

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,

Petitioner,

v.

INTELLECTUAL VENTURES II LLC,

Patent Owner.

Case No. IPR2025-00343
U.S. Patent No. 10,292,138

**DECLARATION OF DR. GARY LOMP IN SUPPORT OF
PATENT OWNER'S RESPONSE**

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I, Dr. Gary Lomp, do hereby declare:

I. INTRODUCTION

1. I am making this declaration at the request of Intellectual Ventures II, LLC (“Intellectual Ventures”) in the matter of the *Inter Partes* Review (“IPR”) proceedings before the United States Patent and Trademark Office (“USPTO”) of U.S. Patent No. 10,292,138 (“the ‘138 Patent”) to provide expert technical opinions with respect to the ‘138 Patent.

2. I am being compensated for my work in this matter at my standard hourly rate of \$450 for such consulting services. My compensation in no way depends on the outcome of this case, and I have no financial interest in the outcome.

3. In preparing this Declaration, I considered the following materials, the subject matter of which are all within the scope of my education and professional experience:

- The ‘138 Patent, Ex. 1001;
- The Petition for *Inter Partes* Review of U.S. Patent No. 10,292,138 (“Pet.”);
- the Declaration of Dr. Ding;
- U.S. Patent Publ. No. 2006/0088058 (Ex. 1005)(“Eckert”);
- U.S. Patent Publ. No. 2007/0297435 (Ex. 1006)(“Bucknell”);
- International Patent Publ. WO 2005/025252 (Ex. 1007)(“Lohr-1”);
- the Patent Owner Preliminary Response

- the Institution Decision, and
- any other exhibits referred to in my Declaration.

II. PROFESSIONAL BACKGROUND

4. Based on my qualifications, education, knowledge, expertise, experience, and work background, I believe I am qualified to offer opinions relating to the technology described in the '138 Patent. Exhibit 2008 is a copy of my current *curriculum vitae* ("CV"), detailing my education and experience. Additionally, the following overview of my background pertains to my qualifications for providing expert testimony in this matter.

5. I am currently an Adjunct Professor in Wireless Communications at the NYU Tandon School of Engineering and President of TekTactiks, a research and expert consulting company. My job duties include directing and performing research in, and technical evaluation of, advanced communication system design, especially new cellular technologies. I have over 45 years of experience in the field of wireless telecommunications, including advanced military communications systems, commercial satellite, WiFi and cellular systems research and development. I have over 20 years of experience in providing expert services in the field of wireless telecommunications. I hold Ph.D., Master's and Bachelor's degrees in Electrical Engineering, all from the Polytechnic Institute of New York (now part of NYU Tandon School of Engineering).

6. I am a named inventor on over 100 issued U.S. Patents in the field of wireless telecommunications. Most of these patents pertain to wireless communication, including communication system architecture, communication system signal processing and communication system protocols.

7. In addition to my technical experience in the field of wireless communications systems, I have been a principal and executive in multiple wireless technology corporations. In the late 1980s and early 1990s, I was Vice President and Chief Scientist at SCS Mobilecom, a wireless company that developed new technology based on spread spectrum technologies and advanced signal processing (DSP) techniques. Following the acquisition of SCS Mobilecom by InterDigital Communications, Corporation in 1992, I held various leadership roles at InterDigital, including General Manager of the Wireless Products Business Unit and Executive Vice President and Chief Technology Officer, where I helped develop 2G and 3G technologies. After InterDigital, I served in leadership positions at several wireless startups, including Symbol Technologies (where I led the Wide Area Wireless technology division), LayerOne Wireless Technologies Inc. (where I served as CEO) and incNetworks (where I served as CTO). I am also the Founder and President of The TekTacktics Group, Inc. a private company that has provided expert services and telecommunications consulting in the Telecommunications industry for the past 15 years.

8. In terms of commercial research and development (R&D) experience, I have worked extensively on the design and optimization of radio frequency (RF) communications systems for enhanced capacity and service coverage. A further object of my work has been to realize systems that are “converged” or are ingredients in a converged network concept. Convergence means the technical integration of heterogeneous services (such as voice, data, and multimedia) and heterogeneous radio technologies (macrocellular, microcellular, WiFi, cordless phone) into a seamless operating unit. This work requires cross functional design in which the respective heterogeneous technologies are made to interoperate.

9. During this career activity, I have had first-hand knowledge and exposure to numerous discussions, and debates in support of the advancement of new wireless technologies and paradigms. These new technologies addressed various air interface methods, including orthogonal frequency division multiplexing (OFDM) and Orthogonal Frequency Division Multiple Access (OFDMA), a closely related method of utilizing the OFDM format to provide shared access. My current research includes the presently evolving 5G cellular concept, which incorporates, among other things, MIMO-OFDM/OFDMA processing. As outlined above, my involvement in wireless R&D has also drawn me to fundamental system architecture issues and philosophies including the functional portioning of the overall wireless network. I have had the benefit of collaboration and debate with numerous top tier innovators,

from many industry-leading organizations in the field. In particular, I have detailed knowledge and recollection of the atmosphere surrounding the ongoing wireless technology revolution that began in the late 1980s and continues to the present day, including the period surrounding the present invention, and also including attempts by interested parties across the globe to promulgate and protect preferred ideas and intellectual property.

10. With respect to the technologies relevant to the '138 Patent, my experience includes over 20 years of research and development in the area of CDMA cellular telephone technology and systems, beginning at the very start of the commercialization of previously classified spread spectrum techniques, with which I had also a decade of prior experience. During that period of my career I had roles ranging from Senior Member of Technical Staff and Senior Principal Engineer to Chief Scientist and Chief Technology Officer heading a team of over 100 engineers in the development of the earliest WCDMA prototypes. I am a named inventor on 7 US Patents pertaining specifically to power control techniques in wireless systems, as well as many additional patents that cover all aspects of CDMA and post-CDMA wireless technology and systems. In addition to direct application to power control in cellular systems, in which numerous challenges and tradeoff analyses are required (as exemplified by the scope and depth of research and invention of concern in the current matter), I also had the benefit (earlier in my career) of 2 years of intensive study and

optimization of Delta Modulation for voice digitization, a project for which I was recognized for creating “the best 16 kilobit per second voice coder yet to be heard”. Many of the core issues that occur in power control of a wireless transmission over a randomly and often drastically varying radio channel are found in the application of delta modulation to voice encoding. An example is the well-known problem of choosing a step size and optimally varying the step size in order to cope with the dichotomous nature of the quantity being controlled (received radio frequency power level) or tracked (voice). In both applications, as dissimilar as they seem, the quantity of interest undergoes changes from near quiescence to rapid variation with large swings of level that challenge any algorithm attempting to stabilize or track said quantity.

11. To place the experience I have in the context of innovation and invention, I have been involved throughout my career in the evolution of many other basic radio communication technologies since their inception, such as MIMO, Multiuser Detection, and FEC coding advances, such as Turbo and LDPC, and soft output decoders such as the Soft Output Viterbi Algorithm (SOVA). A significant portion of the engineering design work I have performed has entailed the introduction of new techniques to provide capabilities that had not existed previously, such as a recently deployed novel baseband processor capable of robust demodulation and combining of signal components received on two antennas,

respectively, at very low signal to noise ratios. Most recently, I have designed an advanced form of OFDM in which the impairments of channel dispersion are mitigated in both the time domain (as in conventional OFDM) and the frequency domain (which is an Achilles heel of OFDM). This achievement is the result of many years of perseverance culminating in the discovery of a mathematical tool of broad applicability (to wit, Simultaneous Approximate Singular Value Decomposition). Previously, a similar tenacity-fueled accomplishment produced the first and only complete closed-form theory of equalization of offset modulation formats in multipath channels, again a result of a persistent creative attack on the problem. In a word, I am well versed and well aware of the nuances of innovation and the toils of invention.

12. My CV contains further details on my education, experience, publications, and other qualifications to render an expert opinion in this case. Ex. 2008.

III. RELEVANT LEGAL STANDARDS

13. I have been asked to provide my opinion as to whether certain claims of the '138 Patent are obvious over Eckert, Lohr-1 and Bucknell.

14. The opinions I am expressing in this report involve the application of my knowledge and experience to the evaluation of certain references with respect to the '138 patent. My formal knowledge of patent law is no different than that of any lay

person. Therefore, I have requested the attorneys from Volpe Koenig, who represent Intellectual Ventures, to provide me with guidance as to the applicable patent law in this matter. The paragraphs below express my understanding of how I must apply current principles related to patent validity to my analysis.

15. I understand that an IPR is a proceeding before the USPTO for evaluating the patentability of an issued patent's claims based on prior-art patents and printed publications.

16. I understand that the claims of a patent are reviewed from the point of view of a hypothetical person of ordinary skill in the art ("POSITA") at the time of the filing of the patent. The "art" is the field of technology to which a patent relates.

17. I understand that in determining whether a patent claim is anticipated or obvious in view of the prior art, the Patent Office must apply the *Phillips* standard to construe the claims.

18. I understand that, in this proceeding, Petitioners have the burden of proving that the challenged claims of the '138 Patent are unpatentable by a preponderance of the evidence. I understand that "preponderance of the evidence" means that a fact or conclusion is more likely true than not true.

19. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can "anticipate" the claim. Second, the prior art can render the claim "obvious" to a POSITA. I understand that for an

invention claimed in a patent to be patentable, it must not be anticipated and must not be obvious based on what was known before the invention was made. For purposes of this Declaration only, I have applied the definition of a POSITA proposed in the Petition.

20. I understand that a patent claim may be invalid as “anticipated” under 35 U.S.C. § 102 if each and every limitation of the claim as construed by the court is found, either expressly or inherently, in a single prior art reference, such as a publication or patent, that predates the claimed subject matter. I also understand that a patent claim may be invalid as obvious under 35 U.S.C. § 103 if the differences between the subject matter claimed and the prior art are such that the claimed subject matter as a whole would have been obvious to a POSITA at the time the invention was made. I also understand that several factual inquiries underlie a determination of obviousness. These inquiries include (1) the scope and content of the prior art, (2) the level of ordinary skill in the field of the invention, (3) the differences between the claimed invention and the prior art, and (4) any objective evidence of non-obviousness (i.e., “secondary considerations”).

21. I also understand that, when a party alleges obviousness based on a combination of references, that party should identify a reason why a POSITA would have been motivated to combine the asserted references in the manner recited in the

claims and to explain why a POSITA would have had a reasonable expectation of success in making such combinations.

22. I understand that an obviousness analysis permits the application of “common sense” in examining whether a claimed invention would have been obvious to a POSITA. For example, I understand that combining familiar elements according to known methods and in a predictable way may suggest obviousness when such a combination would yield nothing more than predictable results. And I understand a party asserting obviousness should still provide a specific motivation to combine the references as recited in the claims and explain why one would have reasonably expected to succeed in doing so.

23. I understand that one indicator of non-obviousness is when a prior art reference leads in a different direction or discourages that combination, recommends steps that would not likely lead to the patent’s result, or otherwise indicates that a seemingly inoperative device would be produced.

IV. SPECIFICATION OF ‘138 PATENT

24. The ‘138 Patent is directed to a system and method for allocating uplink transmission resources among multiple data flows in a wireless communication environment, where each data flow is mapped to a respective radio bearer. These radio bearers are associated with queues (or buffers) at the User Equipment (UE) that store data awaiting transmission.

25. At the time of the ‘138 Patent, conventional resource allocation methods used for dividing resources in a wireless communication environment used a simple absolute priority scheme, i.e., a method in which data is processed in ascending order based on the priority of each queue. Unlike conventional resource allocation techniques, the ‘138 Patent added weighting logic into the algorithm for dividing resources among data in multiple queues. As explained in the ‘138 Patent:

In one embodiment of the present invention, the apparatus further comprises weighting logic operably coupled to the signal processor and the prioritization logic and arranged to provide a set of weight values for each service across a plurality of users such that the prioritization logic allocates bandwidth resource to individual radio bearers according to a set of weight values.

