

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD.,

Petitioner

v.

PANTECH CORPORATION,

Patent Owner.

IPR2025-00762

U.S. Patent No. 10,863,573

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,863,573**

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EXHIBIT LIST

Exhibit	Reference
1001	U.S. Patent No. 10,863,573 (“’573 Patent” or “’573Pat.”)
1002	File History of the ’573 Patent (“’573FH”)
1003	Declaration of Dr. Titus Lo in Support of Petition
1004	Dr. Titus Lo Curriculum Vitae
1005	U.S. Patent Application Publication No. 2014/0301362 (“Koskinen”)
1006	U.S. Patent Application Publication No. 2009/0149189 (“Sammour”)
1007	U.S. Patent Application Publication No. 2016/0021581 (“Deenoo”)
1008	U.S. Patent Application Publication No. 2014/0301281 (Koskinen281)
1009	<i>Pantech Corp.et al. v. Oneplus Tech. (Shenzhen) Co., Ltd.</i> , 5:24-cv-00038-RWS-JBB (E.D. Tex.), Dkt. No. 1, Complaint
1010	<i>Pantech Corp.et al. v. Oneplus Tech. (Shenzhen) Co., Ltd.</i> , 5:24-cv-00038-RWS-JBB (E.D. Tex.), Dkt. No. 9, Waiver of Service
1011	3GPP TS 36.323 v.11.2.0 (2013-03) (Packet Data Convergence Protocol (PDCP) specification)
1012	3GPP TS 36.300 v.11.5.0 (2013-03) (E-UTRAN overall description)
1013	3GPP TS 36.322 v.11.0.0 (2012-09) (Radio Link Control (RLC) protocol specification)
1014	3GPP TS 36.331 v.11.3.0 (2013-03) (Radio Resource Control (RRC); Protocol specification)
1015	<i>Pantech Corp.et al. v. Oneplus Tech. (Shenzhen) Co., Ltd.</i> , 5:24-cv-00038-RWS-JBB (E.D. Tex.), Dkt. No. 47, First Amended Docket Control Order
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CLAIMS APPENDIX

Reference	Claim Limitation
Claim 1	
1[pre]	A method for user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the method comprising:
1[a]	receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station;
1[b]	obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs; and
1[c]	receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,
1[d]	wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),
1[e]	wherein the RRC message includes a PDCP-configuration information element (IE), and
1[f]	the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.
Claim 2	
2	The method of claim 1, further comprising: confirming the respective PDCP SNs of the obtained PDCP SDUs and performing in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.
Claim 3	
3[a]	The method of claim 2, further comprising: confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and

Reference	Claim Limitation
3[b]	driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.
Claim 4	
4[a]	The method of claim 3, wherein before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained,
4[b]	the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n are delivered to the upper layer according to the order of the PDCP SN.
Claim 5	
5	The method of claim 2, wherein when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.
Claim 8	
8[pre]	A user equipment (UE) for receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the UE comprising:
8[a]	a receiving unit receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station and
8[b]	receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message; and
8[c]	a processor obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs,
8[d]	wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),
8[e]	wherein the RRC message includes a PDCP-configuration information element (IE), and

Reference	Claim Limitation
8[f]	the processor determines the value of in-sequence timer based on the PDCP-configuration IE.
Claim 9	
9[a]	The UE of claim 8, wherein the processor confirms the processor confirms the respective PDCP SNs of the obtained PDCP SDUs and
9[b]	performs in-sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.
Claim 10	
10[a]	The UE of claim 9, wherein the processor confirms whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and
10[b]	drives the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.
Claim 11	
11	The UE of claim 10, wherein the processor delivers, when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.
Claim 12	
12	The UE of claim 10, wherein the processor delivers, before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n to the upper layer according to the order of the PDCP SN.

I. INTRODUCTION

Petitioner requests *inter partes* review (“IPR”) of claims 1-5 and 8-12 (“Challenged Claims”) of U.S. Patent No. 10,863,573. Petitioner has shown a reasonable likelihood of prevailing as to each Challenged Claim and respectfully requests the Board institute trial.

II. GROUNDS FOR STANDING

The ’573 patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR; this Petition is filed less than one year before the waiver of service of the District Court Complaint. EX1009; EX1010.

III. RELIEF REQUESTED

Petitioner requests the Challenged Claims be cancelled in view of:

Prior Art
U.S. Patent Application Publication 2014/0301362 (“Koskinen”) is prior art under at least 35 U.S.C. §102(a)(2) (EX1005)
U.S. Patent Application Publication 2009/014.9189 (“Sammour”) is prior art under 35 U.S.C. §102(a)(1) and (a)(2) (EX1006)
U.S. Patent Application Publication 2016/0021581 (“Deenoo”) is prior art under at least 35 U.S.C. §102(a)(2) (EX1007)

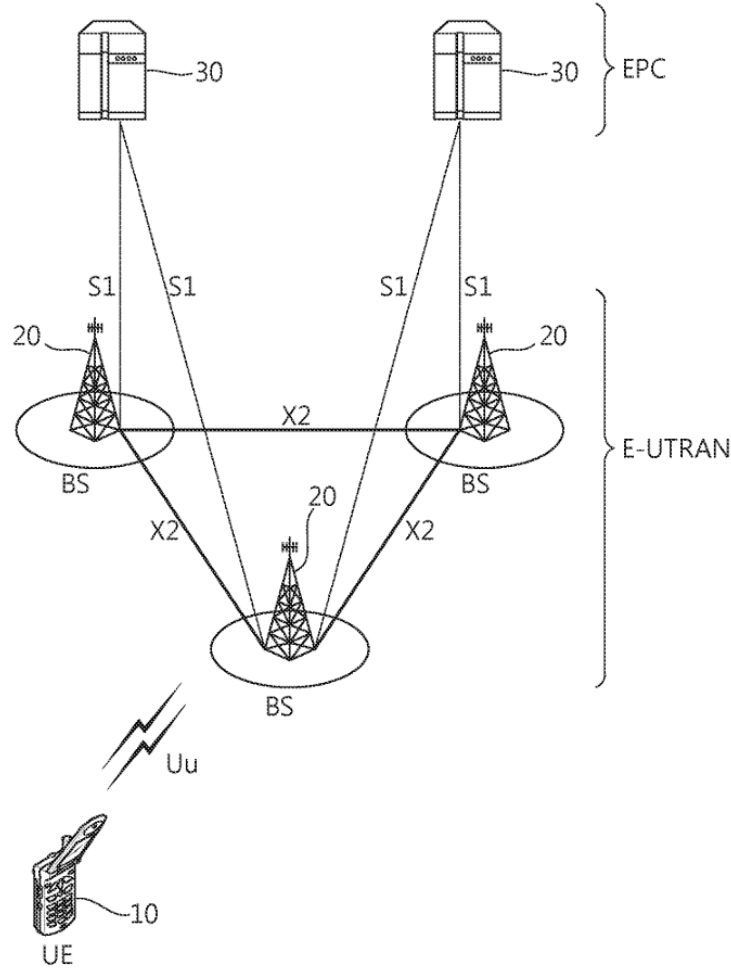
Petitioner also relies on the references listed in the Exhibit List, including declaration of Dr. Titus Lo (EX1003, “Lo”). *See also* EX1004.

Ground (35 U.S.C. §103)	Claims	References
1	1-5, 8-12	Koskinen
2	1-5, 8-12	Koskinen, Sammour
3	1-5, 8-12	Deenoo, Sammour

IV. THE '573 PATENT

A. Overview

The '573 Patent is titled “Method and apparatus for sequential forwarding considering multi-flow in dual connectivity system” ('573Pat., Title), and discloses “user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) in a wireless communication system supporting dual connectivity.” *Id.*, Abstract; Lo, ¶¶41-47, 52-97 (explaining background of the technology). The “[u]ser Equipment (UE) can perform wireless communication through two or more base stations among base stations constituting at least one serving cell.” *Id.*, 1:48-50. “The macro base station manages data flow control, security, and header compression according to a packet data convergence protocol (PDCP) for data transmitted to the small base station through a radio bearer (RB).” *Id.*, 1:61-64. And although, in general, “the wireless communication system is a single flow structure..., [when] supporting the dual connectivity, the service of one EPS bearer can be provided to the UE through not one RB but two RBs established in the macro cell and the small cell, respectively. That is, the service can be provided to the UE through multi-flows.” *Id.*, 1:65-2:4. Figure 1, below, depicts such a system.

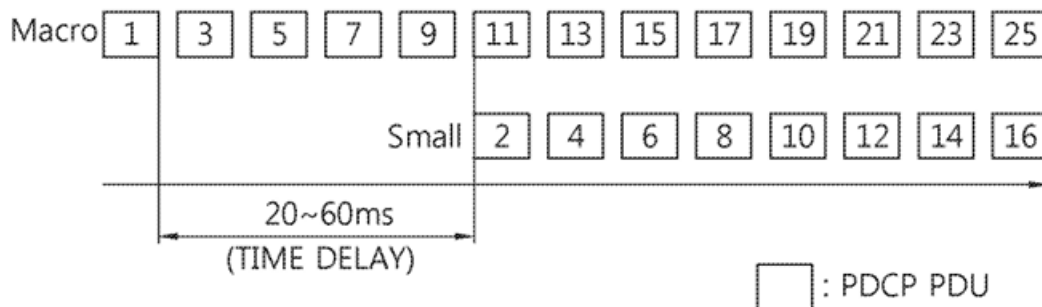


'573Pat., Fig. 1.

“[I]n the case of the UE in which the multi-flows are constituted,” a radio link control (RLC) layer in the UE is associated with each of the macro and small base stations. *Id.*, 2:21-27, 11:66-12:29, Fig. 11; Lo., ¶42. Because of this, the '573 Patent acknowledges the next layer up (packet data convergence protocol or “PDCP”) “cannot sequentially acquire the [data].” '573Pat., 1:61-64, 2:26-27, 12:30-63; Lo, ¶43. Thus, “in the case of the UE using the multi-flows, a new method for sequential delivery of the PDCP SDUs to the upper layer in the PDCP entity is

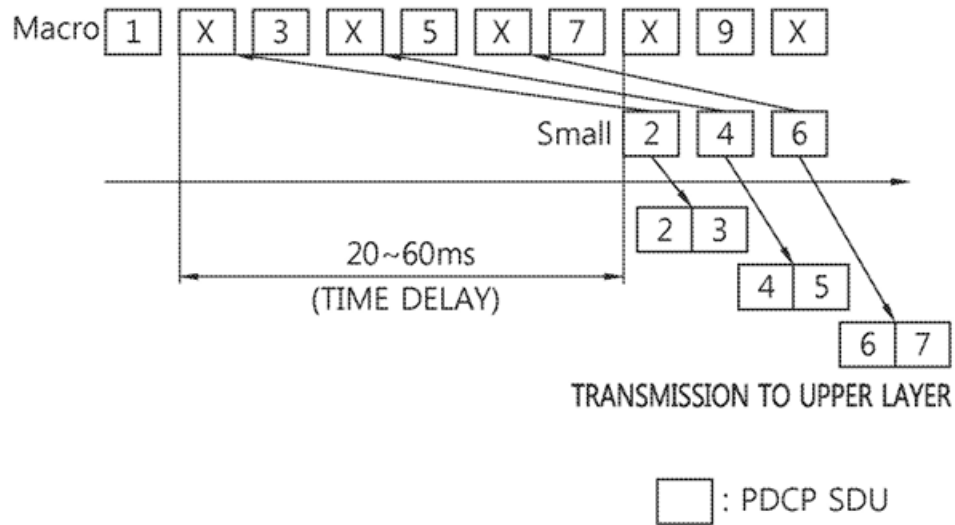
required.” ’573Pat., 2:27-30, 12:64-13:39; Lo, ¶44.

To overcome the issue of non-sequential delivery of PDCP data (PDCP packet data units (“PDU”)), the ’573 Patent proposes to use “an in-sequence timer for the PDCP” to allow for delivering PDCP data (i.e., PDCP service data units (“SDU”)) to upper levels. ’573Pat., 13:43-53; Lo, ¶45. The “in-sequence timer” is started (i.e., “driven”) when a PDCP sequence number (“SN”) is missed. ’573Pat., 13:43-48; Lo, ¶45. “[T]he duration of the in-sequence timer may be determined by considering the receiving delay of the transmission path of the PDCP PDU” or “an overall situation of the system.” ’573Pat., 13:48-53. Figure 12 shows reception of the PDCP PDUs with a gap and time delay.



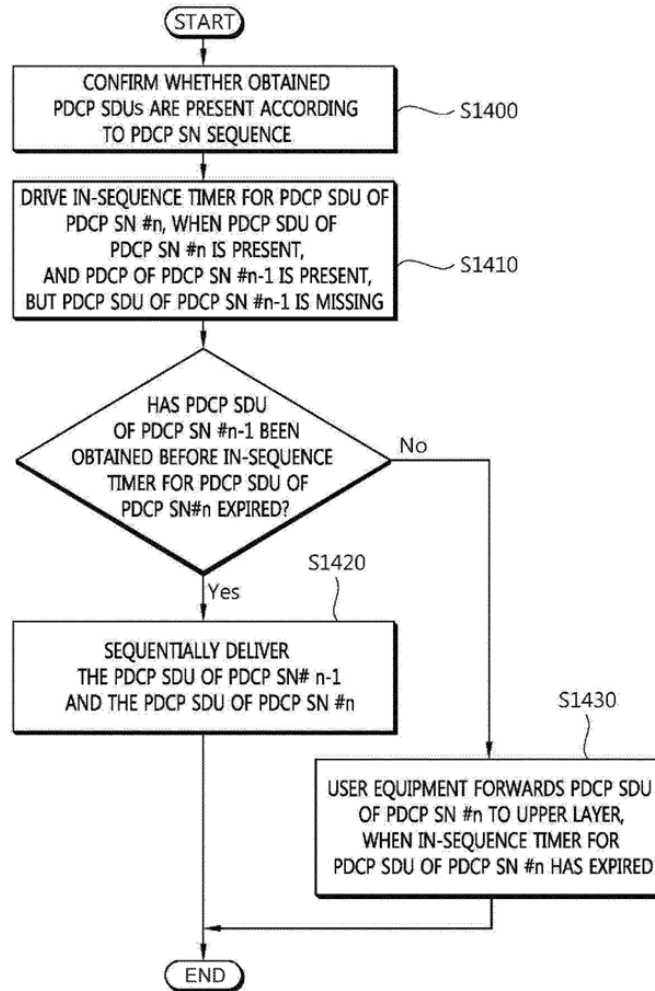
’573Pat., Fig. 12.

By using the “in-sequence timer” in the PDCP, the ’573 Patent purports to solve the problem of out-of-sequence PDCP PDUs by allowing the PDCP to wait for the missed PDUs before sending the corresponding SDUs to the upper level. *Id.*, 13:54-14:55; Lo, ¶46. This is shown in Figure 13.



'573Pat., Fig. 13.

While the '573 Patent further discloses the “timer duration may be established by considering a transmission delay time of the backhaul between the macro base station and the small base station” ('573Pat., 14:58-61; Lo, ¶47), “[t]he in-sequence timer may be transmitted from the macro base station to the UE through the RRC [“radio resource control”] message” (*Id.*, 14:62-63). Notably, the timer may be “included in a PDCP configuration which is an RRC information element [“IE”].” '573Pat., 14:63-66; Lo, ¶47. The sequence of processing the PDCP PDUs using the in-sequence timer is shown in Figure 14.



'573Pat., Fig. 14.

B. Prosecution History

U.S. Patent Application No. 15/935,626 was filed on March 26, 2018, claiming priority to a Korean application filed May 10, 2013. '573Pat., Cover; Lo, ¶48.

The Examiner repeatedly rejected the pending claim because various prior art references independently taught receiving PDCP data in a user equipment using dual connectivity. The Examiner twice noted, regarding prior art Ohta (U.S. Patent

Application Publication No. 2012/0182971), a “source base station” corresponded to the claimed “macro eNB” and a “target base station” corresponded to the claimed “small eNB.” EX1003(“’573FH”), 111, 141; Lo, ¶49. Applicant never contested the Examiner’s Ohta-based rejections. ’573FH, 40-43, 127-129.

To overcome the prior art, Applicant amended the claims to recite “wherein the RRC message includes a PDCP-configuration information element (IE), and the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.” *Id.*, 36. This resulted in the Notice of Allowance. *Id.*, 17-19; Lo, ¶50. The ’573 patent issued on December 8, 2020, with a terminal disclaimer to U.S. Patent No. 9,930,720. ’573FH, 140.

Koskinen, Deenoo, and Sammour were not cited in the ’573 file history. Nor was the cited art related to those references. Lo, ¶51.

C. Level of Ordinary Skill in the Art

For the purposes of this petition, a person of ordinary skill in the art (“POSITA”) in May 2013 would have had a bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field and at least two years of practical experience with design or development of telecommunication and/or wireless communications systems, or the equivalent. Additional education could substitute for industry experience and vice versa. (Lo, ¶¶19-21).

