

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

QUALCOMM INCORPORATED,
Petitioners

v.

NETWORK SYSTEM TECHNOLOGIES, LLC,
Patent Owner

Case IPR2024-_____

U.S. Patent No. 7,373,449

PETITION FOR *INTER PARTES* REVIEW OF
U.S. PAT. NO. 7,373,449

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LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 7,373,449 (the “449 Patent”)
1002	File History of U.S. Pat. No. 7,373,449
1003	Declaration of Todd Mowry Ph.D. in Support of Petition for Inter Partes Review of U.S. Patent No. 7,373,449
1004	Curriculum Vitae of Todd Mowry Ph.D.
1005	K. Goossens, et al., Networks on Silicon: Combining Best-Effort and Guaranteed Services (“Goossens2002”)
1006	U.S. Patent No. 5,461,611 (“Drake”)
1007	K. Goossens, et al., Guaranteeing the Quality of Services in Networks on Chip (“Goossens2003”)
1008	Ahmed Amine Jerraya & Wayne Wolf, Multiprocessor Systems-on-Chips, Ch. 1 (2005) (“Wolf”)
1009	Wael Badawy, System on Chip: The Challenge and Opportunities, SYSTEM ON CHIP FOR REAL-TIME APPLICATIONS, 3–16 (2003) (“Badawy”)
1010	Andrei Rădulescu et al., An Efficient On-Chip Network Interface Offering Guaranteed Services, Shared-Memory Abstraction, and Flexible Network Configuration, 2 PROC. DESIGN, AUTOMATION AND TEST IN EUR. CONF. & EXHIBITION 878 (2004) (“Rădulescu”)
1011	A. Campbell et al., Integrated Quality of Service for Multimedia Communications, Computing Dept. Lancaster University (“Campbell”)
1012	D. Kandlur et al., Real-Time Communication in Multihop Networks, IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 5, NO. 10 (1994) (“Kandlur”)
1013	Jose Duato, et al., Interconnection Networks: An Engineering Approach, IEEE COMPUTER SOCIETY PRESS, Ch. 7 (1997) (“Duato”)
1014	Axel Jantsch and Hannu Tenhunen, Networks on Chip, Ch. 1-3 (2003) (“Jantsch”)
1015	David E. Culler and Jaswinder Pal Singh, Parallel Computer Architecture, A Hardware/Software Approach, Ch. 10 (1999) (“Culler

1016	Hugo De Man, System-on-chip design: Impact on Education and Research, IEEE DESIGN & TEST OF COMPUTERS, Vol. 16, No. 3, pp. 11-19 (July-Sept. 1999) (“Man”)
1017	ETSI Technical Report, Trans European Trunked Radio (TETRA) system; Technical requirements specification, Part 2: Packet Data Optimised (PDO) systems (January 1994)
1018	U.S. Patent No. 5,828,658 (“Ottersten”)
1019	Joint Claim Construction and Prehearing Statement, Network Sys. Techs., LLC v. Tex. Instruments Inc., No. 2:22-cv-00482-RWS, Dkt. 84 (E.D. Tex. Aug. 17, 2023)
1020	Pl.’s Opening Claim Construction Br., Network Sys. Techs., LLC v. Tex. Instruments Inc., No. 2:22-cv-00482-RWS, Dkt. 98 (E.D. Tex. Sept. 27, 2023)
1021	E. Rijpkema et al., Trade-offs in the Design of a Router with Both Guaranteed and Best-Effort Services for Networks on Chip, 150 IEEE PROC.-COMPUT. DIGIT. TECH. 294–302 (2003) (“Rijpkema”)
1022	M. Sgroi et al., Addressing the System-on-a-Chip Interconnect Woes Through Communication-Based Design (2001) (“Sgroi”)
1023	Yasusi Kanada, A Representation of Network Node QoS Control Policies Using Rule-based Building Blocks (2000) (“Kanada”)
1024	IEEE 100, The Authoritative Dictionary of IEEE Standards Terms, p. 344 (“IEEE Dictionary”)
1025	Declaration of Gordon MacPherson regarding K. Goossens, et al., Networks on Silicon: Combining Best-Effort and Guaranteed Services
1026	IEEE Bibliographic Data Regarding K. Goossens, et al., Networks on Silicon: Combining Best-Effort and Guaranteed Services
1027	Declaration of the University of Texas at Austin Libraries regarding “Networks on Chip”
1028	SpringerLink Bibliographic Data Regarding “Networks on Chip”
1029	William J. Dally and Brian Towles, Route Packets, Not Wires: On-Chip Interconnection Networks, Computer Systems Laboratory Stanford University (2001) (“Dally”)
1030	Defendants’ Joint Claim Construction Br. (Excerpts), Network Sys. Techs., LLC v. Tex. Instruments Inc., No. 2:22-cv-00482-RWS, Dkt. 77 (E.D. Tex. Oct. 12, 2023)
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1032	Joint Claim Construction Statement, Network System Technologies, LLC v. Qualcomm Incorporated, et al., No. 1:22-cv-01331-DAE (W.D. Tex. Dec. 18, 2023)
1033	Second Amended Scheduling Order, Network System Technologies, LLC v. Qualcomm Incorporated, et al., No. 1:22-cv-01331-DAE (W.D. Tex. Oct. 23, 2023)
1034	Patent Owner’s Disclaimer of claims 1, 3, 4, and 5 in U.S. Patent No. 7,373,449.
1035	Claim Construction Order, Network System Technologies, LLC v. Texas Instruments, Inc., No. 2:22-cv-00482-RWS (E.D. Tex. Jan. 3, 2024)
1036	Joint Claim Construction and Prehearing Statement, Network System Technologies, LLC v. Samsung Electronics Co., Ltd., et al., No. 2:22-cv-00481-JRG (E.D. Tex. Jan 10, 2024)

Qualcomm Incorporated (“Qualcomm” or “Petitioner”) requests *inter partes* review of Claims 2, 6 and 9-16 of U.S. Patent No. 7,373,449 (the “’499 Patent”) (Ex-1001). The Board has already instituted review of these claims in *Samsung Electronics Co., Ltd. v. Network System Technologies, LLC*, IPR2024-00338 (PTAB) (the “Samsung IPR”). This Petition presents the same or substantially the same grounds as the Samsung IPR¹ and is based on the same or substantially the same evidence as the Samsung IPR. This Petition is accompanied by a motion for joinder to the Samsung IPR.

I. INTRODUCTION

The Challenged Claims are directed to longstanding and well-known networking techniques for the establishment of “connections” between networked

¹ After Samsung filed its IPR but before the Board’s institution decision, PO disclaimed claims 1, 3, 4, and 5. Ex-1034. For consistency, and because Samsung’s Petition was structured to reflect the fact that many elements of earlier (now disclaimed) claims are repeated in later (not disclaimed) claims, Petitioner files substantially the same petition as originally filed by Samsung. To be clear, to the extent this Petition addresses now-disclaimed claims, it is only because those claims contain elements that are repeated in later non-disclaimed claims.

components that can provide communication services with certain properties, such as guaranteed minimum throughput or guaranteed maximum latency.

During prosecution, the Challenged Claims were allowed because the cited prior art did not disclose a “resource manager” that determined whether a requested connection was available based on connection properties. But there is nothing novel about this feature. Determining whether the network resources required to provide a connection with certain properties are available—and the subsequent reservation of those resources—long pre-dates the ’449 Patent. Such a process is described, for example, in U.S. Patent No. 5,461,611 (“Drake”), which was filed a decade before the ’449 Patent.

While the Challenged Claims are directed to networks implemented on an integrated circuit, the determination of the availability of resources—whether in a “network on chip” or in networks more generally—also predates the ’449 Patent. For instance, the use of connections in “network on silicon” was described in K. Goossens, *et al.*, *Networks on Silicon: Combining Best-Effort and Guaranteed Services* (“Goossens2002”), which was published no later than August 7, 2002, and K. Goossens, *et al.*, *Guaranteeing the Quality of Services in Networks on Chip* (“Goossens2003”), which was published no later than January 31, 2003.

The Challenged Claims thus do not contain any novel or inventive concepts, but rather employ known networking technologies in obvious ways. As such,

Petitioner respectfully requests that Challenged Claims be cancelled as unpatentable over the prior art on the grounds detailed below.

II. BACKGROUND OF THE '449 PATENT

The '449 Patent issued on May 13, 2008, from U.S. Application No. 10/530,267 (Ex-1002, “the '267 Application”) filed on April 5, 2005. The '267 Application is a national stage application (under 35 U.S.C. §371) of PCT/IB03/04414 (“the PCT application”) filed on October 7, 2003. The '449 Patent claims priority to a foreign patent application, EP Application No. 02079196, (“the EP196 Application”) filed on October 8, 2002, but for the reasons discussed below, the Challenged Claims are not entitled to claim priority to the EP196 Application for lack of sufficient disclosure.

A. Claims

The '449 Patent has 18 claims. Claims 1-6 and 9-16 are challenged herein, of which two are independent.

B. Overview of the '449 Patent

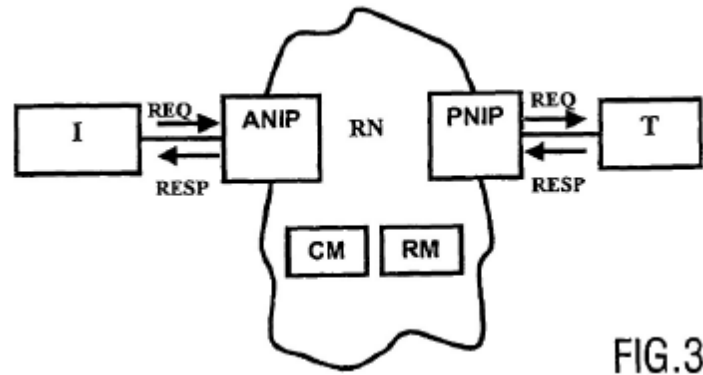
The '449 Patent “relates to an integrated circuit having a plurality of processing modules and a network arranged for providing connections between processing modules.” Ex-1001, 1:5–11. The '449 Patent explains its objective is to provide “more effective usage of the properties of the network.” *Id.*, 7:6–11.

The '449 Patent describes that, in the “transport layer” of the network, the processing modules communicate over “connections,” which are described as “a set of channels, each having a set of connection properties, between a first module and at least one second module.” *Id.*, 8:48–52. The set of channels may comprise a “request channel” and a “response channel.” *Id.*, 8:52–60. “[T]he outgoing and return parts of connections can be configured independently,” such that they have different connection properties. *Id.*, 11:4–55. The “connection properties” provided by these channels may include, for example, throughput and latency. *Id.*, 8:62–9:3.

The '449 Patent also describes that “connections ... must be first created or established with the desired properties before being used.” *Id.*, 10:62–64. To establish such connections, a “communication manager (CM) request[s] a connection with a set of properties between two modules from the resource manager RM.” *Id.*, 10:19–24. The '449 Patent explains that, because “[t]he properties require resources to be implemented[,] ... a connection requiring some properties is opened or not depending on the availability of these resources.” *Id.*, 10:27–31. The resource manager RM thus “enquires if such a connection based on these resources is possible.” *Id.*, 10:24–26. If the resources are available, the resource manager RM “establishes a connection.” *Id.*, 10:41–57.

Figure 3 illustrates an exemplary embodiment of the system of the '449

Patent:



Ex-1001, Fig. 3

C. Prosecution History of the '449 Patent

The '267 application was originally filed with 7 claims, two of them independent. The originally filed independent claims—corresponding to issued claims 1 and 10—contained a subset of the limitations found in the issued claims.

Application claim 1 is representative:

1. Integrated circuit comprising a plurality of processing modules (M; I; S; T) and a network (N; RN) arranged for providing at least one connection between a first and at least one second module, wherein the at least one connection comprises a set of communication channels each having a set of connection properties, the connection properties of the different communication channels of said connection being adjustable independently, wherein said connection supports transactions comprising outgoing messages from the first module to the second module and/or return messages from the second module to the first module.

Ex-1002, 105.

On March 2, 2007, the examiner rejected all pending claims as obvious over U.S. Patent No. 4,807,118 (“Lin”) in view of U.S. Patent App. Pub. No. 2003/0182419 (“Barr”). *Id.*, 53–59. The examiner found the first and third limitations were disclosed by Lin and the second limitation, a connection comprising a set of channels with independently adjustable connection properties, was disclosed by Barr. *Id.*

On May 25, 2007, the applicants submitted an amendment. *Id.*, 43–47. The applicants traversed the examiner’s rejection, arguing that neither Lin nor Barr disclosed multiple processing modules and a network on the same chip. *Id.*, 48.

On August 23, 2007, the examiner issued another office action rejecting the pending claims over U.S. Patent App. Pub. No. 2004/0103230 (“Emerson”) in view of U.S. Patent No. 6,769,046 (“Adams”). *Id.*, 31–37. The examiner found that Emerson discloses a “system on chip (i.e. SoC) comprising numbers of processing modules communicating within the chip” over a network of connections, and Adams discloses connections comprised of channels with independently adjustable connection properties. *Id.*, 33–34.