The provision of weighting logic operably coupled to the signal processor and the prioritization logic allows a proportion of the resource to be allocated to particular radio bearers (e.g. services). This is in contrast to the conventional prioritization scheme provided by 3GPP, which uses a simple absolute priority scheme.

In one embodiment of the present invention, the apparatus further comprises a transmitter transmitting the set of weight values to the wireless communication unit. This feature provides the advantage that the UE can then properly prioritize traffic whilst receiving a single physical allocation from the network and not have to use the simple absolute priority system defined in 3GPP. Ex. 1001, 4:17-35 (emphasis added).

26. Thus, one purpose of the weighting logic disclosed in the ‘138 Patent was to create a resource allocation algorithm that allocated a proportion of a single physical allocation from the network to data from each of the queues. The weighting logic differentiated the algorithm disclosed in the ‘138 Patent from conventional schemes that used only the relative priority of each queue for resource allocation.

27. In the disclosed allocation algorithm, each of the data flows has a Quality of Service (QoS) profile (referred to as an S_{tier} parameter) and is associated with a radio bearer instance. The disclosed allocation process is iterative, and distributes proportions of a single allocation of uplink resources (e.g., codes and timeslots) —referred to as Resource Allocation Assignment Units (RAAUs) — in a manner that is fair over time across radio bearers with similar characteristics. As explained in the ‘138 Patent:

... This single physical allocation of radio resources provided to a UE is shared amongst a number of services, in proportion to their respective QoS requirements, for example in proportion to the signaled weight values (S_{tier}). Ex. 1001, 9:39-43 (emphasis added).

See also, *Id.*, 11:7-10 (equating the “quantum of physical resources” that can be shared out with a combination of spreading codes and timeslots).

28. The allocation algorithm disclosed in the ‘138 Patent limits the distribution of resources to only a subset of queues in order to address signaling problems that may occur when a queue (or radio bearer) is allocated a very small proportion of the overall resources. In the disclosed system, the S_{tier} parameters, which reflect the relative QoS priorities of the radio bearers, are communicated from the network to the UE. In each transmission cycle, the allocation algorithm determines different weights (referred to as W'_q and W''_q) for each queue based on both the S_{tier} values and current fill level of the queues. In each transmission cycle, these weights are used to determine resource allocations (referred to a $RAAU_q$,

$RAAU'_q$ and $RAAU''_q$) for the queues. The algorithm tracks the underallocation or overallocation of resources to each queue over time with a parameter termed $running_RAAU_delta_q$, which reflects, *inter alia*, the difference between the amount of resources that would have been allocated to the queue had transmission not been limited to only a subset of the queues, and the actual resource allocation for each queue when transmission is limited to only a subset of the queues. The $running_RAAU_delta_q$ parameter allows the algorithm to achieve fairness over time across radio bearers with similar characteristics.

29. The following sections explain this allocation process in detail, beginning with an overview of the high-level architecture and progressing through each step of the algorithm as shown in Figure 6 of the '138 Patent. A working example involving four queues is used throughout to illustrate the iterative calculations and resource adjustments that take place. It should be kept in mind that the illustrative example is intended to show the arithmetic operations using actual numbers that may be tracked as the algorithm runs. This shows the logical manipulations that are occurring. The illustrative example does not aim to simulate an actual operational instance of the algorithm, in which the state of the system has evolved from a known (e.g., cold start) state. Such a simulation has been performed separately to further verify performance of the algorithm but will not be presented here for simplicity. The more complete (indeed, state-exact) simulation is best

interpreted when implemented on a computer. The “hand calculation” provided herein can be followed without requiring a computer.

A. Overview Of Allocation Process Disclosed In The ‘138 Patent

30. In the disclosed embodiment, buffers hold data until physical resources (each of which is referred to as a “RAAU”) become available to transmit the data. Ex. 1001, 11:7-8 (“RAAU represents a quantum of physical resources.”). The allocation algorithm allocates a total amount of resources (referred to as “FreeRAAU”) among the data flows using an iterative process. *Id.*, 11:9-10 (“FreeRAAU is the number of free RAAU that the resource allocator (RA) can share out.”) The disclosed allocation process services the queues in a statistically fair fashion. In simple terms, the algorithm keeps track of whether each queue has been overallocated or underallocated resources in the past by defining a quantity termed “*running_RAAU_delta*,” which serves as a numerical measure of service excess or deficiency previously provided to each queue. *Id.*, 10:43-45 and 11:32-38. The algorithm uses the *running_RAAU_delta* parameter to manage the allocation process among the queues in a fair manner. *Id.* For example, the process allocates a share of available resources in each transmission interval in a manner that, for example, maintains equality of performance (over time) across users having the same QoS profile. *Id.*, 8:44-46, 9:4-11 and 9:39-42.

B. Tier-Based Weighted Fair Queueing

31. The allocation process disclosed in the '138 Patent provides "QoS prioritization" across radio bearers by associating a queue weight (referred to as an S_{tier} value) with each radio bearer (or RB). As explained in the '138 Patent:

The structure of this architecture means that it is possible to provide QoS prioritization across multiple users. Hence, for example, in a scenario where there are two users, one may have hyper-text transfer protocol (HTTP) traffic and this may be mapped to RB1, and a second user may employ file transfer protocol (FTP) traffic, which may be mapped to RB2. The S_{tier} associated with RB 1 ($S_{tier\ 1}$) is higher than that for RB2 ($S_{tier\ 2}$). ...

It is noteworthy that there is no restriction on the values associated with each queue weight value (S_{tier}). Therefore, in accordance with embodiments of the present invention, it may be possible to, say, set the relative weight for service 1 for SLA-2 to be higher than a number of services on SLA-1, which may nominally be a higher-priority SLA.

In accordance with one embodiment of the present invention, a mechanism to provide prioritization of services across multiple users in an uplink direction is described. In this regard, weight values are signaled to the UE. If there are multiple QoS requirements within a single 3GPP PDP context, a single physical allocation of radio resources may be made to the UE. ... This single physical allocation of radio resources provided to a UE is shared amongst a number of services, in proportion to their respective QoS requirements, for example in proportion to the signaled weight values (S_{tier}). *Id.*, 9:4-43 (emphasis added).

32. Thus, as discussed more fully below, in one embodiment of the allocation process disclosed in the '138 Patent, queue weight values associated with the QoS requirements of each of the queues are transmitted to a UE (user equipment)

from a Universal Mobile Telecommunication System Radio Access Network (UTRAN) in the form of S_{tier} values, and a single physical allocation of resources provided to the UE is shared amongst the queues based on these weight values.

C. System Disclosed for Implementing the Allocation Process

33. FIG. 5 of the '138 Patent, reproduced below, illustrates a communication system for implementing the disclosed allocation process in the context of uplink scheduling. *Id.*, 5:48-50. The system includes User Equipment (UE) 505 and a Universal Mobile Telecommunication System Radio Access Network (UTRAN) 540. UE 505 receives a single PDP context 510 (packet-data connection) and “splits the single PDP context 510 into separate services on individual radio bearers in divider logic 515.” *Id.*, 10:5-8. The UE then transmits “a message 535 indicating separate buffer occupancy for each of the radio bearers to a UTRAN scheduler 545.” *Id.*, 10:8-10.

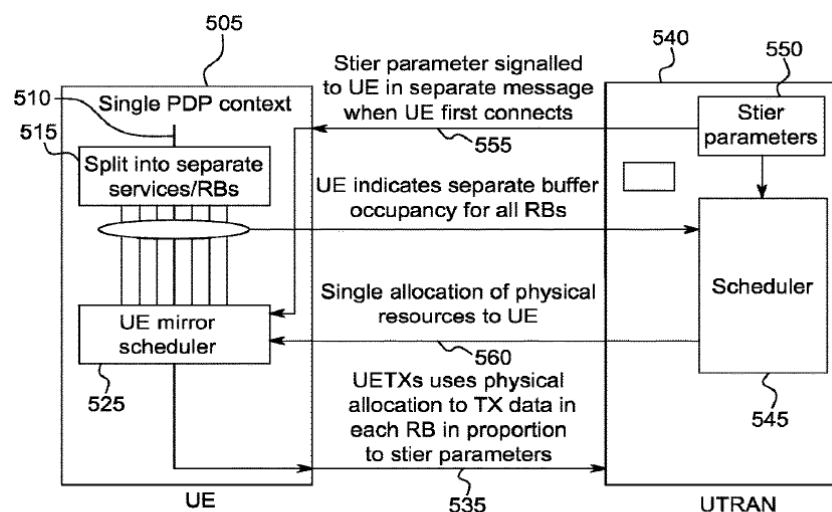


FIG. 5

34. “The separate services on individual radio bearers are input to a UE mirror scheduler 525.” *Id.*, 10:11-12. The UE mirror scheduler 525 receives the S_{tier} parameters 550 (discussed above) from the UTRAN 540, which are also input to the UTRAN scheduler 545. *Id.*, 10:13-16. The UTRAN scheduler 545 provides “a single allocation of a physical resource to the UE mirror scheduler 525 within message 560.” *Id.*, 10:17-18. “The UE mirror scheduler 525 then informs the UTRAN 540 on its use of the physical allocation, “in order to transmit data in each radio bearer in proportion to the informed S_{tier} parameters 550.” *Id.*, 10:19-22. “Thus, within the UE 505, the S_{tier} values are known, together with the total allocation of resources for the UE 505. ... [T]he overall resources allocated by the network are now split up” based on the relative weighting values. *Id.*, 10:23-28.

D. Limiting The Total Number of Queues Served

35. One aspect of the allocation process disclosed in the ‘138 Patent involves limiting the total number of queues serviced to a subset of all queues. This aspect was intended to address signaling problems that may occur when a queue (or radio bearer) is allocated a very small proportion of the overall resources. As explained in the ‘138 Patent:

... it may be the case that very small proportions of the overall resources are allocated to each RB. This may create signalling problems, as the mechanism may result in a large number of individual users being allocated some resource at any one time and each user will require a separate allocation message. Therefore, in an enhanced embodiment of the present invention, a mechanism to implement additional

functionality to limit a total number of queues served, e.g. to be allocated resource allocation units, is described. Thus, this algorithm limits a number queues that can be allocated resource at any one instance, for example to an operator specified value. The algorithm may also ensure that the ratio of allocated resource is maintained, over the long term, to the ratios specified by the S_{tier} values. *Id.*, 10:32-45 (emphasis added).

36. In the disclosed embodiment, “max_number_queues_served” is the parameter used to limit the total number of queues serviced at any time to a subset of all queues:

Referring now to FIG. 6, an algorithm 600 employing embodiments of the present invention is illustrated. The algorithm describes one mechanism to limit a number of queues served at a single instant of time. The algorithm may be run when a number of active users (i.e. those users known to have a buffer occupancy greater than zero in any queue) is greater than a known fixed parameter, for example ‘max_number_queues_served’ ... *Id.*, 10:48-54 (emphasis added).

37. The ‘max_number_queues_served’ value necessarily corresponds to a subset of all queues, because it is used when the number of active users “is greater than” the ‘max_number_queues_served’ value.

