

**UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.**

**Before The Honorable Cameron R. Elliot
Administrative Law Judge**

In the Matter of

**CERTAIN NETWORKING DEVICES,
COMPUTERS, AND COMPONENTS
THEREOF**

Inv. No. 337-TA-1275

COMPLAINANT PROVEN NETWORKS LLC'S INITIAL *MARKMAN* BRIEF

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Complaint Appx. A1	Intentionally Omitted
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Complaint Appx. B2	References cited in the prosecution history of U.S. Patent No. 8,687,573
Ex. A	Dr. Michelle M. Do, <i>LTE QoS (Part 2) – LTE QoS Parameters (QCI, ARP, GBR, MBR, and AMBR</i> , October 15, 2013, available at https://www.netmanias.com/en/?m=view&id=blog&no=5933&tag=36 (last accessed October 12, 2021)

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I. INTRODUCTION

Complainant Proven Networks, LLC and Respondent offer proposals based on fundamentally different approaches to claim construction. Proven's proposals are consistent with the plain and ordinary meanings of the disputed claim terms, the teachings of the asserted patents, the understanding of a person of ordinary skill in the art ("POSITA"), and the law of claim construction and indefiniteness.

In contrast, Respondent began the *Markman* process by identifying 11 different claim terms to be construed for a single patent. Proven managed to reach agreement with Respondent on two of these disputes and Respondent dropped two others, but Respondent remain intent on litigating the meaning of 7 different claim terms. Respondent's scattershot approach is telling. These arguments are inconsistent with Federal Circuit law and are unsupported by intrinsic evidence. In several instances, Respondents seek to import extraneous limitations into the claims without any legally sound basis for doing so. In other cases, Respondents seek to narrow the asserted claims by recharacterizing non-limiting preamble language as limitations of the claims. And for one term, for which Respondent also seeks construction of several terms in the larger term, Respondent raises a meritless indefiniteness argument that ignores the plain and ordinary meaning of the claims to a POSITA.

Respondent's results-driven proposals should be rejected; Proven's should be adopted.

II. LEGAL STANDARDS

A. Claim Construction

The "claim construction inquiry ... begins and ends in all cases with the actual words of the claim." *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1324 (Fed. Cir. 2002). Indeed, "the claims themselves provide substantial guidance as to the meaning of [] terms." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005). Thus, when conducting a claim construction

inquiry, “courts are not (and should not be) required to construe every limitation present in a patent’s asserted claims.” *O2 Micro Int’l v. Beyond Innovation Tech.*, 521 F.3d 1351, 1362 (Fed. Cir. 2008). This is because claim construction is “not an obligatory exercise in redundancy.” *US Surgical Corp. v. Ethicon, Inc.*, 103 F.3d 1554, 1568 (Fed. Cir. 1997). Where a term is used in accordance with its plain meaning, the court should not replace it with different language. *Thorner v. Sony Comp. Ent. Am. LLC*, 669 F.3d 1362, 1366-67 (Fed. Cir. 2012) (“We do not read limitations from the specification into claims; we do not redefine words. Only the patentee can do that.”); *ActiveVideo Networks, Inc. v. Verizon Commc’ns, Inc.*, 694 F.3d 1312, 1326 (Fed. Cir. 2012) (“The district court did not err in concluding that these terms have **plain meanings that do not require additional construction**. ... [T]he district court properly rejected [the proposed] construction and resolved the dispute between the parties.”).¹

There is a “**heavy presumption**” that claim terms carry their “full ordinary and customary meaning, unless [the accused infringer] can show the patentee **expressly relinquished** claim scope.” *Epistar Corp. v. ITC*, 566 F.3d 1321, 1334 (Fed. Cir. 2009). Because that plain meaning “is the meaning that the term would have to a [POSITA] in question at the time of the invention,” construing claims often “involves little more than the application of the widely accepted meaning of commonly understood words.” *Phillips*, 415 F.3d at 1313-14. “There are **only two exceptions**” in which claim terms are not given their full ordinary and customary meaning: “1) when a patentee sets out a definition and acts as his own **lexicographer**, or 2) when the patentee **disavows** the full scope of a claim term either in the specification or during prosecution.” *Thorner*, 669 F.3d at 1365. Without clear and unambiguous disclaimer or lexicography, courts “**do not import limitations into claims from examples or embodiments** appearing only in a patent’s written description, even when

¹ All emphasis in quoted material has been added unless otherwise noted.

a specification describes very specific embodiments of the invention or even describes only a single embodiment.” See *JVW Enters., Inc. v. Interact Accessories*, 424 F.3d 1324 (Fed. Cir. 2005). Similarly, a statement during patent prosecution does not limit the claims unless the statement is a “clear and unambiguous disavowal of claim scope.” *Omega Eng’g, Inc v. Raytek Corp.*, 334 F.3d 1314, 1325 (Fed. Cir. 2003). Moreover, “because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes.” *Phillips*, 415 F.3d at 1317.

