

(51) International Patent Classification:
H04L 29/06 (2006.01)(21) International Application Number:
PCT/EP2019/081045(22) International Filing Date:
12 November 2019 (12.11.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
18206765.2 16 November 2018 (16.11.2018) EP(71) Applicant: **DEUTSCHE TELEKOM AG** [DE/DE];
Friedrich-Ebert-Allee 140, 53113 Bonn (DE).(72) Inventors: **SCHMIDT, Holger**; Am Kabelwerk 15, 41844
Wegberg (DE). **HOFFMANN, Stefan-Peter**; Fritz-Beck-Straße 55A, 56659 Burgbrohl (DE). **MOHANDAS, Ro-**
hith; Klufterstraße 93, 53175 Bonn (DE).(74) Agent: **VOSSIUS & PARTNER**; Patentanwälte Rechtsan-
wälte mbB, Siebertstrasse 3, 81675 München (DE).(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: INTERNET PROTOCOL MULTIMEDIA SUBSYSTEM, IMS CALL SETUP TIME BOOSTER

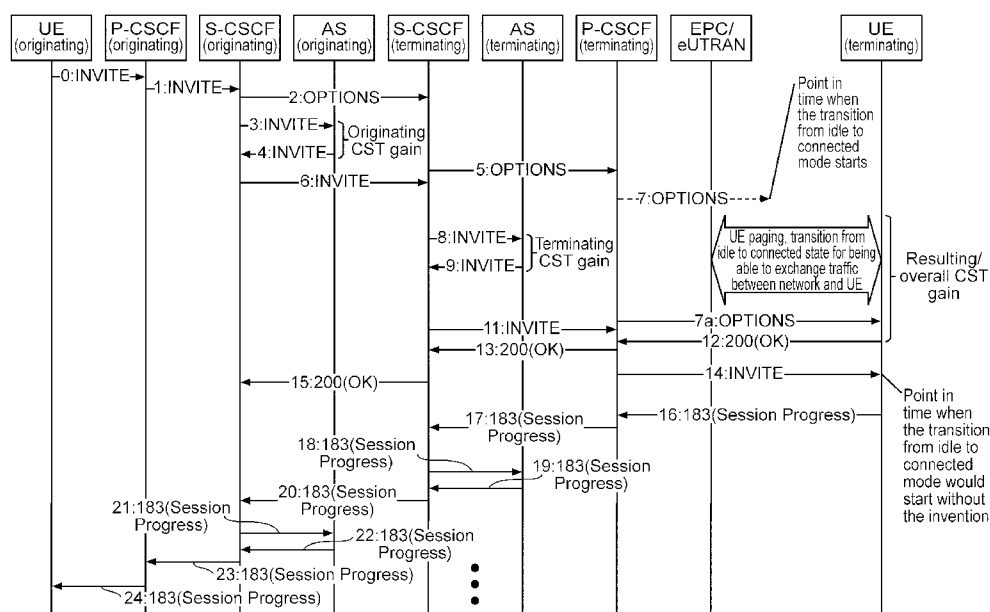


Figure 2

(57) **Abstract:** A method and a system for decreasing the Call Setup Time Key Performance Indicators, CST KPI, of a multimedia call; and a computer-readable storage medium thereof. The method for decreasing a Call Setup Time key performance indicator, CST KPI, of an Internet Protocol, IP, multimedia call in a mobile telecommunication network, the method comprising: initiating the IP multimedia call from an originating user equipment, UE, to a terminating UE; transmitting a session initiation protocol, SIP, call initiation message from the originating UE to a terminating Proxy - Call Session Control Function, P-CSCF, through an originating Serving - Call Session Control Function, S-CSCF; creating a wake-up message via a network element upon receiving the SIP call initiation message; wherein the wake-up message bypasses a plurality of network Application Servers, ASs, to start switching a transition of the terminating UE from an idle state to a connected state before the SIP call initiation message reaches the terminating P-CSCF.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Internet Protocol Multimedia Subsystem, IMS Call Setup Time Booster

The present invention relates to a method and a system for decreasing the Call Setup Time
5 Key Performance Indicator, CST KPI, of an Internet Protocol, IP, multimedia call; and a
computer-readable storage medium thereof.