E. Iterative Allocation Process

38. The iterative allocation process of ‘138 Patent is depicted in Fig. 6 (below):

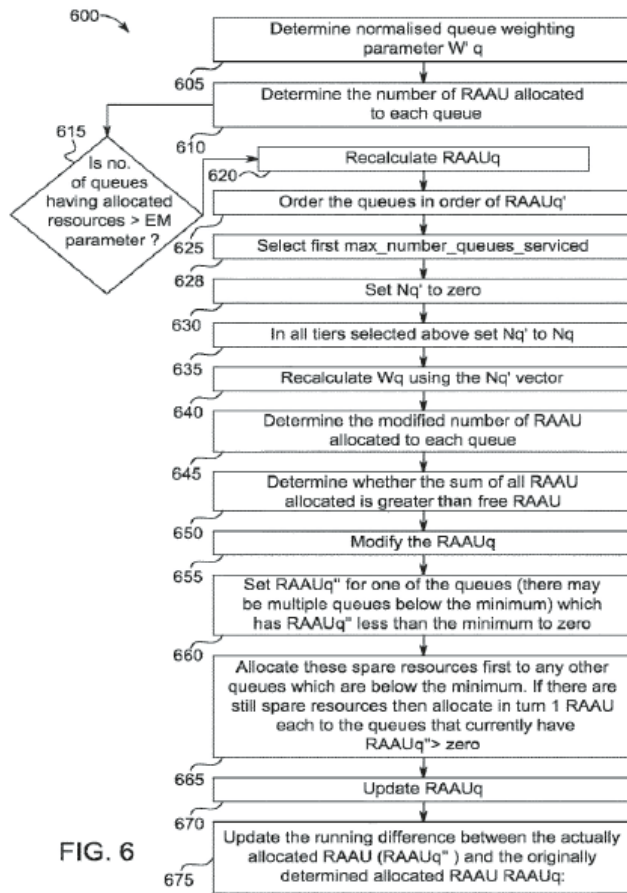


FIG. 6

39. Set forth below is a step-by-step explanation of the allocation process shown in Figure 6. In order to better illustrate how the allocation process operates, an exemplary illustration involving the allocation of resources among four queues (q1, q2, q3, and q4) is discussed and carried forward for each step in the allocation process. For illustration purposes only, the following starting parameters are used for the exemplary illustration:

$$\begin{aligned} \text{FreeRAAU} &= 40 \\ \text{max_num_queues_served} &= 3 \\ \text{cell edge minimum} &= 7 \end{aligned}$$

Queue Number	q1	q2	q3	q4
S_{tier} value for queue (S_q)	0.3	0.3	0.2	0.2
running_RAAU_delta for queue	0	0	0	0
Initial fill level for each queue (N_q)	110	100	55	50

1. Step 605 - Determine Normalized Queue Weightings (W'_q)

40. The process begins at step 605 by determining a normalized weighting (W'_q) of the allocated resources” for each of the queues based on Equation [6] set forth below. *Id.*, 10:57-67.

$$W'_q = \frac{S_q N_q}{\sum_q S_q N_q}$$

In Equation [6], S_q corresponds to the S_{tier} parameter for the queue denoted by the subscript “ q ” in S_q . As noted above, the S_{tier} parameter for each queue (S_q) is provided to the UE from the UTRAN. *Id.*, 10:13-16. Also in Equation [6], N_q is the number of entries in the queue denoted by the subscript “ q ” in N_q . In the illustrated example, the N_q values for the four queues (q1, q2, q3 and q4) correspond to N_1 , N_2 , N_3 and N_4 and were chosen as 110, 100, 55 and 50, respectively.

41. As is evident from Equation [6] and the illustration of the implementation of Equation [6] below, the normalized weighting (W'_q) for each

queue is based on the S_{tier} values of all queues, which have been provided to the UE from the UTRAN, as well as the fill levels (N_q) of all queues. *Id.*, 10:13-16.

42. Applying the exemplary starting values set forth above to Equation [6] results in the following normalized weightings (W'_q) for the queues. The denominator sum is:

$$\begin{aligned}\sum_q S_q N_q &= (0.3 * 110) + (0.3 * 100) + (0.2 * 55) + (0.2 * 50) \\ &= 33 + 30 + 11 + 10 \\ &= 84\end{aligned}$$

Applying this value for the denominator results in the following normalized weightings (W'_q) (rounded to five decimal places) for each of the four queues:

$$W'_1 = \frac{33}{84} = 0.39286$$

$$W'_2 = \frac{30}{84} = 0.35714$$

$$W'_3 = \frac{11}{84} = 0.13095$$

$$W'_4 = \frac{10}{84} = 0.11905$$

2. Step 610 - Determine Queue Allocations ($RAAU_q$)

43. Next, in step 610, the process determines a number of resource allocation units (RAAU) allocated to each queue using Equation [7] set forth below.

Id., 11:1-10.

$$RAAU_q = (FreeRAAU) * W'_q$$

In Equation [7], $RAAU_q$ corresponds to a number of resource allocation units (or RAAU) allocated to the queue denoted by the subscript “ q ” in $RAAU_q$. Continuing with the illustration, application to Equation [7] of the normalized weightings (W'_q) for the queues determined in Step 605 above and the starting value of FreeRAAU=40 chosen for the illustration results in the following $RAAU_q$ values for queues q1, q2, q3 and q4:

$$\begin{aligned} RAAU_1 &= (40)(0.39286) \\ &= 15.714 \end{aligned}$$

$$\begin{aligned} RAAU_3 &= (40)(0.13095) \\ &= 5.2380 \end{aligned}$$

$$\begin{aligned} RAAU_2 &= (40)(0.35714) \\ &= 14.286 \end{aligned}$$

$$\begin{aligned} RAAU_4 &= (40)(0.11905) \\ &= 4.7620 \end{aligned}$$

3. Step 615 - Determine If Max Number Of Queues Is Exceeded

44. Next, in step 615, the allocation process determines whether “the number of queues that have resources allocated is greater than” the max_number_queues_serviced threshold. *Id.*, 11:11-17. Continuing with the illustrative example, each of the four queues (q1, q2, q3 and q4) had resources allocated to it, e.g., each of the four queues had a positive value of $RAAU_q$ as determined in Step 610. In this illustrative example, the value for max_num_queues_serviced = 3 was chosen. As a result, the number of queues having

resources allocated (4 queues) exceeds the `max_num_queues_serviced` value (3 queues) in the example.

4. Step 620 - Determine New Queue Allocations ($RAAU_q'$)

45. “If the number of queues that have resources allocated is greater than” the “parameter `max_number_queues_serviced`, the process moves to step 620,” where the algorithm “re-calculates $RAAU_q$ as follows” using Equation [8] set forth below. *Id.*, 11:17-25:

$$RAAU'_q = RAAU_q + running_RAAU_delta_q$$

In Equation [8], $running_RAAU_delta_q$ corresponds to “the running difference between the number of RAAU” allocated in Step 610 to the queue denoted by the subscript “ q ” in $running_RAAU_delta_q$ “without the limitation of the number of queues serviced” and the number of RAAU allocated to such queue “with the limitation” of the number of queues serviced. *Id.*, 11:27-31. As explained in the ‘138 Patent, “this algorithm is iterative and $running_RAAU_delta$ is determined from the previous iteration of the algorithm.” *Id.*, 11:32-34. Hence, while $running_RAAU_delta_q$ may be zero “in the first iteration, on the second iteration the limitation of the number of queues in the previous iteration” will result in non-zero values of $running_RAAU_delta_q$ because there are some queues that do not receive the number of RAAU that were originally determined in Step 610. *Id.*, 11:34-38.

46. Consistent with the embodiment disclosed in the ‘138 Patent, in the illustrative example, each of the four queues (q1, q2, q3, and q4) begins with its value of *running_RAAU_delta_q* set to zero. Thus, in the illustrative example, the first application of Equation [8] results in the following *RAAU_q*’ values:

$$\begin{aligned} RAAU'_1 &= RAAU_1 + 0 \\ &= 15.714 \end{aligned}$$

$$\begin{aligned} RAAU'_3 &= RAAU_3 + 0 \\ &= 5.238 \end{aligned}$$

$$\begin{aligned} RAAU'_2 &= RAAU_2 + 0 \\ &= 14.286 \end{aligned}$$

$$\begin{aligned} RAAU'_4 &= RAAU_4 + 0 \\ &= 4.762 \end{aligned}$$

47. While in the illustrative example, each of the four queues (q1, q2, q3, and q4) begins with its value of *running_RAAU_delta_q* equal to zero, as demonstrated below, the limitation of the number of queues serviced results in non-zero values of *running_RAAU_delta_q* going forward. As explained more fully below in connection with Step 675, as a result of the limitation on the number of queues serviced, some queues receive a greater number of RAAU than were originally determined in Step 610 and other queues receive a lesser number of RAAU than were originally determined in Step 610. These differences result in non-zero values of *running_RAAU_delta_q* going forward. *See*, Section II(E)(12), *infra*.

5. Step 625 - Order Queues Based On *RAAU_q*’ Values

48. “In step 625, the queues are then ordered in order of *RAAU_q*’, beginning with the highest queue.” *Id.*, 11:39-40. Continuing with the illustrative example, each of the four queues (q1, q2, q3 and q4), the four queues are ranked as follows

based on their respective $RAAU_q'$ values from highest to lowest:

<u>Rank</u>	<u>Queue</u>	<u>$RAAU_q'$</u>
1	q1	15.714
2	q2	14.286
3	q3	5.238
4	q4	4.762

6. Step 628 - Select Max Queues From Ordered List

49. In step 628, “[t]he first max_number queues_serviced queues are then selected.” *Id.*, 11:40-42. In the illustrative example, the value for max_num_queues_serviced = 3 was chosen. Therefore, the top three ranked queues (i.e., q1, q2 and q3) are chosen, as represented by the red box below:

<u>Rank</u>	<u>Queue</u>	<u>$RAAU_q'$</u>
1	q1	15.714
2	q2	14.286
3	q3	5.238
4	q4	4.762

50. In step 628, a subset of all queues (equal to the max_number_queues_serviced) is selected from the top of the ordering.

7. Steps 630 and 635 - Determine N_q' Values

51. Next, the allocation process determines a new N_q value (N_q') for each queue. As noted above in connection with Step 605, N_q represented the number of entries in each queue. *Id.*, 10:65-66. “In all queues not selected in step 628, the N_q' value is set to zero as shown in step 630. In all of the tiers that were selected in step 628, N_q' is set to N_q , as shown in step 635.” *Id.*, 11:43-45. Continuing with the

illustrative example, the N_q and N_q' value for each queue is set forth in the table below:

<u>Queue</u>	<u>N_q (from Step 605)</u>	<u>Queue Selected in Step 628?</u>	<u>N_q' Set In Steps 630 and 635</u>
q1	1100	YES	110
q2	1000	YES	100
q3	1000	YES	55
q4	1000	NO	0

8. Step 640 - Determine New Normalized Queue Weightings (W''_q)

52. In step 640, the normalized queue weighting for each queue is “recalculated using the N_q' vector determined in step 635” based on Equation [10] reproduced below. The ‘138 Patent refers to the recalculated normalized weighting for each queue as W''_q . *Id.*, 11:46-55.

$$W''_q = \frac{S_q N'_q}{\sum_q S_q N'_q}$$

53. As is evident from Equation [10] and the illustration of the implementation of Equation [10] below, the normalized weighting (W''_q) for each selected queue is based on the S_{tier} values of all selected queues, which have been provided to the UE from the UTRAN, as well as the fill levels represented by the N_q' values of all selected queues. *Id.*, 10:13-16.

54. Applying the exemplary starting S_{tier} values and the recalculated N_q' values for the selected queues to Equation [10] results in the following recalculated normalized weightings (W''_q) for the queues. The denominator sum is:

$$\begin{aligned}\sum_q S_q N'_q &= (0.3 * 110) + (0.3 * 100) + (0.2 * 55) + (0.2 * 0) \\ &= 33 + 30 + 11 \\ &= 74\end{aligned}$$

55. Applying this value for the denominator results in the following recalculated normalized weightings (W''_q) for each of the four queues:

$$\begin{aligned}W''_1 &= \frac{33}{74} = 0.4459 & W''_3 &= \frac{11}{74} = .1486 \\ W''_2 &= \frac{30}{74} = 0.4054 & W''_4 &= \frac{0}{74} = 0.000\end{aligned}$$

9. Step 645 - Determine Recalculated Queue Allocations ($RAAU''_q$)

56. Next, the recalculated normalized weightings (W'_q) for each queue determined in Step 640 are used to recalculate the allocation for each queue based on Equation 11 reproduced below. The '138 Patent refers to this recalculated allocation for each queue as $RAAU_q''$. *Id.*, 11:56-60.

$$RAAU''_q = \text{round}[(FreeRAAU)W''_q]$$

In Equation [11], the round (...) function “rounds to the nearest integer.” *Id.*, 11:61. Continuing with the illustrative example, application of the FreeRAAU value

(chosen to be equal to 200) and the recalculated normalized weightings (W'_q) (from Step 640) to Equation [11] results in the following recalculated allocation ($RAAU''_q$) for each queue rounded to the nearest integer:

$RAAU''_1 = (40)(0.4459)$ $= 17.84$ $\rightarrow 18$	$RAAU''_3 = (40)(0.1486)$ $= 5.944$ $\rightarrow 6$
$RAAU''_2 = (40)(0.4054)$ $= 16.22$ $\rightarrow 16$	$RAAU''_4 = (40)(0.0000)$ $= 0$ $\rightarrow 0$

10. Steps 650-655: Adjust Recalculated Queue Allocations ($RAAU''_q$) If They Sum To More Than FreeRAAU

57. In Step 650, the sum of all RAAU allocated in Step 645 (i.e., the sum of all $RAAU''_q$) is determined. If the sum allocated “is greater than freeRAAU (which is possible following the rounding operation in step 645) then the $RAAU_q$ ” may be modified in Step 655. *Id.*, 11:62-66. In the illustrative example, the sum of all RAAU allocated in Step 645 equals the sum of $18 + 16 + 6$, or 40 -- which is no greater than freeRAAU (which in this example equals 40). Accordingly, no adjustment is needed in Step 655.