After considering the intrinsic evidence of the patent claims, specification, and prosecution history, “[e]xtrinsic evidence may also be considered, if needed to assist in determining the meaning or scope of technical terms in the claims.” *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed. Cir. 1996). Extrinsic evidence may include, for example, expert testimony, journal articles, and dictionaries. *Phillips*, 415 F.3d at 1317.

B. Indefiniteness

“[A] patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with **reasonable certainty, those skilled in the art** about the scope of the invention.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). As the Supreme Court has acknowledged, “[t]he definiteness requirement, so understood, mandates clarity, while recognizing that **absolute precision is unattainable**.” *Id.* at 910. Because “[a] patent is presumed valid under 35 U.S.C. § 282,” any defense of indefiniteness must be proven “by **clear and convincing evidence**.” *Biosig Instruments, Inc. v. Nautilus, Inc.*, 783 F.3d 1374, 1377 (Fed. Cir. 2015). This burden falls on the accused infringer. See *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1327 (Fed. Cir. 2008).

III. BACKGROUND OF THE PATENT

U.S. Patent No. 8,687,573 (the “’573 Patent”) is the sole patent asserted in this investigation. The ‘573 Patent is title “Allocating Resources within Communication System” and was granted to the inventors Daniela Laselva and Jeroen Wigard. Those inventors learned that the “there is a desire for both user differentiation and service differentiation so that operators may offer different levels of subscriptions” and thus set out an “aim of the embodiments to provide a system which can allocate resources based upon priorities for services at different user levels, or at least provide a useful alternative.” ’573 Patent at 3:18-23. An advantage of the disclosed embodiments “is that resource allocation may be differentiated on the basis of user levels and service type rather than solely service type. This enables operators of communication systems to offer to subscribers a range of different user levels which may be offered at a range of different pricing levels.” ’573 Patent at 6:44-49.

IV. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art at the time of the invention would have had (a) a bachelor’s degree in engineering, computer science, or a comparable field of study, and (b) at least 2 years of professional experience in digital telecommunications systems or other similarly relevant industry experience. Additional relevant industry experience may compensate for lack of formal education or vice versa.

V. AGREED CONSTRUCTIONS

The parties have agreed on the following claim constructions:

Claim Term	Agreed Construction
“bearer for a station” (’573 Patent, claim 1, 20)	“connection for a station”

Claim Term	Agreed Construction
“a service” (’573 Patent, claims 1, 19, 20)	“one of said plurality of services”

VI. DISPUTED CLAIM TERMS

A. “a matrix of priorities” (’573 Patent, claims 1, 19, 20)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; no construction necessary.	“A table indexed by multiple services and multiple user levels, and containing priorities as values”

Under controlling law, there is a “*heavy presumption*” that claim terms carry their “full ordinary and customary meaning, unless [the accused infringer] can show the patentee *expressly relinquished* claim scope.” *Epistar Corp.*, 566 F.3d at 1334. F5 here attempts to re-tool the simple language of “a matrix of priorities” into a new limitation-laden phrase that lacks support and, indeed, is contradicted by the intrinsic record. Specifically, by attempting to require a table that is “indexed” by multiple services and multiple user levels, F5 seeks to import structural limitations into a matrix of priorities. Likewise, “containing priorities as values” is another attempt to re-define the plain term to add unsupported limitations.

First, the specification does not contain any reference to F5’s proposed construction. Indeed, the term “index” or “indexed” does not appear anywhere in the specification. And the only reference to the term table is in the description of Figure 2, which it describes as a table of priorities for different services at different user levels.” ’573 Patent, 4:28-29.

Turning to the disclosure in the specification, the ’573 Patent speaks broadly about the matrix of priorities:

The matrix may be formed of a plurality of services against a plurality of user levels.

Each service at each user level may be assigned to a priority. The matrix may be generated by another network element of the communications system. For example, in the matrix 200 shown in FIG. 2, there are three user levels 201—Gold, Silver and Bronze. In addition, there are five different services 202—Voice over IP, Streaming, Internet browsing, Gaming, and Peer to Peer (P2P). In the matrix shown, user level Silver 203 is allocated a priority of four 204 for Streaming 205.

‘573 Patent, 5:11-22. And, most tellingly, the specification confirms that “a matrix is received—the *matrix comprises priorities assigned to a plurality of services at a plurality of user levels.*” ‘573 Patent, 6:19-21. There is no such mention of whether there is a “table” that is “indexed” or what it could be “indexed” on, and there is no requirement that the priorities are stored as “values,” as F5’s construction would require.