The VoLTE (Voice over Long Term Evolution) Call Setup Time is usually measured by the
time difference between sending the INVITE request by the caller and the reception of the
10 180_Ringing response by the caller. Some deviations to this basic definition do exist but they
are just there for taking limitations of the measurement systems into account and for avoiding
any manipulations.

Some optimizations of the call setup can be done and are usually done by the operator. The
15 call setup is especially challenging in the mobile network as it involves the radio channel and
complex resource reservation and establishment procedures.

The first optimization can be performed with respect to the reservation of the so-called user
plane bearer. The user plane bearer is used for transporting the audio channel between the
20 caller and the callee. The speech signal is digitalized and encoded using a certain audio codec,
usually an AMR (Adaptive Multi Rate) or EVS (Enhances Voice Service) codec. Originally,
IMS was designed in a way which ensures that the media plane bearer is available and
established before the callee's device/UE starts ringing. This IMS feature is called "Quality of
Service, QoS, Precondition" (making the availability of a QoS enabled media bearer the
25 precondition for ringing the callee). This mechanism is embedded in the SIP call setup
messages and requires some additional SIP messages to be transferred between both parties, it
thus decreasing the CST. This feature which is tailored-made for the characteristics of mobile
networks can be omitted in case the establishment of the user plane bearer can be assumed to
be quick enough and when it can be assumed that user plane resources are always available.
30 Another optimization can be done in the way of how the media plane bearer is established
within the call setup. Furthermore the network deployment can be optimized for ensuring the

minimum path length for the control and user plane messages resulting in minimum transmission delays.

The technical problem to be solved by the present invention is to provide a system and a method for decreasing the CST KPI of a multimedia call, and to overcome the drawbacks of the prior art. The present invention also provides a computer-readable storage medium thereof. This problem is solved with the features of the independent claims. Embodiments of the invention are defined by the dependent claims.

10 In accordance with an aspect of the present invention, there is provided a method for decreasing a Call Setup Time Key Performance Indicator, CST KPI, of an Internet Protocol, IP, multimedia call in a mobile telecommunications network, the method comprising: initiating the IP multimedia call from an originating user equipment, UE, to a terminating UE; transmitting a session initiation protocol, SIP, call initiation message from the originating UE
15 to a terminating Proxy - Call Session Control Function, P-CSCF, through an originating Serving - Call Session Control Function, S-CSCF; creating a wake-up message via an element upon receiving the SIP call initiation message; wherein the wake-up message bypasses a plurality of network Application Servers, ASs, to start switching a transition of the terminating UE from an idle state to a connected state before the SIP call initiation message
20 reaches the terminating P-CSCF.

The wake-up message may be an SIP OPTIONS request or e.g. an INFO or MESSAGE request.

25 The network element creating the wake-up request is preferably the originating S-CSCF, or a CST Improvement Application Server, or an SIP back-to-back user agent, B2BUA, or an Interconnection Border Control Function, IBCF.

The IP multimedia call may include a Voice over Long Term Evolution, VoLTE, call and/or a
30 Video over Long Term Evolution, ViLTE, call. The IP multimedia call may further include Voice over 5G, Vo5G).

The idle state may correspond to a Radio Resource Control/EPS Connection Management RRC_IDLE/ECM_IDLE state, and the connected state may correspond to an RRC_CONNECTED/ECM_CONNECTED state of the terminating UE.

- 5 The mobile telecommunication network may be an Internet Protocol Multimedia Subsystem, IMS, network.

The wake-up message may include a special media feature tag specifying the wake-up purpose of the request. This can be used for processing the request in the terminating UE on
10 application level and/or for network internal routing purposes.

In accordance with another aspect of the present invention, there is provided a system for establishing an Internet Protocol, IP, multimedia call with decreased Call Setup Time Key Performance Indicator, CST KPI, from an originating user equipment, UE, in a mobile
15 telecommunications network, the system comprising the originating UE being configured: to initiate the IP multimedia call from the originating user equipment, UE, to a terminating UE; to transmit a session initiation protocol, SIP, call initiation message from the originating UE to a terminating Proxy - Call Session Control Function, P-CSCF, through an originating Serving - Call Session Control Function, S-CSCF; to request the creation of a wake-up
20 message via a network element upon receiving the SIP call initiation message; wherein the wake-up message is configured to bypass a plurality of network Application Servers, ASs, to start the switching transition of the terminating UE from an idle state to a connected state before the SIP call initiation message reaches the terminating P-CSCF.