11. Steps 660-670: Determine If Resource Allocated To A Queue Is Less Than That Required For A Cell Edge State And Adjust If Necessary

58. As explained in the ‘138 Patent, “[i]t is possible that the volume of resource allocated to the queue may be less than that required given the cell edge

state that the UE is in. For example, if the UE is in cell edge ‘2’ then four RAAU will be needed as a minimum.” *Id.*, 12:1-4. If the amount of RAAU allocated “is less than the minimum required RAAU, given the cell edge state for any q, then $RAAU_q$ ” may be set for one of the queues that has $RAAU_q$ ” less than the minimum to zero, as shown in step 660. .. In this scenario, any spare resources are allocated first to any other queues that are below the minimum, as shown in step 665. If there are still spare resources, then any spare resources are allocated ... to the queues that currently have $RAAU_q$ ” greater than zero.” *Id.*, 12:5-16. In a case where such spare resources are reallocated, the $RAAU_q$ ” values are updated in step 670. *Id.*, 12:17.

59. In the illustrative example, the volume of resources allocated to q3 (in Step 645) is 6, which is less than the cell edge state minimum of 7 in the illustrative example. Thus, in Step 665, $RAAU_q$ ” for q3 is set to zero, and the volume of resources previously allocated to q3 (which was 6) is reallocated to the queues that currently have $RAAU_q$ ” greater than zero (which are q1 and q2 in the illustrative example.) Accordingly, in Step 665, half of the 6 RAAU from q3 (or 3 RAAU) are reallocated to q1 and the other half of the 6 RAAU from q3 (or 3 RAAU) are reallocated to q2. The $RAAU_q$ ” values are then updated in Step 670 to be as follows:

$$\begin{aligned} RAAU_1'' &= 18 + 3 \\ &= 21 \end{aligned}$$

$$RAAU_3'' = 0$$

$$\begin{aligned} RAAU_2'' &= 16 + 3 \\ &= 19 \end{aligned}$$

$$RAAU_4'' = 0$$

12. Step 675: Update *Running_RAAU_Delta_q* Values For Queues

60. In Step 675, for each of the queues, the running difference between the actually allocated RAAU ($RAAU_q''$) from Step 645 above and the originally allocated RAAU ($RAAU_q$) from Step 610 above (rounded to the nearest integer) is then updated using Equation [12] reproduced below (with colored annotations). *Id.*, 12:18-24.

$$\text{running_RAAU_delta}_q = \text{running_RAAU_delta}_q + (RAAU_q - RAAU_q'')$$

In the annotated version of Equation [12] above, the **value in red font** corresponds to the previous value of $\text{running_RAAU_delta}_q$ (immediately before the current update in Step 675), and the **value in blue font** corresponds to the updated value of $\text{running_RAAU_delta}_q$ determined in Step 675.

61. Continuing with the illustrative example, as explained in connection with Step 620 above, the value of $\text{running_RAAU_delta}_q$ may be zero in the first iteration. *Id.*, 11:34-38. Applying a previous value of $\text{running_RAAU_delta}_q$ equal to zero for each queue to the formula of Equation [12] yields the following updated values of $\text{running_RAAU_delta}_q$:

$$\begin{aligned}
\text{running_RAAU_delta}_1 &= \text{running_RAAU_delta}_1 + (\text{RAAU}_1 - \text{RAAU}_1'') \\
&= 0 + (16 - 21) \\
&= -5
\end{aligned}$$

$$\begin{aligned}
\text{running_RAAU_delta}_2 &= \text{running_RAAU_delta}_2 + (\text{RAAU}_2 - \text{RAAU}_2'') \\
&= 0 + (14 - 19) \\
&= -5
\end{aligned}$$

$$\begin{aligned}
\text{running_RAAU_delta}_3 &= \text{running_RAAU_delta}_3 + (\text{RAAU}_3 - \text{RAAU}_3'') \\
&= 0 + (5 - 0) \\
&= 5
\end{aligned}$$

$$\begin{aligned}
\text{running_RAAU_delta}_4 &= \text{running_RAAU_delta}_4 + (\text{RAAU}_4 - \text{RAAU}_4'') \\
&= 0 + (5 - 0) \\
&= 5
\end{aligned}$$

62. As reflected in the results of Step 675, the limitation on the number of queues serviced results in q1 and q2 receiving a greater number of RAAU in Step 645 than were originally determined in Step 610 (q1 and q2 were “overallocated”), and q3 and q4 receiving a lesser number of RAAU in Step 645 than were originally determined in Step 610 (q3 and q4 were “underallocated.”) These differences result in q1 and q2 having negative values of *running_RAAU_delta_q* the next time Step 620 is performed, and q3 and q4 having positive values of *running_RAAU_delta_q* the next time Step 620 is performed. The value of *running_RAAU_delta_q* for each queue thus tracks whether each queue has been overallocated or underallocated resources in the past, and serves as a numerical measure of service excess or deficiency previously provided to each queue. *Id.*, 10:43-45 and 11:32-38. By applying the

current $running_RAAU_delta_q$ value each time the allocation algorithm determines $RAAU'_q$ in Step 620, and then updating each $running_RAAU_delta_q$ each time Step 675 is performed, the allocation process disclosed in the '138 Patent achieves a fair allocation amongst the queues in a manner that, for example, approaches equality of performance over time of queues having the same QoS profile. *Id.*, 8:44-46, 9:4-11 and 9:39-42.

63. In summary, the allocation algorithm uses queue weightings (S_{tier} or S_q) values and the fill levels of the queue (N_q) to compute normalized queue weightings (W'_q and W''_q), that are used to determine a series of resource allocations ($RAAU_q$, $RAAU'_q$ and $RAAU''_q$) for the queues, each of which reflects an amount of the available resource ($FreeRAAU$) each queue should receive. The algorithm uses the $running_RAAU_delta_q$ to track whether resources have been overallocated or underallocated to each queue over time based on the running difference between the amount of resources that would have been allocated to each queue had transmission not been limited to only a subset of the queues ($RAAU_q$), and the actual resource allocation for each queue ($RAAU''_q$).

64. As discussed more fully below, the prior art relied on the Petition bears no resemblance to the allocation algorithm disclosed in the '138 Patent.

V. THE CHALLENGED CLAIMS

65. Claim 1 is exemplary and recites:

A user equipment (UE) comprising:
a processor communicatively coupled to a transmitter and circuitry configured to receive; and
the processor is configured to:
 cause the circuitry to receive parameters associated with a plurality of radio bearers,
 determine a plurality of buffer occupancies, wherein each of the plurality of buffer occupancies is associated with one or more radio bearers of the plurality of radio bearers,
 cause the transmitter to transmit a message including the plurality of buffer occupancies to a network,
 cause the circuitry to receive a single allocation of uplink resources,
 select data from the plurality of radio bearers for transmission using the single allocation of uplink resources, wherein the selection of the data occurs using a first iteration and a second iteration,
 wherein in the first iteration, the selection of the data is selected from a subset of the plurality of radio bearers based on the received parameters,
 wherein in the second iteration, the selection of the data is based on buffered data for respective radio bearers, and
 cause the transmitter to transmit a signal including the selected data.¹

66. Walking through the steps of claim 1, the claim recites that the UE receive parameters associated with a plurality of radio bearers. The S_{tier} parameters (or S_q) provided to the UE from the UTRAN (one such parameter for each of the

¹ Independent claim 8 (also challenged in the Petition) contains substantially the same limitations as claim 1.

queues) discussed in connection with Step 605 above are examples of parameters that are received by the UE and associated with a plurality of radio bearers. Ex. 1001, 10:13-16; *see*, Section IV(E)(1), *supra*.

67. Claim 1 then recites that the UE determines “a plurality of buffer occupancies, wherein each of the plurality of buffer occupancies is associated with one or more radio bearers of the plurality of radio bearers” and transmits a message “including the plurality of buffer occupancies to a network.” Next, the claim recites that the UE receives “a single allocation of uplink resources” from the network. In the ‘138 Patent, the “single allocation” corresponds to a finite “quantum of physical resources” that can be shared out, such as the resources defined by a combination of spreading codes and timeslots. Ex. 1001, 9:39-43 and 11:7-10.

68. Next, claim 1 recites selecting “data from the plurality of radio bearers for transmission using the single allocation of uplink resources.” In the examples disclosed in the ‘138 Patent, this selection involves the sharing of the single allocation among data from different queues in proportion to the signaled weight values for the queues. *Id.*, 9:39-43. Claim 1 then recites that “wherein the selection of the data occurs using a first iteration and a second iteration.”

69. The “first iteration” requires the selection of data “from a subset of the plurality of radio bearers based on the received parameters.” In the disclosed embodiment, the queues chosen in Step 628 correspond to “a subset of the plurality

of radio bearers,” and the recalculated normalized queue weightings (W''_q) for the queues in the subset (determined in Step 640) result in subsequent data selection based on a plurality of the S_{tier} (or S_q) parameters (“received parameters”). *See*, Sections II(E)(6)-(8), *supra*. This aspect of the disclosed embodiment is illustrated by Equation [10], reproduced again below:

$$W''_q = \frac{S_q N'_q}{\sum_q S_q N'_q}$$

70. As is evident from this equation, the W''_q value for each selected queue is based on a plurality of S_{tier} values (a plurality of “received parameters”). Ex. 1001, 10:13-16. Since each of recalculated normalized queue weightings (W''_q) is based on a plurality of “received parameters,” the recalculated queue allocations ($RAAU''_q$) determined in Step 645 using W''_q are similarly “based on the received parameters.” *See*, Section II(E)(9), *supra*.

71. The “second iteration” requires the selection of data “based on buffered data for respective radio bearers.” An example of “the second iteration” is illustrated in the specification where, after the $RAAU''_q$ values are determined in Step 645, the algorithm performs a further reallocation (a “second iteration”) in Steps 655-670 when the volume of resources allocated to queue(s) is less than that required for a given cell edge state. Ex. 1001, 12:1-4; *see also*, Section II(E)(11), *supra*. More specifically, in Step 660, $RAAU_q$ ” is set to zero for queues below the minimum

required given the cell edge state, and resources are reallocated to other queues having a $RAAU_q$ value greater than zero. Ex. 1001, 12:5-16; *see also*, Section II(E)(11), *supra*. This reallocation to queues with $RAAU_q$ greater than zero is “based on buffered data for respective radio bearers,” because $RAAU_q$ is based on W''_q (which was calculated using Equation [10]) and therefore based on, *inter alia*, the respective levels of buffered data in each selected queue as represented by the N_q values of the selected queues) Ex. 1001, 10:13-16; *see*, Section II(E)(8), *supra*. Since the $RAAU''_q$ allocations themselves are “based on buffered data for respective radio bearers,” the use of the $RAAU''_q$ values in Step 660 to reallocate resources to queues having $RAAU_q$ greater than zero (an example of “the second iteration”) is also “based on buffered data for respective radio bearers.”