On November 20, 2007, the applicants submitted an amendment incorporating into independent application claims 1 and 7 limitations from dependent claims pertaining to a “resource manager,” among other things. *Id.*, 21–

25. The applicants traversed the examiner’s rejection, arguing that Emerson’s arbiter does not disclose a resource manager that determines “whether the at least one connection with the communication channel is available based on the connection properties being available” or “a target connection with the desired connection properties is available.” *Id.*, 25–26 (emphasis in original).

The application was allowed on January 9, 2008, with the examiner noting the cited prior art did not teach “the resource manager determines whether the at least one connection with the communication channels is available based on the connection properties being available.” *Id.*, 13–15.

D. Priority Date of the Challenged Claims

Under binding Federal Circuit law, “[a] foreign patent application must meet the requirements of 35 U.S.C. § 112, first paragraph, in order for a later filed United States application to be entitled to the benefit of the foreign filing date under 35 U.S.C. § 119.” *In re Ziegler*, 992 F.2d 1197, 1200 (Fed. Cir. 1993). As such, “the foreign priority application must be examined to ascertain if it supports, within the meaning of section 112, ¶ 1, what is claimed in the United States application.” *In re Gosteli*, 872 F.2d 1008, 1011 (Fed. Cir. 1989).

The Challenged Claims are not supported by the disclosure of the EP196 Application and therefore not entitled to a priority date earlier than October 7, 2003. Ex-1003 ¶46. In particular, the EP196 Application fails to disclose the

claimed “resource manager” (claims 1, 10, and the claims that depend therefrom), and its claimed functions, including “determin[ing] whether the at least one connection with said communication channels is available based on the connection properties being available” (claim 1), “determining whether a target connection with the desired connection properties is available” (claim 10), “responding with the availability of the requested connection to said communication manager” (claims 6 and 10), among others. Ex-1002, 121–169. And the EP196 Application does not disclose the claimed “communication manager” (claims 2, 10, and the claim that depend therefrom), and its claimed functions, including “forward[ing] said request (REQ) for a connection with communication channels each having a specific set of connection properties to said resource manager (RM)” (claim 6) and “forwarding the request to a resource manager” (claim 10 and the claims that depend therefrom). *Id.*

III. IDENTIFICATION AND BASIS OF CHALLENGE

Petitioner’s challenge is based on the following prior art:

- **Goossens2002 (Ex-1005)** - *K. Goossens, et al., Networks on Silicon: Combining Best-Effort and Guaranteed Services* (“Goossens2002”), published no later than August 7, 2002, is prior art under 35 U.S.C. §§102(a) and (b) because it was published

more than one year before October 7, 2003, “the date of the actual filing of the application in this country.” 35 U.S.C. §119(a).²

- **Drake (Ex-1006)** - U.S. Patent No. 5,461,611 to Drake, Jr., et al. (“Drake”), filed on June 7, 1994 and issued on October 24, 1995, is prior art under 35 U.S.C. §§102(a), (b), and (e), because it was filed and issued more than one year before October 7, 2003, “the date of the actual filing of the application in this country.” 35 U.S.C. §119(a).
- **Goossens2003 (Ex-1007)** - *K. Goossens, et al., Guaranteeing the Quality of Services in Networks on Chip* (“Goossens2003”), which was included as chapter 4 of *Networks on Chip*, edited by A. Jantsch and H. Tenhunen (“Jantsch”), and published no later than January 31, 2003, is prior art under 35 U.S.C. §102(a) because it was published before the invention of the ’449 Patent, as reflected in the filing date of the PCT Application (October 7, 2003).

Goossens2002 and Goossens2003 are printed publications pursuant to 35 U.S.C. §311(b) because they were published and publicly available before the priority date of the ’449 Patent. Ex-1005; Ex-1007; *Hulu, LLC v. Sound*

² Cites to 35 U.S.C. §§102, 103, and 119 are to the pre-AIA versions.

Innovations, LLC, IPR2018-01039, Paper 29 at 17-19 (P.T.A.B. Dec. 20, 2019) (precedential). Supporting documentation and testimonial evidence demonstrate that Goossens2002 and Goossens2003 are printed publications that were publicly available prior to the '449 Patent's priority date. *See* Ex-1025; Ex-1027; Ex-1028; *Hulu*, Paper 29 at 12-14, 17-21.

Petitioner requests cancellation of the Challenged Claims on the grounds below:

Ground	Basis	Challenged Claims	Reference(s)
I	§ 103	Claims 2, -6, 9-16	Gosssens2002 and Drake
II	§ 103	Claims 2, 6, 9-16	Gosssens2003 and Drake

Section VII details the statutory grounds for unpatentability of the Challenged Claims. Additional evidence is provided in the accompanying Declaration of Dr. Todd Mowry (Ex-1003) and supporting exhibits.

IV. OVERVIEW OF THE ASSERTED PRIOR ART

A. Goossens2002

Goossens2002 was authored by a group from Philips Research Laboratories that included one of the named inventors of the '449 Patent, Kees Goossens. Ex-1005, 1. Goossens2002 is directed to “systems on silicon,” also known as a systems on chip, or “SoCs.” *Id.*; Ex-1003 ¶¶30–31, 63. Goossens2002 describes

that such systems on silicon are potentially comprised of “hundreds of IPs,” or intellectual property blocks, and is concerned with the communication among those IPs. Ex-1005, 1. Goossens2002 “propose[s] a *network on silicon* (NOS) to implement the communication between these IPs.” *Id.*

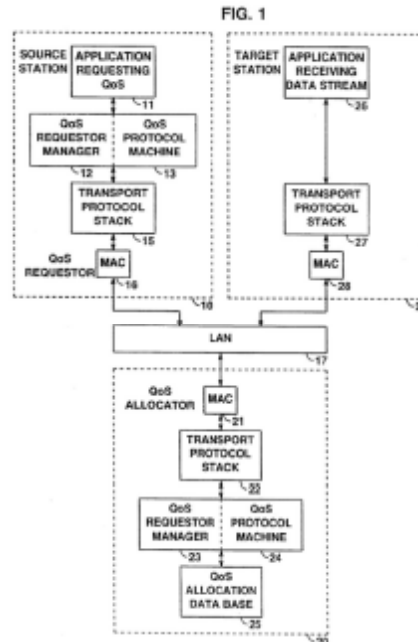
The NOS proposed by Goossens2002 is a packet-switched router network that implements “guaranteed services.” *Id.* Goossens2002 describes that “some IPs have inherent performance requirements, such as a minimum throughput (for real-time streaming data), or bounded latency (for interrupts)” and that “[a] NOS with guaranteed services eases their integration” into larger systems on silicon. *Id.*, 2. The guaranteed services in Goossens2002’s system are provided over “*connections*,” which are combinations of multiple channels between IPs that can be set up and removed by the IPs. *Id.*, 2–3; Ex-1003, ¶64. Goossens2002 describes that the component channels “can have a combined throughput and latency guarantee (GT), or be best effort (BE), with an unspecified finite latency upper bound.” Ex-1005, 3.

Goossens2002 further notes that “[a] service request may be granted or denied by the network” and suggests that this functionality is implemented in a “quality-of-service manager” that “reconfigures” the system on silicon and “steers” the network on silicon. *Id.*

B. Drake

Drake is titled “Quality of Service Management for Source Routing Multimedia Packet Networks,” and was originally assigned to International Business Machines Corporation. Ex-1006, Cover. Drake describes that multimedia information—“particularly audio and full motion video”—that is communicated over a network “has unique properties that impose stringent requirements on the communications network.” *Id.*, 1:22–24. Drake explains these requirements include the availability of “high bandwidth” (*i.e.*, throughput) and that “the data is delivered with (a priori) bounded delay” (*i.e.*, latency). *Id.*, 1:34–46. Drake further describes the need for a system and method to ensure these requirements can be satisfied in packet-switched networks. *Id.*, 1:52–57, 2:14–21; Ex-1003, ¶66.

To address this need, Drake describes a quality of service management system that receives requests for “QoS connections” with specified properties, determines whether the required network resources are available, and reserves those resources for the requesting station. Ex-1006, Abstract. An exemplary embodiment of Drake’s system is shown in Figure 1 below.



Ex-1006, Fig. 1. The components of Drake's system include a "QoS requestor manager," which "assemble[s] a request to reserve a QoS connection," and a "QoS allocator," which receives the request, "determine[s] if a path exists ... which satisfies the requested level of QoS," and assigns available resources to the requestor. *Id.*, 4:26–56; Ex-1003, ¶67.

Drake further describes the component channels of the QoS connection—the "Forward Direction" channel from the source to target, and the "Backward Direction" channel from the target to source—have separately and independently configured properties. *Id.*, 5:30–47.

C. Goossens2003

Goossens2003 was authored by a group from Philips Research Laboratories that included both named inventors of the '449 Patent, Kees Goossens and Andrei

Rădulescu. Ex-1007, 61. Goossens2003 is directed to a “network on chip (NOC)”—the ÆTHEREAL NOC—for providing communications between “intellectual property blocks (IP)” in a system-on-chip. *Id.*, Abstract, 63, 74. Goossens2003 explains that such a NOC “integrates heterogeneous IPs in a standard fashion.” *Id.*, 66; Ex-1003, ¶69.

Goossens2003 describes that “[t]he ÆTHEREAL NOC offers differentiated services with *connections*” and explains that a “connection describes communication between one master and one or more slaves, with an associated service level.” Ex-1007, 71. The services provided by these connections, which Goossens also refers to as “connection properties,” include “data integrity,” “transaction ordering,” “transaction completion,” “connection flow control,” and “connection throughput, latency, and jitter.” *Id.*, 72–74. Goossens2003 further describes that “[c]onnections must be created stating the requested service level” and that “[t]he NOC either accepts or rejects the request for the connection.” *Id.*, 71. This is described as the “negotiation phase” of a “resource management” process. *Id.*; *see also id.*, 65 (“Resource management depends on two phases: negotiation to obtain resources, followed by a steady state in which allocated resources are used.”). Goossens2003 also describes the “request and response” channels of a connection “can be independently configured ... allowing more fine-grained resource management.” *Id.*, 74.

V. LEVEL OF ORDINARY SKILL IN THE ART

As described by Dr. Mowry, a person of ordinary skill in the art (“POSITA”) at the time of the alleged invention would have had at least a Bachelor’s degree in computer science, electrical engineering, computer engineering, or an equivalent technical degree, and two or more years of experience with system-on-chip, interconnect, or networking technologies. Ex-1003 ¶¶59–62. Additional education would compensate for less experience, and vice-versa. *Id.*

The result would be the same under the level of ordinary skill in the art that PO has proposed in related district court proceedings: “a Bachelor of Science (or equivalent) degree in electrical engineering, computer engineering, or a related field, and 2-3 years of work experience in very large-scale integrated (‘VLSI’) systems, such as application-specific integrated circuits (‘ASICs’), application-specific standard parts (‘ASSPs’), system-on-chip (‘SoC’), or field-programmable gate arrays (‘FPGAs’), and has an understanding of on-chip interconnection networks.” Ex-1020, 7.

VI. CLAIM CONSTRUCTION

Claim terms “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b).” 37 C.F.R. § 42.100(b) (2018); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed.

Cir. 2005) (en banc). For the purpose of this IPR only, Petitioner agrees to apply the claim terms as applied in the Samsung IPR.³

VII. SPECIFIC GROUNDS FOR PETITION

A. Ground I: Claim 1-6 and 9-16 Are Rendered Obvious by Goossens2002 in view of Drake.

1. Motivation to Combine Goossens2002 and Drake

A POSITA would have been motivated to combine the teachings of Goossens2002 with those of Drake in order to create an SoC with improved performance and efficiency. Ex-1003 ¶¶71–82.

Goossens2002 discloses “a network on silicon (NOS)” to implement communications between intellectual property blocks (IPs) in a system on silicon (SOS). Ex-1005, 1. Goossens2002 further describes that communications in its NOS are performed over “connections” used to provide “guaranteed services” to

³ In the district court case against Petitioner Qualcomm, Qualcomm provided constructions of certain terms of the ’449 patent and also contended that “communication manager” is indefinite. Ex-1032, 4-5; *see also* footnotes 5-6, *infra*. In agreeing to apply the claim terms as applied in the Samsung IPR for the purpose of this Petition, Petitioner Qualcomm does not waive, and reserves all rights to continue to raise, claim construction arguments in any litigation concerning the ’449 patent.

the IPs, such as “minimum throughput” or “bounded latency,” among other properties. *Id.*, 2 (describing IPs with “inherent performance requirements”). Goossens2002 claims that such guaranteed services are “essential.” *Id.*, 1, 2. Goossens2002 recognizes that managing network resources is critical to the provision of guaranteed services and describes a “quality-of-service [QoS] manager” that plays a beneficial role in that process, but does not provide specific details for that management. *Id.*, 3.