Finally, to the extent any structure of the matrix is required, the claim language itself provides the requirements: “each priority in said matrix being assigned to one of a plurality of services for one of a plurality of user subscriber levels.” *See, e.g.*, ‘573 Patent, Claim 1.

F5 cannot show support for its construction which inserts limitations not supported by the specification and for which the Patentee neither limited the scope to, or for which the Patentee defined through their own lexicography. F5’s construction should be rejected.

B. “being assigned to” (‘573 Patent, claims 1, 19, 20)

Proven’s Proposed Construction	Respondents’ Proposed Construction
Plain and ordinary meaning; no construction necessary	<u>“corresponding to a unique combination of”</u>

Here, F5 seeks to rewrite the plain English words “being assigned to” as “corresponding to a unique combination of” to import a limitation not required by the claims or specification. Such a construction is improper as a matter of law. The term should be left to its plain and ordinary meaning. Where a term is used in accordance with its plain meaning, the court should not re-characterize it using different language. *See Mentor H/S, Inc. v. Med. Device Alliance, Inc.*, 244 F.3d 1365, 1380 (Fed. Cir. 2001) (“[T]he court properly instructed the jury that these terms should

receive their ordinary meanings.”).

F5 cannot overcome the “heavy presumption” that claim terms carry their “full ordinary and customary meaning, unless [the accused infringer] can show the patentee expressly relinquished claim scope.” *Epistar*, 566 F.3d at 1334 . And because “the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention,” the task of comprehending the claims often “involves little more than the application of the widely accepted meaning of commonly understood words.” *Phillips*, 415 F.3d at 1313-14.

There are only two exceptions in which claim terms are not given their “full ordinary and customary meaning: “1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Thorner*, 669 F.3d at 1365.

Here, neither exception is met—the patent contains no lexicographic definition nor is there any disclaimer. Moreover, F5 seeks to import a limitation into the claims. “Being assigned to” is used in the claims to refer to the fact that each priority in the “matrix of priorities” is assigned to “one of a plurality of services for one of a plurality of user subscriber levels.” *See* Claims 1, 20. Nothing in the claim language or specification, requires that the priority “uniquely” correspond the combination those services and subscriber levels as F5’s construction suggests. Neither the teaching nor the patent’s claims precludes more than one priority from being assigned to the same service and subscriber level, or from being assigned to more than one service or subscriber level, as F5’s construction suggest. Indeed, the word “unique” is not even used in the specification. F5’s proposal should be rejected.

C. “wherein said user subscriber levels indicate subscriber value as measured by pricing levels associated therewith” (‘573 Patent, claims 1, 19, 20)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; no construction necessary	<u>Indefinite</u>

A patent can only be invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus*, 572 U.S. at 901. Because “[a] patent is presumed valid under 35 U.S.C. § 282,” any defense of indefiniteness must be proven “by clear and convincing evidence.” *Biosig Instruments, Inc.*, 783 F.3d at 1377. This burden falls on the accused infringer. *See Tech. Licensing Corp.*, 545 F.3d at 1327.

Respondent contended during meet and confer that “subscriber value” is a term that simply could not be understood by a POSITA. Yet “wherein said user subscriber levels indicate subscriber value as measured by pricing levels associated therewith” obviously has a plain meaning to a lay person, let alone a POSITA, even without the patent specifications of the asserted patents to guide them. It is subscriber value based on pricing levels. Any person having bought any tiered service understands this obvious concept. And “read in light of the specification,” as the Supreme Court in *Nautilus* requires us all to do, there can be no question what the scope of the “said user subscriber levels indicate subscriber value as measured by pricing levels associated therewith are in this case.”

Indeed, this claim term for construction was a term added (and for which allowance was granted) in response to a rejection, where it was used to overcome prior art Sadr because “[t]here is no teaching or suggestion in Sadr that the priority of flow requests may be based on pricing levels.” *See* Sept. 25, 2013 Response to Office Action at 9-10. Describing the support for the amendment, Applicant cited to Specification page 12, lines 3-7, which corresponds to Column 6, lines 44-49, which states as follows:

A potential advantage of embodiments of the present invention is that resource allocation may be differentiated on the basis of user levels and service type rather than solely service type. This enables operators of communications systems to offer to subscribers a range of different user levels which may be offered at a range of different pricing levels.

‘573 Patent, 6:44-49; Appx. B1, Certified File History at 17 (indicated same language at page 12, lines 3-7).

It is not clear what F5 is specifically contending on this issue, because it have never clearly articulated what its argument for indefiniteness really is. But what is clear is that, under controlling law and the weight of the intrinsic examples and extrinsic evidence here, F5 cannot meet its heavy burden of showing this term is invalid for indefiniteness.