D. Claim Construction

Petitioner believes no express constructions are necessary to assess whether the prior art reads on the challenged claims. The claims should be given their plain and ordinary meaning. *Lo*, ¶117.

V. SPECIFIC GROUNDS

A. Ground 1: Claims 1-5 and 8-12 Are Obvious Over Koskinen

1. Koskinen

Koskinen (EX1005) is titled “Delivery of protocol data units.” Koskinen, Title. Koskinen discloses an evolved packet system (e.g., LTE) utilizing a single PDCP layer in base stations sending packets destined for a user equipment to multiple lower RLC layers before being transmitted to the UE. *Lo*, ¶120. Koskinen’s UE received the packets via at least two RLC layers and delivers the packets to a single higher PDCP layer. Because during handover from source to a target base station packets may be lost causing gaps in the data, Koskinen describes using a reordering timer in the PDCP like the conventional reordering timer in the RLC layer. *Id.* Koskinen explains using such a timer ensures missing PDCP packets are either not missed or do not prevent received packets from being delivered to higher layers. *Id.*

Koskinen is analogous art to the ’573 patent because it is in the same field and directed to solving similar problems, including “observing a gap in a sequence of protocol data units received from a plurality of lower-layer protocol entities

providing data transfer” and “starting a timer upon the gap observation.” Koskinen, Abstract, ¶18; Lo, ¶121. And like the ’573 Patent, Koskinen’s system utilizes a “PDCP bearer terminated at the user equipment and the eNB [that] is carried over two independent RLC bearers, one over each of the two radio interfaces of the user equipment.” Koskinen, ¶¶15, 34, Fig. 1; ’573Pat., 10:4-12, 11:1-10, Figs. 9, 11; Lo, ¶121.

Koskinen discloses “the PDCP entity at the user equipment may...receive PDCP protocol data units from multiple underlying RLC entities in a highly interlaced manner” when a plurality of RLC bearers are used to send data of a PDCP bearer as shown in Figure 1. Koskinen, ¶35; Lo, ¶122. Koskinen further explains during handover “without forwarding the bearer may go into deadlock, because the gaps created by packets that were not forwarded will never be received.” Koskinen, ¶35. Accordingly, Koskinen discloses “apparatuses and methods for the PDCP entity at the user equipment to deduce when not to expect reception gaps to be filled.” *Id.*, ¶36.

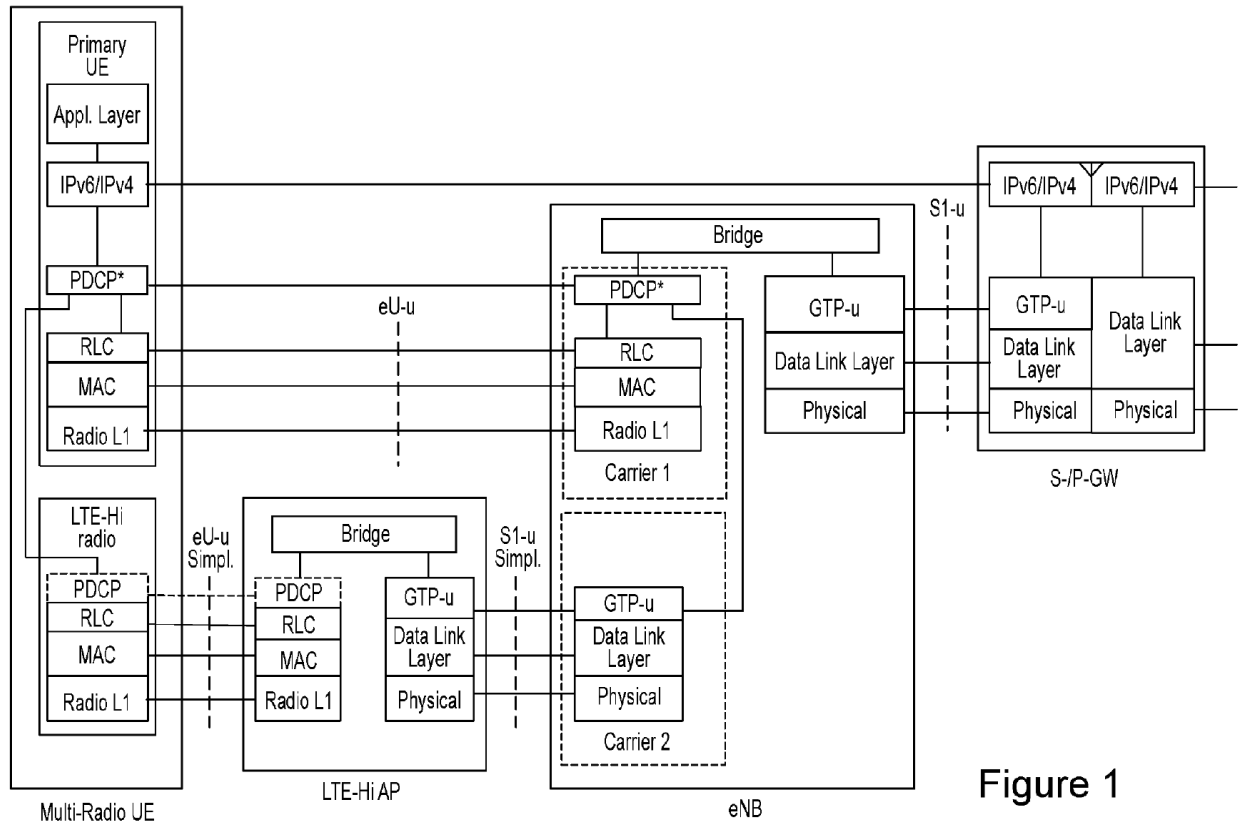
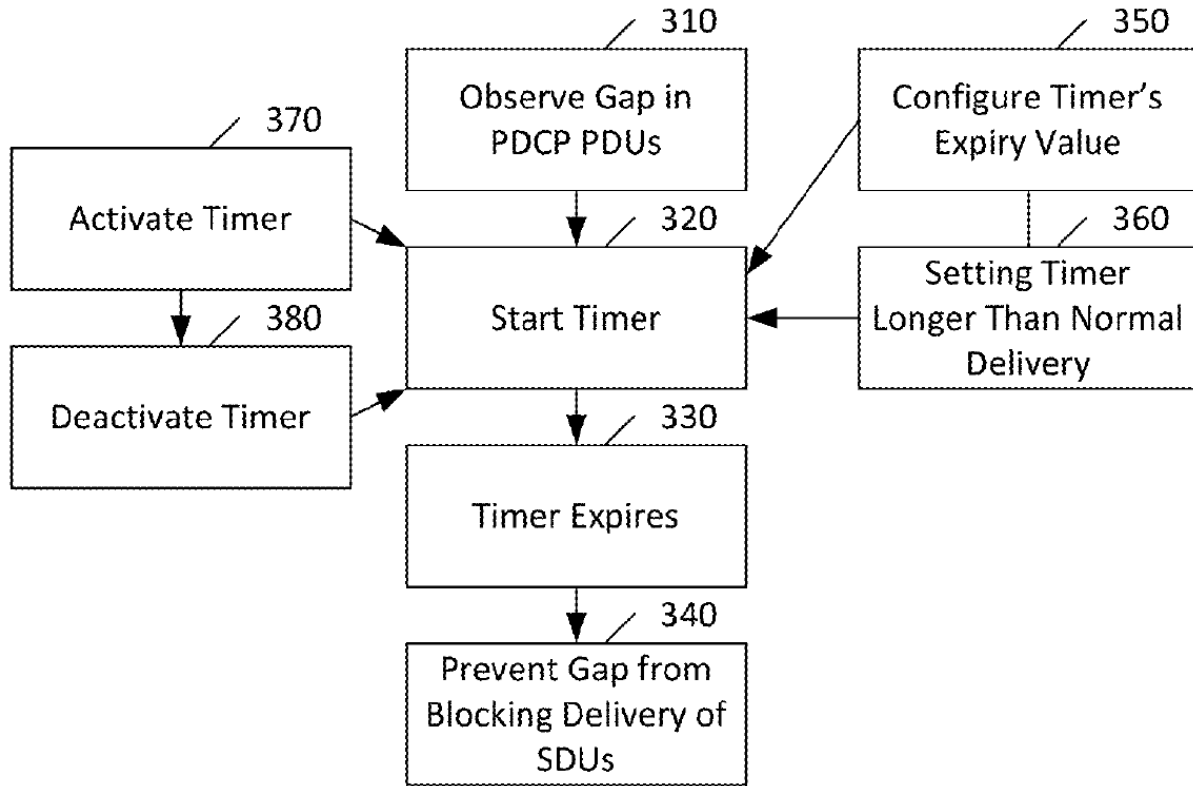


Figure 1

Koskinen, Fig. 1.

For example, “certain embodiments utilize a timer, such as a reordering timer, as shown in FIG. 2.” *Id.*, ¶37. Koskinen explains “the timer and its handling, along with the related state variables” can be repurposed from the RLC to the PDCP. *Id.*; Lo, ¶123. Moreover, “[t]he timer’s expiry value can be configured by radio resource control (RRC).” Koskinen, ¶39. And “t-Reordering and a state variable like VR(UX) can be handled similar to” reordering in the RLC. *Id.*, ¶46; Lo, ¶123.



Koskinen, Fig. 2.

2. Independent Claim 1

- a. **1[pre]: “A method for user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the method comprising:”**

If limiting, Koskinen teaches or suggests 1[pre]. Lo, ¶¶124-132.

As explained further below, Koskinen discloses the following:¹

¹ Italicized text denotes claim language.

- “*evolved packet system (EPS) bearer...supporting dual connectivity*”:

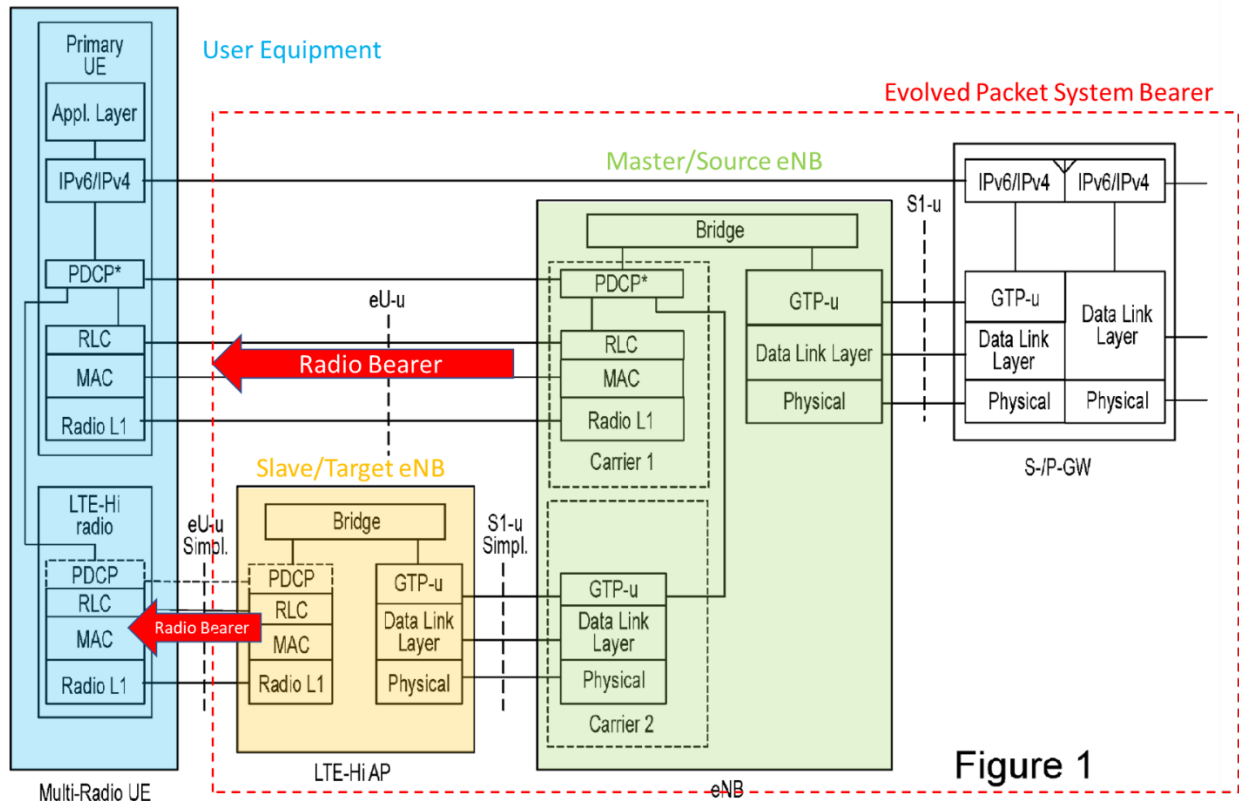
E-UTRAN

- “*macro base station (macro eNB)*”: source eNB
- “*small base station (small eNB)*”: target eNB (LTE Hi AP)
- “*user equipment receiving multi-flow data*”: user equipment receiving
PDCP protocol data units from multiple underlying RLC entities

Lo, ¶125; Koskinen, Abstract, ¶¶34-36, Fig. 1.

Koskinen discloses the claimed wireless communication system supporting dual connectivity because it describes an Evolved Universal Terrestrial Radio Access Network (E-UTRAN) with dual-connectivity, utilizing a user plane (U-plane) “having independent RLC in each node.” Koskinen, ¶¶4, 7. Figure 1, below, illustrates the U-plane with multiple radios (e.g., radio bearers) where the “protocol stacks may be based on having independent RLC in each node for dual connectivity” and used for “offloading or inter carrier aggregation” of data. *Id.*, ¶7, Fig. 1; Lo, ¶126. Figure 1 further illustrates an S-/P-GW (serving or packet data network gateway) connected and sending data to the system. *Id.* As explained by Dr. Lo, data is transmitted to user equipment from the S-/P-GW through the eNB and LTE-Hi AP. *Id.* POSITAs would have understood the combination of the eNB/LTE-Hi AP and gateways as an “*evolved packet system bearer*” because it provides a logical connection between the user equipment and the gateways, facilitating data traffic

transport. *Id.*, ¶¶126, 59-60; *see* '573Pat., 4:30-60 (“E-UTRAN and the EPC 30 [including S-/P-GW] are integrated to be called an evolved packet system (EPS)”).



Koskinen, Fig. 1 (annotated).

Koskinen’s dual-connectivity E-UTRAN provides connectivity through two different eNBs, including a source eNB and a target eNB, where the source eNB “may forward in order to the target eNB all downlink PDCP SDUs [service data units] with their SN [sequence number] that have not been acknowledged by the [user equipment].” Koskinen, ¶8. POSITAs would have understood Koskinen’s source and target eNBs correspond to the claimed “macro” and “small” eNBs, respectively. Lo, ¶127. Notably, Koskinen in connection with the configuration of

Figure 1 refers to the target (LTE-Hi AP) as the slave eNB and to the source as master eNB. Koskinen, ¶12 (“PDCP entity at the eNB interfaces a co-located master RLC entity...[and] a slave RLC entity operating at the LTE-Hi AP.”). The “LTE-Hi AP” is an LTE access point that POSITAs would have recognized as a “*small base station*” within the context of the ’573 Patent because it is an evolved system (e.g., LTE or Long Term Evolution) supporting dual-connectivity. Lo, ¶¶127, 66; ’573Pat., 2:46-48. Furthermore, the “LTE-Hi AP” is a lower power access point receiving data from and dependent on the source eNB, and POSITAs would have recognized such a configuration is consistent with a the ’573 Patent’s description of a small base station. Lo, ¶¶127, 66; ’573Pat., 1:29-47, 4:37-48. Furthermore, the “LTE-Hi AP” is a lower power access point receiving data from and dependent on the source eNB, and POSITA would have recognized such a configuration is consistent with a the ’573 Patent’s description of a small base station. Lo, ¶¶127, 66; ’573Pat., 1:29-47, 4:37-48. Furthermore, POSITAs would have recognized Koskinen’s eNB and LTE Hi AP are a macro eNB and pico eNB (or similar structure) and operate in the same manner. Lo, ¶¶128, 64-66 (discussing Koskinen281 (EX1008), ¶7, Fig. 1). This interpretation is corroborated by the original prosecution of the ’573 Patent, where the Examiner rejected the same limitations based on Ohta (US 2012/0182971), disclosing source and target base stations. Lo, ¶¶127, 49.

Accordingly, Koskinen teaches an E-UTRAN receiving data from an S- or P-GW (“*evolved packet system (EPS) bearer*”) and comprising a source or master eNB (“*through a macro base station (macro eNB)*”), a target or slave eNB (an LTE-Hi AP) (“*a small base station (small eNB)*”) supporting “*dual connectivity*,” and UE. Lo, ¶129.