Drake is directed to the same goal of managing network resources in order to “ensure[] selected levels of quality of services,” and a POSITA would have been motivated to combine Goossens2002’s disclosures with Drake’s disclosures regarding a system for QoS management to obtain the benefits of Drake’s known solution to ensuring the availability of network resources for guaranteed services. Ex-1006, Abstract; Ex-1003 ¶¶77–79. A POSITA would have looked to Drake’s disclosure to implement a “QoS requestor manager” to formulate requests for guaranteed services with particular properties and a “QoS allocator” to determine whether the required network resources are available for the requested services. Ex-1006, 4:17–56; *see also id.*, 2:14–40. To enable this functionality, Drake’s QoS allocator includes a database that stores information regarding the resources of the network and the existing connections using those resources. *Id.*, 5:8–14; *see also id.*, 2:32–41, 5:14–23, Figs. 1–2. Drake further describes that, when requesting the

establishment of a connection, a source can specify different QoS requirements for the forward (*i.e.*, outgoing) and backward (*i.e.*, incoming) channels. *Id.*, 5:30–50.

A POSITA would have understood that using Drake’s QoS management process would improve the performance and efficiency of Goossens2002’s NOS by ensuring that connections established to provide guaranteed services are, in fact, able to provide the required services. Ex-1003 ¶79. As Drake explains, the purpose of its QoS management process “is to deny network access to those streams whose level of quality of service requirements are not currently available.” Ex-1006, 2:18–21. In addition, a POSITA would have understood that utilizing Drake’s channel-specific QoS parameters in the establishment of connections would allow IPs to reserve only those network resources (such as throughput) that they actually need for a given channel, thereby utilizing the network resources more efficiently, increasing the pool of resources available for other IPs, and minimizing waste. For instance, Drake describes the playback of stored video, which only requires high throughput in a single direction, as compared to “two-way video (interactive or conferencing),” which requires high throughput in both directions. *Id.*, 1:34–44.

A POSITA would also have had a reasonable expectation of success in combining the disclosures of Goossens2002 and Drake. Ex-1003 ¶80–81. They would have understood that doing so merely combines prior art elements according

to known methods to yield predictable results, as both discuss managing resources to provide guaranteed services, and Drake provides additional details about such a system that is consistent with and would have worked with the system of Goossens2002. Indeed, Goossens2002 and Drake occupy the same field of data communication in packet-based networks, and both are directed to ensuring that sufficient resources are available for the communication of multimedia content, such as audio and video. *See* Ex-1005, 2 (describing “audio and video streams”); Ex-1006, 1:22–24 (describing “audio and full motion video”). As such, a POSITA would have reasonably expected that use of Drake’s known solution to ensuring the availability of network resources for guaranteed services would improve Goossens2002’s NOS in the same way. Ex-1003 ¶¶82. A POSITA would also have understood that Drake’s disclosure is applicable to networks on chip, including because certain resources are more limited in the on-chip context and need to be managed carefully. Ex-1005, 3 (“a NOS that offers guaranteed services must accurately model its resources to offer those services”). Because Drake’s QoS management process would more efficiently utilize the resources of the network and minimize their waste, it is well-suited for such a resource-constrained environment. Ex-1003 ¶¶79–81. A POSITA would have understood that mature networking technologies like those described by Drake could be usefully applied in the context of newer networks on chip. Ex-1003 ¶82. Indeed, the ’449 Patent

describes that many issues that arise when using networks for on-chip communication “have been already the subject of research in the field of local and wide area networks” and further describes that such networks are “very much related to on chip networks, and many of the results in those fields are also applicable on chip.” Ex-1001, 1:50–66.

2. Claim 1

Goossens2002 in view of Drake teaches all the limitations of claim 1, and thus would have rendered that claim obvious. Ex-1003 ¶83.

a. Claim 1[pre]: “Integrated circuit comprising”

If limiting, Goossens2002 discloses the preamble. Ex-1003 ¶84. Goossens2002 is directed to communications in “systems on silicon (SOSs),” also known as systems on chip (SoCs). Ex-1005, 1 (“In this section we consider how a SOS containing hundreds of IPs can be designed....”); Ex-1003 ¶84. A POSITA would have understood that a SOS is implemented on a single integrated circuit chip. Ex-1003 ¶85. Indeed, Goossens2002 refers to “the implementation of the physical on-chip wires.” Ex-1005, 2. Furthermore, as discussed below regarding elements 1[a]–[b], Goossens2002’s system on silicon includes IP blocks interconnected by a network on silicon. *See infra* VII.A.2.b, VII.A.2.c; Ex-1003 ¶ 86. Thus, Goossens2002 discloses an integrated circuit, including under the construction that Patent Owner (“PO”) has proposed in parallel district court proceedings: “interconnected circuitry on a chip.” *See* Ex-1019, 9.

b. Claim 1[a]: “a plurality of processing modules (M; I; S; T)”

Goossens2002 discloses this limitation. Ex-1003 ¶87. Goossens2002 describes that its system on silicon includes multiple intellectual property blocks or “IPs.” Ex-1005, 1 (“a SOS contains hundreds of IPs that are bought or premade”). Goossens2002 further describes these IPs may be processors that perform computations. *Id.*, 2 (“computation is mapped to functional IPs (e.g. tasks to processors)”); *see also id.*, 1. This is consistent with the specification of the ’449

Patent, which describes the “modules” of its disclosed embodiments “can be so-called intellectual property blocks IPs (computation elements, memories or a subsystem which may internally contain interconnect modules).” Ex-1001, 9:42–46. Thus, a POSITA would have understood that the IPs in Goossens2002’s system on silicon are processing modules. Ex-1003 ¶87.

c. Claim 1[b]: “network (N; RN)”

Goossens2002 discloses this limitation. Ex-1003 ¶88. Goossens2002 describes “a network on silicon (NOS).” Ex-1005, 1 (“We propose a network on silicon (NOS) to implement the communication between these IPs.”); *see also id.*, 1 (“We advocate a network on silicon (NOS) as a hardware architecture to implement communication between IP cores ... and as a software model in the form of a protocol stack to structure the programming of NOSs”). Goossens2002 further describes that this NOS is comprised of a “router network based on packet switching.” *Id.*; *see also id.*, 1 (describing “network topology and router layout”), 2 (describing “NOS infrastructure (such as routers and protocol stack),” 3 (describing “NOS hardware architecture based on a packet-switched router network”). Goossens2002 also explains the NOS implements the “OSI [Open Systems Interconnection] protocol stack,” including the “physical layer,” “data-link layer,” “network layer,” “transport layer,” “session layer,” “presentation layer,” and “application layer.” *Id.*, 2.

To the extent PO advocates a construction of “network” here as “a multi-hop interconnection between modules separated by one or more network nodes” (Ex-1019 at 9), a POSITA would have understood that Goossens2002 discloses such a network. Goossens2002 explains that a NOS packet traverses a number of routers, and refers to each such traversal as a “hop.” Ex-1005, 2. A POSITA would have understood that Goossens2002’s routers are “network nodes,” and the packet’s traversal of a number of routers means that Goossens2002’s NOS is a “multi-hop interconnection between modules separated by one or more network nodes.” Ex-1003 ¶89. Indeed, PO has argued in parallel district court litigation that NoCs like Goossens2002’s NOS meet this construction. Ex-1020, 2 (“Each interconnection between routers may be called a ‘hop,’ such that the NoC is a ‘multi-hop’ interconnection between modules separated by routers, or network nodes.”).

d. Claim 1[c]: “at least one resource manager (RM) for managing resources of the network (N)”

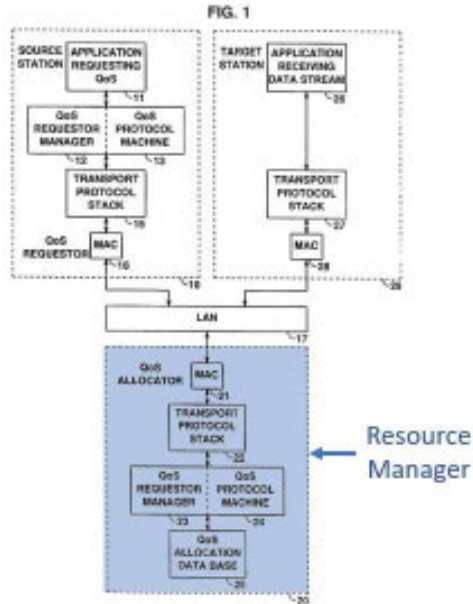
This limitation is disclosed by Goossens2002 and/or rendered obvious by Goossens2002 in view of Drake. Ex-1003 ¶90. Goossens2002 describes that its system on silicon includes a “quality-of-service manager” (*i.e.*, resource manager) that can “observe and steer” the NOS (Ex-1005, 3), and a POSITA would have recognized that it is a circuit and that its functionality involves managing resources of the network. Ex-1003 ¶90. Thus, Goossens2002 discloses a resource manager,

including under PO’s proposed construction: “circuit that manages network resources.” Ex-1019, 13.

Drake discloses a “resource manager” in similar terms, specifically, “a quality of service (QoS) allocator.” Ex-1006, 4:22–25; *see also id.*, 4:66–5:14, Fig. 1. Drake’s QoS allocator manages resources of the network. Ex-1003 ¶91. For example, the QoS allocator receives requests for connections with certain properties and examines the resources of the network to determine whether those requests can be satisfied. *Id.*, 4:49–54 (“The overall function of allocator 20 is to ... examine the resources of LAN 17, and determine if a path exists ... which satisfies the requested level of QoS.”); *see also id.*, Abstract (“An allocator in the management system determines if the requested facilities are available and, if so, reserves these facilities for the requesting station.”), 2:14–21, 2:65–3:6, 10:41–51, 10:52–11:48, Figs. 4–5. Drake describes those connection properties as “quality-of-service parameters that describe the service expected from the network,” including throughput and end-to-end delay (*i.e.*, latency). Ex-1006, 5:30–50; Ex-1003 ¶¶91–92. Drake describes the QoS allocator includes a “QoS allocation database” that stores information regarding the resources of the network as well as information regarding the existing connections using those resources. Ex-1006, 5:8–14; *see also id.*, 2:32–41, 5:14–23, Figs. 1–2. Thus, Drake also discloses a resource manager, including under PO’s proposed construction. Ex-1003 ¶91.

Drake's QoS allocator provides the same functionality as the “resource manager” of the '449 Patent. Like Drake, the '449 Patent describes that its resource manager receives requests for connections with certain properties, “enquires if such a connection based on these resources is possible,” and “reserves the available connection i.e. the required resources.” Ex-1001, 10:19–57. Furthermore, the “quality-of-service parameters” described by Drake—throughput and end-to-end delay (*i.e.*, latency)—are consistent with the “connection properties” identified by the '449 Patent. *See id.*, 8:62–9:3 (stating “connection properties may include ... throughput ... [and] latency”), 9:52–55 (similar), 13:5–9 (similar).

Drake's Figure 1 shows the QoS allocator.



Ex-1006, Fig. 1 (annotated).

For the reasons discussed above, a POSITA would have looked to Drake’s disclosures regarding a QoS allocator for details regarding the implementation of Goossens2002’s quality-of-service manager, and would have had a reasonable expectation of success in doing so. *See* VII.A.1; Ex-1003 ¶¶71–82, 94.

e. Claim1[d]: “wherein the modules, network and resource manager are disposed on a chip and arranged for providing at least one connection between a first and at least one second module”

This limitation is disclosed by Goossens2002 and/or rendered obvious by Goossens2002 in view of Drake. As discussed regarding elements 1[pre]–1[c], Goossens2002 describes a system on silicon that includes multiple IPs (*i.e.*, modules), a NOS (*i.e.*, network), and a “quality-of-service manager” (*i.e.*, resource manager), and a POSITA would have understood that all of these components are on the same chip. *See* VII.A.2.a–VII.A.2.d; Ex-1003 ¶95. Dr. Mowry explains the hallmark of a system on silicon is that the system and its components are self-contained within the same chip. Ex-1003 ¶95. Furthermore, as discussed above, Drake discloses a QoS allocator (*i.e.*, resource manager), and a POSITA would have looked to Drake’s disclosures regarding a QoS allocator for details regarding the implementation of Goossens2002’s quality-of-service manager. *See* VII.A.1.