D. “indicate subscriber value” (’573 Patent, claims 1, 19, 20)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; no construction necessary.	“demonstrate relative importance of a user versus other users”

After first contending that the entire phrase “wherein said user subscriber levels indicate subscriber value as measured by pricing levels associated therewith” is indefinite, F5 next attempts to construe “indicate subscriber value” to mean “demonstrate relative importance of a user versus other users” without a known rationale or basis.

In doing so, F5 cuts off the portion of the claim language “indicate subscriber value,” to remove the remaining words of the phrase, which is “as measured by pricing levels associated therewith.” This attempt to carve out a few words is an attempt to ignore the context of the term as used in the claim itself, contrary to black letter claim construction case law. *See Phillips*, 415 F.3d at 1314 (“the claims themselves provide substantial guidance as to the meaning of [] terms.”).

None of the words or concepts of F5’s produced construction appears anywhere in the specification (aside from the term user). Instead, F5 appears to attempt to manufacture this

construction from whole cloth, either in an attempt at servicing (or backstopping) it's meritless indefiniteness argument, or injecting unnecessary and unsupported mental intent into a term that does not need it. F5 cannot show a disavowal of claim scope or lexicographic definition of the term to support its construction, and its construction should be rejected.

E. “associated therewith” (‘573 Patent, claims 1, 19, 20)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; No construction necessary,	<u>“associated with said user subscriber levels”</u>

F5’s construction contradicts the specification. “Associated therewith” appears in the limitation “receiving a matrix of priorities, each priority in said matrix being assigned to one of a plurality of services for one of a plurality of user subscriber levels, wherein said user subscriber levels indicate subscriber value as measured by pricing levels associated therewith” of claims 1 and 20. F5’s construction erroneously imports the limitation that the “pricing levels” are associated only with the “user subscriber levels.”

Such a limitation is not taught by the claim language. “Therewith” as used in the claims includes *both* the services associated with the subscriber levels as well as the subscriber levels. If it were limited to just “subscriber levels” the term “associated therewith” would be mere surplusage. *Unique Concepts, Inc. v. Brown*, 939 F.2d 1558, 1562 (Fed. Cir. 1991) (“All the limitations of a claim must be considered meaningful.”).

Moreover, the specification is clear that pricing levels can be set based on service type *and* subscriber levels. ‘573 Patent at 6:44-49. Indeed, the patent teaches use both the type and level of service to set pricing as one of the novelties of the inventions:

A potential advantage of embodiments of the present invention is that resource allocation may be differentiated *on the basis of user levels and service type* rather than solely service type. This enables operators of communications systems to offer to subscribers a range of different user levels which may be offered at a range of *different pricing levels*.

Id. (emphasis added). F5’s construction contradicts the patent’s clear teaching and should be rejected. The term should be left to its plain and ordinary meaning.

F. “ascertained” (‘573 Patent, claims 13, 32)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; no construction necessary	<u>“Analyzed and assigned a QCI parameter”</u>

F5 seeks to re-write the plain English word “ascertained” with six different words in the absence of either lexicographic definition or disclaims solely to import a limitation into the claims. The construction should be rejected for this reason alone.

The construction should also be rejected as importing an unfounded limitation into the claims. “Ascertained” is used in claims 13 and 32 to require “wherein the service provided over the bearer is *ascertained* by a gateway of the communication system.” Nothing in the claim requires, or even suggests, use of a QCI parameter as being the only to ascertain the service provided over the bearer.

Indeed, F5 appears to be incorporating the requirements of dependent claims 17 and 36 into claims 13 and 32 with its construction. These claims require “[t]he method as claimed in claim 1, where in the service is defined by a quality control indication (QCI) of the bearer.” Principles of claim differentiation thus require the rejection of F5’s proposed construction. *Nystrom v. TREX Co.*, 424 F.3d 1136, 1143 (Fed. Cir. 2005) (“When different words or phrases are used in separate claims, a difference in meaning is presumed.”).

Moreover, the specification is clear that use of a QCI to determine the service level is only way of practicing the invention:

In one embodiment, *the QCI parameter may be used for determining the service* and ARP parameter may be used for determining the user level. *However, it will be appreciated that* specifications for radio networks change and *that different parameters may be used to define the service or user level*. For example, a specific user level parameter may be introduced into a new version of the 3GPP specification,

in which case, the RRM may determine the user level from the specific user level parameter associated with the bearer.

’573 Patent at 5:30-38. A fundamental of claim construction is that courts “do not import limitations into claims from examples or embodiments appearing only in a patent’s written description, even when a specification describes very specific embodiments of the invention or even describes only a single embodiment.” *JVW Enters.*, 424 F.3d at 1335. This principle is even more applicable here where the specification confirms that the exemplary embodiment F5 seeks to import is not the only way to practice the invention. F5’s construction should be rejected.