The E-UTRAN described by Koskinen sends sequential PDCP data to a user equipment by splitting the data and sending it through two radio links with independent RLCs. Koskinen, ¶¶4-17, Fig. 1; Lo, ¶130. Because the “PDCP protocol data units [are sent] from multiple underlying RLC entities in a highly interlaced manner,” POSITAs would have understood the two RLC entities are part of the same cell. *Id.*, ¶35; Lo, ¶130. Accordingly, the source or master eNB and target or slave eNB (“*a macro base station (macro eNB) and a small base station (small eNB)*”) are a system of radio bearers sending a single stream of data to a user equipment (“*serving a single cell in a wireless communication system*”). *Id.*

Koskinen discloses the user equipment “may be a mobile station (MS) such as a mobile phone or smart phone or multimedia device,” or other such wireless device. Koskinen, ¶50. Furthermore, unlike in traditional E-UTRAN models, the user equipment receives PDCP data “over two independent RLC bearers, one over each of the two radio interfaces of the user equipment.” *Id.*, ¶¶34-35. In other words, the user equipment receives “multi-flow data” as described by the ’573 patent. Lo,

¶131; '573Pat., 1:65-2:6. Furthermore, the '573 Patent admits each element of the preamble was well-known to POSITAs at the time of priority date of the '573 Patent. '573Pat., 1:29-2:6; Lo, ¶131.

Accordingly, Koskinen (and applicant admitted prior art) teaches a method for a user equipment receiving sequential PDCCP data through two radio links (“*user equipment receiving multi-flow data with respect to*”) the E-UTRAN comprising the source and target eNBs.

b. 1[a]: “receiving packet data convergence protocol (PDCCP) packet data units (PDUs) through the macro base station and the small base station;”

Koskinen teaches or suggests this limitation. Lo, ¶¶133-134.

The '573 Patent admits each element of 1[a] was well-known to POSITAs at the time of priority date of the '573 Patent. '573Pat., 2:7-18; Lo, ¶134. Furthermore, as explained above for 1[pre], Koskinen’s UE receives “PDCCP protocol data units [PDU] from multiple underlying RLC entities in a highly interlaced manner.” Koskinen, ¶¶4-15, 35; §V.A.2.a. Furthermore, as shown in Figure 1, the multiple underlying RLC entities discussed in Koskinen are part of the source and target eNBs (“*macro base station and the small base station*”). Koskinen, ¶¶8, 15, Fig. 1; Lo, ¶¶134, 127.

c. 1[b]: “obtaining PDCCP service data units (SDUs) corresponding to the PDCCP PDUs; and”

Koskinen teaches or suggests this limitation. Lo, ¶¶135-138.

Koskinen discloses the UE receiving downlink PDCP SDUs from the target eNB when the source eNB sends downlink PDCP SDUs (either itself or through the target eNB) in the downlink. Koskinen, ¶8. Koskinen further discloses PDCP SDUs may be delivered to upper layers after receiving the PDCP PDUs. *Id.*, ¶¶10, 12, 45. Moreover, Koskinen incorporates by reference 3GPP TS 36.323 describing the “Packet Data Convergence Protocol (PDCP) specification” and 3GPP TS 36.300 providing the overall description of an E-UTRAN.² *Id.*, ¶¶8, 10; EX1011; EX1012. 3GPP TS 36.300 explains a PDCP PDU includes a PDCP header and a PDCP SDU. EX1012, §6.3.2. 3GPP TS 36.323 further explains a PDCP PDU in the user plane includes a PDCP SDU serial number (SN) and a compressed or uncompressed PDCP SDU. EX1011, §6.1. POSITAs with knowledge of the E-UTRAN structure and protocols would have thus understood a PDCP SDU is obtained by removing the header from a PDCP PDU. Lo, ¶¶136, 74-76. The PDCP SDU is the portion of the PDU delivered to the higher layers. Koskinen, ¶¶8, 12, 45; Lo, ¶¶136, 74-76.

Moreover, the ’573 Patent admits each element of 1[b] was well-known to POSITAs at the time of priority date of the ’573 Patent. ’573Pat., 2:7-18; Lo, ¶137.

Accordingly, Koskinen’s UE receives PDCP PDUs and obtains the

² Dr. Lo explains the 3GPP technical specifications were publicly available to POSITAs at the time of the ’573 Patent. Lo, ¶¶98-116.

corresponding SDUs to deliver PDCP SDUs to higher layers (“*obtain[s] PDCP service data units (SDUs) corresponding to the PDCP PDUs*”). *Id.*, ¶138.

- d. **1[c]: “receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,”**

Koskinen teaches or suggests this limitation. Lo, ¶¶139-141.

Koskinen discloses the RLC layer of the UE includes a reordering timer—*t-Reordering*—used as a time interval in which to determine whether reordering of received RLC data is out of order and must be reordered by waiting for in-sequence RLC data. Koskinen, ¶¶4, 16-17; EX1013, §5.1.2.2 (incorporated by reference); Lo, ¶140. Koskinen further discloses the PDCP layer or entity of the UE can “deduce when not to expect reception gaps to be filled” by using a timer. Koskinen, ¶¶36-37. Furthermore, Koskinen describes re-purposing the timer operating at the RLC level to be used at the PDCP layer (“*in-sequence timer*”). Notably, Koskinen describes, for the PDCP entity to determine a gap will not be filled, “the timer and its handling, along with the related state variables needed, that are currently specified for RLC-UM can be repurposed for AM data transfer.” *Id.*, ¶37. In other words, the reordering timer from the RLC layer, and other state variables associated with it, is repurposed to be used in the PDCP layer. Lo, ¶140. Because the timer is used by the PDCP layer, POSITAs would have recognized and found obvious the repurposed timer was a PDCP timer, determining reordering of SDUs for sequential delivery to higher layers

(“*in-sequence timer for the PDCP SDUs*”). Koskinen, ¶¶37-39; Lo, ¶¶140, 92-96.

Koskinen further discloses the “timer's expiry value can be configured by radio resource control (RRC).” Koskinen, ¶39, Claims 2 and 16. Because Koskinen in Figure 1 discloses a single PDCP entity in the Master/Source eNB, the Master/Source eNB transmits the RRC, since it is a higher layer than the PDCP and the RRC originates at the eNB controlling communication. Lo, ¶141; EX1012, §4.1. According to 3GPP TS 36.331, which describes the “procedures and messages” of RRC, the RRC uses a Signaling Radio Bearer (SRB) to send RRC messages. EX1014, §§4.1, 4.2.2. It was well-known the RRC message was sent from the macro (or source/master) eNB (e.g., base station) because it controls the transmission of data. Lo, ¶¶141, 86; *see* Koskinen281, Fig. 1.. POSITAs would have recognized and found obvious the UE receives “*from the macro base station*” RRC “*messages*” because Koskinen discloses UE configuration by RRC and the RRC configures the UE by using messages from the macro base station. Lo, ¶¶141, 86.

e. 1[d]: “wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),”

Koskinen teaches or suggests this limitation. Lo, ¶¶142-145.

Koskinen explains “the UE receives a PDCP SDU...deliver it to higher layer together with all PDCP SDUs with lower SNs.” Koskinen, ¶8 (quoting 3GPP TS 36.300 §§10.1.2.3 and 10.1.2.3.1). Thus, the “downlink PDCP SDUs” have a sequence number (defined in Koskinen as “SN Sequence Number”) (“*the PDCP*

SDUs are indicated by a...PDCP sequence number (SN)”). *Id.*, ¶¶8, 56; Lo, ¶143.

Furthermore, as Dr. Lo explains, it was well known that each PDCP SDU had an associated serial number. Lo, ¶143. In the PDCP receiving side (i.e., in the UE), reordering is based on the PDCP Sequence Number (SN), which is part of the PDCP header, and the reordering process relies on the PDCP header being intact to extract the SN. *Id.* It was well-known that the PDCP PDU is received by the PDCP layer, the SN is extracted from the header, the PDCP SDU is extracted—i.e., the header is removed—and the SDU is delivered to the higher layer. Lo, ¶143 (discussing EX1011, §5.2.1.2). This is further corroborated by the 3GPP standard specifications; 3GPP TS 36.300 (incorporated by reference in Koskinen) explains “[t]he PDU sequence number carried by the RLC header is independent of the SDU sequence number (i.e. **PDCP sequence number**).” EX1012, §6.2.2.

Moreover, the ’573 Patent presents the same understanding as illustrated in Figures 12 and 13. Lo, ¶144. Figure 12 illustrates receiving PDCP PDUs with SNs (’573Pat., 12:30-42), and Figure 13 “illustrates an example of sequential upper layer transmission depending on the PDCP sequence number (SN) in the PDCP entity of the UE” (*id.*, 14:15-17). The ’573 Patent consistently refers to the SN of the SDU and the same SN of the received PDU. *Id.*, 14:23-55, Figs. 12-13; Lo, ¶144. Regarding Figure 14, the ’573 Patent explains the “acquired PDCP SDUs are sequentially present in the order of the PDCP SN.” ’573Pat., 15:51-53. Thus,

POSITAs would have understood, based on the 3GPP specifications and operation of E-UTRAN systems, and confirmed by the '573 Patent, the SN associated with the PDCP PDU, received from the lower layer, was also associated with the SDU—the portion of the PDU not including the header information (“*the PDCP SDUs are indicated by a...PDCP sequence number (SN)*”). Lo, ¶144.

Furthermore, the “PDCP SN is maintained on a bearer basis and the source eNB informs the target eNB about the next DL PDCP SN to allocate to a packet which does not have a PDCP sequence number yet (either from source eNB or from the Serving Gateway).” EX1012, §10.1.2.1.2. And TS 36.300 explains “[a] sequence number (COUNT) is used as input to the ciphering and integrity protection” and “[a] given sequence number must only be used once for a given eNB key.” *Id.*, §14.1. POSITAs would have therefore recognized the sequence number was “*predefined*,” at least because it cannot be reused and so must be defined before it can be assigned to the PDCP PDU/SDU. Lo, ¶145.

f. 1[e]: “wherein the RRC message includes a PDCP-configuration information element (IE), and”

Koskinen teaches or suggests this limitation. Lo, ¶146-149.

As explained above for 1[c], Koskinen discloses the eNB and the UE include a PDCP layer, and the timer used for PDCP reordering in the UE is in the PDCP layer. Koskinen, ¶¶4, 36-39; §V.A.2.d. According to Koskinen, the timer is configured by RRC. Koskinen, ¶39, Claims 2 and 16; §V.A.2.d. As explained above

for 1[c], POSITAs would have recognized Koskinen's source eNB sends an RRC message to configure the UE. Lo, ¶¶147, 141; §V.A.2.d. Because the UE includes a PDCP layer and is configured by RRC, POSITAs would have recognized and found obvious the RRC included a PDCP configuration information element. Lo, ¶¶147-148, 82. PDCP information elements, well-known at the time of the '573 Patent, were specified in the 3GPP technical specifications, including TS 36.331 (reproduced below). EX1014, 202. POSITAs would have consulted the specification for information about the RRC. Lo, ¶¶147, 82 (discussing PDCP information elements in EX1014). The example PDCP configuration IE from TS 36.331 includes various parameters such as time and sequence values and header compression. *Id.*, ¶147. The IE *PDCP-Config* is used to set the configurable PDCP parameters for data radio bearers. *Id.*

PDCP-Config information element

```
-- ASN1START
PDCP-Config ::=
    discardTimer
    rlc-AM
    statusReportRequired
    rlc-UM
    pdcp-SN-Size
    headerCompression
    notUsed
    rohc
    maxCID
    profiles
    profile0x0001
    profile0x0002
    profile0x0003
    profile0x0004
    profile0x0006
    profile0x0101
    profile0x0102
    profile0x0103
    profile0x0104
    },
    ...
}
},
...
[[ rn-IntegrityProtection-r10
]],
[[ pdcp-SN-Size-v1130
]]
}
-- ASN1STOP
```

EX1014, 202.

g. 1[f]: “the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.”

While Koskinen describes the in-sequence timer information is provided to the UE (see Element 1[c]), it does not explicitly describe a *configuration IE field* for the in-sequence timer; but this limitation would have been obvious based on Koskinen’s teachings. Lo, ¶¶150-154.

As explained above for 1[c] and 1[e], Koskinen describes a PDCP reordering timer configured by RRC. Lo, ¶151; §V.A.2.d; §V.A.2.f. Koskinen further discloses the PDCP timer uses variables like those used for the RLC-UM (radio link control – unacknowledged mode). Koskinen, ¶¶37-38, 56. POSITAs would have known and been familiar with information elements (IEs) specifying an RLC reordering timer

based on (1) POSITAs' general familiarity that IEs carried information in RRC messages (Lo, ¶¶151, 82), and (2) 3GPP technical standards, for example, 3GPP TS 36.331, describing an IE carrying reordering timer duration information for the RLC layer, as shown below (EX1014, 219-220). Accordingly, POSITAs would have found obvious the PDCP timer information, which used similar variables as its RLC counterpart (Koskinen ¶¶37-38), would also be carried in a PDCP-configuration IE. Lo, ¶151.

```

T-Reordering ::=
    ENUMERATED {
        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
        ms75, ms80, ms85, ms90, ms95, ms100, ms110,
        ms120, ms130, ms140, ms150, ms160, ms170,
        ms180, ms190, ms200, spare1}

```

EX1014, 219-220.

Furthermore, POSITAs would have been motivated and would have had a reasonable expectation of success to include a variable or a field in the PDCP configuration sent by the RRC message to specify the timer expiration duration because it would have allowed reliable setting of the UE timer through a known methodology already included in the 3GPP specification. Lo, ¶¶152-153, 82. Including such a variable as part of an IE would have required nothing more than the application of known, conventional techniques (using the RRC message to set parameters in a UE conveyed through a field in a configuration element) to yield predictable results (setting parameters to set timers in the UE) as described in Koskinen. Lo, ¶¶152, 82. Using such a technique was well within the skill of

POSITAs. Lo, ¶152.

3. **Claim 2: “The method of claim 1, further comprising: confirming the respective PDCP SNs of the obtained PDCP SDUs and performing in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.”**

Koskinen teaches or suggests the additional limitations of Claim 2. Lo, ¶¶155-158.

Claim 2 recites the unremarkable and well-understood principle within E-UTRAN systems of the UE forwarding sequential PDCP data packets to higher levels. Lo, ¶156. Notably, this claim does not include any recitation of the timer, its value, or out-of-order reception of the data units. Regardless, Koskinen teaches this well-known PDCP function or “in-sequence delivery of upper layer PDUs at re-establishment of lower layers” where “protocol stacks may be based on having independent RLC in each node for dual connectivity.” Koskinen, ¶¶6-7.

At stage-3 (i.e., PDCP layer), “this principle looks as follows in 3GPP TS 36.323 [Packet Data Convergence Protocol (PDCP) specification] §§5.1.2, 5.1.2.1, and 5.1.2.1.2:

‘. . . if the PDCP PDU received by PDCP is not due to the re-establishment of lower layers: **deliver to upper layers in ascending order of the associated COUNT value:** all stored PDCP SDU(s) with an associated COUNT value less than the COUNT value associated with the received PDCP SDU; **all stored PDCP SDU(s) with consecutively**

**associated COUNT value(s) starting from the COUNT
value associated with the received PDCP SDU”**

Id., ¶¶10.^{3, 4} In other words, the 3GPP specification explains to deliver sequential SDU’s to upper layers as normal. *Lo*, ¶157. This is because “the system assumes that no PDU with lower SN will follow after the one received, and deliver SDUs to higher layer accordingly.” Koskinen, ¶11. Furthermore, “the system refrains from any SDU delivery to higher layer that would leave a hole in the SN sequence of delivered SDUs.” *Id.*, ¶¶12-13.

Accordingly, consistent with the 3GPP specifications, Koskinen teaches tracking PDCP SDU sequence numbers (“*confirming the respective PDCP SNs of the obtained PDCP SDUs*”) and delivering them sequentially to higher levels (“*performing in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN*”). *Lo*, ¶158.