Additionally, Goossens2002 discloses that its network on silicon provides “connections” between the IPs in its system on silicon. For example, Goossens2002 describes that “[t]he aim of the *transport layer* is to provide reliable

end-to-end services over *connections*.” Ex-1005, 2; *see also id.*, 3 (“IPs can set up and remove connections”). The IPs on either end of these connections are first and second modules. Drake likewise describes “connections” between source and target stations (*i.e.*, first and second processing modules), which it also refers to as “QoS connections,” “QoS streams” and “QoS data streams.” *See* Ex-1006, 4:26–29 (“[S]tation 10 is the source of a desired multimedia transmission and comprises an application 11 which requests a *QoS connection* to the destination or target station 29.”), 7:45–8:5 (“QoSStream 42–Represents a QoS reserved end-to-end data stream”), 14:2–7 (“each source station, like source station 10 in FIG. 1, must continually refresh its request for the *QoS data stream* allocation at predetermined intervals or the requested bandwidth will be de-allocated to make this bandwidth available for other *connections*.”), 15:28–31; EX-1003 ¶¶96–98; *see also id.*, Abstract, 4:54–55, 11:17–21, 11:49–55, Fig. 2.

Thus, Goossens2002, alone or in combination with Drake, discloses this limitation.

- f. **Claim 1[e]: “wherein the at least one connection comprises a set of communication channels each have a set of connection properties, the connection properties of the different communication channels of said connection being adjustable independently”**

This limitation is disclosed by Goossens2002 and/or rendered obvious by Goossens2002 in view of Drake. Ex-1003 ¶99. **First**, Goossens2002 describes

that its connections comprise a set of communication channels, explaining that a “connection combines multiple channels.” Ex-1005, 3. Because Goossens2002 explains these connections enable two-way communications between the processing modules over one-way channels (*id.*, 2–3 (“simplex” channels and “full duplex connections”), a POSITA would have understood that Goossens2002’s connections comprise “a set of communication channels,” one that provides a communication pathway in a forward direction (e.g., an output channel) and another that provides a communication pathway in a reverse direction (*e.g.*, an input channel). Ex-1003 ¶100.

Second, Goossens2002 describes that each of its channels has certain connection properties. EX-1003 ¶101. For example, Goossens2002 explains that “[a] channel can have a combined throughput and latency guarantee (GT), or be best effort (BE), with an unspecified finite latency upper bound.” Ex-1005, 3; *see also id.*, 2–3 (describing properties including “uncorrupted transmission, lossless transmission, in-order delivery, throughput, jitter (delay variation), and latency” and “flow control and reordering for lossless in-order (multicast) transmission”). These are the same properties described in the specification of the ’449 Patent. Ex-1001, 9:52–55 (describing “properties, such as guaranteed throughput, bounded latency and jitter, ordered delivery, or flow control.”); *see also id.*, 8:62–9:3. Thus,

Goossens2002 discloses the claimed connection properties, including under PO's proposed construction. Ex-1019, 6;⁴ EX-1003 ¶102.

Third, a POSITA would have understood that the connection properties of the different channels are “adjustable independently.” Ex-1003 ¶¶103–105. Thus, one such channel (*e.g.*, the output channel) may be “best effort (BE), with an unspecified finite latency upper bound,” while another (*e.g.*, the input channel) may “have a combined throughput and latency guarantee (GT).” *Id.*

To the extent PO argues that Goossens2002 does not explicitly disclose that its channels are adjustable independently, this would have been obvious in view of Drake. Ex-1003 ¶¶106–107. Like Goossens2002, Drake describes two different channels: one in the “forward direction,” for communications “from source station 10 to target station 29,” and a second in the “backward direction,” for communications “from the target station 29 to the source station 10.” Ex-1006, 5:30–50. Drake further describes that each of these channels has separately specified requirements for “throughput” and “end-to-end delay” (*i.e.*, latency)—the same connection properties described by Goossens2002:

Throughput—Forward Direction. The average throughput in bits per second over an interval of length T from source station 10 to target station 29.

⁴ Petitioner Qualcomm agreed to PO's construction in the district court case. *See* Ex-1032, 2.

Throughput—Backward Direction. The average throughput in bits per second over an interval of length T from the target station 29 to the source station 10.

End-to-End Delay—Forward Direction. The maximum elapsed time between the storage of a packet in the LAN entry device at source station 10 and the reception of the packet from the LAN exit device at target station 29.

End-to-End Delay—Backward Direction. The maximum elapsed time between the storage of a packet in the LAN entry device at the target station 29 and the reception of the packet from the LAN exit device at source station 10.

Id. (“quality-of-service parameters that describe the service expected from the network can be specified”); *see also id.*, 5:51–6:28 (describing direction-specific services and “traffic descriptors”), 12:35–13:62, Figs. 7–9 (describing adjustment of bandwidth and delay parameters for a multimedia transmission path). Thus, Drake discloses the claimed connection properties, including under PO’s proposed construction. Ex-1019, 6.

A POSITA would have understood that, because the properties are separately specified for each directional channel, these channels can be configured to have different properties, such that they are “adjustable independently.” Ex-1003 ¶108. For example, a POSITA would have understood that one amount of throughput (*i.e.*, bandwidth) can be reserved for the forward direction channel and a different

amount reserved for the backward direction channel. Ex-1003 ¶109. This is exactly what is disclosed in the '449 Patent, which describes that “the outgoing and return parts of connections can be configured independently” such that “different bandwidths can be reserved for requests and responses.” Ex-1001, 11:4–55.

In addition, Drake describes different routes or “connection paths” between a source and a destination that can be specified by a “route selection mechanism.” *See* Ex-1006, 2:61–63, 5:8–14. A POSITA would have recognized that each of these connection paths is a channel and that a two-way connection could include different routes for the outgoing and return channels. Ex-1003 ¶110. Drake also describes the properties of these channels can have different connection properties, such as bandwidth (*i.e.*, throughput) and delay, are adjustable independently, based on the components included in the selected route. Ex-1006, 9:60–62; *see also id.*, 8:31–35, 10:41–51.

- g. Claim 1[f]: “wherein said connection supports transactions comprising at least one of outgoing messages from the first module to the second module and return messages from the second module to the first module”**

This limitation is disclosed by Goossens2002 and/or rendered obvious by Goossens2002 in view of Drake. Ex-1003 ¶111. As discussed regarding element 1[e], Goossens2002 describes that its network provides connections that enable two-way communications between IPs (*i.e.*, first and second modules). Ex-1005,

2. Goossens2002 also describes that its connections support “transactions” and “message passing.” *Id.* A POSITA would have thus understood that Goossens2002’s connections support outgoing messages from a first to a second IP and return messages from the second to the first IP. Ex-1003 ¶112. Further, as shown above, Drake likewise describes communications in the “forward direction” (*i.e.*, outgoing messages) and in the “backward direction” (*i.e.*, return messages) between source and target stations (*i.e.*, first and second modules). *See* VII.A.2.f.

h. Claim 1[g]: “wherein the resource manager determines whether the at least one connection with said communication channels is available based on the connection properties being available”

Goossens2002 in view of Drake renders this limitation obvious.⁵ Ex-1003 ¶113. As discussed regarding element 1[c], Goossens2002 in view of Drake discloses a “resource manager” in the form of quality-of-service manager/QoS

⁵ In district court litigation, Petitioner Qualcomm argued that this limitation should be construed in light of the prosecution history to exclude an arbiter that prioritizes which port of a switching device is to be used. *See* Ex-1032, 5. The district court in another proceeding rejected this argument. Ex-1035, 43-46. Because the “resource manager” in Drake is not an arbiter that prioritizes which port of a switching device is to be used, it is not necessary for the Board to resolve this issue.

allocator that receives requests for connections with certain QoS properties. *See* VII.A.2.d. As shown above, Drake’s QoS allocator examines the network resources to “determine if the QoS parameters required for the data stream is available,” *i.e.*, whether the connection properties are available such that the requested connection can be established. Ex-1006, 10:41–46; *see also id.*, Abstract (“An allocator in the management system determines if the requested facilities are available...”), 2:14–21, 2:65–3:6, 4:49–56 (QoS allocator “examine[s] the resources” of the network and determines if it can “satisf[y] the requested level of QoS”), 10:41–51, 10:52–11:48; Ex-1003 ¶113. Thus, Drake’s QoS allocator determines whether the requested connection is available to be created/established.

Drake describes the QoS allocator's process for determining the availability of the requested connection properties by reference to Figures 4 and 5. Ex-1006, 10:9–51, 10:52–11:48, Figs. 4–5; EX-1003 ¶114. First, a requesting module

“sends a request to the allocator 26 to determine

if the QoS parameters required for the data

stream is available.” *Id.*, 10:41–46. Once the

QoS allocator receives the request, it

“determine[s] if the QoS is available in the

components in the multimedia transmission

path.” *Id.*, 10:46–49. Drake explains that this

determination is made using a database, which

contains information regarding the components

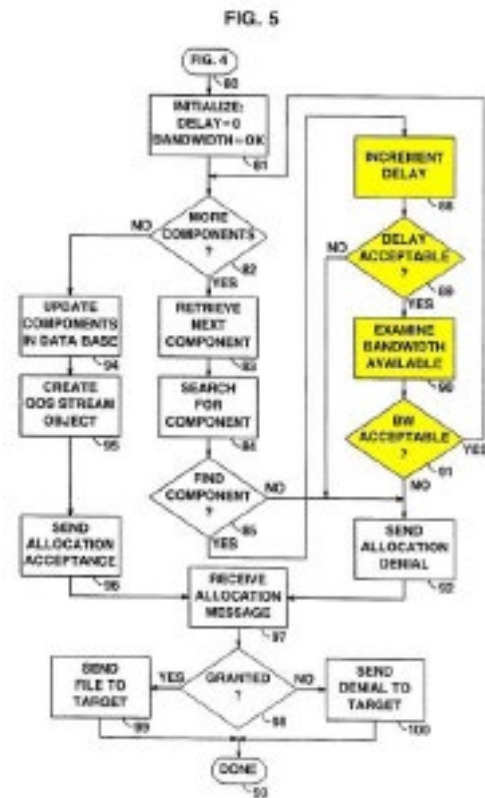
of the network and the resources reserved by

previously allocated connections. *Id.*, 5:8–14, 10:60–11:48. This is just like the

resource manager of the '449 Patent, which determines the availability of resources

based on network, channel, and connection properties that are maintained in a

“property table.” Ex-1001, 10:34–40; Ex-1003 ¶¶115–116.



3. Claim 2: “Integrated circuit according to claim 1, further comprising: at least one communication manager (CM) for managing the communication between different modules”

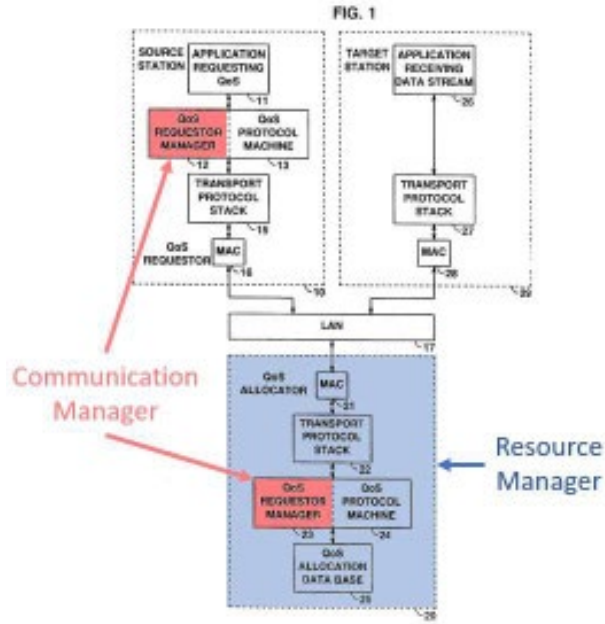
Claim 1 is obvious. *See* VII.A.2. In addition, Goossens2002 in view of Drake renders this limitation obvious. Ex-1003 ¶117. Drake discloses a “communication manager”⁶ in the form of a “QoS requestor manager.” Ex-1006, 4:32–37; *see also id.*, 4:62–65, 5:5–8, Fig. 1. Drake explains that there are QoS requestor managers associated with source stations, and that the QoS requestor managers manage communications between modules by “assembl[ing] a request to reserve a QoS connection for a multi-media data stream ... between source station 10 and target station 29,” which request is sent to the QoS allocator (i.e., resource manager). *Id.* This is consistent with the disclosure of the communication manager

⁶ In its Institution Decision in the Samsung IPR, the Board found it unnecessary to determine which of PO’s or Petitioner’s proposed constructions of “communication manager” should be applied. *See* Samsung IPR, Paper 10, 22-24. Petitioner Qualcomm maintains that this term is indefinite because it is a means-plus-function term and the patent fails to disclose sufficient structure. Ex-1032, 5. However, given that this invalidity ground cannot be raised in IPR, for the purpose of this IPR only and without waiving its indefiniteness position, Petitioner is willing to apply any of the proposed constructions in the Samsung IPR.

in the specification of the '449 Patent, which describes that “[t]he communication manager CM request[s] a connection with a set of properties between two modules from the resource manager RM.” Ex-1001, 10:19–24; EX-1003 ¶¶118–119.