G. “adaptively” (’573 Patent, claims 15, 34))

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning; no construction necessary.	<u>“after the bearer is first requested”</u>

F5 once again seeks to rewrite a plain English term in the absence of lexicography or disclaimer. Indeed, not only does F5 seeks substitute one word “adaptively” with six additional words, it seeks to do so in manner that is both: (1) contrary to teachings of the patent; and (2) the plain usage of the term adaptively.

The term is used in dependent claims 15 and 34 to require “the resources are allocated adaptively.” Nothing in the claim language suggests this done only “after the bearer is first requested” as F5 proposes. In fact the specification teaches that assigning the resources after the bearer is first requested is the *opposite* of assigning them adaptively:

In one embodiment, the RRM may *allocate resources for 45 the bearers adaptively rather than when the bearer is first requested*. This may be beneficial because radio conditions generally change dynamically. For example, new bearers may be allocated which may necessitate reallocation of resources to existing bearers.

’573 Patent at 5:45-50 (emphasis added). F5 proposal simply lacks any support in the patent’s teachings.

Moreover, “adaptively” in and of itself, implies that the way the resources are allocated is not restricted to one specific manner but adapts to the situation. F5 seeks to remove this plain meaning of “adaptively” limiting it one, and only one, manner of allocating resources. This construction is improper. F5’s proposal should be rejected and the term left to its plain and ordinary meaning.

H. “communication system” (’567 Patent, claim 15)

Proven’s Proposed Construction	Respondent’s Proposed Construction
Plain and ordinary meaning, which to a person of ordinary skill in the art means <u>“communication system compliant with 3GPP Release 8.0 or later”</u>	Plain and ordinary meaning, or, in the alternative, <u>“a facility which facilitates communication between two or more entities such as communication devices, network entities, and other nodes”</u>

Here, both Proven and F5 agree that the term should be given its plain and ordinary meaning, but disagree as to what that plain and ordinary meaning should be. While F5’s construction cherry picks certain language from the specification, that language is facially incorrect and ignores the context under which a POSA must read the specification.

Indeed, the specification makes clear that the communication system must be compliant with 3GPP Release 8.0 or later, which is the standard for radio and core networks for LTE begins. This plain and ordinary meaning is evident from the use of the lexicon that refers to LTE over prior standards. For example, the specification clearly identifies that “LTE can provide several means for Quality of Service (QoS) control and differentiation.” ’573 Patent, 2:7-11. These include QCI, ARP, GBR, and MBR, parameters that are well understood to relate to the LTE standard. See Ex. A, Dr. Michelle M. Do, *LTE QoS (Part 2) – LTE QoS Parameters (QCI, ARP, GBR, MBR, and AMBR*, October 15, 2013 (available at <https://www.netmanias.com/en/?m=view&id=blog&no=5933&tag=36>).

F5 itself implicitly acknowledges that the communication system must be 3GPP Release

8.0 or later. In improperly attempting to construe ascertained, F5 proposed a construction that required assignment of a ***QCI Parameter***, a QoS parameter related to 3GPP Release 8.0 or later communication systems.

In contrast, F5's construction adds more confusing language, such as "a facility that facilitates" and does not move the needle toward the parties dispute regarding the scope of the term.

VII. CONCLUSION

For the reasons set forth above, Proven respectfully requests that the ALJ adopt Proven's proposals and reject Respondent's claim construction and indefiniteness arguments.

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Respectfully submitted,

/s/ Steven Udick

Matthew D. Aichele
Jonathan Link
RUSS AUGUST & KABAT
800 Maine Ave, SW, Suite 200
Washington, DC 20004
Telephone: (310) 826-7474

Reza Mirzaie
Marc A. Fenster
Paul Kroeger
RUSS AUGUST & KABAT
12424 Wilshire Boulevard, 12th Floor
Los Angeles, CA 90025
Telephone: (310) 826-7474
Facsimile: (310) 826-6991
E-Mail: rak_neodron_itc@raklaw.com

Steven Udick
RUSS AUGUST & KABAT
5570 FM 423, Suite 250-2069
Frisco, TX 75034
Telephone: (310) 826-7474

Counsel for Complainant Proven, Inc.

