent Office • Office européen des brevets •

EPPU 02: 25.05.22 1215

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IPR2024-01036