To the extent the claimed communication manager must have the ability to request that the resource manager release reserved connections and resources (Ex-1001, 10:51–54), that too is disclosed by Drake. *See* Ex-1006, 8:65–9:1 (“QoS de-allocation announcement” message), 11:49–12:34 (describing process for “de-allocating a previously allocated QoS data stream”). In addition, it would have been obvious that the QoS requestor managers could either accept or reject connections established by the QoS allocator based on the specified QoS parameters. Ex-1003 ¶120.

Drake further describes that a QoS requestor manager associated with the QoS allocator “receives, decodes and acts upon the QoS request from source station 10.” Ex-1006, 5:5–8. These QoS requestor managers are depicted in Drake’s Figure 1.



Ex-1006, Fig. 1 (annotated).⁷

For the reasons discussed above, a POSITA would have looked to Drake's disclosures regarding a QoS requestor manager to obtain the benefits of Drake's known solution to ensuring the availability of network resources for guaranteed services and would have had a reasonable expectation of success in doing so. *See*

⁷ Petitioner Qualcomm annotates this Figure in this way here and in Ex-1003 to maintain consistency with Samsung's IPR Petition. However, as the Board recognized in its Institution Decision in the Samsung IPR, the Samsung Petition (and, therefore, this Petition) explain that the claimed "communication manager" corresponds to Drake's "QoS requestor manager 12 in source station 10" and "does not include QoS requestor manager 23." Samsung IPR, Paper 10, 55.

VII.A.1; Ex-1003 ¶¶72–82, 120. Furthermore, a POSITA would have been motivated to do so by implementing the functionality of Drake’s QoS requestor manager as a circuit on the same integrated circuit chip as Goossens2002’s IP blocks and NOS. *Id.* As Dr. Mowry explains, the hallmark of a system on silicon—like the one described by Goossens2002—is that the components of the system are included on the same chip, and the nature of Drake’s QoS requestor managers—which intermediate communications between functional blocks over the network—require that they be tightly integrated with Goossens2002 IP blocks and QoS manager. Ex-1003 ¶120. Thus, Goossens2002 in view of Drake renders obvious a communication manager, including under PO’s proposed construction: “circuit that manages communication between modules.” Ex-1019, 12; EX-1003 ¶122.

4. Claim 3: “The integrated circuit of claim 1, further comprising at least one of a switch and router”

Claim 1 is obvious. *See* VII.A.2. In addition, Goossens2002 describes that its system includes both routers and switches. For example, as discussed regarding element 1[b], Goossens2002 describes that its NoS contains “a number of routers.” *See* VII.A.2.c; Ex-1005, 2. Goossens2002 further describes that its NOS contains switches to implement a form of circuit switching. Ex-1005, 3 (“We use a combination of circuit and packet switching, in the spirit of ATM [1].” “GT streams use time-division-multiplexed circuit switching.”). Thus, to the extent the

claim requires “at least one switch and at least one router” (Ex-1019, 7), this is disclosed by Goossens2002. Ex-1003 ¶¶123–124.

5. Claim 4: “The Integrated circuit of claim 1, further comprising a chip, wherein the processing modules and the network are disposed on said chip”

Claim 1 is obvious. *See* VII.A.2. This limitation is disclosed for the same reasons as claim element 1[d]. *See* VII.A.2.e; Ex-1003 ¶125.

6. Claim 5: “The Integrated circuit of claim 1, wherein the connection properties comprise at least one of data transport ordering, flow control, throughput, latency, and lossiness”

Claim 1 is obvious. *See* VII.A.2. In addition, as discussed regarding element 1[e], Goossens2002 describes that each of its channels has connection properties that include “throughput and latency.” Ex-1005, 2–3. Drake likewise describes that its channels have properties that include “throughput” and “end-to-end delay” (*i.e.*, latency). Ex-1006, 5:30–50; Ex-1003 ¶126.

7. Claim 6

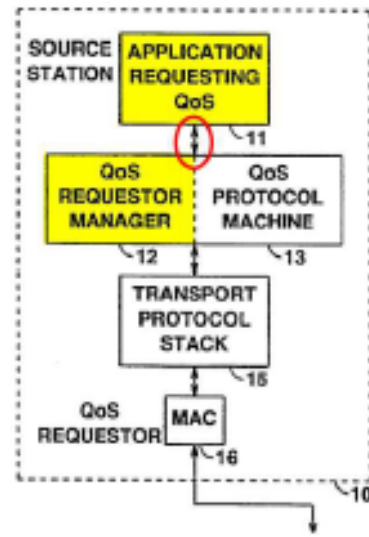
a. Claim 6[pre]: “Integrated circuit according to claim 2”

Claim 2 is obvious. *See* VII.A.3.

- b. Claim 6[a]: “wherein said first module (M; I) is adapted to issue a request (REQ) for a connection with at least one of said second modules to said communication manager (CM)”**

Goossens2002 in view of Drake renders this limitation obvious. Ex-1003 ¶128. Goossens2002 describes that its IPs (*i.e.*, processing modules) “can set up and remove connections.” Ex-1005, 3. Goossens2002 explains that the IPs do so by making a “service request” that includes information regarding the performance requirements of the connection. *Id.*, 2–3. The IP that makes a service request is a “first module” and the IP that is the destination or target of the connection is a “second module.” Ex-1003 ¶128. Similarly, Drake describes that an application in a source station (*i.e.*, first module) “requests a QoS connection to the destination or target station” (*i.e.*, second module). Ex-1006, 4:26–29; *see also id.*, Abstract, 5:25–50, 2:32–41 (describing “requested QoS values”). A POSITA would have understood from these disclosures that the requests described by Goossens2002 and Drake include desired connection properties. Ex-1003 ¶129.

Drake further describes that the application in the source station (*i.e.*, first module) communicates this request to a QoS requestor manager (*i.e.*, communication manager) for subsequent transmission to a QoS allocator, as discussed further below. Ex-1006, 4:62–65 (“The QoS requestor manager 12 interacts with application using internal messages as is well known in the art”), Fig. 1; *see also id.*, 4:32–37, 4:50–54, 5:5–8, 3:21–28. This is indicated by the arrows in Drake’s Figure 1. *Id.*, Fig 1 (excerpted, annotated); EX-1003 ¶130.



- c. **Claim 6[b]: “said communication manager (CM) is adapted to forward said request (REQ) for a connection with communication channels each having a specific set of connection properties to said resource manager (RM)”**

Goossens2002 in view of Drake renders this limitation obvious. Ex-1003 ¶131. Drake describes that, having received a request for a connection from an application in the source station (*i.e.*, first module), the QoS requestor manager (*i.e.*, communication manager) “assemble[s] a request to reserve a QoS connection.” Ex-1006, 4:32–37. Drake explains that the QoS requestor manager “utilizes QoS protocol machine 13 to format the QoS request,” which is also referred to by Drake as a “QoS allocation request.” *Id.*, 4:62–65; *see also id.*, 8:31–49, 9:52–10:8 (QoS request “contains a specification of the quality of service

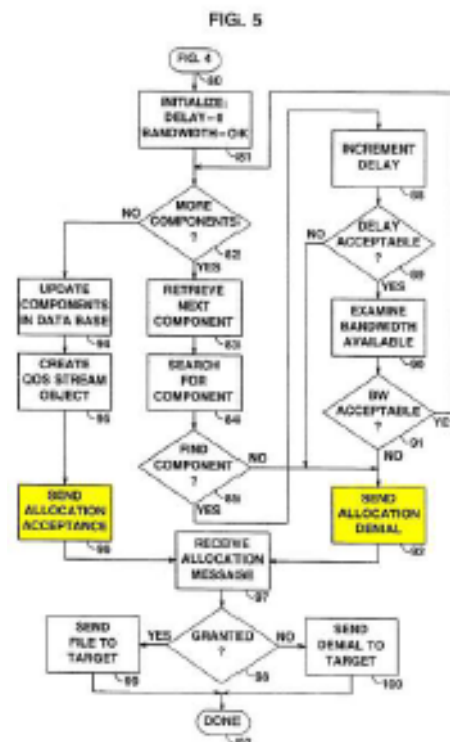
which is desired” and the minimum acceptable quality of service), Fig. 3. The QoS request is then sent to the QoS allocator (*i.e.*, resource manager). *Id.*, 4:50–54 (“The overall function of allocator 20 is to receive the QoS request from station 10...”); *see also id.*, 5:5–8 (“Allocator station 20 ... receives, decodes and acts upon the QoS request from source station 10.”).

Additionally, as discussed regarding element 1[e], the connections requested by Drake’s QoS requestor manager comprise communication channels each having a specific set of connection properties. *See* VII.A.2.f.

d. Claim 6[c]: “said resource manager (RM) responding with the availability of the requested connection to said communication manager (CM)”

Goossens2002 in view of Drake renders this limitation obvious. Ex-1003

¶133. As discussed regarding element 1[g], Drake describes that, when the QoS allocator receives requests for connections with certain QoS properties, it examines the resources of the network to “determine if the QoS parameters required for the data stream is available,” *i.e.*, whether a connection with the requested connection properties is available to be established. *See* VII.A.2.h. Drake further

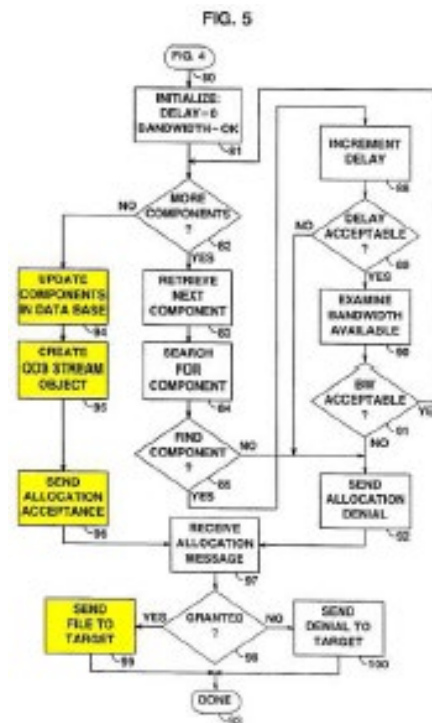


describes that, once the QoS allocator has made its determination, it sends a “QoS allocation reply,” which indicates, among other things, whether the requested connection and connection properties are available. Ex-1006, 4:55–57 (describing reply sent if “the QoS is not available,”), 8:20–29 (describing “QoS allocation reply” message), 8:50–64 (describing contents of “AllocationReply” message including “QoS granted”), Fig. 5 (annotated).

- e. **Claim 6[d]: “wherein a connection between the first and second module is established based on the available properties of said communication channels of said connection”**

Goossens2002 in view of Drake renders this limitation obvious. Ex-1003

¶134. Drake describes that, if the QoS allocator determines that the requested QoS properties are available, the requested connection between the source and target stations is established along a designated path through the network and required resources are reserved. See Ex-1006, Abstract (“An allocator in the management system determines if the requested facilities are available and, if so, reserves these facilities for the requesting station.”); 10:9–11 (describing “the process of allocating a QoS transmission path between a source of multimedia data and a user of such



data.”), 11:17–19, 11:26–28 (“If the allocation has been accepted, ... the multimedia file is transmitted to the target station 29”), Fig. 5 (annotated). This newly established connection is identified and described in the “QoS allocation reply” message by a “StreamID,” “Route Designator Fields,” and an identification of the “QoS parameters of the path granted” to the connection. *Id.*, 8:50–64. Drake also describes that the database is updated to reflect the resources that have been reserved for the newly established connection and are therefore unavailable for future connection allocations. *Id.*, 11:11–17 (describing reserved bandwidth is “subtracted from the previously available bandwidth on the components in the multimedia data path to determine the new bandwidth available for the next allocation”), Fig. 5.

8. **Claim 9: “Integrated circuit according to claim 2, further comprising: at least one network interface means (NI), associated to each of said modules, for managing the communication between said modules and said network (N)”**

Claim 2 is obvious. *See* VII.A.3. This limitation is disclosed by Goossens2002, which describes “network interfaces” that “implement multipath and multi-channel ordering, and channel flow control.” Ex-1005, 3; *see also id.* (describing channels implement “point-to-point communication between two network interfaces”). Goossens2002 further describes that the computation performed by IPs is decoupled from communication over the NOS. *Id.*, 1. As such,

a POSITA would have understood that Goossens2002's system on silicon includes network interfaces between the IP modules and the NOS, and the network interfaces manage the communication between the IPs and the NOS. Ex-1003 ¶136.