4. Claim 3

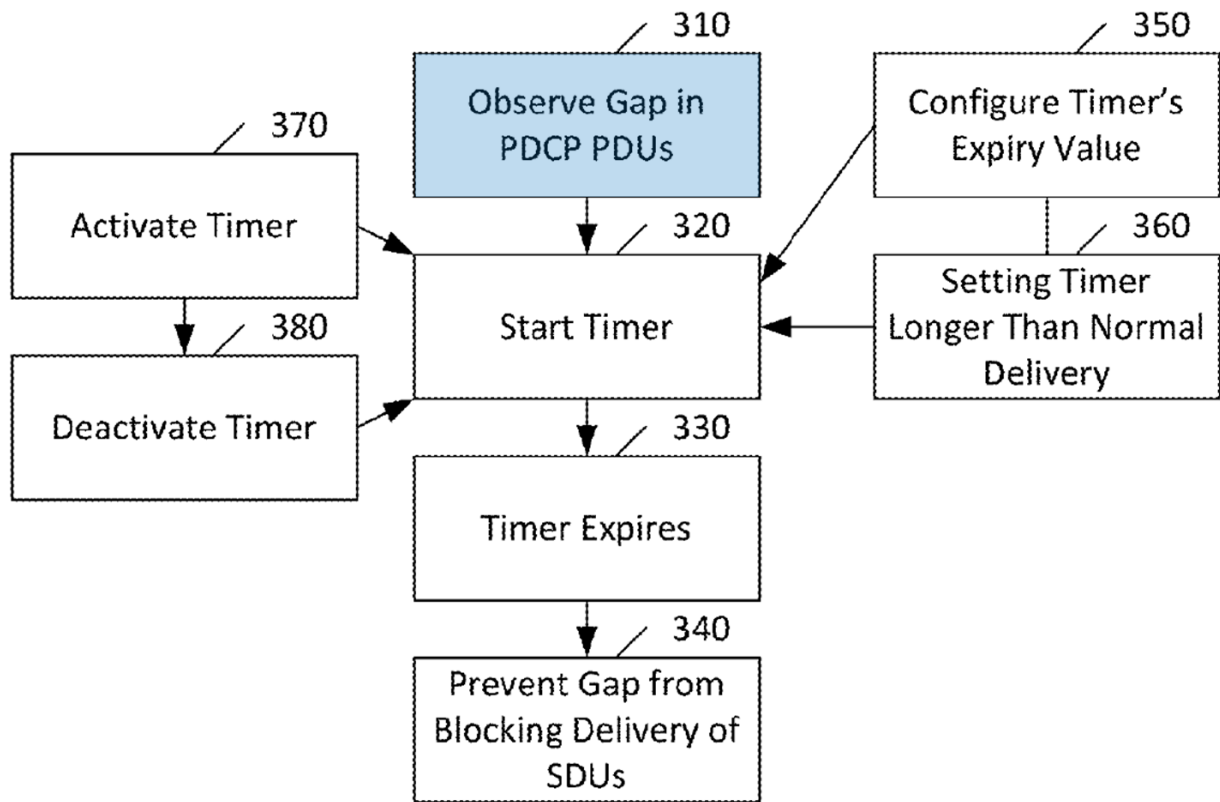
- a. 3[a]: “The method of claim 2, further comprising:
confirming whether there is a PDCP SDU of PDCP
SN #n–1 which is missed notwithstanding obtaining a
PDCP SDU of PDCP SN #n; and”**

Koskinen teaches or suggests this additional limitation. *Lo*, ¶¶159-162.

³ Unless otherwise noted all emphases are added.

⁴ The PDCP SN is equivalent to the COUNT value. Koskinen, ¶47.

Koskinen contemplates its UE receives PDCP data units out of order (Koskinen, ¶35), and discloses “observing a gap in a sequence of protocol data units received from a plurality of lower-layer protocol entities providing data transfer.” *Id.*, ¶¶18, 21, 24. For example, the “gap in the received protocol data units is observed at 310, such as by observing a gap in a sequence of protocol data units,” as shown in Figure 2, below. *Id.*, ¶38; Lo, ¶160. Koskinen discloses gap detection occurs at the UE. Koskinen, ¶¶35-36.



Koskinen, Fig. 2 (annotated).

As explained above in 1[d] and as Dr. Lo explains regarding the terminology of PDUs and SDUs, on the reception side (e.g., when a UE receives data from the

base stations), the data packets passed up from a current layer to the layer above are considered SDUs from the point of view of the current layer, and they are considered PDUs from the point of view of the receiving layer. Lo, ¶¶161, 143, 75; §V.A.2.e. Therefore, in Figure 2 of Koskinen, which depicts the process at the PDCP layer, the received PDU's correspond to SDUs sent by the RLC layer. *Id.* Accordingly, when Koskinen in connection to element 310 in Figure 2 references PDCP data units, it is referring to SDUs passed up by the RLC layer, and received at the PDCP layer.

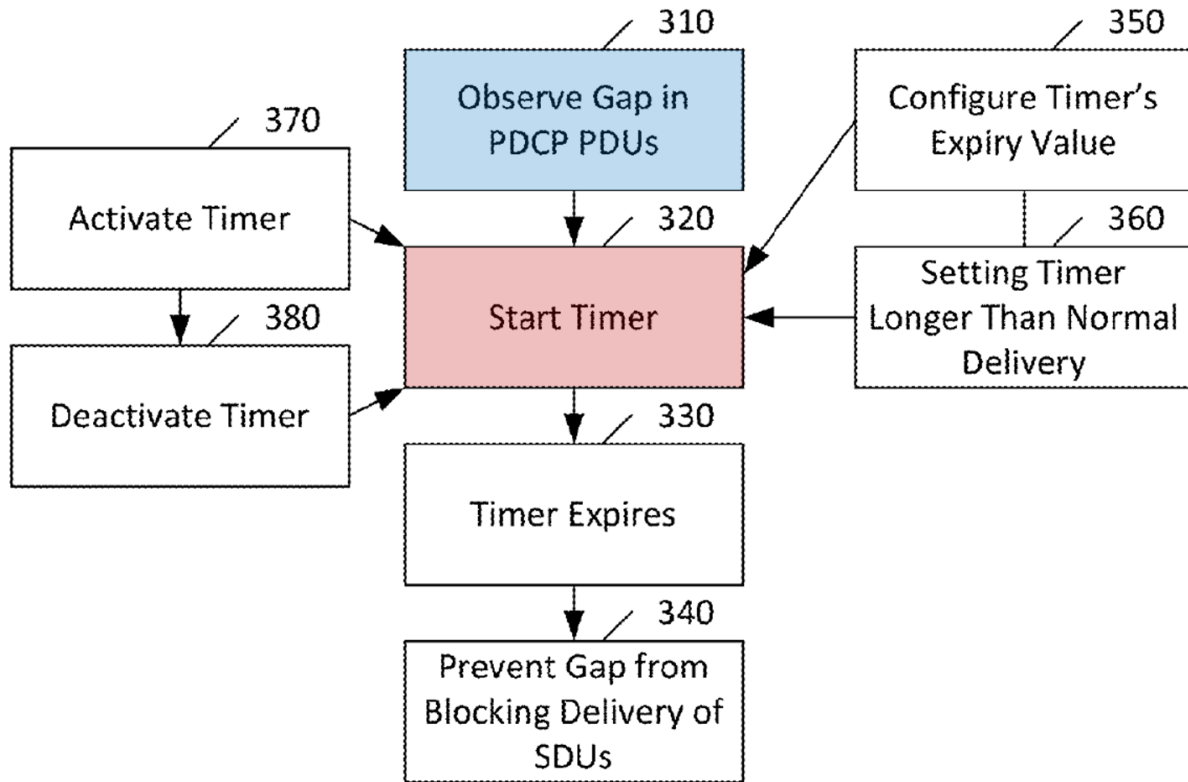
Because Koskinen describes using sequence numbers to identify PDCP SDUs (see §V.2.e), POSITAs would have recognized and found obvious detecting gaps in the sequence of PDCP PDUs (and the corresponding SDUs) indicates a previous data packet (i.e., with “*SN #n-1*”) was not received, while the current data packet (i.e., with “*SN #n*”) has been received. Lo, ¶162. Accordingly, by detecting gaps in PDU reception at the UE, the current PDU is received but the previous PDU is missed (“*PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n*”). Lo, ¶162.

b. 3[b]: “driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.”

Koskinen teaches this additional limitation. Lo, ¶¶163-165.

Koskinen further discloses “certain embodiments utilize a timer, such as a reordering timer” that “can be started at 320 whenever a gap in the received protocol

data units is observed at 310, such as by observing a gap in a sequence of protocol data units.” Koskinen, ¶¶ 37-38; *see* Figure 2, below; Lo, ¶164.



Koskinen, Fig. 2 (annotated).

As explained above in 1[c], POSITAs would have recognized and found it obvious the reordering timer to be an “*in-sequence*” timer. Lo, ¶¶165, 140; §V.A.2.d. Furthermore, POSITAs would have found it obvious that to “*drive*” a timer is to start the timer, which is consistent with the disclosure of the ’573 Patent. ’573Pat., 13:4-7 (when an SDU is received a timer **starts**); 13:18-27 (**driving** the timer for every SDU processed); Lo, ¶165.

5. Claim 4

- a. 4[a]: “...wherein before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained,”

Koskinen teaches this additional limitation. Lo, ¶¶166-168.

Koskinen discloses the timer can be set “long enough **so that the timer does not expire during normal delivery delay** of protocol data units sent by the eNB to the user equipment via a small-cell node, for example, including all possible HARQ and ARQ retransmissions at MAC and RLC level therein, respectively.” Koskinen, ¶39. In other words, the timer duration is longer than a normal delay in the transmission of the PDU so the missing PDU is received before the timer expires. Lo, ¶167. Furthermore, Koskinen discloses a “forwarding-status report [that] can be a new PDCP control PDU” from the eNB to “tell the user equipment (after handover) at 410, which protocol data unit sequence numbers (PDU SNs) the user equipment should expect to receive.” Koskinen, ¶40. Koskinen thus discloses the timer is set longer than an expected delay, and the eNB tells the UE to expect certain missed PDCP PDUs (as determined by the gap). Lo, ¶167. Koskinen further discloses the procedures utilizing the timer are part of the PDCP procedure. Koskinen, ¶¶45-46; Lo, ¶167 (citing EX1013, §5.1.2.2.3).

Accordingly, POSITAs would have recognized, at least in certain circumstances, the UE receives the missing PDCP PDU (“*the PDCP SDU of PDCP*

SN #n-1 is obtained”) because the eNB has indicated the PDU was sent and the timer would not expire before it is received (“*before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired*”). Lo, ¶168.

- b. 4[b]: “the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n are delivered to the upper layer according to the order of the PDCP SN.”**

Koskinen teaches or suggests this additional limitation. Lo, ¶¶169-170.

Koskinen discloses “apparatuses and methods for when a PDCP entity receiving protocol data units from multiple RLC-AM entities should and should not assume gap-less reception of protocol data units, and how to deliver Service data units to higher layer accordingly.” Koskinen, ¶44. As explained above for claim 2, when the correct sequence of PDCP SDUs is received, they are delivered to higher layers. §V.A.3; Lo, ¶¶170, 156-157. Delivering consecutive PDCP PDUs without gaps is further disclosed in “embodiments in which both a timer and a forwarding-status report are included.” Koskinen, ¶45; Lo, ¶170.

- 6. Claim 5: “...wherein when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.”**

Koskinen teaches or suggests the additional limitations of Claim 5. Lo, ¶¶171-173.

Koskinen discloses “[o]nce the timer expires at 330, that gap is no longer

allowed to block delivery of service data units to higher layer, at 340.” Koskinen, ¶38. In other words, “[p]reventing the block of delivery can be carried out by **proceeding with the delivery of service data units to the higher layer** without a delay caused by waiting for protocol data units.” *Id.* Thus, the PDCP layer may “deliver other Service data units to higher layer, as if a PDCP Data PDU with that PDCP SN was received.” *Id.*, ¶47. Koskinen further discloses the procedures utilizing the timer are part of the PDCP procedure. Koskinen, ¶¶45-46; Lo, ¶172 (citing EX1013, §5.1.2.2.4).

Accordingly, POSITAs would have found obvious all of the stored PDCP SDUs are delivered to the higher layer and the delivered SDUs include the received SDU triggering the detected gap (“*the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1*”). Lo, ¶173.

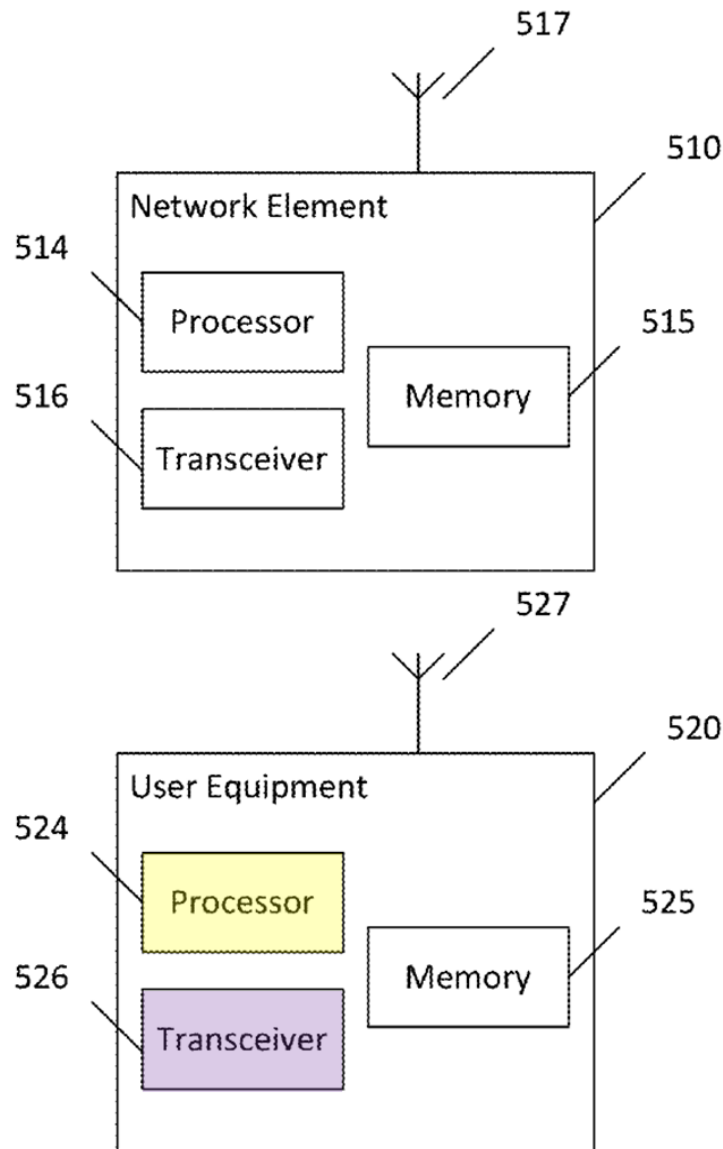
7. Independent claim 8

Koskinen teaches claim 8 for substantially the same reasons as claim 1 (§V.A.2) because the claims are substantively identical and Koskinen further teaches a user equipment with receiving unit and processor. Koskinen, ¶48; *compare* claim limitations 1[pre]-1[f] with claim limitations 8[pre]-8[f]; Lo, ¶¶174-179, 124-153.

Claim 8[pre] is substantially similar to 1[pre], except it recites a “user equipment” for performing functions instead of a “method.” Lo, ¶¶176, 125-132. As

discussed above, Koskinen describes the recited steps are performed by a UE. §V.A.2; Lo, ¶176.

Furthermore, with respect to limitation 8[a], Koskinen discloses the UE includes a transceiver, as shown below in Figure 4. Koskinen, ¶48, Fig. 4; Lo, ¶177. The transceiver may be “a transmitter, a receiver, or both a transmitter and a receiver, or a unit or device that may be configured both for transmission and reception.” Koskinen, ¶49. Koskinen further discloses the UE receives PDCP PDUs and RRC messages. *Id.*, ¶¶8-14, 35, 39, 42. POSITAs would have understood the RRC messages used to configure the UE are received over a radio interface by Koskinen’s receiver as part of the transceiver. Lo, ¶¶69-73, 177 (discussing 3GPP TS 36.331).



Koskinen, Fig. 4 (annotated).

With respect to limitation 8[c] and 8[f], Koskinen discloses the UE includes a processor, shown above in Figure 4. Koskinen, ¶48, Fig. 4; Lo, ¶178. Koskinen explains the processor carries out the embodiments disclosed in Koskinen. Koskinen, ¶51. For example, the processor performs the functions of “observing a

gap in received protocol data units, starting a timer upon the gap observation and preventing the gap from blocking delivery of service data units to a higher layer, when the timer expires.” *Id.* Furthermore, the processor executes software “perform[ing] a process such as one of the processes described” in Koskinen. *Id.*, ¶¶52-54. POSITAs would have thus understood the processor processes the received data from the macro and small base stations because it executes software to perform those functions. Lo, ¶¶178, 67-68.

The table below correlates the reasons why the Koskinen teaches the limitations of claim 1 with limitations 8[a]-13[f]. Lo, ¶179.