VI. MATERIALS RELIED ON IN THE PETITION

72. Ground 1 alleges that claims 1-4 and 8-11 are obvious over Eckert (Ex. 1005) in view of Lohr-1 and Bucknell. Ground 2 alleges that dependent claims 5 and 12 are obvious over Eckert in view of Bucknell, Lohr-1, and Hans. Ground 3 alleges that dependent claims 6 and 13 are obvious over Eckert in view of Bucknell, Lohr-1 and Lohr-2. Each of the relied on references is discussed next.

A. Eckert

73. All three Grounds rely on Eckert as the primary reference. Patent Owner’s discussion of Eckert begins with Eckert’s description of the background art

and the problem that Eckert sought to address. Next, Patent Owner describes examples of Eckert's proposed solution.

1. Eckert's Description Of The Problem

a. The Control Header For HS-DSCH Is Very Simple Because Data From Just One Queue Is Transmitted In Each Transmission Time Interval

74. The Background of Eckert contained a description of the “High Speed Downlink Packet Access (HSDPA) ... for the packet data transmission via the shared transport channel High Speed Downlink Shared Channel (HS-DSCH)” set forth in the “UMTS communication standard release 5 for the downlink.” Ex. 1005, [0018]. Eckert explained that “[i]n comparable fashion to the enhanced uplink medium access control protocol, the fundamental characteristics of the HSDPA method ... are performed in the medium access control subprotocol layer MAC-hs (Medium Access Control High Speed).” *Id.*

75. Eckert explained that “[t]he MAC-hs subprotocol layer receives the data which are to be processed in the downlink transmission direction ... which correspond to the MAC-hs service data units (SDU).” *Id.*, [0019]. A “MAC-hs protocol data unit comprises an MAC-hs header field (header) and one or more MAC-hs SDUs.” *Id.*, [0020]. However, “as described in 3GPP TS 25.321, Technical Specification ... all the MAC-hs SDUs in a transmission time interval belong to the same priority queue, i.e. in each transmission time interval only MAC-hs SDUs

having the same priority are transmitted on an HS-DSCH transport channel.” *Id.*, [0020]. Since “in each data transmission time interval the data from just one priority queue are transmitted via the HS-DSCH, ... the control data header of an MAC-hs protocol data unit has a very simple structure and it is necessary to transmit only the information regarding the priority queue from which the data to be transmitted originate.” *Id.*, [0022] (emphasis added).

b. The Problem: How To Reduce The Signaling In The Control Header Of Each MAC-e Protocol Data Unit Containing Data From Multiple Queues

76. The Background in Eckert also discussed the then recent introduction by the 3rd Generation Partnership Project (3GPP) of “a new dedicated transport channel called Enhanced Dedicated Channel (E-DCH)” in order to improve “the packet data transmission via dedicated transport channels in the uplink.” Ex. 1005, [0012]. In connection with the E-DCH, the NodeB (base station) provides the mobile radio terminal “a set of defined transport formats for the E-DCH transport channel” and the mobile radio terminal selects an appropriate transport format from the defined set for uplink transmissions. *Id.*, [0014] (emphasis added).

77. In contrast to the HS-DSCH, in the E-DCH framework “data from various priority queues, are transmitted in an MAC-e protocol data unit within a data transmission time interval.” *Id.*, [0023] (emphasis added). Eckert next identified a problem: how should a device transmitting data from multiple queues signal to the

receiver the specifics of the queue(s) from which the data transmitted in the MAC-e protocol data unit originated, as well as the amount of data from each such queue being transmitted. As Eckert explained:

One possible solution to signaling the association of an MAC-e SDU, i.e. an MAC-d PDU, for example, with a respective priority queue and with a respective MAC-d data stream would be to add to each MAC-e SDU a control data header with an identification of the respective MAC-d flow (flow-ID, FID) and then to add a control data header with an identification of the respective priority queue (queue ID, QID) to every single data packet from a priority queue before transmission, so as then to be able to split the data at the receiver again as appropriate in the data link layer.

However, this would be disadvantageous on account of the enormous volume of additional signalling data in the control data header (large overhead) which is required. ...

On the basis of the prior art, it is thus merely possible to signal the total size of an MAC-e protocol data unit but not how the data of an MAC-e protocol data unit need to be made up, i.e. from which priority queues how many and using what packet size it is necessary to transmit data in an MAC-e protocol data unit. *Id.*, [0024]-[0027] (emphasis added).

78. Having identified the problem of how to signal the makeup of the transmitted data to the receiver without incurring an “enormous volume of additional signaling data,” Eckert begins the Detailed Description by stating that the invention was directed toward reducing signalling complexity:

The invention is based on the problem of mapping data from at least one logical channel onto at least one transport channel in a data link layer protocol unit in simple fashion with reduced signalling complexity in comparison with known procedures. *Id.*, [0040] (emphasis added).

79. Thus, Eckert's goal was to reduce the amount of additional signalling data that a UE operating in the E-DCH framework needed to send to the network in order to inform the network the makeup of the transmitted data.

2. Eckert's Proposed Solution

- a. **Use The Mobile Radio Terminal's Selection Of One Of A Set Of Predefined Transport Formats To Convey To The Receiver The Queues From Which The Transmitted Data Originated As Well As The Amount Of Data Being Transmitted From Each Queue**

80. In Eckert's solution, the mobile radio device selects a transport format for transmission of data on the uplink from a set of transport formats predefined by the base station. *Id.*, [0042], [0109], [0201] and [0206]. Each transport format in the defined set includes predefined data amount(s) from predefined queue(s). *Id.*, [0014], [0028], [0042], [0069], [0102], [0154], [0194] and [0204], The mobile radio terminal signals to the makeup of the transmitted data to the base station by signaling a selected transport format to the base station.

The information regarding how many data packets are transmitted in an MAC-e protocol data unit 607 from which MAC- d flow 301, 302 is indicated in the respectively selected transport format and is described in the table shown above, for example. *Id.*, [0234] (emphasis added).

See also, id., [0044]-[0045].

81. Eckert discloses the following exemplary table of predefined transports. Each row of the table corresponds to a predefined transport format, and indicates

how much data from each priority queue (PQ) is being transmitted in that transport format.

TF	PQ #1		PQ #2		PQ #3	
	# of TBs	TB size (bit)	# of TBs	TB size (bit)	# of TBs	TB size (bit)
#1	0	100	0	100	0	100
#2	1	100	0	100	0	100
#3	0	100	1	100	0	100
#4	0	100	0	100	1	100
...	...	...	...	...	...	...
#10	2	200	2	100	0	100
#11	3	200	2	100	1	100
#12	2	300	1	200	2	100
...	...	...	...	...	...	...
# n	5	300	3	300	1	300

Id., [0204]. In the above table, “a first column (TF) indicates the number of the respective transport format,” “a second column (PQ#1/# of TBs) indicates a number of data packets in the first priority queue” admissible with “the respective transport format,” “a third column (PQ#1/TB size (bit)) indicates the size of the transport block in bits in which the data packets in the first priority queue” are “intended to be inserted into the MAC-e protocol data unit,” a fourth column (PQ#2/# of TBs) indicates a number of data packets in the second priority queue” admissible with “the respective transport format,” “a fifth column (PQ#2/TB size (bit)) indicates the size of the transport block in bits in which the data packets in the second priority

queue” are “intended to be inserted into the MAC-e protocol data unit,” “a sixth column (PQ#3/# of TBs) indicates a number of data packets in the third priority queue” admissible with “the respective transport format,” and “a seventh column (PQ#3/TB size (bit)) indicates the size of the transport block in bits in which the data packets in the third priority queue” are “intended to be inserted into the MAC-e protocol data unit.” *Id.*, [0205]-[0212].

82. In Eckert, the table predefining the transport formats is stored “both on the terminal and on the network, which means that just one index for the respective table row needs to be written to the control range of the MAC-e protocol data unit 607, which additionally achieves significant savings in terms of bits required in the control data range 608, i.e. in the header field of the MAC-e protocol data unit 607, and still permits explicit coding and decoding of the data on the basis of the MAC-e protocol, i.e. particularly splitting of the multiplexed data over the respective priority queues 306 and the MAC-d flows at the receiver, particularly in the mobile radio base Station 109.” *Id.*, [0235]-[0236]; *see also*, [0051]-[0052] (“Signalling this information in the transport formats allows or achieves very simple signalling of this information, preferably on the network, for a mobile radio device”) and [0081] (“In this way, very simple and efficient signalling of the assignment of the respective data to the data link layer protocol buffer storages and/or data link layer data streams is

made possible without the need to indicate this assignment information to every single protocol data unit”).

b. Use Of Weightings That Specify Numerical Proportions For Mapping Data From Queues To Transport Channels

83. In order to simplify the mapping of data onto transport channels, Eckert disclosed the use of “weighting values,” which Eckert defined differently than the “priority” of each queue. As Eckert explained:

Within the context of this description, the priority associated with a priority queue is to be understood to mean the relative or absolute significance of the data buffer-stored in the respective priority queue’s buffer storage.

A weighting value within the context of this description is to be understood to mean an indication of a data transmission bandwidth which is to be respectively allocated, in other words reserved, for reading the data stored in the respective data link layer protocol buffer storage. *Id.*, [0062]-[0063] (emphasis added).

84. By way of example, Eckert discloses an exemplary embodiment where there are four priority queues A, B, C, D, where each queue is assigned the following weights:

for the first priority queue A 50% of the total available data transmission bandwidth,

for the second priority queue B 30% of the total available data transmission bandwidth,

for the third priority queue C 15% of the total available data transmission bandwidth, and

for the fourth priority queue D 5% of the total available data transmission bandwidth. *Id.*, [0254]-[0258] (emphasis added).

85. The weighting scheme disclosed in Eckert supports a proportional mapping of data from queues to the transport channels based on weights, a result that is not possible using only a priority ranking of each queue. For example, assuming queues A, B, C, and D had absolute priorities of 1, 2, 3 and 4, respectively, if the only information available for mapping data from queues to the transport channels was the priority of each queue (without also weights), it would not be possible to define a proportional mapping method where 50%, 30%, 15% and 5% of the total available transmission bandwidth was respectively allocated to each of queues A, B, C and D. Put another way, if the only information available for mapping data from queues to the transport channels was the priority of each queue, the schemes for mapping the data from the queues would be strictly constrained to mapping schemes based on priority alone. This distinction sets Eckert apart from Lohr-1 and Bucknell (both are discussed later) which, in contrast to Eckert, use only the priority of queues (without also weights) to map data from the queues to the available resources.

86. A “fundamental aspect” of Eckert’s weighting scheme “may be seen in the application of the inherently known weighted fair queueing principle, which involves the data streams being assigned to the individual queues, with each queue

being assigned a weighting which represents a defined percentage of the total transmission bandwidth.” *Id.*, [0131] (emphasis added).

87. Significantly, while in some embodiments, Eckert sends the weights from the mobile radio network to the mobile terminal, Eckert also includes embodiments where the weightings “are *not explicitly signalled*.” *Id.*, [0107], [0115] and [0118] (emphasis added). Instead, “weighting values can be *assigned* to the priority queues” *a priori* on the basis of, e.g., the four known traffic classes provided in UMTS, i.e., “conversational, streaming, interactive, background.” *Id.*, [0118]-[0121]. By way of example, Eckert discloses that “streaming data are weighted with 40%, conversational data are weighted with 30%, interactive data are weighted with 20% and background data are weighted with 10%.” *Id.*

c. Eckert’s System Links The Weights To The Transport Formats

88. In Eckert, *the set of transport format combinations* from which the mobile station selects a transport format for each uplink transmission are *tied* to the *weightings* used to proportionally allocate the total available transmission bandwidth among the queues. *Id.*, [0109] (“the weighting values ... preferably being linked to the respective transport formats”). Thus, when the mobile station proportionally allocates the total available transmission bandwidth among the queues in accordance with the weights, the process results in a combination of data from the queues which

corresponds to one of the transport formats available for the mobile terminal to select. The linkage between the weighting values and the available transport formats is what allows Eckert to use a single index value (corresponding to the selected transport format) transmitted in the header of the MAC-e protocol data unit to signal to the receiver the queue(s) from which the data transmitted originated, as well as the amount of data from each such queue being transmitted. *Id.*, [0051]-[0052], [0081] and [0235]-[0236].