- 25 In accordance with a further aspect of the present invention, there is provided a computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to carry out the steps of any one of the methods mentioned above.

The present invention has the following advantageous technical effects:

- 30
- It is cumulative to the above described CST enhancements, i.e. it can be performed in addition to the above described CST optimizations of the prior art.
 - It parallelizes the IMS and radio resource control procedures. These procedures are currently performed strictly sequentially.

- The processing time that is required by the different IMS Application Servers, ASs, in the originating and terminating leg can be collected for improving the CST.
- It works when the UE is in the Radio Resource Control/EPS Connection Management RRC Idle/ECM Idle State which is the case when the UE is not transferring any data, i.e. not having any call or the user is not surfing the web. This is the state that the UE is residing in most of the time.

The drawings described herein are intended to provide further understanding of the present invention and to constitute part of the present invention. The illustrative examples of the present invention and the description thereof are used to explain the present invention, and they may/must not be understood as constituting improper limitations for the present invention.

Brief description of the drawings:

Figure 1 illustrates general Terminating Call Procedures of the related art.

Figure 2 illustrates Call Procedures of the present invention.

Figure 3 illustrates a close up view of the Call Procedures of Figure 2 at the Terminating Side.

The present inventive concept of the invention is the parallelization of the transition of the initial SIP call setup request (INVITE request) through the originating_and_terminating IMS network, and the transition of the UE from the RRC_idle/ECM_idle to RRC_connected/ECM_connected state/mode. This invention allows parallelization of these two procedures to a large extent as will be detailed further below.

More details and background information for the RRC_idle and RRC_connected modes are available, for instance at <http://know-lte.blogspot.com/2016/06/lte-rrc-states.html>

Usually, the first SIP signaling packet that arrives at the terminating Proxy - Call Session Control Function, P-CSCF and that is sent onward by the P-CSCF via the Packet Data Network – Gateway, PDN-GW, to the UE on the Gm interface, starts the procedure for activating the radio channel between the network and the UE. If no data (IMS or internet traffic) is being sent then this channel is suspended for resource usage optimization. That is to say, the procedure on a high level is as illustrated in Figure 1: Terminating Call Procedures.

It can be seen in Figure 1 that the Evolved Packet Core/Evolved-UMTS Terrestrial Access Network, EPC/eUTRAN, procedures and the SIP call setup procedures are performed strictly sequentially. The time needed for performing both is thus cumulative when determining the CST.

5

As further shown in Figure 1, the INVITE (5a) request that the terminating P-CSCF forwards onward on the Gm interface starts the reestablishment of the radio channel. Thus, a problem with the state of the art is that the INVITE (5b) request can only be sent to the UE when the radio channel has been reestablished.

10

The present invention avoids this by performing both procedures in parallel as this reduces the CST directly. This is achieved by sending an SIP ping request from the IMS network to the terminating UE. This ping is realized preferably by a wake-up message such as an SIP OPTIONS (message 2) request and it is created by a network element, such as the originating
15 Serving - Call Session Control Function, S-CSCF, when receiving the initial INVITE request (message 1) for the Voice over Long Term Evolution, VoLTE, call setup, as can be seen in Figure 2: Invention enriched Call Procedures.

The wake-up message/request may also contain a special media feature tag (see RFC 3840
20 and RFC 3841) for routing purposes, e.g. like +g.3gpp.wake-up. Such an extension tag in the sense of RFC 3840 would help in avoiding that this request gets routed via IMS Application Server and it would make it possible to indicate the wake-up nature of this request e.g. for avoiding informing the end-user about its reception or even advise the terminating UE for responding in a certain way.

25

This CST improvement thus results in starting the EPC/eUTRAN procedures already with message (7) before the call setup request, which means that the initial INVITE request is forwarded by the terminating P-CSCF finally via the PDN-GW onward, message (14). The CST reduction equals the time the INVITE request needs for transition through the different
30 IMS Application Servers (ASs), i.e. the time the originating and terminating AS needs for delivering its service (request processing time). Note that there is usually more than one AS in the flow per originating and terminating side. Furthermore, the AS on the originating side usually performs more features/procedures than on the terminating side. This results in that

the CST reduction is larger on the originating side than on the terminating side. Roughly, the gain on the originating side should be 3 times higher than on the terminating side.