Claim 8		
Limitation	Substantially Similar Limitation(s)	Reference
8[pre]	1[pre]	§V.A.2.a
8[a]	1[a]	§V.A.2.b
8[b]	1[c]	§V.A.2.d
8[c]	1[b]	§V.A.2.c
8[d]	1[d]	§V.A.2.e
8[e]	1[e]	§V.A.2.f
8[f]	1[f]	§V.A.2.g

- 8. Claim 9: “...wherein the processor confirms the processor confirms the respective PDCP SNs of the obtained PDCP SDUs and performs in-sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.”**

Koskinen teaches claim 9’s additional limitations for the reasons discussed for claim 2 (§V.A.3). Lo, ¶¶180-181, 155-158. Claim 9 is substantially similar to claim 2, except the processor performs functions equivalent to the method steps in

claim 2. Lo, ¶181. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Koskinen. §V.A.7; Lo, ¶¶181, 178. Accordingly, POSITAs would have understood the processor in Koskinen's UE performs the functions of claim 9 for the same reasons Koskinen teaches the limitations of claim 2. Lo, ¶181.

9. **Claim 10: "...wherein the processor confirms whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and drives the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed."**

Koskinen teaches claim 10's additional limitations for the reasons discussed for claim 3 (§V.A.4). Lo, ¶¶182-183, 159-162. Claim 10 is substantially similar to claim 3, except the processor performs functions equivalent to the method steps in claim 3. *Id.*, ¶183. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Koskinen. §V.A.7; Lo, ¶¶183, 178. Accordingly, POSITAs would have understood the processor in Koskinen's UE performs the functions of claim 10 for the same reasons Koskinen teaches the limitations of claim 3. *Id.*, ¶183.

10. **Claim 11: "...wherein the processor delivers, when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1."**

Koskinen teaches claim 11's additional limitations for the reasons discussed

for claim 5 (§V.A.6). Lo, ¶¶184-185, 171-173. Claim 11 is substantially similar to claim 5, except the processor performs functions equivalent to the method steps in claim 5. *Id.*, ¶185. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Koskinen. §V.A.7; Lo, ¶¶185, 178. Accordingly, POSITAs would have understood the processor in Koskinen's UE performs the functions of claim 11 for the same reasons Koskinen teaches the limitations of claim 5. Lo, ¶185.

- 11. Claim 12: "...wherein the processor delivers, before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n to the upper layer according to the order of the PDCP SN."**

Koskinen teaches claim 12's additional limitations for the reasons discussed for claim 4 (§V.A.5). Lo, ¶¶186, 166-170. Claim 12 is substantially similar to claim 4, except the processor performs functions equivalent to the method steps in claim 4. Lo, ¶186. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Koskinen. §V.A.7; Lo, ¶¶186, 178. Accordingly, POSITAs would have understood the processor in Koskinen's UE performs the functions of claim 12 for the same reasons Koskinen teaches the limitations of claim 4. Lo, ¶186.

B. Ground 2: Claims 1-5 and 8-12 Are Obvious Over Koskinen and Sammour

As explained above in Ground 1 for claim element 1[c], Koskinen discloses a PDCP reordering timer used to account for gaps in received PDCP PDUs from multiple RLC layers. §V.A.2.d. Koskinen further discloses the timer is configured using RRC. *Id.* And as also explained in 1[f], POSITAs would have found obvious the PDCP configuration IE in the RRC message would have a variable or a field specifying the duration of the reordering timer. §V.A.2.g; Lo, ¶¶187-188, 150-154.

To the extent PO argues, or the Board finds, Koskinen does not disclose or render obvious 1[e] and 1[f], the combination of Koskinen and Sammour renders obvious the duration of the timer being a variable in the PDCP configuration section of the RRC. Lo, ¶188. POSITAs would have been motivated to look to Sammour to implement Koskinen’s timer because Sammour is in the same field as Koskinen. *Id.* Further motivations to combine are provided below.

1. Sammour

Sammour (EX1006) is titled “Method and apparatus for supporting configuration and control of the rlc and pdcp sub-layers.” Sammour, Title. Sammour is analogous art to the ’573 Patent because it is in the same field, solving similar problems by implementing “support configuration and/or control of the radio link control (RLC) and packet data convergence protocol (PDCP) sub-layers by defining and utilizing radio resource control (RRC) parameters and procedures, and by

including information elements (IEs) in RRC messages in both the uplink and downlink for RLC and PDCP configuration.” *Id.*, Abstract; Lo, ¶189. For example, “[i]n evolved UMTS systems including LTE systems, there is need to define and configure new...PDCP parameters...and/or the procedures and messages that will carry those parameters so that the communication devices in the system, including WTRUs and eNBs, operate properly, and their various functions and sub-layers are controlled and configured properly.” Sammour, ¶14. Consequently, Sammour discloses “a PDCP Flush Timer IE to indicate to the WTRU the value of the flush timer that the WTRU should use to stop reordering for” the particular radio bearer. *Id.*, ¶152.

2. Motivation to Combine Koskinen and Sammour

As explained below, POSITAs would have been motivated to extend Koskinen to incorporate Sammour’s “flush timer” in Koskinen’s RRC. Lo, ¶190. Koskinen discloses the PDCP reordering timer’s “expiry value can be configured by radio resource control (RRC).” Koskinen, ¶39; *see* §V.A.2.d. However, to the extent PO argues, or the Board finds, Koskinen’s disclosure does not render obvious a “PDCP-configuration IE” indicating the value of the timer, POSITAs would have looked to other references providing further details of how to deliver Koskinen’s PDCP timer information to the UE. Lo, ¶190.

POSITAs would have looked to Sammour, which is in the same field of

endeavor as Koskinen and is directed specifically to providing “new...PDCP parameters” to enable user equipment to operate properly in “evolved UMTS systems including LTE systems.” Sammour, ¶¶14, 20; Lo, ¶¶191-192. Sammour and Koskinen both disclose evolved packet systems (LTE) and RRC configuration of a UE. Sammour, ¶¶6-9, 14; Koskinen, ¶¶4-7, 39. Sammour further discloses a “Reordering Stop Mode IE” and a “flush Timer IE” in the RRC message, telling the UE when and how to stop reordering in the PDCP. Sammour, ¶¶148-153.

POSITAs would have been guided by Sammour’s explanation that RRC information elements were used to provide PDCP configuration information to similarly provide PDCP timer information of Koskinen through an PDCP configuration IE delivered via the RRC message. Lo, ¶192. POSITAs would have been motivated to combine Sammour with Koskinen because it would have provided a reliable and established way to provide the timer information, and it would have required nothing more than the application of known, conventional techniques (using the PDCP configuration IE delivered via the RRC message to set parameters in a UE) to yield predictable results (setting parameters to set timers in the UE) as described in Koskinen and Sammour. Koskinen, ¶¶14-17, 37-39; Sammour, ¶¶14-15; *KSR Int’l Co., v. Teleflex, Inc.*, 550 U.S. 398, 416 (2007); Lo, ¶¶193-194.

POSITAs would have had a reasonable expectation of success in using Sammour’s enhanced RRC information elements to control the activation and

expiration of Koskinen's PDCP reordering timer because Sammour showed using such a technique of adding information elements to an RRC was well within the skill ofPOSITAs. *Id.*, ¶¶195, 192-193. Furthermore, sending a reordering timer value to a UE would have been a straightforward application of known, conventional configuration of a UE in an evolved packet system. *Id.* Applying Sammour's teachings to Koskinen would have been nothing more than applying Sammour's known technique expanding the RRC message to include new IEs to improve Koskinen's gap detection and SDU forwarding system and methods in the same manner. *Id.*, ¶195.

3. Independent Claims 1 and 8

To the extent PO argues, or the Board finds, Koskinen does not render obvious 1[e] (“*the RRC message includes a PDCP-configuration information element (IE)*”) and/or 1[[f] (“*the PDCP-configuration IE includes a field indicating a value of the in-sequence timer*”), the Koskinen-Sammour combination does. Lo, ¶¶196-201.

Koskinen discloses its PDCP reordering timer is configured using RRC. Koskinen, ¶39. Koskinen further discloses activation of the timer is also controlled by RRC. *Id.*, ¶42.

Sammour discloses similar evolved UTRANs communicating with UEs.⁵

⁵ Sammour discloses that a UE is equivalent to a wireless transmit/receive unit

Sammour, ¶4. Sammour further explains a need to expand the RRC with respect to the PDCP to properly control and configure the functions of the UE. *Id.*, ¶14; Lo, ¶¶189-198. Sammour discloses “[i]nformation elements (IEs) are introduced...for some of the features and functions of PDCP, and/or certain procedures that will make use of those IEs.” Sammour, ¶21. These IEs are transmitted to the UE in a downlink RRC message. *Id.*, ¶23. Sammour thus discloses PDCP IEs “can be applied on a per-Radio Bearer basis.” *Id.*, ¶141.

One such IE is the “Reordering Stop Mode IE.” *Id.*, 148. Like the activation of the reordering timer in Koskinen (Koskinen, ¶42), Sammour discloses “[t]he eNB uses a PDCP Reordering Stop Mode IE to indicate to the WTRU that the WTRU PDCP entity whether it should use the timer mechanism (e.g., Flush Timer) to stop reordering following handover, or whether it should use stop reordering after all stored PDCP SDUs have been delivered to upper layers.” Sammour, ¶149. Sammour further discloses a “Flush timer IE...to indicate to the WTRU the value of the flush timer that the WTRU should use to stop reordering for this RB.” *Id.*, ¶152. Thus, Sammour discloses a timer duration to be used for reordering in the PDCP. Lo, ¶199.

For the reasons explained in §V.B.2, POSITAs would have been motivated to incorporate Sammour’s PDCP timer activation and duration in Koskinen so

(WTRU), a term used throughout Sammour. Sammour, ¶¶4, 20.

“WTRUs and eNBs, operate properly, and their various functions and sub-layers are controlled and configured properly.” Sammour, ¶14; Lo, ¶¶200, 190-195.

Accordingly, to the extent not rendered obvious by Koskinen, the Koskinen-Sammour combination renders limitations 1[e] and 1[f], and claim 1 as a whole, obvious. Lo, ¶201.

4. Dependent Claims 2-5, 8-12

The Koskinen-Sammour combination teaches dependent claims 2-5 and 9-12 for the reasons explained above. §§V.A.3-V.A.6,V.A.8-V.A.11.

C. Ground 3: Obvious Over Deenoo and Sammour

1. Deenoo

Deenoo (EX1007) is titled “Packet data convergence protocol (pdcp) placement.” Deenoo, title. It is analogous art to the ’573 patent because it is in the same field and directed to solving similar problems, including “Small Cell Enhancements such as PDCP Placement and impact on control and data plane procedures.” *Id.*, Abstract; Lo, ¶203. Deenoo further discloses “[s]mall-cell enhancements such as they relate to dual-connectivity scenarios.” Deenoo, Abstract. Deenoo applies these enhancements to many communications systems, including “Evolved UMTS Terrestrial Radio Access (E-UTRA).” *Id.*, ¶43. Like the ’573 Patent, Deenoo discloses the PDCP may be in the macro cell and in some embodiments may also be terminated there. *Id.*, ¶104; ’573Pat., 10:4-12. Moreover, like the ’573 Patent, Deenoo contemplates single radio bearer and multiple radio

bearer models (analogous to the '573 Patent's single-flow and multi-flows). Deenoo, ¶105; '573Pat., 10:13-15, Figs. 10-11; Lo., ¶¶203, 41-42.

Deenoo discloses that for a single DRB “split between a macro and a small cell...a PDCP in a macro can have two underlying corresponding RLC protocol set entities, one set in macro and/or another set in the small cell.” Deenoo, ¶114, Figs. 4-5. For such a system, Deenoo discloses “one or more aspects of reconfiguration of traffic from one small cell node to another small cell node.” *Id.*, ¶115. This can include “PDCP re-ordering, and/or security for reconfiguration of small cells.” *Id.*, ¶116. Deenoo discloses in the case of a macro cell with the PDCP and small cells sharing the single DRB, the macro cell can reconfigure the UE using RRC. *Id.*, ¶¶143, 151-153; Lo, ¶204.

Specifically, for reordering in the PDCP, Deenoo discloses the WTRU⁶ “may be configured to start a timer...upon determining that the first packet may be an out-of-sequence packet.” Deenoo, ¶14. The UE may then wait for the missing packet while the timer is running or flush the PDCP data to a higher layer if the timer expires. Deenoo, ¶¶14, 208-211, Fig. 8; Lo, ¶205.

⁶ Deenoo explains that “a user equipment (UE) may also be referred to as a wireless transmit/receive unit (WTRU).” Deenoo, ¶78.

2. Motivation to Combine Deenoo and Sammour

As explained below, POSITAs would have been motivated to extend Deenoo to incorporate Sammour's "flush timer" configuration in Deenoo's RRC. Lo, ¶¶206-212. Deenoo discloses for the single DRB case, the UE may "receive one or more reordering procedures." Deenoo, ¶123. Deenoo further discloses configuring a WTRU (e.g., user equipment) using an RRC message, where the "the Macro eNB may configure the measurement parameters/events/triggers for the UE in an RRC CONNECTED mode." *Id.*, ¶¶12, 143, 173, 198; *see* §V.C.3.d. For example, when a small cell is added, an RRC reconfiguration message "may include a timing advance to be applied to the small cell, radio bearer configuration for the small cell, offset to the sub frame containing resource allocation, and/or a response window." Deenoo, ¶251. The "[m]acro can also provide the propagation delay estimated by the small cell to the UE." *Id.*, ¶248. Moreover, Deenoo discloses to "start the PDCP reordering timer as soon as out of sequence PDCP Data PDU" is detected. *Id.*, ¶208. Although obvious, as explained below in §V.C.3.d, Deenoo does not expressly disclose how the expiration time for the reordering timer is received at the UE. Lo, ¶206. POSITAs would have looked to other references for details of how to implement Deenoo's timer. *Id.*, ¶207.

POSITAs would have looked to Sammour, which is in the same field of endeavor as Deenoo and is directed specifically to providing "new...PDCP

parameters” to enable user equipment to operate properly in “evolved UMTS systems including LTE systems.” Sammour, ¶¶14, 20; Deenoo, ¶43; Lo, ¶¶208, 189. Sammour and Deenoo both disclose evolved packet systems (LTE) and RRC configuration of a UE. Sammour, ¶¶6-9, 14; Deenoo, ¶¶43-45, 173, 198. Sammour further discloses a “Reordering Stop Mode IE” and a “flush Timer IE” in the RRC, telling the UE when and how to stop reordering in the PDCP. Sammour, ¶¶148-153.

POSITAs would have been motivated to incorporate Sammour’s new PDCP reordering IEs in Deenoo to reliably configure Deenoo’s reordering timer when small cells are present with the macro cell and both sending data to the UE. Lo, ¶210. Sammour and Deenoo share applicants,⁷ content, and field of use. Lo, ¶¶208-210; *ZUP, LLC v. Nash Mfg, Inc.*, 896 F.3d 1365, 1371-73 (Fed. Cir. 2018) (upholding invalidity for obviousness over combination of two patents to the same inventor directed to solving the same problem because the “motivation to combine may be found explicitly or implicitly in...‘interrelated teachings of multiple patents’”). Moreover, they also both seek to enhance LTE system functionality regarding configuration of the PDCP layer in dual-connectivity. Deenoo, Abstract, ¶89; Sammour, Abstract, ¶¶14, 21; Lo, ¶210. Thus, POSITAs would have understood

⁷ Both Deenoo and Sammour list Interdigital Patent Holdings, Inc., as assignee.

Deenoo, Cover (73); Sammour, Cover (73).

Deenoo and Sammour were combinable and would have been motivated to combine them. Lo, ¶210. POSITAs would have also been motivated to combine Deenoo and Sammour because the combination would have required nothing more than the application of known, conventional techniques (using RRC information elements to configure a UE) to yield predictable results (configuring the UE) as described in Deenoo and Sammour. Deenoo, ¶198; Sammour, ¶¶14-15; Lo, ¶211; *KSR Int'l Co., v. Teleflex, Inc.*, 550 U.S. 398, 416 (2007).

POSITAs would have had a reasonable expectation of success in using Sammour's enhanced RRC information elements to control the activation and expiration of Deenoo's PDCP reordering timer because Sammour shows using such a technique of adding information elements to an RRC was well within the skill of POSITAs. Lo, ¶212, 192-193. Furthermore, sending a reordering timer value to a UE would have been a straightforward application of known, conventional configuration of a UE in an evolved packet system. *Id.* Applying Sammour's teachings to Deenoo would have been nothing more than applying Sammour's known technique of expanding the RRC message to include new IEs to improve Deenoo's gap detection and SDU forwarding system and methods in the same manner. Lo, ¶212.

3. Independent Claim 1

a. 1[pre]:

If limiting, Deenoo teaches or suggests 1[pre]. Lo, ¶¶213-218.