B. Lohr-1

89. Lohr-1 discloses the use of Radio Resource Control (RRC) messaging between a radio network and user equipment to establish and configure a transport format combination set (TFCS). Ex. 1007, 3:21-23. In Lohr-1, “[t]he user equipment autonomously chooses among the allocated transport format combinations based on its own status e.g. available power and buffer status.” *Id.*, 3:23-26 (emphasis added).

1. TFC Selection That Identifies Data To Be Transmitted According To The Absolute Priorities Of Logical Channels

90. Lohr-1 discloses an E-DCH MAC architecture where “[t]here are M different data flows (MAC-d) carrying data packets to be transmitted from user equipment to Node B,” where “[t]he data packets can be stored in different Priority Queues. *Id.*, 5:30-6:1. When the user equipment (UE) wants to send data on the

uplink, the “user equipment has to send a request message to the Node B. ... With a grant message sent in the downlink from the Node B to the UE, the Node B assigns the UE” the transport format combination set (TFCS). *Id.*, 7:2-9 (emphasis added). “The UE selects a suitable TFC from the ‘Node B controlled TFC subset’ ... Any TFC in the ‘Node B controlled TFC subset’ might be selected by the UE, provided there is sufficient power margin, sufficient data available and TFC is not in the blocked state.” *Id.*, 8, 29-32.

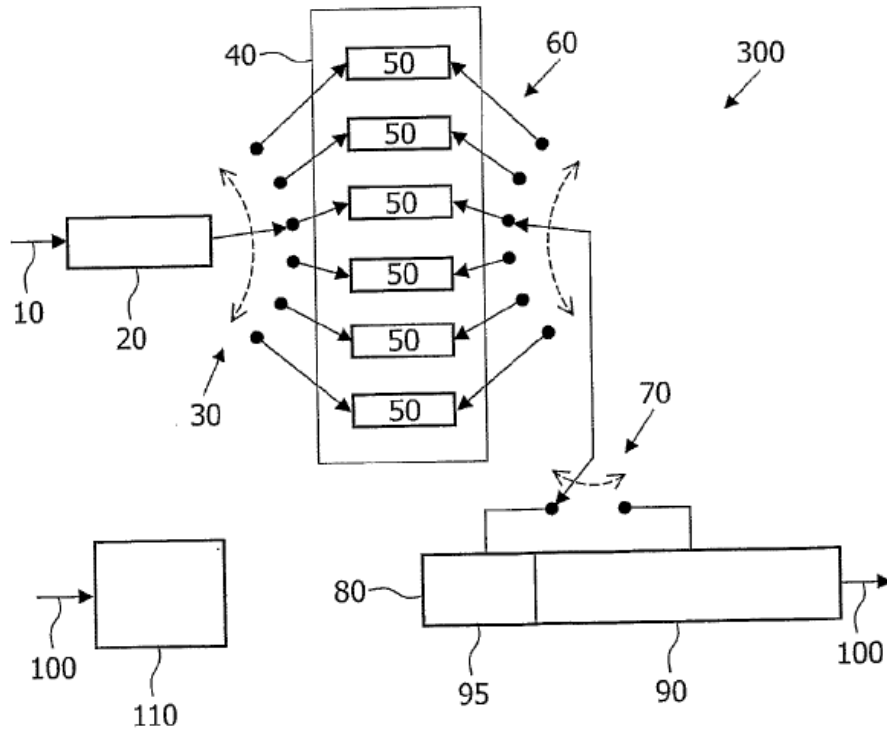
91. Lohr-1 discloses that “the UE-RRC creates a new RLC entity associated with” a “new radio bearer.” *Id.*, 14:7-8. “At radio bearer setup/reconfiguration each involved logical channel is assigned a MAC Logical channel Priority (MLP) in the range of 1 to 8. An MLP of 1 denotes the highest degree of priority.” *Id.*, 14:13-16. The UE performs selection of the transport format combination [TFC] (from the transport format combination set [TFCS]) “in accordance with the priorities indicated by RRC (MLPs).” *Id.*, 17:13-14. Lohr-1 follows an “absolute priority” scheme in which “the MAC may select a TFC from the TFCS, which maximizes the transmission of higher priority data.” *Id.*, 17:14-15. “During selection, the logical channels may be processed in ascending order of their priority values (MLP), in descending order of their degree of priority.” *Id.*, 17:27-18:13.

2. Scheduling Modes

92. Lohr-1 disclosed two scheduling modes: (i) a rate controlled mode, and (ii) a time and rate controlled mode. *Id.*, 18:14-15. “In the rate controlled mode, UEs are allowed to transmit autonomously up to a maximum data rate, signaled by Node B. ... Since Node B scheduler has no control on the transmission timing of UEs in the rate controlled mode, uplink resources are not explicitly reserved for a UE.” *Id.*, 18:15-20 (emphasis added). “In the time and rate controlled scheduling mode, Node B additionally controls the time when UEs are allowed to transmit.” *Id.*, 18:21-22 (emphasis added). “Node B controlled time and rate scheduling provides a more precise RoT control compared to the rate-only controlled scheduling as already mentioned before. However this more precise control of the interference at this Node B is obtained at the cost of more signaling overhead and scheduling delay (scheduling request and scheduling assignment messages) compared to rate control scheduling.” *Id.*, 10:25-29 (emphasis added).

C. Bucknell

93. Figure 2 of Bucknell discloses “an apparatus for multiplexing” data as shown below:



94. In the multiplexing apparatus of Figure 2, “an input 10 for receiving data packets” is coupled to “an input buffer 20, such as a random access memory, for storing the received data packets.” Ex. 1006, [0020]. A bank 40 includes of “a plurality of queue stores 50 for containing queues.” *Id.* “The input buffer 20 is coupled to the bank 40 by a first routing means 30 ... for routing each data packet from the input buffer 20 to one of the queue stores 50 according to a priority assigned to each data packet.” *Id.* An output buffer 80 stores “the data packets prior to transmission on an output 100.” *Id.*

95. “The output buffer 80 comprises a first portion 90 and a second portion 95.” *Id.* “Data packets are selected for transfer from the queue stores 50 to the output buffer 80 by means of a second routing means 60 ... and are transferred into the first

portion 90 or the second portion 95 by means of a switch 70.” *Id.*

96. The Petition relies on Examples 1-4 and 9 in Bucknell “of how the data packets may be selected from the queues in the queue stores 50 to populate the group of data packets assembled in the first portion 90 and second portion 95 of the output buffer 80.” *Id.*, [0025]. These examples provide as follows:

1) Strict priority based selection: In this case each MAC-d flow is assigned a priority. Then for the first selection, data packets are taken from the queue having the highest priority until the resource available for the first portion 90 is filled. If this queue becomes empty, data packets are taken from the queue with the next highest priority and so on. For the second portion 95 the same procedure is carried out, but for a subset of the queues.

2) Fair selection for the second portion: In this case the second portion 95 is populated by taking one data packet in turn from each of the subset of queues, excluding the highest priority queue. To maximize fairness, especially when a large number of queues are present, the last selected queue may be remembered for use in subsequent multiplexing operations.

3) As a variation on 2), if the resource available for the first portion 90 is not fully used, then the unused resource can be made available for the second portion 95.

4) As a further variation on 2), the second portion 95 can be populated before the first portion 90. This may allow some flexibility in regard to which queues make use of which of the portions. ...

9) One or both selections for the first and second portions 90, 95 can be modified to take into account the length of queue, for example by preferentially selecting from queues exceeding a certain length.

Ex. 1006, [0026]-[0028].

97. Bucknell does not disclose how the transmitting device signals the receiver with the makeup of the queue(s) from which the data transmitted originated, and the amount of data from each such queue being transmitted. Nor does Bucknell suggest that any of its data selection schemes are linked with predefined transport formats, or explain how its scheme could be implemented in the context of a transmitter that selects a predefined transport format from a predefined set of transport formats in order to transmit uplink data.

D. Hans

98. “Hans is directed to a conventional set of protocol layers in a UMTS system.” Pet., 63, *citing*, Ex. 1008.

E. Lohr-2

99. “Lohr-2 relates to a UMTS system that employs data transmitted in the E-DCH channel.” Pet., 73, *citing*, Ex. 1009.

VII. GROUND 1 FAILS TO CARRY ITS BURDEN TO DEMONSTRATE THAT CLAIM 1 WOULD HAVE BEEN OBVIOUS

100. Ground 1 relies on Eckert as the primary reference and alleges that claims 1-4 and 8-11 are obvious over Eckert in view of Lohr-1 and Bucknell. As explained next, the Petition has failed to even map all of the elements of claim 1 to these references. Moreover, the rationale set forth in the Petition fails to demonstrate that a POSITA would have been motivated to modify Eckert based on Lohr-1 and Bucknell in the manner alleged.

A. The Petition Has Failed To Demonstrate That A UE In Eckert Or Lohr-1 Receives A Single Allocation of Uplink Resources

101. Claim 1 requires that the UE receive “a single allocation of uplink resources” from the network. In the ‘138 Patent, the “single allocation” corresponds to a finite quantum of physical resources that can be shared out, such as the resources defined by a combination of spreading codes and timeslots. Ex. 1001, 9:39-43 and 11:7-10. The Petition alleges that this element is met by Eckert alone or, in the alternative, Eckert in combination with Lohr-1.

1. The Petition Has Failed To Demonstrate That Eckert Discloses A Single Allocation Of Uplink Resources

102. The Petition initially alleges that “Eckert discloses or renders obvious” the requirement that the UE receive “a single allocation of uplink resources” (referred to as Element [1.6] in the Petition). Petition, 34-35. More specifically, the Petition alleges that Eckert’s “allocated E-DCH channel ... is an example of a single allocation of uplink resources.” *Id.* This mapping is premised on the Petitioner’s erroneous allegation that, in the context of the ‘138 Patent, an entire transport channel (e.g., the E-DCH) is an example of “a single allocation of uplink resources.” *Id.*, at 35. More specifically, the Petition alleges:

The ‘138 patent confirms that a transport channel is an example of “a single allocation of [] radio resources.” Ex.1001, 9:36-43 (“In this manner, **a single PDP context implies a single CCTrCh. This single physical allocation of radio resources** provided to a UE...”). The abbreviation CCTrCh was understood in the art to refer to a

transport channel known as the Coded Composite Transport Channel. Ex.1003, ¶88 (citing Ex.1011, [0021]). Petition, 35 (emphasis in original).

103. The cited passage from the ‘138 Patent (9:36-43) does not equate a transport channel with a single allocation of uplink resources. Petitioner’s argument is based on an out-of-context, truncated quotation of the subject passage from the ‘138 Patent. The subject passage actually states:

If there are multiple QoS requirements within a single 3GPP PDP context, a single physical allocation of radio resources may be made to the UE. In this manner, a single PDP context implies a single CCTrCh. This single physical allocation of radio resources provided to a UE is shared amongst a number of services, in proportion to their respective QoS requirements, for example in proportion to the signalled weight values (S_{tier}). Ex. 1001, 9:36-43 (emphasis added).

104. This passage is not equating a CCTrCh (a Coded Composite Transport Channel) with a single allocation of uplink resources as the Petition suggests. Rather, the reference to “This single physical allocation of radio resources” in the third sentence of the passage is referring back to “a single physical allocation of radio resources” in the first sentence of the passage -- rather than a CCTrCh as suggested by the out-of-context quote included in the Petition. The ‘138 Patent does not describe a method where the entirety of a CCTrCH (e.g., including infinite time frames and spreading codes) “is shared among a number of services ... in proportion to the signalled weight values.” Rather, the ‘138 Patent discloses that a “single allocation” corresponds to a finite quantum of physical resources that can be shared

out, such as the resources defined by a combination of spreading codes and timeslots. Ex. 1001, 9:39-43 and 11:7-10. In fact, if the single allocation of resources could comprise infinite resources (i.e., use of a transport channel for an infinite number of time slots), the algorithm set forth in Figure 6 of the '138 Patent would be inoperable because the fractions used to implement the algorithm would have infinity in their denominators.