Exhibit A

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NETMANIAS TECH-BLOG

LTE QoS (Part 2) - LTE QoS Parameters (QCI, ARP, GBR, MBR and AMBR)

October 15, 2013 | By Dr. Michelle M. Do (tech@netmanias.com)

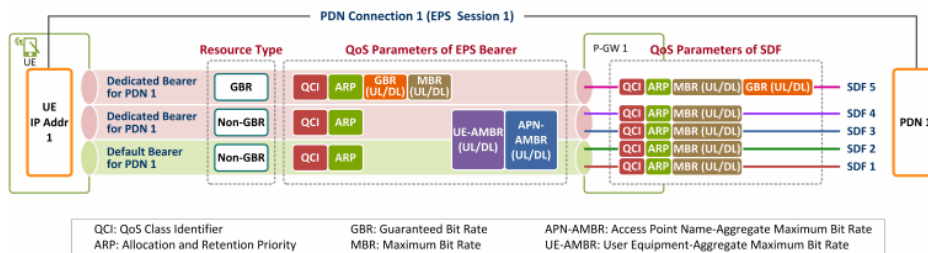
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We will look a little bit further into LTE QoS that we [discussed last time](#), and learn what QoS parameters are for.



There are two types of EPS bearers: default and dedicated. In the LTE network, the EPS bearer QoS is controlled using the following LTE QoS parameters:

- ▶ Resource Type: GBR or Non-GBR
- ▶ QoS Parameters
 - QCI
 - ARP
 - GBR
 - MBR
 - APN-AMBR
 - UE-AMBR

Every EPS bearer must have QI and ARP defined. The QCI is particularly important because it serves as reference in determining QoS level for each EPS bearer. In case of bandwidth (bit rate), GBR and MBR are defined only in GBR type EPS bearers, whereas AMBR (APN-AMBR and UE-AMBR) is defined only in Non-GBR type EPS bearers.

Below, we will explain the LTE QoS parameters one by one.

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Resource Type = GBR (Guaranteed Bit Rate)

For an EPS bearer, having a GBR resource type means the bandwidth of the bearer is guaranteed. Obviously, a GBR type EPS bearer has a "guaranteed bit rate" associated (GBR will be further explained below) as one of its QoS parameters. Only a dedicated EPS bearer can be a GBR type bearer and no default EPS bearer can be GBR type. The QCI of a GBR type EPS bearer can range from 1 to 4.

Resource Type = Non-GBR

For an EPS bearer, having a non-GBR resource type means that the bearer is a best effort type bearer and its bandwidth is not guaranteed. A default EPS bearer is always a Non-GBR bearer, whereas a dedicated EPS bearer can be either GBR or non-GBR. The QCI of a non-GBR type EPS bearer can range from 5 to 9.

QCI (QoS Class Identifier)

QCI, in an integer from 1 to 9, indicates nine different QoS performance characteristics of each IP packet. QCI values are standardized to reference specific QoS characteristics, and each QCI contains standardized performance characteristics (values), such as resource type (GBR or non-GBR), priority (1~9), Packet Delay Budget (allowed packet delay shown in values ranging from 50 ms to 300 ms), Packet Error Loss Rate (allowed packet loss shown in values from 10⁻² to 10⁻⁶). For more specific values, search on Google for "3GPP TS 23.203" and see Table 6.1.7 in the document. For example, QCI 1 and 9 are defined as follows:

QCI = 1

: Resource Type = GBR, Priority = 2, Packet Delay Budget = 100ms, Packet Error Loss Rate = 10⁻², Example Service = Voice

QCI = 9

: Resource Type = Non-GBR, Priority = 9, Packet Delay Budget = 300ms, Packet Error Loss Rate = 10⁻⁶, Example Service = Internet

QoS to be guaranteed for an EPS bearer or SDF varies depending on the QCI values specified.

QCI, though a single integer, represents node-specific parameters that give the details of how an LTE node handles packet forwarding (e.g. scheduling weights, admission thresholds, queue thresholds, link layer protocol configuration, etc). Network operators have their LTE nodes pre-configured to handle packet forwarding according to the QCI value.

By pre-defining the performance characteristics of each QCI value and having them standardized, the network operators can ensure the same minimum level QoS required by the LTE standards is provided to different services/applications used in an LTE network consisting of various nodes from multi-vendors.

QCI values seem to be mostly used by eNBs in controlling the priority of packets delivered over radio links. That's because practically it is not easy for S-GW or P-GW, in a wired link, to process packets and also forward them based on the QCI characteristics all at the same time (As you may know, a Cisco or Juniper router would not care about delay or error loss rate when it processes QoS of packets. It would merely decide which packet to send first through scheduling (WFQ, DWRR, SPQ, etc.) based on the priority of the packets (802.1p/DSCP/MPLS EXP)).

ARP (Allocation and Retention Priority)

When a new EPS bearer is needed in an LTE network with insufficient resources, an LTE entity (e.g. P-GW, S-GW or eNB) decides, based on ARP (an integer ranging from 1 to 15, with 1 being the highest level of priority), whether to:

- remove the existing EPS bearer and create a new one (e.g. removing an EPS bearer with low priority ARP to create one with high priority ARP); or
- refuse to create a new one.