9. Claim 10

Goossens2002 in view of Drake teaches all the limitations of claim 10, and thus would have rendered that claim obvious. Ex-1003 ¶137.

a. Claim 10[pre]

- i. Claim 10[pre.1]: “Method for exchanging messages in an integrated circuit comprising a plurality of modules, the messages between the modules being exchanged over connections via a network”**

If limiting, Goossens2002 discloses this part of the preamble. Ex-1003 ¶138. As discussed regarding elements 1[pre]–1[b] and 1[d], Goossens2002 describes a system on silicon (*i.e.*, integrated circuit) in which multiple intellectual property blocks (*i.e.*, modules) communicate with one another over connections via a “network on silicon.” *See* VII.A.2.a, VII.A.2.b, VII.A.2.c, VII.A.2.e; *see also* Ex-1005, 1 (describing “a network on silicon (NOS) ... to implement communication between IP cores”), 3 (“IPs can set up and remove connections”). Goossens2002 further describes that these IPs “interact in many different ways” including “message passing.” Ex-1005, 2. Such messages are communicated over

the connections in the form of packets. *Id.*, 1–2 (describing a “packet-switched router network” and “a NOS based on packet-switching”), 3 (similar).

- ii. **Claim 10[pre.2]: “wherein said connections comprises a set of communication channels each having a set of connection properties, any communication channel being independently configurable.”**

If limiting, this part of the preamble is disclosed by Goossens2002 and/or rendered obvious by Goossens2002 in view of Drake for the same reasons as element 1[e], including under the construction of “independently configurable” proposed by PO: “Able to be configured with connection properties that do not depend on those of another configuration.” *See* VII.A.2.f; Ex-1030, 13; Ex-1003 ¶139.

- iii. **Claim 10[pre.3]: “wherein said connection through the network supports transactions comprising at least one of outgoing messages from the first module to the second module and return messages from the second module to the first module.”**

If limiting, Goossens2002 discloses this part of the preamble for the same reasons as element 1[f]. *See* VII.A.2.g; Ex-1003 ¶140.

- b. **Claim 10[a]: “the first module issuing a request for a connection with the second module to a communication manager wherein the request comprises desired connection properties associated with the sets of communication channels.”**

This limitation is rendered obvious by Goossens2002 in view of Drake for the same reasons as element 6[a]. *See* VII.A.7.b; Ex-1003 ¶141.

c. Claim 10[b]: “the communication manager forwarding the request to a resource manager”

This limitation is rendered obvious by Goossens2002 in view of Drake for the same reasons as element 6[b]. *See* VII.A.7.c; Ex-1003 ¶142.

d. Claim 10[c]: “the resource manager determining whether a target connection with the desired connection properties is available”

This limitation is rendered obvious by Goossens2002 in view of Drake for the same reasons as element 1[g]. *See* VII.A.2.h; Ex-1003 ¶143.

e. Claim 10[d]: “the resource manager responding with the availability of the target connection to the communication manager”

This limitation is rendered obvious by Goossens2002 in view of Drake for the same reasons as element 6[c]. *See* VII.A.7.d; Ex-1003 ¶144.

f. Claim 10[e]: “the target connection between the first and second module being established based on the available properties of said communication channels of said connection”

This limitation is rendered obvious by Goossens2002 in view of Drake for the same reasons as element 6[d]. *See* VII.A.7.e; Ex-1003 ¶145.

10. Claim 11: “The method of claim 10, wherein the network manages traffic utilizing at least one of a switch and a router”

Claim 10 is obvious. *See* VII.A.9. This limitation is disclosed by Goossens2002 for the same reasons as claim 3. *See* VII.A.4; Ex-1003 ¶146.

11. Claim 12: “The method of claim 10, wherein the processing modules and the network are disposed on a chip”

Claim 10 is obvious. *See* VII.A.9. This limitation is disclosed by Goossens2002 for the same reasons as claim 4. *See* VII.A.5; Ex-1003 ¶147.

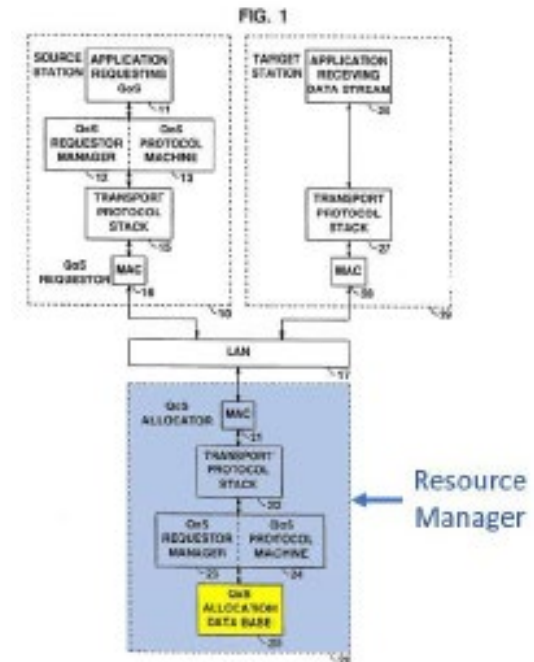
12. Claim 13: “The method of claim 10, wherein the connection properties comprise at least one of data transport ordering, flow control, throughput, latency, and lossiness”

Claim 10 is obvious. *See* VII.A.9. This limitation is disclosed by Goossens2002 for the same reasons as claim 5. *See* VII.A.6. A POSITA would have understood that Goossens2002 discloses the claimed property of “flow control,” including under PO’s proposed construction: “controlling flow whereby a remote buffer is reserved for a connection, and a data producer will be allowed to send data only when it is guaranteed that space is available for the produced data.” Ex-1019, 6; Ex-1005, 2 (“Flow control avoids data loss by aligning IP production and consumption rates.”); Ex-1003 ¶148.

13. Claim 14: “The method of claim 10, further comprising the resource manager determining whether the target connection with the desired connection properties is available based on reding of a centralized or distributed

property table comprising properties associated with the network”

Claim 10 is obvious. *See* VII.A.9. This limitation is rendered obvious by Goossens2002 in view of Drake. Ex-1003 ¶149. As discussed regarding element 1[g], Drake describes that its QoS allocator (i.e., resource manager) determines whether a requested connection is available by referencing a “QoS allocation data base” (i.e., a centralized property table), which contains information regarding the properties associated with the components of the network and the resources reserved by previously allocated connections. *See* VII.A.2.h; *see also* Ex-1006, 3:14–20 (“network topology information and current data stream allocations are maintained in a hierarchical database”), 5:14–8:19, (describing “detailed contents of the database”), Fig. 2. Drake’s QoS allocator queries the database to determine whether requested connection properties, such as “bandwidth” (i.e., throughput) and/or “maximum delay” (i.e., latency), are available, and if so, the requested connection is established and the required resources are reserved. *Id.*, 10:63–11:7; *see also id.*, Abstract. The QoS allocation database is depicted in Drake’s Figure 1. *Id.*, Fig. 1 (annotated); EX-1003 ¶150.



- 14. Claim 15: “The method of claim 10, further comprising the resource manager reserving the target connection after determining whether the target connection with the desired connection properties is available”**

Claim 10 is obvious. *See* VII.A.9. Additionally, as discussed regarding element 1[g], Drake describes that, when the QoS allocator (*i.e.*, resource manager) determines that a requested connection is available, the QoS allocator reserves the resources required for the requested connection. *See* VII.A.2.h; *see also* Ex-1006, Abstract (“An allocator in the management system determines if the requested facilities are available and, if so, reserves these facilities for the requesting station.”); 4:31–36 (describing “a request to reserve a QoS connection”), 7:45–8:5 (“QoSStream 42–Represents a QoS reserved end-to-end data stream”); Ex-1003 ¶¶151–152.

- 15. Claim 16: “The method of claim 10, wherein the connection properties comprise at least one of throughput, latency and jitter”**

Claim 10 is obvious. *See* VII.A.9. This limitation is disclosed by Goossens2002 for the same reasons as claim 5. *See* VII.A.6; Ex-1003 ¶¶153–154.

B. Ground II: Claim 1-6 and 9-16 Are Rendered Obvious by Goossens2003 in View of Drake

1. Motivation to Combine Goossens2003 and Drake

A POSITA would have been motivated to combine the teachings of Goossens2003 with those of Drake in order to create an SoC with improved performance and efficiency. Ex-1003 ¶¶156–166.

Goossens2003 describes a network on chip (NOC) for use in providing communications between “intellectual property blocks (IP)” in a system-on-chip. Ex-1007, Abstract, 63, 74. Goossens2003 further describes that this NOC “offers guaranteed services to obtain the advantages ... of QOS-based design ... for real-time and critical functions.” Ex-1007, 71. These guaranteed services are provided via “connections” which may require the reservation of NOC resources. *Id.* But, as Goossens2003 explains, “SOCs ... have limited resources, and they must be shared and managed.” Ex-1007, 65; *see also id.*, 67. Goossens2003, however, does not describe a component or mechanism for managing resource usage within the NOC or for determining the availability of the resources required for a requested connection. Ex-1003 ¶¶157–159.

Drake is directed to the same goal of managing network resources in order to “ensure[] selected levels of quality of services,” and a POSITA would have been motivated to combine Goossens2003’s disclosures with Drake’s disclosures regarding a system for QoS management to obtain the benefits of Drake’s known

solution to ensuring the availability of network resources for guaranteed services.

Ex-1003 ¶160. A POSITA would have looked to Drake’s disclosure of a “QoS requestor manager” to formulate requests for guaranteed services with particular properties and a “QoS allocator” to determine whether the network resources required for the requested services are available. Ex-1006, 4:17–56; *see also id.*, 2:14–40.

A POSITA would have understood that using Drake’s QoS management process would improve the performance and efficiency of Goossens2003’s NOC by ensuring that connections established by IPs are able to provide the required services. Ex-1003 ¶¶161–163. As Drake explains, the purpose of its QoS management process “is to deny network access to those streams whose level of quality of service requirements are not currently available.” Ex-1006, 2:18–21. This is consistent with Goossens2003, which describes that requests for connections will be accepted or rejected depending on whether the NOC “has sufficient resources available.” Ex-1007, 67.

A POSITA would also have had a reasonable expectation of success in combining the disclosures of Goossens2003 and Drake. Ex-1003 ¶164. They would have understood that doing so merely combines prior art elements according to known methods to yield predictable results, as both discuss managing resources to provide guaranteed services. Drake provides additional details about such a

system that is consistent with and would have worked with the system of Goossens2003. Indeed, Goossens2003 and Drake occupy the same field of data communication in packet-based networks, and both are directed to ensuring that sufficient resources are available for the communication of multimedia content, such as audio and video. *See* Ex-1006, 1:22–24 (describing “audio and full motion video”); Ex-1007, 62 (describing QoS for “real-time applications ... involving audio and video”). As such, a POSITA would have reasonably expected that use of Drake’s known solution to ensuring the availability of network resources for guaranteed services would improve Goossens2003’s NOC in the same way. Ex-1003 ¶164. A POSITA would also have understood that Drake’s disclosure is applicable to networks on chip, including because certain resources are more limited in the on-chip context and need to be managed carefully. Ex-1007, 65 (“SOCs ... have limited resources, and they must be shared and managed.”). Because Drake’s QoS management process would more efficiently utilize the resources of the network and minimize their waste, it is well-suited for such a resource-constrained environment. Ex-1003 ¶¶165–166. A POSITA would have understood that mature networking technologies like those described by Drake could be usefully applied in the context of newer networks on chip. *Id.* Indeed, the ’449 Patent describes that many issues that arise when using networks for on-chip communication “have been already the subject of research in the field of local

and wide area networks” and further describes that such networks are “very much related to on chip networks, and many of the results in those fields are also applicable on chip.” Ex-1001, 1:50–66.

2. Claim 1

Goossens2003 in view of Drake teaches all the limitations of claim 1, and thus would have rendered that claim obvious. Ex-1003 ¶167.

a. Claim 1[pre]

If limiting, Goossens2003 discloses the preamble. Ex-1003 ¶168. Goossens2003 is directed to communications in “systems on chip (SOC).” *See* Ex-1007, 61 (describing “quality of service ... in the context of ... systems on a chip (SOC)”); *see also id.*, Abstract, 63–65, 67–68, 71, 78. A POSITA would have understood that a system on chip is implemented on a single integrated circuit chip. Ex-1003 ¶168. Indeed, in discussing such SOC, Goossens2003 describes “the number of transistors that can be integrated in an IC,” or integrated circuit, and “the intrinsic computational power of an IC.” Ex-1007, 63. Furthermore, as discussed below regarding elements 1[a]–[b], Goossens2003’s SOC includes IP blocks interconnected by a network on chip. *See infra* VII.A.2.b, VII.A.2.c. Thus, Goossens2003 discloses an integrated circuit, including under the construction that PO has proposed in parallel district court proceedings. Ex-1019, 9; Ex-1003 ¶168.

b. Claim 1[a]

Goossens2003 discloses this limitation. Ex-1003 ¶170. Goossens2003 describes that its SoC includes multiple “intellectual property blocks (IP),” which it also refers to as “masters” and “slaves.” Ex-1007, 63; *see also id.*, 61, 67–69 (describing “combining IPs to obtain a SOC”), 71–74 (“communication[s] between one master and one or more slaves”), 77–78. A POSITA would have understood that these IPs constitute processing modules. Ex-1003 ¶170. Figure 4.5 of Goossens2003, annotated below, depicts three such IPs, including one labeled “μP”—microprocessor—and two labeled “M,” for “memory module.”