105. Simply put, the Petition's mapping of Eckert's E-DCH channel as a whole (e.g., including every possible time frame and spreading code) to the "a single allocation of uplink resources" must be rejected because it is based on the erroneous proposition that the specification of the '138 Patent equates an entire transport channel to "a single allocation of uplink resources," and because allowing it would render the entirety of the math required by the '138 Patent to return an undefined value, thereby functionally disabling the system.

2. The Petition Has Failed To Demonstrate That Eckert Combined With Lohr-1 Discloses A Single Allocation Of Uplink Resources

106. In the alternative, the Petition initially alleges that "Eckert combined with Lohr-1 also renders obvious ... a single allocation of uplink resources at an even more granular level than a transport channel." Petition, 35.

107. As mentioned above, Lohr-1 disclosed two scheduling modes to be used for E-DCH -- (i) a rate controlled mode, and (ii) a time and rate controlled mode.

Id., 18:14-15. Neither suffices to meet the claim element. Each of Lohr-1's modes are examined next.

a. The Petition Has Failed To Demonstrate That The Rate Controlled Mode In Lohr-1 Comprises A Single Allocation Of Uplink Resources

108. Lohr-1 discloses that, “[i]n the rate controlled mode, UEs are allowed to transmit autonomously up to a maximum data rate, signaled by Node B. ... Since Node B scheduler has no control on the transmission timing of UEs in the rate controlled mode, uplink resources are not explicitly reserved for a UE.” *Id.*, 18:15-20 (emphasis added); *see also*, 9:12-15 (“[i]n Node B controlled rate scheduling all uplink transmissions may occur in parallel ... Hence, transmissions from different user equipments may overlap in time. With Rate scheduling a Node B can only restrict the uplink TFCS but does not have any control of the time when UEs are transmitting data on the E-DCH”). Given the express statement in Lohr-1 that “uplink resources are not explicitly reserved for a UE,” it is clear that the “rate controlled mode” fails to disclose “a single allocation of uplink resources” provided to the UE from the network, as claimed. The Petition fails to address this aspect of the “rate controlled mode” disclosed in Lohr-1, or provide any explanation how a system where uplink resources are not explicitly reserved for a UE suggests providing to the UE with “a single allocation of uplink resources.”

b. The Petition Has Failed To Demonstrate That The Time And Rate Controlled Mode In Lohr-1 Comprises A Single Allocation Of Uplink Resources

109. Lohr-1 also discloses a “time and rate controlled scheduling mode” where “Node B additionally controls the time when UEs are allowed to transmit.” *Id.*, 18:21-22 (emphasis added). However, even in that mode, “[t]he user equipment is allowed to autonomously choose among the allocated transport format combinations based on its own status e.g. available power and buffer status.” *Id.*, 3:23-26 (emphasis added); *see also*, 7:5-8 (“With a grant message sent in the downlink from the Node B to the UE, the Node B assigns the UE the TFCS with maximum data rate and the time interval, the UE is allowed to send”), Lohr-1 provides the following disclosure with respect to its transport format combination (TFC) selection process:

Node B controlled scheduling is one of the technical features for E-DCH which is foreseen to enable more efficient use of the uplink power resource in order to provide a higher cell throughput in the uplink and to increase the coverage. The term “Node B controlled scheduling” denotes the possibility for the Node B to control, within the limits set by the RNC, the set of TFCs from which the UE may choose a suitable TFC. The set of TFCs from which the UE may choose autonomously a TFC is in the following referred to as “Node B controlled TFC subset”.

The “Node B controlled TFC subset” is a subset of the TFCS configured by RNC as seen in Fig. 8. The UE selects a suitable TFC from the “Node B controlled TFC subset” ... Any TFC in the “Node B controlled TFC subset” might be selected by the UE, provided there is sufficient power margin, sufficient data available and TFC is not in the blocked state.

Two fundamental approaches to scheduling UE transmission for the E-DCH exist. The scheduling schemes can all be viewed as management of the TFC selection in the UE and mainly differs in how the Node B can influence this process and the associated signaling requirements. Ex. 1007, 8:22-9:3 (emphasis added).

110. As example of a transport format combination set from which the UE may autonomously select was show in Eckert and is reproduced again below:

TF	PQ #1		PQ #2		PQ #3	
	# of TBs	TB size (bit)	# of TBs	TB size (bit)	# of TBs	TB size (bit)
#1	0	100	0	100	0	100
#2	1	100	0	100	0	100
#3	0	100	1	100	0	100
#4	0	100	0	100	1	100
...	...	...	...	...	...	...
#10	2	200	2	100	0	100
#11	3	200	2	100	1	100
#12	2	300	1	200	2	100
...	...	...	...	...	...	...
# n	5	300	3	300	1	300

Ex. 1005, [0204]. As illustrated in the table, the individual transport formats (TFs) in the set correspond to vastly different quantities of transmitted data. For example, TF#2 transmits 100 bits of data (1 transport block of 100 bits from PQ#1 and no data from PQ#2 or PQ#3); while TF# n transmits 2700 bits of data (5 transport blocks of 300 bits from PQ#1, 3 transport blocks of 300 bits from PQ#2, and 1 transport block of 300 bits from PQ#3). Thus, the set of transport formats provided to the UE

comprise multiple data quantities from which the UE autonomously selects. The Petition fails to explain how providing the UE with multiple data quantity options for transmitting data equates to providing the UE with “a single allocation of uplink resources” from the network, as claimed.

111. Thus, for the above reasons, the Petition has failed to demonstrate that either of the two scheduling modes in Lohr-1 (i.e., (i) a rate controlled mode, and (ii) a time and rate controlled mode) satisfy the requirement in claim 1 that that the UE be provided with “a single allocation of uplink resources” from the network.

c. A POSITA Motivated To Reduce Control Signaling Overhead Would Not Have Selected The Time And Rate Controlled Mode In Lohr-1

112. Assuming for the purposes of argument that the Petition had somehow demonstrated that the allocation of a transmission time interval in the “time and rate” mode of Lohr-1 was equivalent to providing the UE with “a single allocation of uplink resources” (to be clear, for the reasons discussed in VII(A)(2)(b) above, the Petition has failed to make this showing), it is clear that a POSITA interested in reducing control signaling overhead (Eckert's explicit goal) would not have implemented the “time and rate” controlled scheduling mode of Lohr-1 in the context of Eckert. Lohr-1 explains that, while “Node B controlled time and rate scheduling provides a more precise RoT control compared to the rate-only controlled scheduling ... this more precise control of the interference at this Node B is obtained

at the cost of more signaling overhead and scheduling delay (scheduling request and scheduling assignment messages) compared to rate control scheduling.” Ex. 1007, 10:25-29 (emphasis added).

113. When it comes to modifying Eckert based on Bucknell, the Petition posits that a POSITA would have been motivated to modify Eckert’s system in order “to reduce control signaling overhead.” Petition, 49 and 52. However, if a POSITA putting the references in Ground 1 together was motivated “to reduce control signaling overhead,” the POSITA would not have been drawn to use the “time and rate” scheduling mode from Lohr-1 because that scheduling mode comes “*at the cost of more signaling overhead and scheduling delay*.” Ex. 1007, 10:25-29. In this regard, the proposed rationale for combining Eckert, Lohr-1, and Bucknell must be rejected as internally inconsistent. More specifically, the Petition has failed to provide a rational underpinning for the proposition that a POSITA who was allegedly motivated to modify Eckert’s system in order “to reduce control signaling overhead” would simultaneously select a scheduling mode from Lohr-1 that is explicitly taught to increase control signaling overhead.

B. The Petition Has Failed To Demonstrate That It Would Have Been Obvious To Modify Eckert Based On Bucknell

114. As explained next, the Petition’s proposed modifications of Eckert (the primary reference) based on Bucknell would eviscerate the stated purpose of Eckert.

In addition, the Petition's proposed reasons why a POSITA would have been motivated to modify Eckert based on Bucknell do not withstand scrutiny.

1. The Petition's Proposed Modification Of Eckert Based On Bucknell Would Render Eckert Inoperable For Its Primary Purpose Of Reducing Signaling Overhead

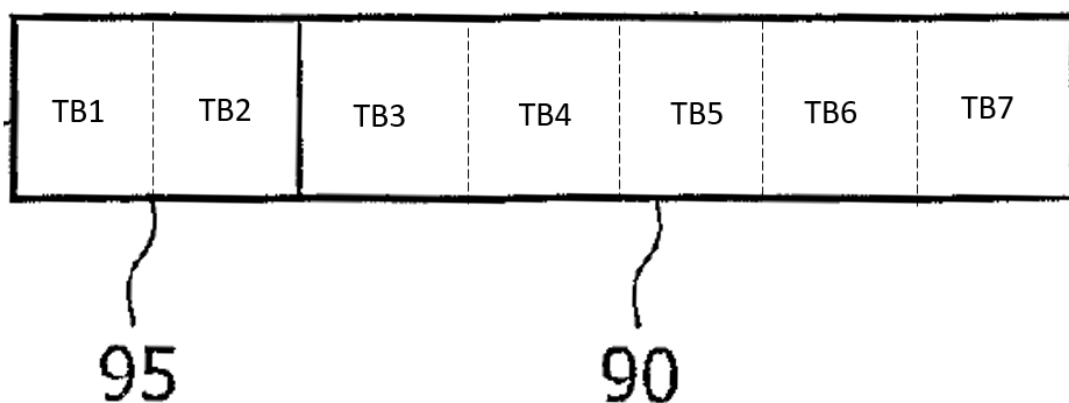
115. The Petition proposes eliminating from Eckert, the weightings used in Eckert for proportionally mapping data from queues to the transport channels, and substituting in place thereof several of the priority-based allocation algorithms disclosed in Bucknell. Petition, 51-52. However, doing away with Eckert's weightings would have rendered Eckert inoperable for its intended purpose, i.e., reducing signaling overhead by using a single index value (corresponding to the selected transport format) transmitted in the header to signal the makeup of the transmitted data to the receiver. Ex. 1005, [0051]-[0052], [0081] and [0235]-[0236].

116. Eckert recognized that, when transmitting data from multiple queues, signaling the makeup of the transmitted data to a receiver has the potential to add an "enormous volume of additional signaling data in the control data header." Ex. 1005, [0024]-[0027]. Eckert's goal was to reduce the amount of additional signaling data that a UE operating in the E-DCH framework needed to send to the network in order to inform the network the specifics of the queue(s) from which the transmitted data originated, as well as the amount of data from each such queue being transmitted. *Id.*, [0040].