5 It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A method for decreasing a Call Setup Time Key Performance Indicator, CST KPI, of
5 an Internet Protocol, IP, multimedia call in a mobile telecommunications network, the method comprising:

initiating the IP multimedia call from an originating user equipment, UE, to a terminating UE;

10 transmitting a session initiation protocol, SIP, call initiation message from the originating UE to a terminating Proxy - Call Session Control Function, P-CSCF, through an originating Serving - Call Session Control Function, S-CSCF;

creating a wake-up message via a network element upon receiving the SIP call initiation message;

15 wherein the wake-up message bypasses a plurality of network Application Servers, ASs, to start switching a transition of the terminating UE from an idle state to a connected state before the SIP call initiation message reaches the terminating P-CSCF.

2. The method according to claim 1,

20 wherein the wake-up message is preferably an SIP OPTIONS request or an INFO or MESSAGE request.

3. The method according to claim 1 or 2,

25 wherein the network element is preferably the originating S-CSCF, or a CST Improvement Application Server, or a SIP back-to-back user agent, B2BUA, or an Interconnection Border Control Function, IBCF.

4. The method according to any one of claims 1 to 3,

30 wherein the IP multimedia call includes a Voice over Long Term Evolution, VoLTE, call and/or a Video over Long Term Evolution, ViLTE, call.

5. The method according to any one of claims 1 to 4,

wherein the idle state corresponds to a Radio Resource Control/EPS Connection Management RRC_IDLE/ECM_IDLE state, and the connected state corresponds to a RRC_CONNECTED/ECM_CONNECTED state of the terminating UE.

- 5 6. The method according to any one of claims 1 to 5,
 wherein the mobile telecommunications network is an Internet Protocol Multimedia Subsystem, IMS, network.
7. The method according to any one of claims 1 to 6,
10 wherein the wake-up message includes a special media feature tag specifying a wake-up purpose of the request.
8. A system for establishing an Internet Protocol, IP, multimedia call with decreased Call Setup Time Key Performance Indicator, CST KPI, from an originating user equipment, UE, in
15 a mobile telecommunications network, the system comprising the originating UE being configured to:
 initiate the IP multimedia call from the originating user equipment, UE, to a terminating UE;
 transmit a session initiation protocol, SIP, call initiation message from the originating
20 UE to a terminating Proxy - Call Session Control Function, P-CSCF, through an originating Serving - Call Session Control Function, S-CSCF;
 request the creation of a wake-up message via a network element upon receiving the SIP call initiation message;
 wherein the wake-up message is configured to bypass a plurality of network
25 Application Servers, ASs, to start the switching transition of the terminating UE from an idle state to a connected state before the SIP call initiation message reaches the terminating P-CSCF.
9. The system according to claim 8,
30 wherein the wake-up message is an SIP OPTIONS request or an INFO or MESSAGE request.
10. The system according to claim 8 or 9,

wherein the network element is preferably the originating S-CSCF, or a CST Improvement Application Server, or a SIP back-to-back user agent, B2BUA, or an Interconnection Border Control Function, IBCF.

- 5 11. The system according to any one of claims 8 to 10,
 wherein the IP multimedia call includes a Voice over Long Term Evolution, VoLTE,
 call or a Video over Long Term Evolution, ViLTE, call.
12. The system according to any one of claims 8 to 11,
10 wherein the idle state corresponds to a Radio Resource Control/EPS Connection
 Management, RRC_IDLE/ECM_IDLE state and the connected state corresponds to an
 RRC_CONNECTED/ECM_IDLE state of the terminating UE.
13. The system according to any one of claims 8 to 12,
15 wherein the mobile telecommunications network is an Internet Protocol Multimedia
 Subsystem, IMS, network.
14. The system according to any one of claims 8 to 13,
 wherein the wake-up message includes a special media feature tag specifying a wake-
20 up purpose of the request.
15. A computer-readable storage medium comprising instructions which, when executed
 by a computer, cause the computer to carry out the steps of the method of any one of claims 1
 to 7.