For example, Deenoo “contemplate[s] Small Cell Enhancements such as PDCCP Placement and impact on control and data plane procedures.” Deenoo, Abstract. Deenoo discloses “[d]ifferent RAN, protocol stack and radio bearer (RB) architectures,” including “a small-cell that may be capable of supporting RLC modes.” *Id.* The RAN comprises “a macro enhanced Node-B (MeNB) device and a small cell enhanced Node-B (SCeNB) device.” *Id.*, ¶16. Deenoo explains base stations in the RAN “may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 115/116/117 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A).” *Id.*, ¶43, Figs. 1A (“a system diagram of an example communications system in which one or more disclosed embodiments may be implemented”), C-E. Furthermore, Deenoo explains the small cells may use the same spectrum as macro cells and may be low power devices, such as Pico or Femto eNBs. *Id.*, ¶80. As shown in Figures 1C through 1E, Deenoo’s system comprises a “RAN” connected to a “Core Network,” with the RANs including base stations and the Core Networks including gateways and MME. *Id.*, ¶¶58-78. Deenoo explains each of these examples “may be used within the communications system illustrated in FIG. 1A.” *Id.*, ¶¶21-

23. As explained by Dr. Lo, data is transmitted to user equipment from the Core Network through the base stations. Lo, ¶214. POSITAs would have understood the combination of the base stations and gateways/MME as an “*evolved packet system bearer*” because it provides a logical connection between the user equipment and the gateways, facilitating data traffic transport. *Id.*, ¶¶214, 59-61; *see* ’573Pat., 4:30-60 (“E-UTRAN and the EPC 30 [including S-/P-GW and MME] are integrated to be called an evolved packet system (EPS)”).

With respect to transmission of data packets, Deenoo “contemplate[s] PDCP in a macro cell” with “RLC, MAC and/or PHY in small cell.” Deenoo, ¶104. Furthermore, “embodiments contemplate at least two alternatives, single RB model or separate RB model,” where the “single DRB may be split between a macro and a small cell.” *Id.*, ¶¶105, 114. The “PDCP in a macro can have two underlying corresponding RLC protocol set entities, one set in macro and/or another set in the small cell.” *Id.*, ¶114, Figs. 4, 4A, 5. POSITAs would have understood such a single DRB model with the PDCP in the macro cell with RLC entities in the macro and small cells would have comprised a single cell of the E-UTRA. Lo, ¶215. POSITAs would have further understood a single DRB split between a macro and small cell with separate radio bearers (RB) is consistent with “*multi-flow*” as described by the ’573 Patent. *Id.*, ¶¶215, 85-87; ’573Pat., 9:65-67 (“in the case where one EPS bearer provides the service to the UE through two or more RBs, it regarded that the

multi-flows are configured”).

Accordingly, Deenoo teaches an E-UTRA comprising a Core Network, RAN, and wireless transmit/receive units (WTRUs), where “a user equipment (UE) may also be referred to as a wireless transmit/receive unit (WTRU).” Deenoo, ¶¶38, 78. Data is transmitted to UE through bearer between Core Network and UE (“*one evolved packet system (EPS) bearer*”), the bearer between Core Network and UE comprising a DRB radio bearer, which is split between a macro eNB (“*through a macro base station (macro eNB)*”) and a small cell (SCeNB) (*and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity*”). Lo, ¶216.

Deenoo further discloses “[e]mbodiments contemplate a usefulness for dual connectivity, where UE (or WTRU) may be connected to both the macro and the small-cell layer simultaneously.” *Id.*, ¶84. In other words, “dual-connectivity may be also meant to cover scenarios where the user equipment ((UE) or wireless transmit/receive unit (WTRU)) may be connected to the macro-layer and one or more small-cells simultaneously (e.g. **UE might be actively receiving data from the cells it may be connected to**).” *Id.*, ¶90.

Furthermore, the ’573 Patent admits each element of the preamble was well-known to POSITAs at the time of priority date of the ’573 Patent. ’573Pat., 1:29-2:6; Lo, ¶218. Accordingly, Deenoo (and applicant admitted prior art) teaches a UE

simultaneously receiving data from the macro and small eNB of the E-UTRA (“*user equipment receiving multi-flow data*”) where the “*system support[s] dual connectivity*.” *Id.*

b. 1[a]:

Deenoo teaches or suggests this limitation. Lo, ¶¶219-221.

The '573 Patent admits each element of 1[a] was well-known to POSITAs at the time of priority date of the '573 Patent. '573Pat., 2:7-18; Lo, ¶220. Furthermore, as explained above, the PDCP may be in the macro cell with underlying RLC entities in both the macro and small cell. Deenoo, ¶¶104, 114; §V.C.3.a; Lo, ¶¶220, 215. Because the PDCP is in the macro cell, which sends the downlink data to the RLCs in both the macro and small cells, POSITAs would have understood the PDCP data (PDUs) is transmitted to the UE through the radio bearers of the macro and small cells. Lo, ¶¶220, 215; Deenoo, ¶¶205-212. Deenoo illustrates the PDCP packets transmitted to the UE through the macro and small cells below in Figure 5 (annotated). Lo, ¶220.

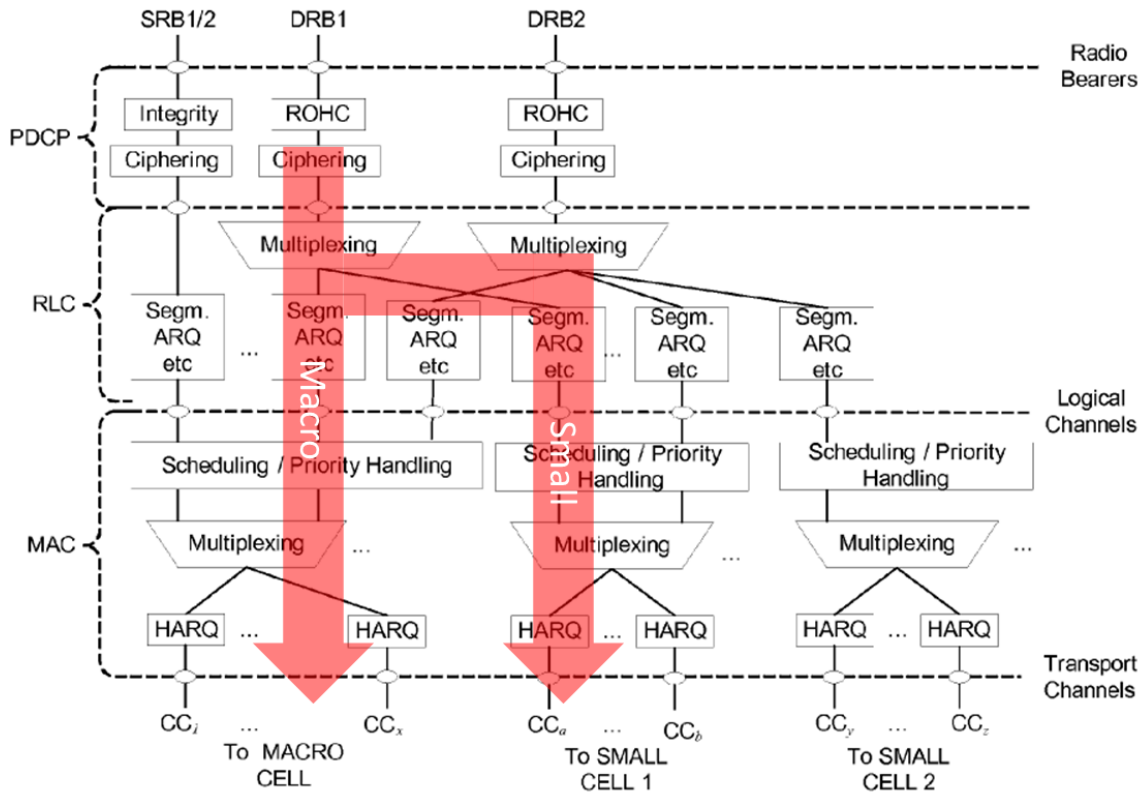


FIG. 5

Accordingly, Deenoo teaches or suggests this limitation. Lo, ¶221.

c. 1[b]:

Deenoo teaches or suggests this limitation. Lo, ¶¶222-225.

As explained above, Deenoo discloses PDCP Placement in an E-UTRA and transmission of PDCP packets to a UE. Lo, ¶¶223, 214; Deenoo, Abstract, ¶43. Furthermore, Deenoo discloses its system is based on the 3GPP specifications. Deenoo, ¶¶80, 112, 122, 164, 202; Lo, ¶223. And Deenoo explains the UE may receive “out of order PDCP SDUs” during handover (Deenoo, ¶122), but regardless

PDCP data is delivered to higher levels of the UE system. *Id.*, ¶¶208-210.

The 3GPP TS 36.323 describes the “Packet Data Convergence Protocol (PDCP) specification” and 3GPP TS 36.300 provides the overall description of an E-UTRA. EX1011; EX1012. 3GPP TS 36.300 explains a PDCP PDU includes a PDCP header and a PDCP SDU. EX1012, §6.3.2. 3GPP TS 36.323 further explains a PDCP PDU in the user plane includes a PDCP SDU sequence number (SN) and a compressed or uncompressed PDCP SDU. EX1011, §6.1.1. POSITAs with knowledge of the E-UTRAN structure and protocols would have thus understood a PDCP SDU is obtained by stripping the header from a PDCP PDU. Lo, ¶¶224, 76. The PDCP SDU is the portion of the PDU delivered to the higher layers. Koskinen, ¶¶8, 12, 45; Lo, ¶¶224, 76.

Moreover, the '573 Patent admits each element of 1[b] was well-known to POSITAs at the time of priority date of the '573 Patent. '573Pat., 2:7-18; Lo, ¶¶225, 137. Accordingly, because Deenoo's UE receives PDCP PDUs and delivers PDCP data to higher layers, POSITAs would have understood the UE “*obtain[s] PDCP service data units (SDUs) corresponding to the PDCP PDUs.*” Lo, ¶225.

d. 1[c]:

Deenoo teaches or suggests this limitation. Lo, ¶¶226-231.

Deenoo teaches the macro cell may “send an RRC Connection reconfiguration to the UE with macro and/or the small cell configuration.” Deenoo, ¶153.

Furthermore, the “[m]acro eNB may configure the measurement parameters/events/triggers for the UE in an RRC CONNECTED mode.” Deenoo, ¶¶143, 173, 198. Accordingly, Deenoo teaches the macro eNB configuring the UE through RRC, where the UE receives the RRC message (“*receiving from the macro base station...a radio resource control (RRC) message*”). Lo, ¶227,

Deenoo further discloses a “re-ordering algorithm” in the PDCP of the UE utilizing a reordering timer. Deenoo, ¶¶205-212. POSITAs would have found obvious the RRC message to the UE in RRC CONNECTED mode would be used to set the duration of the reordering timer because the RRC message “configure[s] the measurement parameters/events/triggers for the UE.” Lo, ¶228; Deenoo, ¶143. Accordingly, the RRC message would have contained “*information related to an in-sequence timer for the PDCP SDUs.*” Lo, ¶228.

To the extent PO argues, or the Board finds, Deenoo does not render obvious “*information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,*” Sammour teaches this aspect.

Like Deenoo, Sammour discloses E-UTRANs communicating with UEs.⁸ Sammour, ¶4. Sammour further identifies the need to expand the RRC message with

⁸ Like Deenoo, Sammour discloses a UE is a wireless transmit/receive unit (WTRU), a term used throughout Sammour. Sammour, ¶¶4, 20.

respect to the PDCP to properly control and configure new functions of the UE. *Id.*, ¶14; Lo, ¶230. As explained in Ground 2, Sammour discloses introducing new information elements for the PDCP, as well as making use of the new IEs, and transmitting them in downlink RRC message. Sammour, ¶¶21, 23, 141; §V.B.3; Lo, ¶¶230, 198-199.

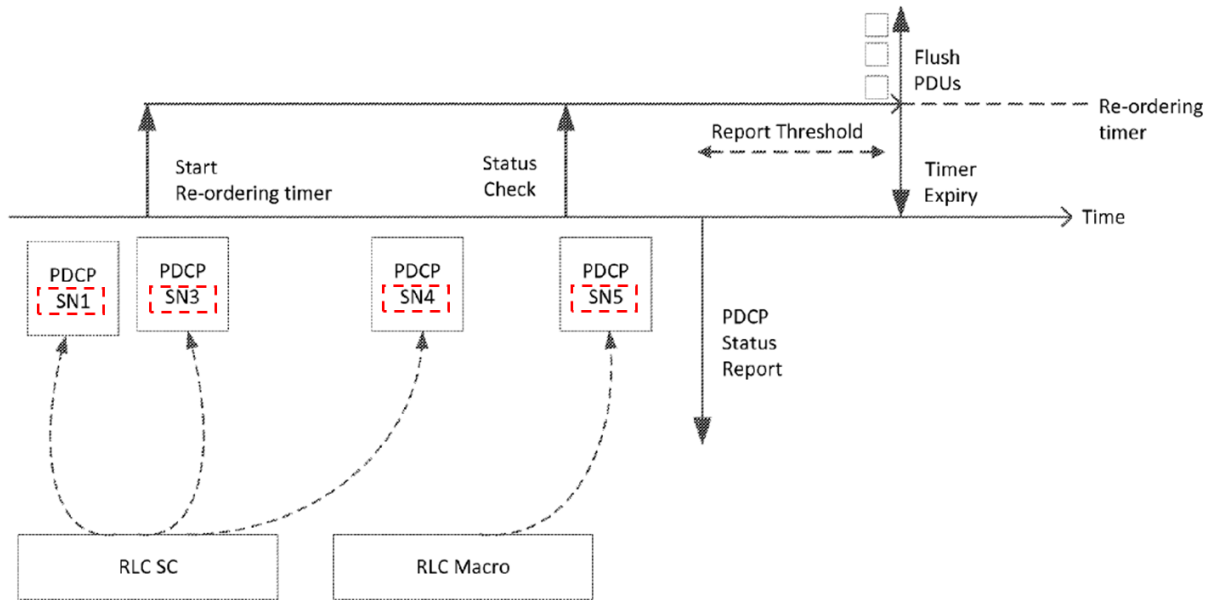
For example, Sammour discloses a “Reordering Stop Mode IE” in the PDCP. Sammour, ¶148. Sammour discloses “[t]he eNB uses a PDCP Reordering Stop Mode IE to indicate to the WTRU that the WTRU PDCP entity whether it should use the timer mechanism (e.g. Flush Timer) to stop reordering following handover, or whether it should use stop reordering after all stored PDCP SDUs have been delivered to upper layers.” *Id.*, ¶149. Sammour further discloses a “Flush timer IE...to indicate to the WTRU the value of the flush timer that the WTRU should use to stop reordering for this RB.” Thus, Sammour discloses a timer duration to be used for reordering in the PDCP. *Id.*, ¶¶151-152; Lo, ¶231. As explained above, Deenoo uses a timer to determine when to stop waiting for missing PDCP packets and flush the received packets to a higher layer. Deenoo, ¶¶14, 208-211, Fig. 8; Lo, ¶¶231, 205. POSITAs would have recognized Deenoo’s timer (e.g., reordering timer) and Sammour’s “flush timer” operated in the same way and for the same purpose and, thus, would have been motivated to incorporate Sammour’s RRC configuration of the timer into Deenoo. Lo, ¶231.

For the reasons explained in §V.C.2, POSITAs would have been motivated to incorporate Sammour's PDCP timer activation and duration in Deenoo so "WTRUs and eNBs, operate properly, and their various functions and sub-layers are controlled and configured properly." Sammour, ¶14; Lo, ¶231. Accordingly, the Deenoo-Sammour combination teaches "*information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,*" as claimed. *Id.*

e. 1[d]:

Deenoo teaches or suggests this limitation. Lo, ¶¶232-234.

Deenoo discloses the UE may determine missing PDCP PDU sequence numbers. Deenoo, ¶¶14, 206-211, Fig. 8. Furthermore, as illustrated in Figure 8, below, the UE receives unique PDCP SNs from the macro and small cells. *Id.*, Fig. 8; Lo, ¶233. Moreover, assigning predetermined sequence numbers to downlink PDCP PDUs was general knowledge in the industry and specified by 3GPP. *Id.*; EX1012, §§6.2.2, 10.1.2.1.2, 14.1; *see* §V.A.2.e; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020) ("general knowledge" of a person having ordinary skill in the art can indeed be relied upon to render a claimed invention obvious).



Deenoo, Fig. 8 (annotated).

POSITAs would have thus understood the PDCP PDU (and corresponding SDUs, *see* §V.C.3.c) are assigned sequence numbers (e.g., in an ascending sequence based on the order of the PDUs), so the UE can determine when a particular PDU is missing (i.e., missing SN) (“*the PDCP SDUs are indicated by a predefined PDCP sequence number (SN)*”). Lo, ¶234.

f. 1[e]:

Deenoo teaches this limitation. Lo, ¶235-237.

As explained above, Deenoo teaches configuring the UE, including PDCP features, using an RRC message. Deenoo, ¶¶143, 173, 198; Lo, ¶236, 227-228; §V.C.3.d. Furthermore, Sammour expressly discloses configuration of a UE “utilizing radio resource control (RRC) parameters...including information

elements (IEs) in RRC messages in both the uplink and downlink for RLC and PDCP” (Sammour, Abstract) and “Other PDCP IEs” (*id.*, ¶141).