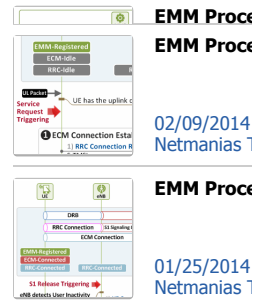
So, the ARP is considered only when deciding whether to create a new EPS bearer or not. Once a new bearer is created and packets are delivered through it, the ARP does not affect the priority of the delivered packet, and thus the network node/entity forwards the packets regardless of their ARP values. One of the most representative examples of using the ARP is an emergency VoIP call. So, an existing EPS bearer can be removed if a new one is required for a emergency 119 (911 in US, 112 in EC, etc) VoIP call.

GBR (UL/DL)

This parameter is used for a GBR type bearer, and indicates the bandwidth (bit rate) to be guaranteed by the LTE network. It is not applied to a non-GBR bearer with no guaranteed bandwidth (UL is for uplink traffic and DL is for downlink traffic).

MBR (UL/DL)

MBR is used for a GBR type bearer, and indicates the maximum bit rate allowed in the LTE network. Any packets arriving at the bearer after the specified MBR is exceeded will be discarded.

APN-AMBR (UL/DL)**View All (836)**

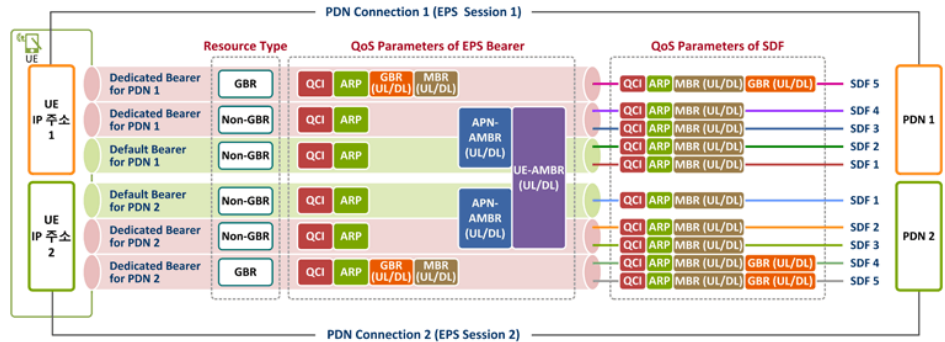
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As you read the foregoing paragraph, you may wonder why a non-GBR type bearer does not have a "bandwidth limit"? In case of non-GBR bearers, it is the total bandwidth of all the non-GBR EPS bearers in a PDN that is limited, not the individual bandwidth of each bearer. And this restriction is controlled by APN-AMBR (UL/DL). As seen in the figure above, there are two non-GBR EPS bearers, and their maximum bandwidths are specified by the APN-AMBR (UL/DL). This parameter is applied at UE (for UL traffic only) and P-GW (for both DL and UL traffic).

UE-AMBR (UL/DL)

In the figure above, APN-AMBR and UE-AMBR look the same. But, please take a look at the one below. A UE can be connected to more than one PDN (e.g. PDN 1 for Internet, PDN 2 for VoIP using IMS, etc.) and it has one unique IP address for each of its all PDN connections. Here, UE-AMBR (UL/DL) indicates the maximum bandwidth allowed for all the non-GBR EPS bearers associated to the UE no matter how many PDN connections the UE has. Other PDNs are connected through other P-GWs, this parameter is applied by eNBs only.



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Boby 2014-08-21 15:59:14

SDF will decide QoS and QCI, so these SDF will give PCRF at the time of provisioning. But SDF will be different for INTERNET, SDF will be different for SKYPE and SDF will be different for IMS. So my query is how PCRF knows this packet is from Internet, this packet is from IMS, this packet is from SKYPE (so based on these packets only SDF will decide right).

Abhi1103 2015-08-27 02:36:25

If Skype and Internet have to have 2 different QoS, then PCRF shall get 2 different PCC rules one for each and its PCRF who has to decide which rule has to be applied, based on SDF filters configured.
SDF 1 for Skype and SDF 2 for Internet which will be configured in PCRF. SDFs are IP flows where multiple IP flows can have single SDF or single IP flow can have single SDF, its completely operator driven.

Tarun 2015-01-30 18:32:54

Nice and good description of QoS; Thank you very much.. I have below doubt, could you please address it.
What is the difference between SDF and TFT, please give example if possible?

Joao Nuno 2015-04-16 21:55:02

Hello NetManias,
Thanks for the presentation..

I would like to know what the role of eNB in all this QoS process? is there any requirement from the eNB in order to keep the balance with what is pre-defined at Core level?