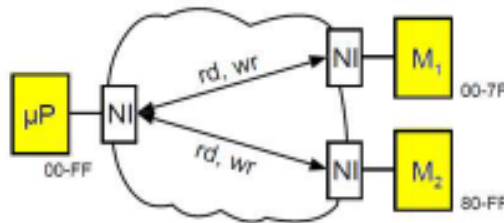
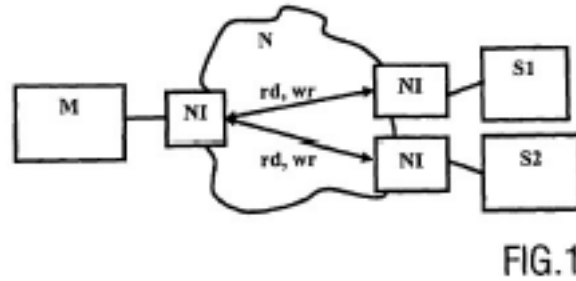


Figure 4.5. A narrowcast connection.

Ex-1007, Fig. 4.5 (annotated); *see also id.*, 72. This is consistent with the specification of the '449 Patent, which says the “modules” of its disclosed embodiments “can be so-called intellectual property blocks IPs (computation elements, memories or a subsystem which may internally contain interconnect modules).” Ex-1001, 9:42–46. Indeed, the '449 Patent contains a nearly identical figure.



Id., Fig. 1

c. Claim 1[b]

Goossens2003 discloses this limitation. Ex-1003 ¶171. Goossens2003 describes that its IPs communicate via “networks on chip (NOC).” *See* Ex-1007, Abstract, 64, 66 (“[u]sing a NOC for the platform interconnect” to “integrate[] heterogeneous IPs in a standard fashion”), 68–69 (“[a]n IP connected to a NOC”), 71–77. Goossens2003 further describes that this NOC is comprised of “routers” that “transport data.” *Id.*, 74. Goossens2003 depicts a portion of its NOC—including three routers (r_1 , r_2 , r_3)—in Figure 4.6, below.

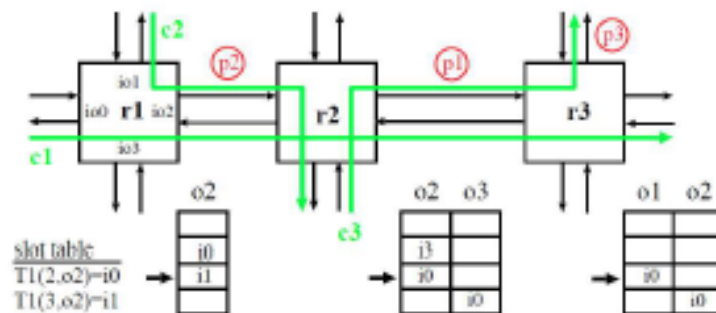


Figure 4.6. Three routers, all in slot $s = 3$, switch packets p_i of circuit c_i to outputs o_i , for $T(s, o_i) = c_i$. For each table, only the relevant columns (outputs) are shown. Input/output link pairs are labelled io_i .

Ex-1007, Fig. 4.6.

To the extent PO advocates a construction of “network” here as “a multi-hop interconnection between modules separated by one or more network nodes” (Ex-1019, 9), a POSITA would have understood that Goossens2003 discloses such an interconnect means as its routers are “network nodes” and the need for a packet to traverse one or more of such routers from its source to its destination means it includes a “multi-hop interconnection between modules separated by one or more network nodes.” Ex-1003 ¶172; *see also* Ex-1020, 2 (“Each interconnection between routers may be called a ‘hop,’ such that the NoC is a ‘multi-hop’ interconnection between modules separated by routers, or network nodes.”). Indeed, Goossens2003 distinguishes its NOC from “single-hop on-chip communication such as busses and switches.” Ex-1007, 77.

d. Claim 1[c]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶173. As discussed above, Goossens2003 explains the implementation of connections in a NOC requires “resource management,” but does not describe a specific component or mechanism for tracking resource usage within the NOC or for determining the availability of the resources required for a requested connection. See VII.B.1; *see also* Ex-1007, 65, 68–69, 74. As discussed in Ground I, however, Drake discloses a “resource manager” in the form of “a quality of service (QoS) allocator.” *See* VII.A.2.d.

For the reasons discussed above, a POSITA would have looked to Drake's disclosures regarding a QoS allocator for details regarding the implementation of resource management in Goossens2003's NOC, and would have had a reasonable expectation of success in doing so. *See* VII.B.1; Ex-1003 ¶¶156–166, 173.

Furthermore, a POSITA would have been motivated to implement the functionality of Drake's QoS allocator as a circuit on the same integrated circuit chip as Goossens2003's IP blocks and NOC. Ex-1003 ¶175. As Dr. Mowry explains, the hallmark of a system on chip—like the one described by Goossens2003—is that the components of the system are included on the same chip, and the nature of Drake's QoS allocator—which manages the resources of the network and intermediates communications between functional blocks—requires that it be tightly integrated with those components. *Id.* Thus, Goossens2003 in view of Drake renders obvious a resource manager, including under PO's proposed construction. Ex-1019, 13.

e. Claim 1[d]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶174. As discussed regarding elements 1[pre]–1[b], Goossens2003 describes a system on chip that includes multiple IPs and a NOC, and a POSITA would have understood that these components are on the same chip. *See* VII.B.2.a–VII.B.2.c; Ex-1003 ¶174. And, as discussed above, a POSITA would have been motivated to

implement the functionality of Drake's QoS allocator on the same chip. See VII.B.2.d.

Additionally, Goossens2003 discloses that its network on chip is arranged to provide “connections” between the various IPs. For example, Goossens2003 describes that its NOC “offers differentiated services with connections” and explains these connections are between a “master” (*i.e.*, first module) and “one or more slaves” (*i.e.*, second modules). Ex-1007, 71; *see also id.*, 67, 71 (“Different connections are created and closed independently”) 72 (describing “simple,” “narrowcast,” and “multicast” connections). Goossens2003 depicts these connections in Figures 4.4 and 4.5.

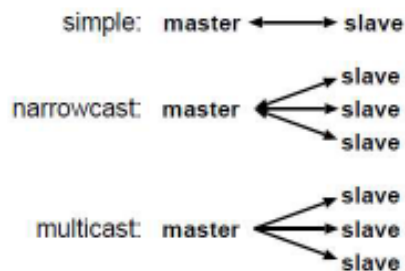


Figure 4.4. Connection types.

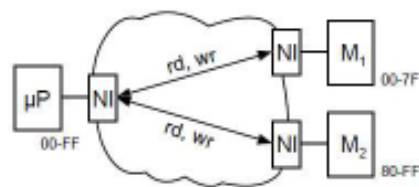


Figure 4.5. A narrowcast connection.

Ex-1007, Figs. 4.4–4.5; Ex-1003 ¶176.

As discussed in Ground I, Drake likewise describes “connections” between an application in a source station (*i.e.*, first module) and a target station (*i.e.*, second module). *See* VII.A.2.e.

f. Claim 1[e]

Goossens2003 discloses this limitation. Ex-1003 ¶178. Goossens2003 describes that its connections comprise “request” and “response” channels, and explains these channels have “connection properties,” including flow control and throughput guarantees, that “can be independently configured.” Ex-1007, 74 (“the request and response communications can be independently configured (*e.g.* for flow control, and throughput guarantees), allowing more fine-grained resource management”); *see also id.*, 72–74 (describing “connection properties”); Ex-1003 ¶178. This is the same functionality that is disclosed in the ’449 Patent, which describes that “the connection properties of the request and response parts of a connection can be configured independently for all of throughput, latency and jitter.” Ex-1001, 11:4–55. Thus, Goossens2003 discloses the claimed connection properties, including under PO’s proposed construction. Ex-1019, 6.

In addition, as discussed in Ground I, Drake describes connections with two channels—the “forward direction” channel and the “backward direction” channel—for which “throughput” and “end-to-end delay” (*i.e.*, latency)—can be adjusted independently. *See* VII.A.2.f. These are the same channels and properties disclosed by Goossens2003. Ex-1003 ¶179.

g. Claim 1[f]

Goossens2003 discloses this limitation. Ex-1003 ¶¶180-181. Goossens2003 describes that “[o]nce a connection has been created, the master initiates transactions by means of requests which zero or more slaves execute, perhaps leading to a response.” Ex-1007, 72 (“The master initiates transaction which the slave executes, possibly resulting in a response....”); *see also, e.g., id.*, 73 (“Within a single transaction ... the master sends a request, a slave receives the request and executes it, the slave sends the response, the master receives the response.”).

As discussed in Ground I, Drake likewise describes communications in the “forward direction” (*i.e.*, outgoing messages) and in the “backward direction” (*i.e.*, return messages). *See* VII.A.2.g.

h. Claim 1[g]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶182. Goossens2003 describes that when requests for connections are issued by IPs, its NOC “will honor the request if has sufficient resources available, and will reject it otherwise.” Ex-1007, 67. But Goossens2003 does not describe the component of its NOC that determines whether sufficient resources are available, nor the process by which it does so.

As discussed in Ground I, however, Drake describes that its QoS allocator (*i.e.*, resource manager) receives requests for connections with certain QoS

properties and “determine[s] if the QoS parameters required for the data stream is available” such that the request can be satisfied and the connection established. *See* VII.A.2.h. For the reasons discussed above, a POSITA would have looked to Drake’s disclosures regarding a QoS allocator for details regarding the implementation of resource management in Goossens2003’s NOC, and would have had a reasonable expectation of success in doing so. *See* VII.B.1; Ex-1003 ¶¶156–166, 183.

3. Claim 2

Claim 1 is obvious. *See* VII.B.2. Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶184. Goossens2003 describes that its system includes “network interfaces,” and explains that “end-to-end” connection properties – those properties which relate to the interactions between the master and slave modules, including “reordering, transaction completion, and flow control”—“are implemented by the network interfaces.” Ex-1007, 76–77; Ex-1003 ¶185. Goossens2003 further describes that “IPs negotiate with network interfaces to obtain connections with certain properties.” Ex-1007, 77. This is just like the interaction between the modules and communication manager described in the ’449 Patent. Ex-1001, 10:3–54. Thus, a POSITA would have understood that Goossens2003’s network interfaces are circuits that manage the communication

between different modules and disclose a communication manager under PO's proposed construction. Ex-1019, 12; Ex-1003 ¶186.

Additionally, as discussed in Ground I, Drake discloses a “communication manager” in the form of a “QoS requestor manager.” *See* VII.A.3. For the reasons discussed above, a POSITA would have looked to Drake's disclosures regarding a QoS requestor manager to obtain the benefits of Drake's known solution to ensuring the availability of network resources for guaranteed services and would have had a reasonable expectation of success in doing so. *See* VII.B.1; Ex-1003 ¶¶156–166,187.

4. Claim 3

Claim 1 is obvious. *See* VII.B.2. Additionally, Goossens2003 describes that its NOC utilizes both switches and routers. Ex-1003 ¶188–189. As discussed regarding claim element 1[b], Goossens2003 describes that its NOC is comprised of “routers” that “transport data.” *See* VII.B.2.c. These routers are depicted in Figure 4.7:

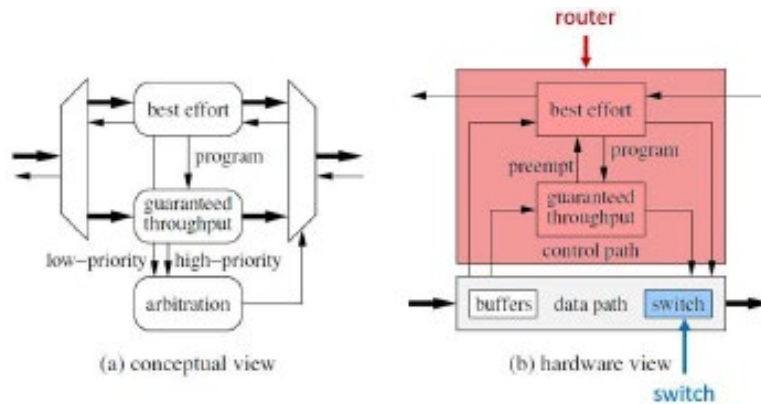


Figure 4.7. Two views of the combined GT-BE router.

Ex-1007 at Fig. 4.7 (annotated). Goossens2003 further describes that its NOC utilizes a switch to control whether “guaranteed (GT)” or “best-effort (BE)” packets have access to the data path. *Id.*, 75–76. Thus, to the extent the claim requires “at least one switch and at least one router” (Ex-1019, 7), this is disclosed by Goossens2003.