Accordingly, Deenoo alone and/or the Deenoo-Sammour combination teach this limitation. Lo, ¶237.

g. 1[f]:

Deenoo teaches this limitation. Lo, ¶¶238-241.

As explained above for 1[c], POSITAs would have been motivated to modify Deenoo to incorporate Sammour’s new PDCP IEs. Lo, ¶¶240, 227-231; §V.C.3.d. Specifically, understanding Deenoo configures a reordering timer of its UE using RRC messages, POSITAs would have incorporated Sammour’s “Reordering Stop Mode IE” and “Flush Timer IE” into Deenoo’s RRC message to properly configure Deenoo’s reordering timer functionality. Lo, ¶¶240, 231; §V.C.3.d; V.C.2.

Accordingly, the Deenoo-Sammour combination teaches a PDCP reordering timer (e.g., “flush timer”) configured using an RRC message (“*PDCP-configuration IE includes a field indicating a value of the in-sequence timer*”). Lo, ¶241.

4. Claim 2:

Deenoo teaches the additional limitations of Claim 2. Lo, ¶¶242-245.

As explained above in Ground 1, delivering sequential PDCP SDUs is an unremarkable and well-known technique. *Id.*, ¶¶243, 156; §V.A.3. Regardless, Deenoo teaches this well-known PDCP function “in a case of a PDCP in macro

(single DRB).” Deenoo, ¶207. For example, during handover, where gaps may be detected, Deenoo discloses the “[m]acro eNB may configure the measurement parameters/events/triggers for the UE in an RRC CONNECTED mode.” Deenoo, ¶198. Deenoo discloses the following “reordering algorithm” performed at the UE:

	UE PDCP RECEIVER OPERATION:
	[0208] Normal case: re-ordering algorithm:
SN #n-1	0) Receive the PDCP data PDU from lower layers
	1) Let the next in-sequence PDU SN be N.
	2) If it is duplicate or PDU out of re-ordering window. Discard the packet and go to line 0.
Confirm	3) If received PDCP Data PDU SN=N goto line 7.
SN #n	4) If re-ordering timer is not running, start the PDCP re-ordering timer as soon as out of sequence PDCP Data PDU SN>N (from say RLC1/RLC2) is received.
	5) When the re-ordering timer is running, if PDCP Data PDU (from say RLC2/RLC1 respectively) is received with SN>N, then
	[0209] a. If the remaining re-ordering time is greater than threshold, trigger a PDCP status report and wait for in-sequence PDCP PDU with SN=N. goto line 0.
	[0210] b. Stop re-ordering timer and perform same actions as re-ordering timer expiry.
	6) If the re-ordering timer expires goto 7.
Send queued SDUs to higher layer	7) Deliver the queued packets to the higher layer, starting from closest received SN to N in order until the next SN gap and, for example, perhaps if there is any SN gap, start re-ordering timer similar to line 4.
	8) Set N=1+SN of PDCP data PDU last delivered to higher layer in line 7.
	9) Goto line 0.

Deenoo, ¶¶208-210 (annotated).

As shown above, two sequential PDCP PDUs (#n-1 and #n) are received at

the UE⁹ (“*confirming the respective PDCP SNs of the obtained PDCP SDUs*”). *Id.*, ¶208; Lo, ¶¶243-244. Following reception, the UE delivers the received packets (i.e., PDCP SDUs) to the higher layer in order based on the SN of the received PDCP PDUs (“*performing in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN*”). Lo, ¶244.

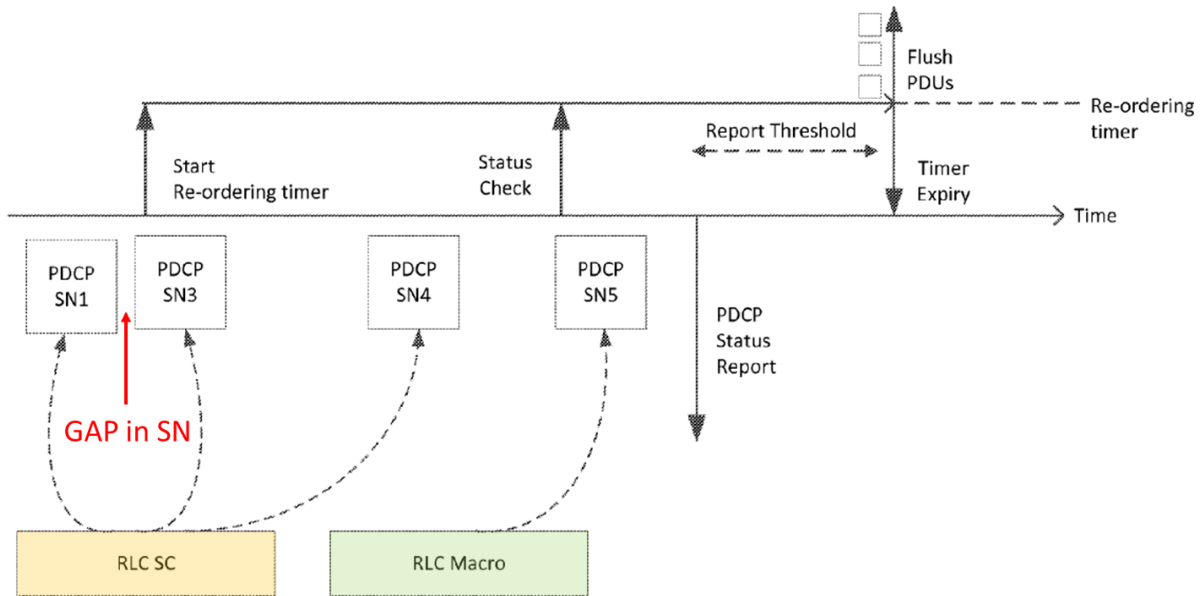
5. Claim 3

a. 3[a]:

Deenoo teaches this additional limitation. Lo, ¶¶246-249.

Referring to Deenoo ¶¶208-210, above, at step 3 the UE confirms if the SN of the next received PDCP PDU (and respective SDU) from either RLC 1 or RCL2 is greater than the next expected SN. Deenoo, ¶208; Lo, ¶247; *see* V.C.3.c. Thus, if the next received PDU is #n+1, then POSITAs would have understood a gap exists in the received PDUs, where PDU #n was missed. Lo, ¶247. The gap in PDCP SN reception is represented in Figure 8, below. Deenoo, ¶¶211-212, Fig. 8; Lo, ¶247.

⁹ As explained in Ground 1 for limitation 1[b] (§V.A.2.c), PDCP PDUs contain PDCP SDUs and the SDUs are delivered to higher layers.



Deenoo, Fig. 8 (annotated).

POSITAs would have understood the designators #n and #n-1 as used in the claim to modify “*PDCP SN*” were merely for convenience and used to distinguish the claimed missing PDCP SN from the received PDCP SN. Lo, ¶248; *Free Motion Fitness, Inc. v. Cybex Int’l, Inc.*, 423 F.3d 1343, 1348 (Fed. Cir. 2005) (“As we have previously held, ‘[t]he use of the terms “first” and “second” is a common patent-law convention to distinguish between repeated instances of an element or limitation.’”). POSITAs would have also understood the designators SN=N and SN>N in Deenoo were also merely convenient labels intended to distinguish between multiple instances of PDCP SNs. Lo, ¶248. In other words, POSITAs would have recognized and found obvious the claimed “*SN #n-1*” mapped onto any PDCP SN, so long as the SN in Deenoo meets all other claim limitations ascribed to or associated with

“SN #n-1” (and the same with respect to the claimed “SN #n”). *Id.*

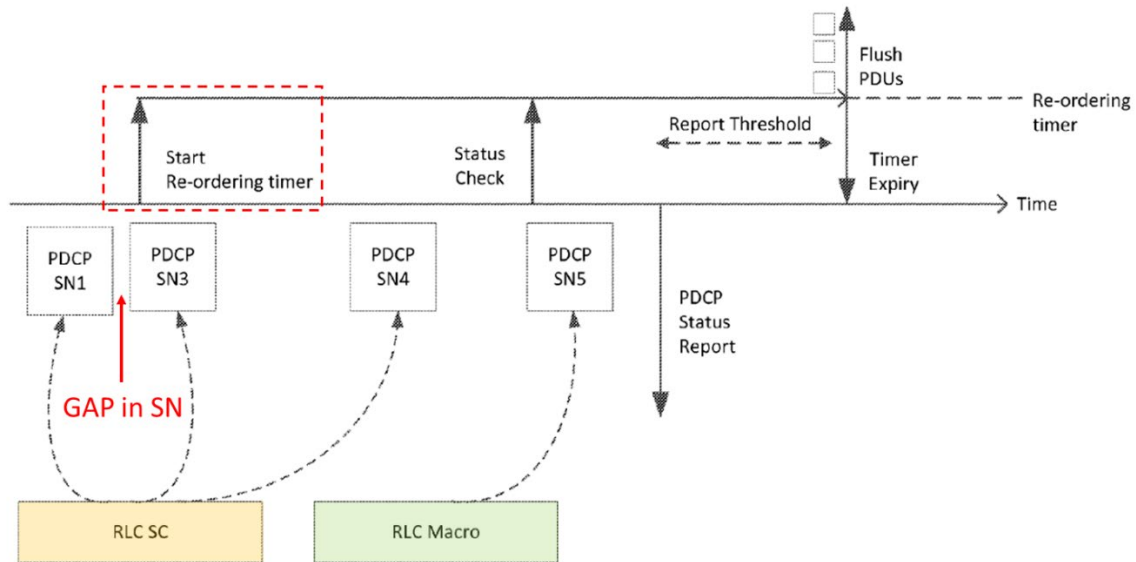
Accordingly, Deenoo teaches confirming a gap of SN=N (“*confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed*”) when the received PDCP is SN>N (“*notwithstanding obtaining a PDCP SDU of PDCP SN #n*”). *Id.*, ¶249.

b. 3[b]:

Deenoo teaches or suggests this additional limitation. Lo, ¶¶250-252.

Deenoo discloses at step 4 that “[i]f re-ordering timer is not running, start the PDCP re-ordering timer as soon as out of sequence PDCP Data PDU...is received.” Deenoo, ¶208. Starting the timer is annotated in Figure 8, below, where the timer is started¹⁰ when PDCP SN3 is received (“*driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n*”) after receiving SN1 and missing SN2 (“*when there is the PDCP SDU of PDCP SN #n-1 which is missed*”). Lo, ¶251; Deenoo, ¶¶211-212.

¹⁰ As explained in Ground 1 claim 3[b], “*driving*” a timer is equivalent to starting a timer. Lo, ¶251, 165; §V.A.4.b.



Deenoo, Fig. 8 (annotated).

6. Claim 4:

a. 4[a]:

Deenoo teaches or suggests this additional limitation. Lo, ¶¶253-255.

In ¶¶208-210 (reproduced above for claim 2), Deenoo discloses after receiving $SN > N$, the UE “wait[s] for in-sequence PDCP PDU with $SN = N$ ” and returns to line 0 of the algorithm. Deenoo, ¶209. As explained for Claim 2, Deenoo discloses at step 3 $SN = N$ is received (“when the PDCP SDU of PDCP SN #n-1 is obtained”). *Id.*, ¶208. Furthermore, POSITAs would have understood the timer is still running when the PDCP PDU $SN = N$ is received (“wherein before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired”) because the step is immediately after checking whether the “remaining re-ordering time is greater than threshold.” *Id.*, ¶209; Lo, ¶254.

b. 4[b]:

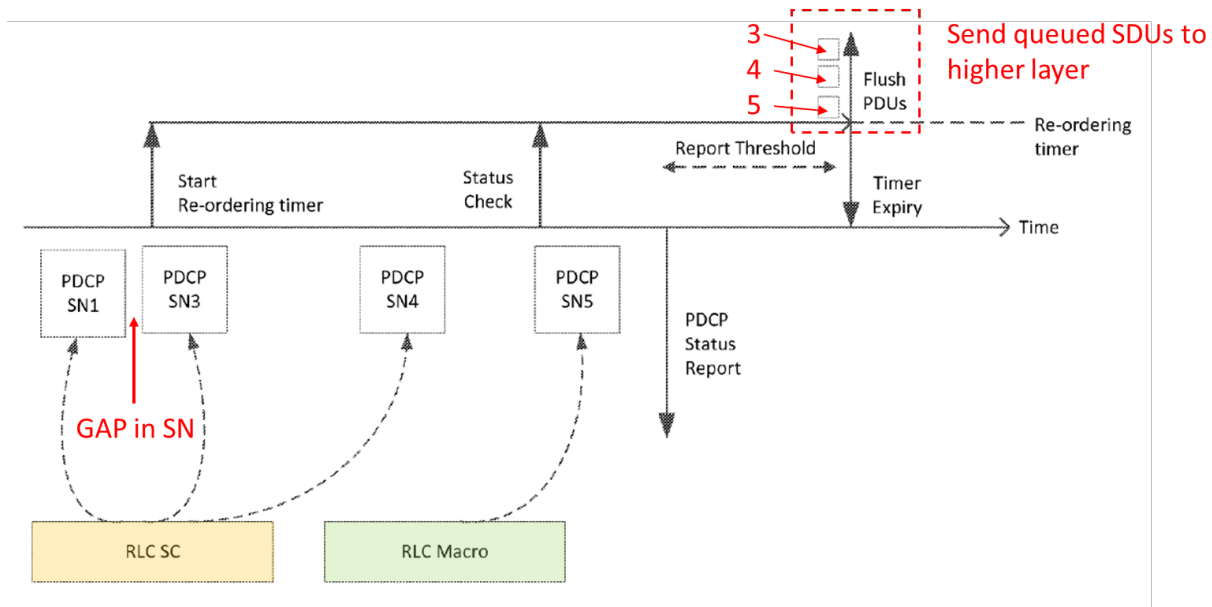
Deenoo teaches or suggests this additional limitation. Lo, ¶¶256-258.

As explained for Claim 2, when PDCP SN=N is received at step 3, the UE delivers the received packets (i.e., PDCP SDUs) to the higher layer in order. Lo, ¶¶257, 243-244; §V.C.4.

7. Claim 5:

Deenoo teaches or suggests the additional limitations of Claim 5. Lo, ¶¶259-261.

Deenoo discloses that “[i]f the re-ordering timer expires...[d]eliver the queued packets to the higher layer.” Deenoo, ¶210. Delivery of the packets “start[s] from closest received SN to N in order until the next SN gap.” *Id.* POSITAs would have understood the “closest received SN to N” (where N is the claimed “#n-1”) is either the next SN>N, which is the claimed “#n” because the packets are delivered “in order until the next SN gap.” Lo, ¶260. As shown in Figure 8, below, when the timer expires, the PDUs (and corresponding SDUs) are flushed to the higher layer. *Id.*; Deenoo, ¶¶211-212.



Deenoo, Fig. 8 (annotated).

Accordingly, Deenoo teaches when the re-ordering timer started after the gap was detected expires (“*wherein when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired*”), all of the PDCP SDUs after the gap are delivered to the higher layers, including the SN immediately after the gap (“*the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1*”).

8. Independent claim 8

Deenoo in combination with Sammour teaches claim 8 for substantially the same reasons as claim 1 (§V.C.3) because the claims are substantively identical and Deenoo further teaches a user equipment with receiving unit and processor. Deenoo, ¶49; *compare* claim limitations 1[pre]-1[f] *with* claim limitations 8[pre]-8[f]; Lo, ¶¶262-268, 213-241.

Claim 8[pre] is substantially similar to 1[pre], except it recites a “user equipment” for performing functions instead of a “method.” Lo, ¶263. As discussed above, Deenoo describes the recited steps are performed by a UE. §V.C.3; Lo, ¶¶262-263, 213-218.

Furthermore, with respect to limitation 8[a], Deenoo discloses the UE includes a transceiver, as shown below in Figure 1B. Deenoo, ¶¶49-53, Fig. 1B (annotated). “The transceiver 120 may be configured to modulate the signals that are to be transmitted by the transmit/receive element 122 and to demodulate the signals that are received by the transmit/receive element 122.” *Id.*, ¶53. Deenoo further discloses “the eNode-B 160a, for example, may use multiple antennas to transmit wireless signals to, and receive wireless signals from, the WTRU 102 a.” *Id.*, ¶65. POSITAs would have thus understood the UE receives PDCP PDUs and RRC messages through the transceiver. *Id.*, ¶¶143, 208-212; Lo, ¶¶264, 67-68.