If we have a VIP User, how eNB knows that some specific QCI must be assigned to that user? Are all the definitions/rules coming or set from the PCRF(PCC)?

BR
Joao

Peeyush 2015-05-01 00:50:49

Hi Tarun,

As per my understanding TFT for a bearer is one. This term is basically used on the S5/S8 interface. It can contain multiple SDF (Service Data Flow) which are related to a particular service.

A single bearer can have multiple SDF which are mapped to different service. The packet filters which we send in a PCC rules are usually considered as SDF. Term SDF is usually used on the Gx interface,

I hope it helps.

Regards,
Peeyush

Gary Casagrande 2015-10-08 01:30:43

Hope someone can help. I am trying to understand what levers QCI manipulates to impact latency, packet loss, etc. Is it ARP? Secondary question. Why is QCI 6 better for video than QCI 7 (or the opposite). This goes to the base of the question... what are the levers that QCI is manipulating for the different levels of QCI. Thank you.

jamee dade 2016-06-08 09:26:55

Excellent comments ! I was fascinated by the specifics - Does someone know if my company could access a template DS-11 form to type on ?

CHARISSE LIPTON 2016-06-10 07:38:32

Greetings Jameel my assistant saw a blank DS-11 form at this site <http://pdf.ac/5gMlzi>

nidhishankaryadav@gmail.com 2016-10-19 15:44:11

I would like to know what the role of eNB in all this QoS process? is there any requirement from the eNB in order to keep the balance with what is pre-defined at Core level?

If we have a VIP User, how eNB knows that some specific QCI must be assign to that user? Are all the definitions/rules coming or set from the PCRF(PCC)?

berseek 2016-11-18 15:55:20

Hello

if GBR/MBR qos paramter of the specific flow (data flow) are set to GBR bearer. so that tuple of Bandwidth is below like
MBR> bandwidth of the specific flow > GBR , am I right?

Raj 2016-11-30 20:39:32

Thank you for such great information.....

yasin akar 2017-12-10 09:03:32

Hello,
firstly, thanks for the valuable presentation. My Question is;

In case there are more than one PDN that a Ue connected, default bearers for all PDNs (i.e Internet, email and IMS services), maintained until the UE detach? I mean, default bearer for IMS will be maintained after a Voice call has been ended (dedicated bearer released) and other services are in ongoing state. Or It will be maintained until the UE Powered Off. And after all services has ended, all of the default bearers still exists while UE in Idle state (not detached).

thanks for your supports.

bijal 2018-09-07 21:50:12

i love you

Dheeraj 2018-12-18 01:47:54

In lte a UE can have max 11 bearers, 3 SRBs and rest 8 DRBs. Out of the given 8 DRBs what is the max value of default bearers that can be configured for a UE ?

I read somewhere that UE will be able to only have max 3 default bearers but found no 3gpp reference for the same. Kindly tell me abt the max default bearers per UE in LTE and any 3gpp reference for the same ?

anamika 2019-05-23 16:03:34

Hi all,

Does UE AMBR decides the max num of ues that can be attached?If yes please do say how.

Guillermo Rafael Martinez Ramacciotti 2020-07-20 03:11:44

Hi anamika, UE-AMBR is a parameter received UE per UE so does not affect the max num of UEs that can be attached at all. It only tells how much throughput the UE can achieve toward the SGW. Max num of ttached UE limitation would be ruled buy other factors like MME capacity or even eNB PUCCH capacity as Admission Control entity (just to name 2 possibilities).

Br,

Guillermo

vikrant28 2020-05-06 18:13:48

Hi,

As a bearer can have multiple SDFs in it if the QoS of all the SDF is different how we will be deciding the bearer level QoS for the bearer with multiple SDF/Rule in it.

amit kasnale 2020-05-25 14:59:10

Is there any criteria where TFT filters IP packet like you mention SDF having set up rules 5 tuples?

Can you please suggest any spec for TFT filters?

Guillermo Rafael Martinez Ramacciotti 2020-07-20 03:11:24

Hi, is there any table to know wiich is the maximum UE-AMBR value to be configured? Through 4G traces I've seen up to 256000000bits/s.

Br and many thanks in advanced!

Guillermo

sauroabhmi 2020-12-25 17:37:29

Can someone explain , what will be real qos speed delivered to UE ? So Far i know it should be the qos delivered by PCRF.

My question is that how we can check that which qos (speed) is being delivered to UE to access the network ?

Thank you for visiting Netmanias! Please leave your comment if you have a question or suggestion.

Steve Udick

.....

Characters: 0, Words: 0

Comment

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Cori McGowens

Legal Assistant

RUSS AUGUST & KABAT

12424 Wilshire Boulevard, 12th Floor

Los Angeles, CA 90025

Phone: (310) 826-7474