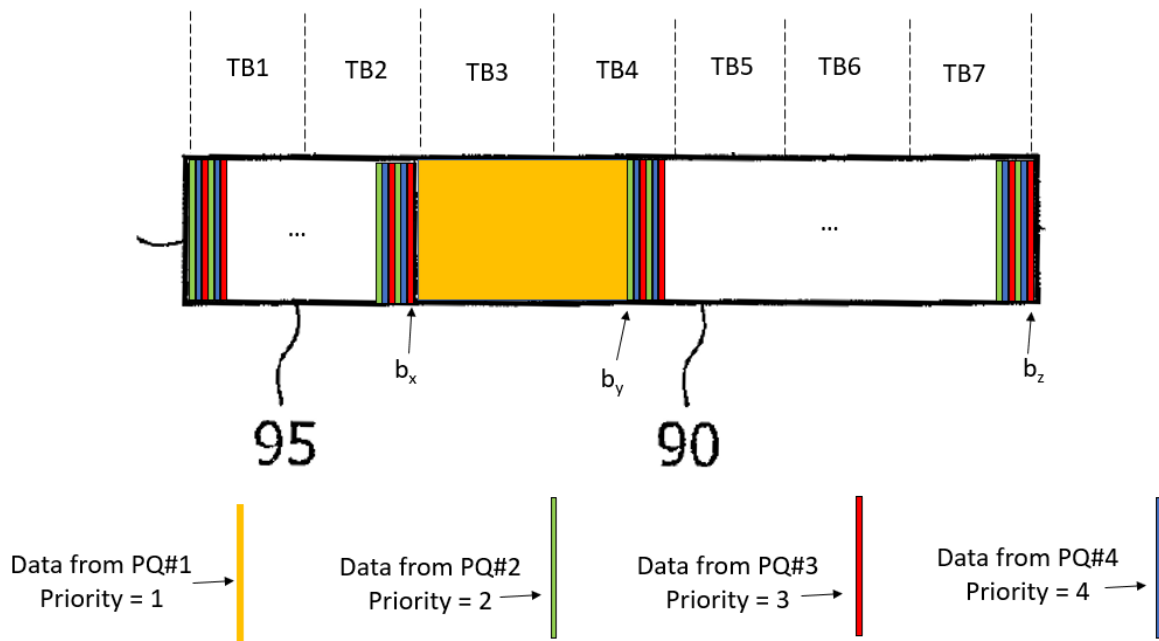
117. In order to reduce the signalling overhead, Eckert proposed a solution based on the use of “weighting values” for proportionally mapping data from queues to the transport channels based on weights. *Id.*, [0062]-[0063] and [0254]-[0258]. Eckert then tied the set of transport format combinations from which the mobile station selects a transport format to the weightings used to proportionally allocate the total available transmission bandwidth among the queues. *Id.*, [0109]. Thus, in Eckert, when the mobile station proportionally allocates the total available transmission bandwidth among the queues in accordance with the weights, the process results in a combination of data from the queues which corresponds to one of the transport formats available for the mobile terminal to select. The linkage between the weighting values and the available transport formats is what allows Eckert to reduce signaling overhead by using a single index value (corresponding to the selected transport format) transmitted in the header to signal the makeup of the transmitted data to the receiver. *Id.*, [0051]-[0052], [0081] and [0235]-[0236].

118. Removing the weightings from Eckert as proposed in the Petition would eliminate Eckert’s linkage between the proportional queue allocations and the predefined set of transport format combinations provided by the base station to the UE. The Petition does not allege that a network could set up predefined transport format combinations linked to any of the priority-based allocation algorithms disclosed in Bucknell, because doing so would be impractical. For example, consider

a scenario (illustrated below) where Bucknell’s “second portion 95” is mapped to two transport blocks (TB1 and TB2) and Bucknell’s “first portion 90” is mapped to five transport blocks (TB3-TB7).



119. Next, consider the case illustrated below under Bucknell’s Examples 1-3 involving four priority queues (PQ#1, PQ#2, PQ#3, PQ#4) in descending order of priority, i.e., PQ#1 is assigned the highest priority and PQ#4 is assigned the lowest priority. In this case, Bucknell’s “first portion 90” is partially filled using data packets from the highest-priority queue (PQ#1 - shown in orange) but there is insufficient data in the highest-priority queue (PQ#1) to fully fill the first portion 90 and so the first portion 90 is filled only up to the bit position labelled b_y . In the diagram below, the bit position labelled b_x denotes where the first bit in the first portion 90 is placed, and b_z denotes where the last bit of data from PQ#1 would have been positioned had there been sufficient data from PQ#1 to fully fill the first portion 90.



120. In this scenario, under Bucknell’s Examples 1-3, the remaining space in the first portion 90 (from bit positions b_y to b_z) is used for the “second portion 95” and thus, the space between bit positions b_y to b_z and the space originally allocated to the “second portion” is filled “by taking one packet in turn” from each of PQ#2, PQ#3 and PQ#4. Ex. 1006, [0025]-[0028]. Next, as shown in the table below, consider how much information about the arrangement resulting from this scenario would need to be signalled from the transmitter to the receiver in the control header:

<u>Transport Block #1</u>	<u>Signaling Information Required In Control Header</u>
TB1-TB2	Starting with PQ #2, interleaved data from PQ#2, PQ#3 and PQ#4
TB3	Data from PQ #1

TB4	Data from PQ#1 up to position b_y , followed by interleaved data from PQ#2, PQ#3 and PQ#4 starting with PQ #2
TB5-TB7	Starting with next queue in the rotation after the queue associated with the last position in TB4, interleaved data from PQ#2, PQ#3 and PQ#4

121. As is clear from this example, the quantity of signaling data when transmitting data populated into the “first portion 90” and the “second portion 95” using Bucknell’s Examples 1-3 would be “enormous,” especially compared to Eckert’s solution which conveyed the makeup of the data being transmitted with a single index value (corresponding to the selected transport format). Ex. 1005, [0051]-[0052], [0081] and [0235]-[0236]. It is also apparent that, given the myriad of possible ways that the first and second portions could be filled with data from the different queues using Examples 1-3 of Bucknell, it would be impractical to link a defined set of predefined transport format combinations to all of the possible allocation outcomes that could be produced.

122. Without the linkage in Eckert between the proportional queue allocations (associated with the weights) and the predefined set of transport format combinations, the UE will lose the ability to use a single index value (corresponding to the selected transport format) transmitted in the header to signal to the receiver the queue(s) from which the data transmitted originated, as well as the amount of data from each such queue being transmitted. *Id.*, [0051]-[0052], [0081] and [0235]-

[0236]. At that point, Eckert would cease to function for its intended purpose of reducing the amount of additional signaling data that a UE operating in the E-DCH framework needs to send to the network. Instead, the modified system will suffer from the very problem that Eckert first identified, namely, the need for an “enormous volume of additional signaling data in the control data header” to convey the specifics of the queue(s) from which the data transmitted originated, as well as the amount of data from each such queue being transmitted. Ex. 1005, [0024]-[0027].

2. Neither Of The Petition’s Reasons For Modifying Eckert Based On Bucknell Withstands Scrutiny

123. The Petition offers two reasons why a POSITA would be motivated to do away with Eckert’s weightings, neither of which withstands scrutiny. According to the Petition:

A POSITA would have been motivated to modify Eckert’s method of selecting data from MAC-d priority queues for transmission with Bucknell’s method of selecting data from MAC-d priority queues for two reasons: (1) to reduce control signaling overhead and (2) to reduce complexity compared to Eckert’s method. Petition, 48-49 (emphasis added).

* * *

.. Bucknell discloses a number of ways to fill two portions of a MAC-e PDU, see Ex.1006, [0025]-[0031], as alternatives to Eckert’s queue weighting for selecting packets from queues, that a POSITA would have found advantageous and looked to for the following reasons. First, Bucknell’s alternatives do not require sending weighting values from a base station to a UE, as is done in Eckert, ... thus beneficially achieving reducing control signaling overhead compared to Eckert’s techniques.

Second, Bucknell's methods reduce complexity compared to Eckert's use of queue weights by avoiding the use of calculations that involve selecting data from queues in proportion to weighting values. Petition, 51-52 (emphasis added).

124. Thus, the Petition's first reason why a POSITA would be motivated to do away with Eckert's weightings is to reduce the signaling overhead associated with transmitting the weighting values from the base station to the UE. This rationale fails because Eckert includes embodiments where the weightings "are not explicitly signalled." *Id.*, [0107], [0115] and [0118] (emphasis added). Instead, "weighting values can be assigned to the priority queues" on the basis of, e.g., the four known traffic classes provided in UMTS, i.e., "conversational, streaming, interactive, background." *Id.*, [0118]- [0121]. By way of example, Eckert discloses that "streaming data are weighted with 40%, conversational data are weighted with 30%, interactive data are weighted with 20% and background data are weighted with 10%." *Id.* Since Eckert itself discloses a way to implement Eckert's system without explicitly signaling the weights from the base station to the UE, it is illogical that a POSITA would have been motivated to cast aside Eckert's weighting methodology to reduce the signalling overhead associated with transmitting the weighting values.

125. Moreover, even if Eckert required the weightings to be transmitted from the base station to the UE at set-up time, the bandwidth required to transmit the weights pales in comparison to the additional signaling overhead that would be

required in the control header for every data transmission if Eckert's weighting methodology were tossed aside in favor of any of the examples from Bucknell relied on in the Petition. As explained above in Section V(B)(1), the quantity of signaling data when transmitting data populated into the "first portion 90" and the "second portion 95" using Bucknell's Examples 1-3 would be enormous compared to Eckert's solution which conveyed the makeup of the data being transmitted by using a single index value (corresponding to the selected transport format). The additional signaling overhead required in the control header of each transmission assembled with Bucknell's examples would be orders of magnitude larger than the bandwidth required to transmit Eckert's weightings from the base station to the UE at set-up time.

126. The Petition's second reason why a POSITA would be motivated to do away with Eckert's weightings is to "reduce complexity ... by avoiding the use of calculations that involve selecting data from queues in proportion to weighting values." Petition, 52. This purported motivation presumably involves eliminating a simple multiplication operation where a weight value (e.g., 40%) is multiplied by the available bandwidth in Eckert, and is flawed on multiple levels. First, there is no need for the UE in Eckert to do any "calculations" to determine the amount of data associated with each weighting value because, in Eckert, the results of such calculations are already "baked into" the pre-defined transport formats provided by

the base station to the UE. *See*, Eckert at [0204]. Second, the fraction of a clock cycle of processing required to multiply an available bandwidth quantity by an allocation percentage is so trivial that it would not motivate a POSITA to do away with the benefits of Eckert's weighting methodology, i.e., the ability to reduce signaling overhead by using a single index value (corresponding to the selected transport format) transmitted in the header to signal to the makeup of the transmitted data to the receiver. It defies credulity that a POSITA would toss aside the intended purpose of Eckert, or at the very least, engage in a substantial redesign of Eckert to substitute a priority based allocation methodology for Eckert's weighting-based system, in order to save a fraction of a clock cycle.

127. In summary, the Petition's purported reasons why a POSITA would be motivated to do away with Eckert's weightings are unpersuasive and fail to demonstrate by a preponderance of the evidence that a POSITA would have been motivated to cast aside Eckert's weightings in favor of a priority-based allocation scheme from Bucknell.

VIII. GROUND 1 FAILS TO DEMONSTRATE THAT CLAIMS 2-4 AND 8-11 ARE UNPATENTABLE

128. For the reasons set forth in Section VII, *supra*, the Petition has failed to demonstrate that independent claim 1 is unpatentable over Eckert in view of Lohr-1 and Bucknell. Independent claim 8 is substantially the same as independent claim 1,

and the Petition's mappings for independent claim 8 are substantially the same as those of claim 1. Thus, the Petition has failed to demonstrate the unpatentability of claim 8 under Ground 1 for the same reasons that the Petition failed to demonstrate the unpatentability of independent claim 1 in Ground 1.

129. In addition to independent claims 1 and 8, Ground 1 also challenges dependent claims 2-4 and 9-11. With respect to these dependent claims, Ground 1 relies on the same mappings for the independent claims discussed above. Accordingly, the Petition has failed to demonstrate the unpatentability of dependent claims 2-4 and 9-11 in Ground 1.

IX. GROUND 2 FAILS TO DEMONSTRATE THE UNPATENTABILITY OF DEPENDENT CLAIMS 5 AND 12

130. With respect to dependent claims 5 and 12, Ground 2 relies on the same deficient mappings discussed above in connection with Ground 1. Accordingly, the Petition has failed to demonstrate the unpatentability of dependent claims 5 and 12 in Ground 2.

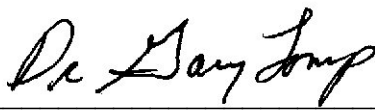
X. GROUND 3 FAILS TO DEMONSTRATE THE UNPATENTABILITY OF DEPENDENT CLAIMS 6 AND 13

131. With respect to dependent claims 6 and 13, Ground 3 relies on the same deficient mappings discussed above in connection with Ground 1. Accordingly, the Petition has failed to demonstrate the unpatentability of dependent claims 6 and 13 in Ground 3.

XI. DECLARATION

132. I, Dr. Gary Lomp, declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: November 19, 2025

By: 
Dr. Gary Lomp