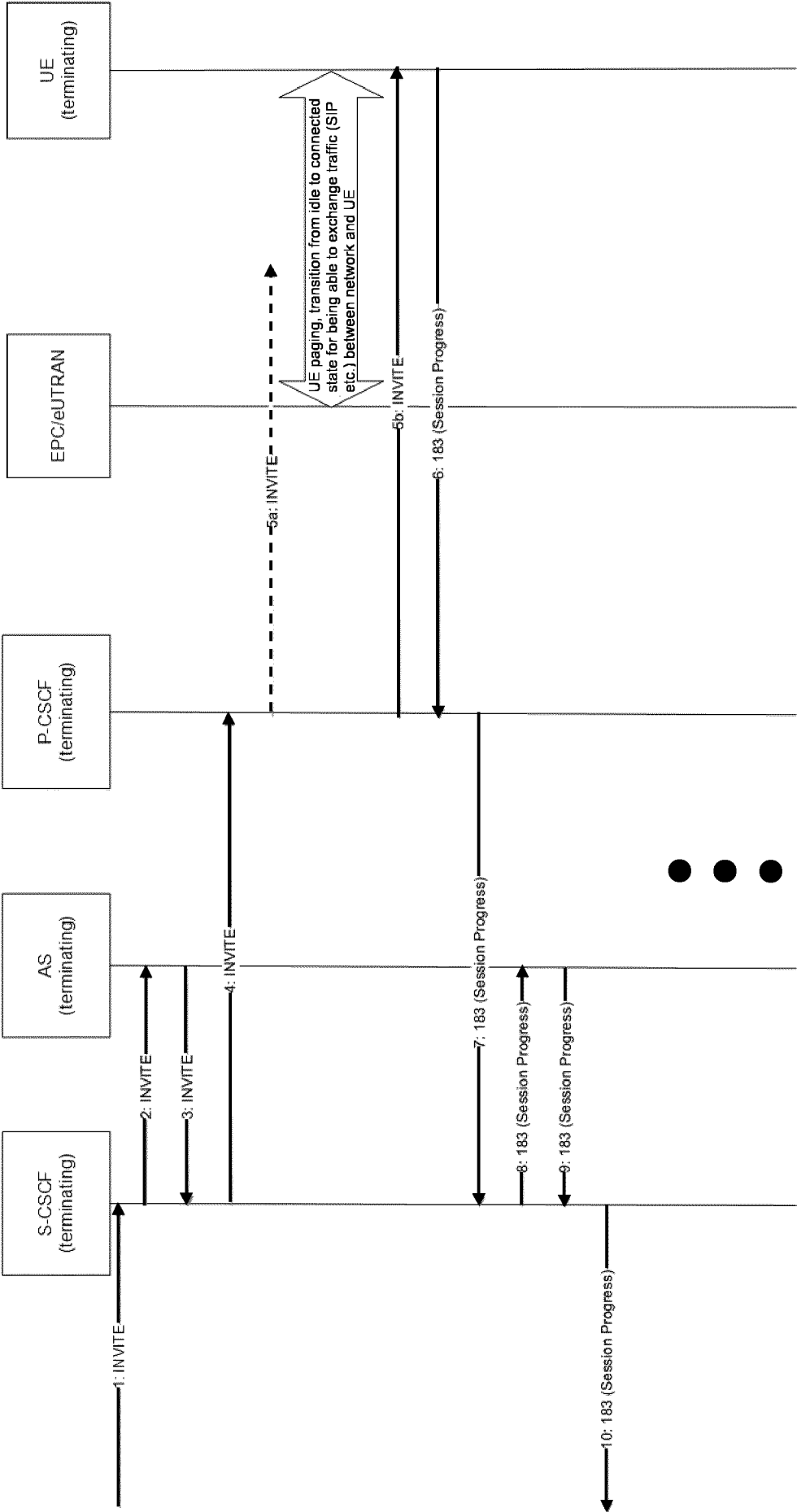


Figure 1

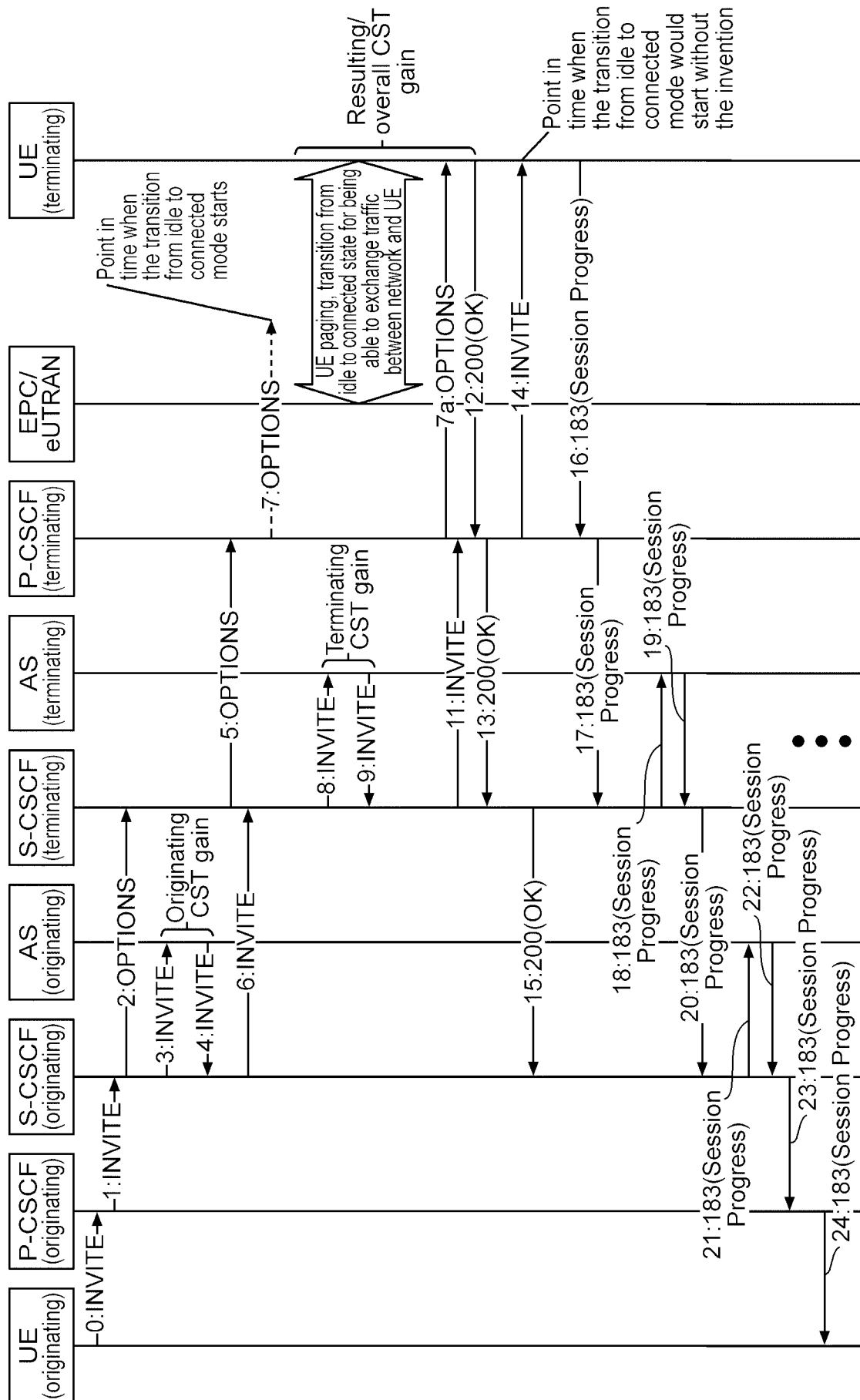


Figure 2

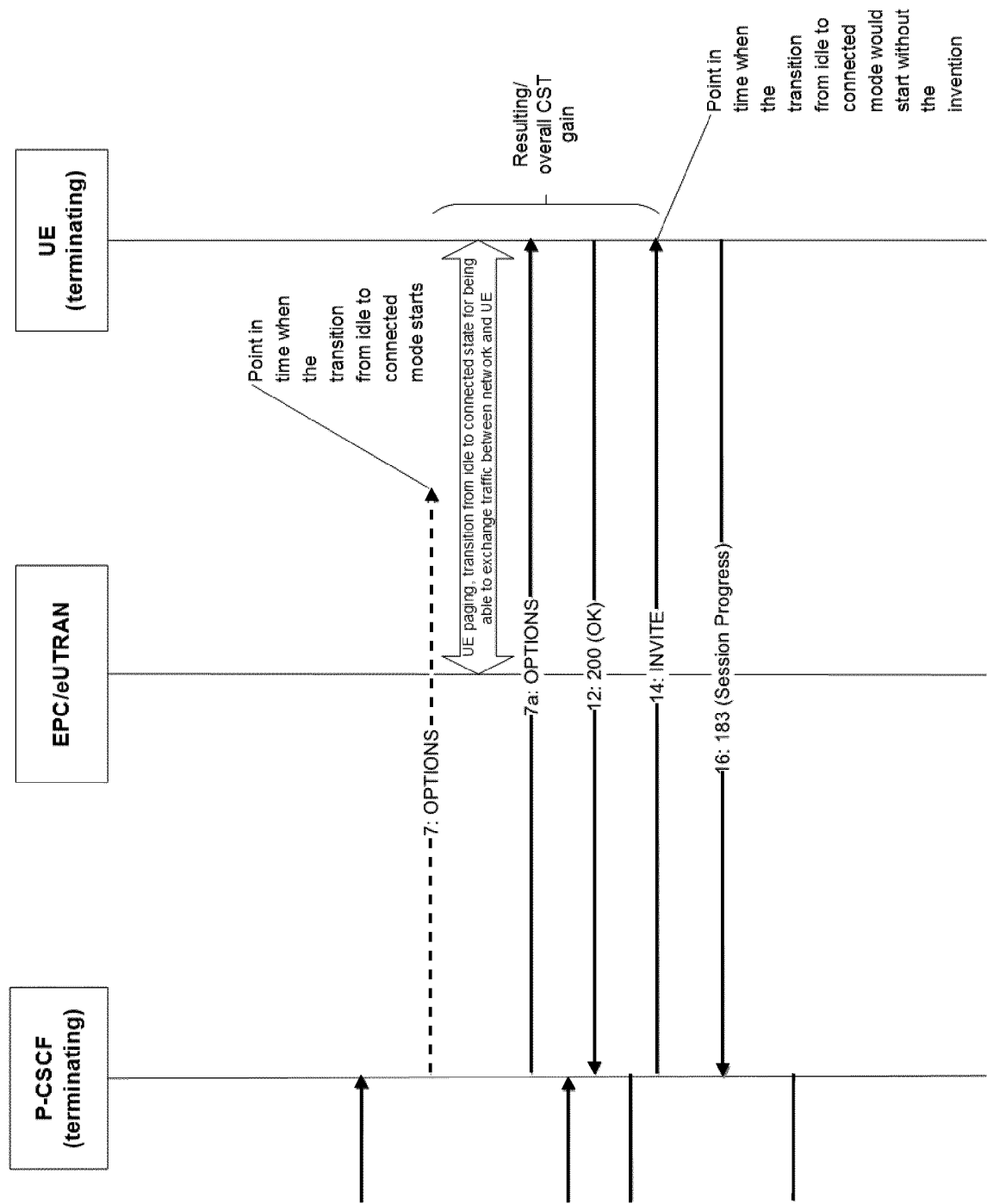


Figure 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2019/081045

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H04L29/06
 ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 H04L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, COMPENDEX, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ELENA GRIGOREVA ET AL: "M2M wake-ups over cellular networks", ALL THINGS CELLULAR, ACM, 2 PENN