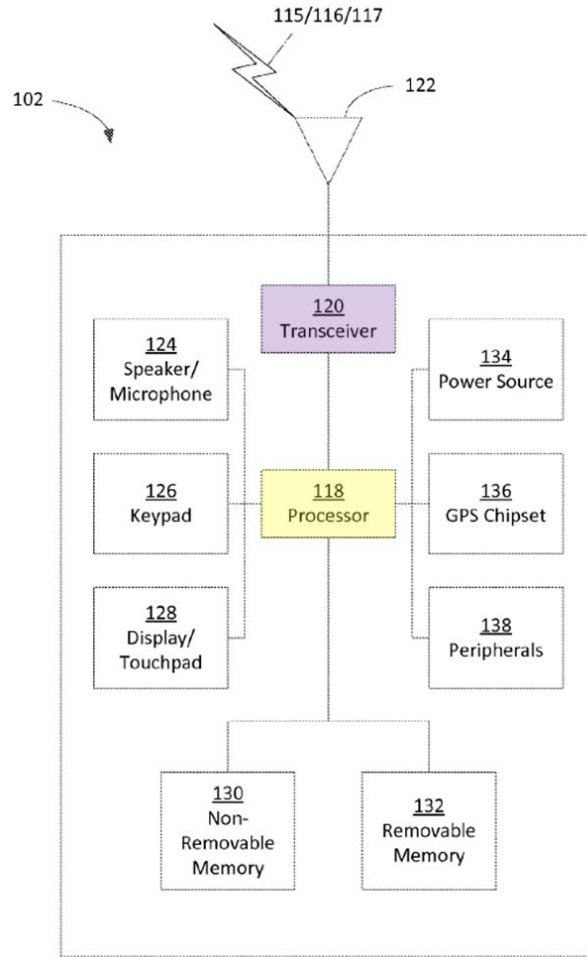


FIG. 1B

For example, POSITAs would have recognized Figure 1F, reproduced and annotated below, shows signaling (e.g., RRC) and data (e.g., PDCP packets) sent from the macro and small eNB base stations to the UE. Deenoo, Fig. 1F; Lo., ¶265. POSITAs would have understood the PDCP data packets (e.g., PDUs) and RRC messages used to configure the UE are received over a radio interface by Deenoo's receiver as part of the transceiver. Lo, ¶¶69-73, 265 (discussing 3GPP TS 36.331).

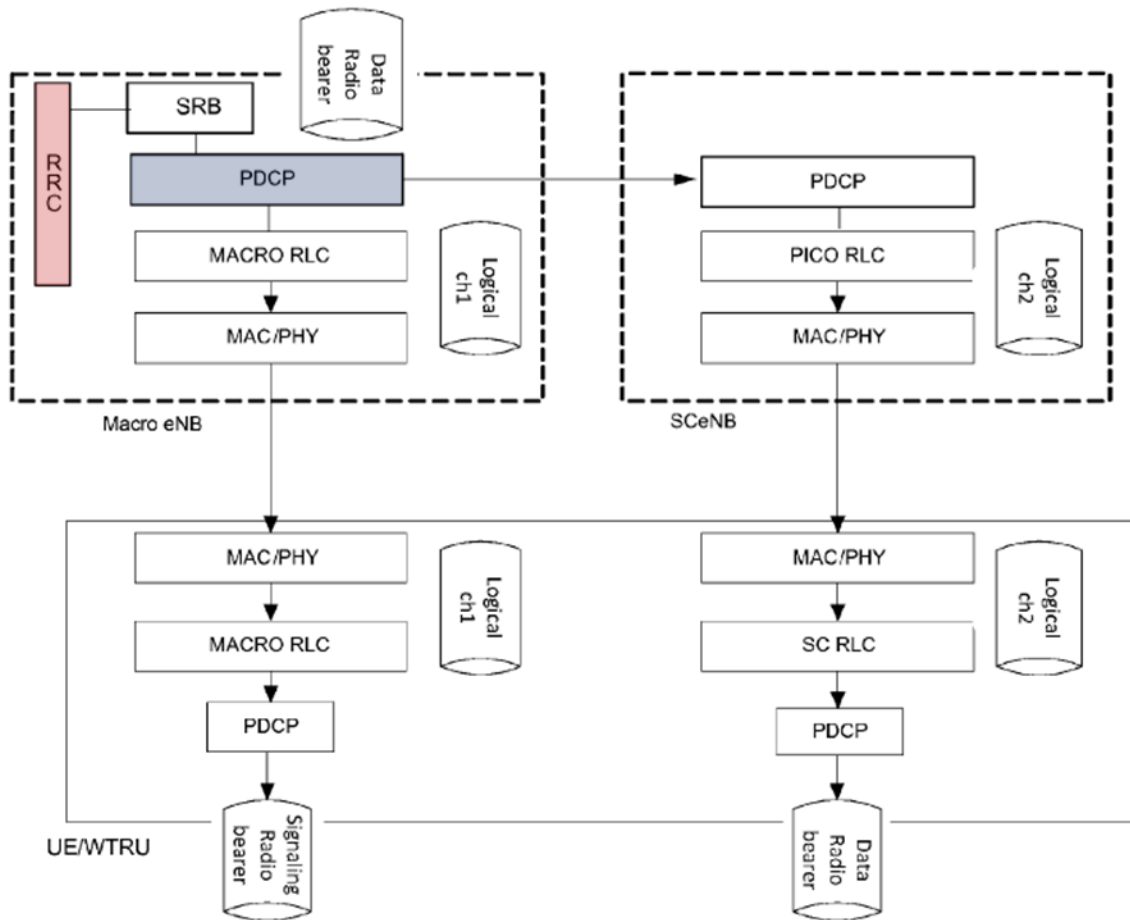


FIG. 1F

Regarding limitations 8[c] and 8[f], Deenoo discloses the UE includes a processor, shown above in Figure 1B. Deenoo, ¶¶49-50, 54-57, Fig. 1B. Deenoo explains “[t]he processor 118 may perform signal coding, data processing, power control, input/output processing, and/or any other functionality that enables the WTRU 102 to operate in a wireless environment.” *Id.*, ¶50. “The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122.” *Id.* Furthermore, Denoo discloses its methods “may be implemented in a computer program, software, or firmware incorporated in a computer-readable

medium for execution by a computer or processor.” *Id.*, ¶262. POSITAs would have thus understood the processor processes the received data from the macro and small base stations because it executes software the perform those functions. *Lo*, ¶¶266, 67-68.

The table below correlates the reasons why the combination teaches the limitations of claim 1 with limitations 8[a]-13[f]. *Lo*, ¶267.

Claim 8		
Limitation	Substantially Similar Limitation(s)	Reference
8[pre]	1[pre]	§V.C.3.a
8[a]	1[a]	§V.C.3.b
8[b]	1[c]	§V.C.3.d
8[c]	1[b]	§V.C.3.c
8[d]	1[d]	§V.C.3.e
8[e]	1[e]	§V.C.3.f
8[f]	1[f]	§V.C.3.g

9. Claim 9:

Deenoo teaches claim 9’s additional limitations for the reasons discussed for claim 2 (§V.C.4). *Lo*, ¶¶269, 242-245. Claim 9 is similar to claim 2, except the processor performs functions equivalent to the method steps in claim 2. *Lo*, ¶269. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Deenoo. §V.C.8; *Lo*, ¶¶269, 266. Accordingly, POSITAs would have understood the processor in Deenoo’s UE (or WTRU) performs the functions of claim 9 for the same reasons Deenoo teaches the limitations of claim 2. *Id.*, ¶269.

10. Claim 10:

Deenoo teaches claim 10's additional limitations for the reasons discussed for claim 3 (§V.C.5). Lo, ¶¶270, 246-252. Claim 10 is substantially similar to claim 3, except the processor performs functions equivalent to the method steps in claim 3. Lo, ¶270. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Deenoo. §V.C.8; Lo, ¶¶270, 266. Accordingly, POSITAs would have understood the processor in Deenoo's UE performs the functions of claim 10 for the same reasons Deenoo teaches the limitations of claim 3. Lo, ¶270.

11. Claim 11:

Deenoo teaches claim 11's additional limitations for the reasons discussed for claim 5 (§V.C.7). Lo, ¶¶271, 259-261. Claim 11 is similar to claim 5, except the processor performs functions equivalent to the method steps in claim 5. *Id.*, ¶271. As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Deenoo. §V.C.8; Lo, ¶¶271, 266. Accordingly, POSITAs would have understood the processor in Deenoo's UE performs the functions of claim 11 for the same reasons Deenoo teaches the limitations of claim 5. *Id.*, ¶271.

12. Claim 12:

Deenoo teaches claim 12's additional limitations for the reasons discussed for claim 4 (§V.C.6). Lo, ¶¶272, 253-258. Claim 12 is similar to claim 4, except the

processor performs functions equivalent to the method steps in claim 4. Lo, ¶272.

As explained above for claim 8, the processor executes software to perform the embodiments and functions disclosed in Deenoo. §V.C.8; Lo, ¶¶272, 266.

Accordingly, POSITAs would have understood the processor in Deenoo's UE performs the functions of claim 12 for the same reasons Deenoo teaches the limitations of claim 4. Lo, ¶272.

VI. DISCRETIONARY DENIAL WOULD BE INAPPROPRIATE

A. §325(d)

The Board should not exercise its discretion under §325(d) to deny institution. No prior art in this Petition were cited or considered during the original examination. This Petition is neither cumulative, nor provides overlapping arguments with those in the original examination. Additionally, this Petition is accompanied by the expert testimony of Dr. Titus Lo, which the Office lacked during the original prosecution.

B. §314(a)

No discretionary denial is warranted under 35 U.S.C. § 314(a) either, as the *Fintiv* factors in totality favor institution. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). This case is distinguishable in numerous, important ways from the recent, non-precedential Director Review decision in *Motorola Solutions, Inc. v. Stellar, LLC*, IPR2024-01205, Paper 19 (Mar. 28, 2025) (denying institution where the district court's set trial date was eleven months before projected FWD, opening and rebuttal expert reports had been served

in district court, the district court had issued a *Markman* order, and *Fintiv* factors 1, 2, and 5 weighed in favor of denial). Such facts are not present here; instead, the Board is presented with much less district court investment and diligent Petitioners providing a *Sotera* stipulation early in litigation. A holistic balancing of the *Fintiv* factors shows discretionary denial is not warranted.

Factor 1: Because no stay has been requested or granted currently, this factor is neutral.

Factor 2. The current trial date in the EDTX case is late April 2026, which is around the same time as the projected statutory deadline of this IPR in September 2026. EX1015, 1. Further, Judge Schroeder’s median time to trial of 30 months puts trial at around December 2026, accounting for the more than three month stay.¹¹ EX1016. This fact shows the FWD is likely to issue before or at the same time as the trial. *See Dish Network L.L.C. v. Broadband iTV, Inc.*, IPR2020-01280, Paper 17, 16 (Feb. 4, 2021).

Moreover, the month-long post-trial proceedings in the EDTX case could result in a final judgment after the IPR statutory deadline. To the extent this factor

¹¹ March 24, 2025, Memorandum (“Boalick Memo”),

https://www.uspto.gov/sites/default/files/documents/guidance_memo_on_interim_procedure_recission_20250324.pdf (Board still considers time-to-trial statistics).

favors denial of institution, Petitioner submits this factor only does so marginally, and the other *Fintiv* factors favor institution. *Facebook*, Paper 11 at 10-11; *Abbott Vascular, Inc. v. FlexStent, LLC*, IPR2019-00882, Paper 11 at 31 (PTAB Oct. 7, 2019) (declining to adopt a bright-line rule that an early trial date alone requires denial in every case).

Factor 3: This factor favors institution because investment in the co-pending litigation has been minimal. The EDTX case was stayed by agreement of the parties. Since the EDTX case resumed, the parties have only served initial contentions, and the court has issued no substantive orders related to the '573 patent.

Petitioner diligently filed its Petition less than five months after receiving PO's infringement contentions and less than three months after serving invalidity contentions in the related district court case. EX1015; *Corning Optical Comm'ns LLC v. Dali Wireless, Inc.*, IPR2021-00762, Paper 8, 9-10 (Oct. 13, 2021); *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12, 17 (§II.A precedential) (Dec. 1, 2020) (finding petition filing within two months of invalidity contentions weighed in favor of denying institution).

Further, the district court's investment is minimal. Expert reports are scheduled to be exchanged after the anticipated date for institution decision. EX1015, 4. To the extent the court issues a claim construction order prior to institution decision, it would not impact on the merits of this proceeding. The PTAB

has previously found this factor weighs against exercising discretion to deny institution in part because the disputed claim terms in the parallel proceeding were not relevant to the IPR. *Facebook, Inc. v. Onstream Media Corp.*, IPR2020-01527, Paper 11 at 13-14 (PTAB Apr. 5, 2021); *Apple Inc. v. Parus Holdings, Inc.*, IPR2020-00686, Paper 9 at 16-17 (Sept. 23, 2020) (finding “little risk of the parties or us duplicating work” where the parties relied on the plain meaning in the IPR). Petitioner’s diligence in filing its Petition and the district court’s minimal investment thus far tip this factor in favor of institution. *Zynga Inc. v. IGT*, IPR2022-00199, Paper 11, 14-16 (June 14, 2022).

Furthermore, Petitioner’s filing of this IPR is prior to receiving PO’s validity contentions in the EDTX case. *Snap v. SRK Tech.*, IPR2020-00820, Paper 15 at 12-13 (PTAB Oct. 21, 2020) (precedential) (finding Petitioner’s conduct neutral because petition “was not filed in close proximity to any response by [PO] to the invalidity contentions”).

Factor 4: This factor strongly weighs against discretionary denial. Petitioner challenges more claims than are at issue in district court, but to eliminate any doubt as to the absence of meaningful overlap between litigation and IPR, Petitioner hereby stipulates that if the PTAB institutes IPR, it will not pursue, in the EDTX case, any ground Petitioner raised or reasonably could have raised in an IPR. This broad stipulation “mitigates any concerns of duplicative efforts between the district

court and the Board, as well as concerns of potentially conflicting decisions” and “ensures that an inter partes review is a true alternative to the district court proceeding.” *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 19 (PTAB Dec. 1, 2020) (precedential). Accordingly, “this factor weighs strongly in favor of not exercising discretion to deny institution.” *Id.*

Factor 5: Even though the parties in this proceeding are identical to those in the EDTX case, this factor is at worst neutral. *See Mobileye Global, Inc. v. Facet Tech. Corp.*, IPR2024-01111, Paper 14 at 16 (PTAB Mar. 5, 2025); *see also Sotera*, Paper 12 at 19-21 (instituting review where parties are identical); *Sand Revolution II, LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 12-14 (PTAB Jun. 16, 2020) (informative) (same).

Moreover, as here, where the parties are the same and an FWD “is likely to issue before the district court trial [the Board] weigh[s] this factor against exercising discretion.” *BMW of N. Am., LLC v. Michigan Motor Techs. LLC*, IPR2023-01234, Paper 11, 14-15 (Jan. 26, 2024) (collecting cases). All available data shows the Board is likely to issue an FWD before the district court trial.

Factor 6: This factor favors institution because the grounds raised in this Petition are particularly strong. Specifically, this Petition presents a single reference obviousness ground, disclosing or suggesting all limitations of every challenged claim, including the limitation on which allowability hinged. Accordingly,

“institution of a trial may serve the interest of overall system efficiency and integrity.” *Fintiv*, Paper 11 at 14-15.

VII. CONCLUSION

The Board should institute IPR and cancel the challenged claims.

VIII. MANDATORY NOTICES (37 C.F.R. § 42.8(A)(1))

A. Real Party in Interest (37 C.F.R. § 14.8(b)(1))

The real parties-in-interest are OnePlus Technology (Shenzhen) Co., Ltd. and Guangdong OPPO Mobile Telecommunications Corp., Ltd.

B. Notice of Related Matters (37 C.F.R. §42.8(b)(2))

To the best of Petitioner’s knowledge, the ’573 patent has been involved in the following matters:

- *Pantech Corporation and Pantech Wireless v. OnePlus Technology (Shenzhen) Co., Ltd.*, 5:24-cv-00038 (E.D. Tex.)

C. Counsel and Service Information (37 CFR §42.8(b)(3) and (4))

Petitioner consents to electronic service. All services and communications to the attorneys listed below may be sent to:

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D. Power of Attorney

A power of attorney is filed herewith according to 37 C.F.R. §42.10(b).

Dated: April 24, 2025

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CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(d)

Pursuant to 37 C.F.R. § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for Inter Partes Review of U.S. Patent No. 10,863,573 totals 13,958, excluding the parts exempted by 37 C.F.R. § 42.24(a). Accordingly, this Petition is under the word count limit of 14,000 words.

This word count was calculated by using the built-in word-count tool in the word-processing system used to prepare this Petition.

Dated: April 24, 2025

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true copy of the foregoing
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
10,863,573 and supporting materials (Exhibits 1001 - 1040 and Power of Attorney)
have been served this 24th day of April, 2025, by FedEx® mail delivery service on
Patent Owner at the correspondence address for the attorney of record for the '573
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