PLAZA, SUITE 701 NEW YORK NY 10121-0701 USA, 3 October 2016 (2016-10-03), pages 37-42, XP058280183, DOI: 10.1145/2980055.2980059 ISBN: 978-1-4503-4249-0 the whole document	1-15
A	----- WO 2011/146205 A1 (KODIAK NETWORKS INC [US]; VEMPATI BRAHMANANDA R [US] ET AL.) 24 November 2011 (2011-11-24) the whole document	1-15
A	----- US 2005/141541 A1 (CUNY RENAUD [FI] ET AL) 30 June 2005 (2005-06-30) the whole document	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 January 2020

Date of mailing of the international search report

22/01/2020

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Mannekens, Jan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/081045

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011146205	A1	24-11-2011	CA 2800060 A1 24-11-2011
			DK 2599326 T3 01-02-2016
			EP 2599326 A1 05-06-2013
			ES 2554929 T3 28-12-2015
			US 2011294494 A1 01-12-2011
			WO 2011146205 A1 24-11-2011

US 2005141541	A1	30-06-2005	CN 1918926 A 21-02-2007
			EP 1702484 A1 20-09-2006
			KR 20070006721 A 11-01-2007
			US 2005141541 A1 30-06-2005
			US 2009257378 A1 15-10-2009
			WO 2005064962 A1 14-07-2005