5. Claim 4

Claim 1 is obvious. *See* VII.B.2. This limitation is also disclosed for the same reasons as element 1[d]. *See* VII.B.2.e; Ex-1003 ¶190.

6. Claim 5

Claim 1 is obvious. *See* VII.B.2. In addition, as discussed regarding element 1[e], Goossens2003 describes that each of its channels has properties that include at least “flow control” and “throughput guarantees.” Ex-1007, 74; see also *id.*, 72–74 (“connection properties” including “transaction ordering” and “bounds on connection throughput, latency, and jitter,” and “transaction completion”); Ex-

1003 ¶191. Drake likewise describes that its channels have properties that include “throughput” and “end-to-end delay” (*i.e.*, latency). Ex-1006, 5:30–50.

7. Claim 6

a. Claim 6[pre]

Claim 2 is obvious. *See* VII.B.3.

b. Claim 6[a]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶193. Goossens2003 describes that “IPs negotiate with network interfaces to obtain connections with certain properties.” Ex-1007, 77. Thus, a POSITA would have understood that Goossens2003’s master IPs (*i.e.*, first module) issue requests for connections to the network interfaces (*i.e.*, communication managers). Ex-1003 ¶193. As explained above, the requested connections are between a “master” (*i.e.*, first module) and “one or more slaves” (*i.e.*, second modules). Ex-1007, 71. Goossens2003 further describes that when IPs make a request for a connection, the desired communication properties and level of service “must be stated explicitly.” *Id.*, 67; *see also id.*, 71 (“[c]onnections must be created stating the requested service level”). Thus, a POSITA would have understood the requests issued by the IPs comprise desired connection properties. Ex-1003 ¶194.

As described in Ground I, Drake similarly describes that an application in a source station (*i.e.*, first module) “requests a QoS connection” and that it directs

these requests to a “QoS requestor manager” (*i.e.*, communication manager). *See* VII.A.7.b.

c. Claim 6[b]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶196. As discussed in Ground 1, Drake describes that, having received a request for a connection, the QoS requestor manager (*i.e.*, communication manager) “assemble[s] a request to reserve a QoS connection” and forwards the request to the QoS allocator (*i.e.*, resource manager). *See* VII.A.7.c. Additionally, as discussed regarding element 1[e], both Goossens2003 and Drake describe the requested connections comprise communication channels each having a specific set of connection properties. *See* VII.B.2.f.

d. Claim 6[c]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶197. As discussed in Ground I, Drake describes that, when the QoS allocator receives requests for connections with certain QoS properties, it “examine[s] the resources” of the network to determine whether those requests can be satisfied and sends a “QoS allocation reply” to the QoS requestor manager (*i.e.*, communication manager) which indicates, among other things, whether the requested connection and connection properties are available. *See* VII.A.7.d.

e. Claim 6[d]

Goossens2003 in view of Drake renders this limitation obvious. Ex-1003 ¶198. Goossens2003 describes that a request for a connection will be granted and the connection established if the NoC “has sufficient resources available.” Ex-1007, 67. Likewise, as discussed in Ground I, Drake describes that, if the QoS allocator determines that the requested QoS properties are available, the requested connection between the source and target stations is established and required resources are reserved. *See* VII.A.7.e.

8. Claim 9

Claim 2 is obvious. *See* VII.B.3. This limitation is disclosed by Goossens2003. Ex-1003 ¶199. Goossens2003 explains that, in its SOC, “network interfaces” translate between the “transport layer” utilized by the IPs to request services and the “network layer” utilized by the routers of the NOC to transport data. Ex-1007, 74; *see also id.*, 75 (describing “network interface to network interface” communications). Goossens2003 further describes that “IPs negotiate with network interfaces to obtain connections with certain properties” and reserve network resources. *Id.*, 76–77. As such, a POSITA would have understood that these network interfaces manage the communications between the IPs (*i.e.*, modules) and the NOC (*i.e.*, network). Ex-1003 ¶¶199–200. The position of these

network interfaces between the IP modules and the NOC is shown in Goossens2003's Figure 4.5.

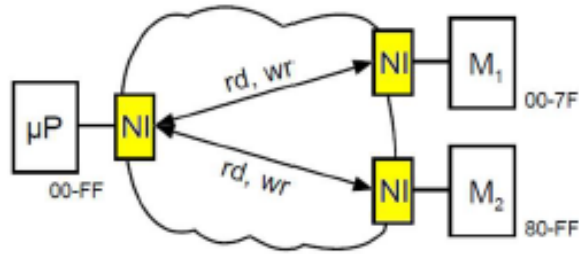


Figure 4.5. A narrowcast connection.

Ex-1007, Fig 4.5 (annotated).

9. Claim 10

Goossens2003 in view of Drake teaches all the limitations of claim 10, and thus would have rendered that claim obvious. Ex-1003 ¶201.

a. Claim 10[pre]

i. Claim 10[pre.1]

If limiting, Goossens2003 discloses this part of the preamble. Ex-1003 ¶202. As discussed regarding elements 1[pre]–1[b] and 1[d], Goossens2003 describes an SoC (*i.e.*, integrated circuit) in which multiple IP blocks (*i.e.*, modules) communicate with one another over connections via a “network on chip.” *See* VII.B.2.a, VII.B.2.b, VII.B.2.c, VII.B.2.e.

ii. Claim 10[pre.2]

If limiting, this part of the preamble is disclosed by Goossens2003 and/or rendered obvious by Goossens2003 in view of Drake for the same reasons as element 1[e], including under the construction of “independently configurable” proposed by PO. *See* VII.B.2.f; Ex-1030, 13; Ex-1003 ¶203.

iii. Claim 10[pre.3]

If limiting, Goossens2003 discloses this part of the preamble for the same reasons as element 1[f]. *See* VII.B.2.g; Ex-1003 ¶204.

b. Claim 10[a]

This limitation is obvious for the same reasons as element 6[a]. *See* VII.B.7.b; Ex-1003 ¶205.

c. Claim 10[b]

This limitation is obvious for the same reasons as element 6[b]. *See* VII.B.7.c; Ex-1003 ¶206.

d. Claim 10[c]

This limitation is obvious for the same reasons as element 1[g]. *See* VII.B.2.h; Ex-1003 ¶207.

e. Claim 10[d]

This limitation is obvious for the same reasons as element 6[c]. *See* VII.B.7.d; Ex-1003 ¶208.

f. Claim 10[e]

This limitation is obvious for the same reasons as element 6[d]. *See* VII.B.7.e; Ex-1003 ¶209.

10. Claim 11

Claim 10 is obvious. *See* VII.B.9. This limitation is disclosed by Goossens2003 for the same reasons as claim 3. *See* VII.B.4; Ex-1003 ¶210.

11. Claim 12

Claim 10 is obvious. *See* VII.B.9. This limitation is disclosed by Goossens2003 for the same reasons as claim 4. *See* VII.B.5; Ex-1003 ¶211.

12. Claim 13

Claim 10 is obvious. *See* VII.B.9. This limitation is disclosed by Goossens2003 for the reasons described regarding claim 5. *See* VII.B.6; Ex-1003 ¶212. A POSITA would have understood that Goossens2003 discloses the claimed property of “flow control,” including under PO’s proposed construction. Ex-1019, 6; Ex-1007, 69 (describing “reserving buffer resources at the receiver” and “using end-to-end flow control to constrain the sender to never send more than the available space”), 77; Ex-1003 ¶212.

13. Claim 14

Claim 10 is obvious. *See* VII.B.9. This limitation is rendered obvious by Goossens2003 in view of Drake. Ex-1003 ¶213. As discussed in Ground I, Drake

describes that its QoS allocator (*i.e.*, resource manager) determines whether a requested connection is available by referencing a “QoS allocation data base” (*i.e.*, a centralized property table), which contains information regarding the properties associated with the components of the network and the resources reserved by previously allocated connections. *See* VII.A.13.

14. Claim 15

Claim 10 is obvious. *See* VII.B.9. In addition, as discussed in Ground I, Drake describes that, when the QoS allocator (*i.e.*, resource manager) determines that a requested connection is available, the QoS allocator reserves the resources required for the requested connection. *See* VII.A.14. Goossens2003 likewise describes that “[c]onnection acceptance may lead to resource reservations in the NOC.” Ex-1007, 71; Ex-1003 ¶214.

15. Claim 16

Claim 10 is obvious. *See* VII.B.9. This limitation is disclosed by Goossens2003 for the same reasons as claim 5. *See* VII.B.6; Ex-1003 ¶¶215–216.

VIII. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

Evaluation of the factors under *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (P.T.A.B. Mar. 20, 2020) (precedential) as well as the clarifications in the June 2022 Director’s Memorandum show that discretionary denial under Section 314(a) would not be appropriate.

None of the parties have requested a stay; *Fintiv* **factor 1** is neutral.

Factor 2 is the proximity of the district court’s trial date to the projected statutory deadline. This factor strongly favors institution, as there no trial date set yet for the Texas case. Ex-1033, ¶18 (“The trial date will be determined at a later date by the Court.”). The fact that no trial date has been set yet weighs strongly discretionary denial because any attempt to argue that trial may occur prior to a final written decision would necessarily rely largely on speculation. *E.g., Oticon Med. AB v. Cochlear Ltd.*, IPR2019-00975, Paper 15 at 23–24 (PTAB Oct. 16, 2019) (designated precedential in relevant part) (lack of trial date weighs against discretionary denial, even when discovery is “well underway”); *Micron Tech., Inc. v. Godo Kaisha IP Bridge 1*, IPR2020-01008, Paper 10 at 12 (PTAB Dec. 7, 2020).

To the extent the PO tries to speculate using median time-to-trial statistics, the Board has found such statistics of minimal value when there is not a scheduled trial date. *E.g., Tesla, Inc., v. Charge Fusion Techs., LLC*, IPR2023-00062, Paper 13 at 14 (PTAB May 11, 2023).

The Texas case is still in the early stages and no substantive orders have been issued, including no claim construction order (**factor 3**). Fact discovery remains open for at least 4 months. Ex-1033, ¶10. Expert reports are not due for at least 5 months (again well after any institution decision), and expert discovery does not begin until after that. Ex-1033, ¶¶12-14. The early stage of the Texas

case weighs against discretionary denial. *See, e.g., Google LLC, v. Jawbone Innovations, LLC*, IPR2022-01027, Paper 11 at 12 (PTAB Dec. 5, 2022) (fact discovery ongoing, expert discovery not started).

Three of the ten challenged claims are not at issue in the district court case PO brought against Petitioner (this Petition challenges claims 2, 6, 9-16; PO asserted claims 10-16 in the district court case). Thus, there will be issues this Petition addresses (including the validity of claims 2, 6, and 9) that do not overlap with any Texas case trial (**factor 4**). This factor weighs against discretionary denial.

The petitioner here (Qualcomm) is a defendant in the Texas case; there is currently also another defendant in the Texas case (Arteris, Inc.) (**factor 5**).

The merits of this Petition (**factor 6**) are particularly strong, as explained above and further below.

Thus, at least four of the six *Fintiv* factors weigh against discretionary denial; none clearly weighs in favor. The Board should not discretionarily deny this Petition.

Additionally, as demonstrated in Section VII, the Petition presents “compelling” arguments for unpatentability of the Challenged Claims based on the same features and functionality described in the specification of the ’449 Patent. *See* Director’s Memorandum at 4–5 (“the PTAB will not deny institution based on

Fintiv if there is compelling evidence of unpatentability”); *see also CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 3-5 (P.T.A.B. Feb. 27, 2023) (precedential) (evidence is compelling when it is “highly likely that the petitioner would prevail with respect to at least one challenged claim”). Institution is consistent with the significant public interest against “leaving bad patents enforceable.” *Thryv, Inc v. Click-To-Call Techs., LP*, 590 U.S. 45, 55 (2020).

IX. MANDATORY NOTICES

A. Real Party-In-Interest

Qualcomm Incorporated and Qualcomm Technologies, Inc. are the real parties-in-interest.

B. Related Matters

The '449 Patent is the subject of multiple parallel proceedings in the Eastern District of Texas and Western District of Texas, *Network System Technologies, LLC v. Samsung Electronics Co., Ltd. et al.*, No. 2:22-cv-00481 (E.D. Tex.); *Network System Technologies, LLC v. Texas Instruments Inc.*, No. 2:22-cv-00482 (E.D. Tex.); *Network System Technologies, LLC v. Lenovo Group Ltd.*, No. 2:23-cv-00167 (E.D. Tex.); *Network System Technologies, LLC v. Ford Motor Co.*, No. 2:23-cv-00440 (E.D. Tex.); *Network System Technologies, LLC v. OnePlus Technology (Shenzhen) Co., Ltd.*, No. 1:23-cv-00520 (E.D. Tex.); *Network System Technologies, LLC v. Qualcomm Inc. et al.*, No. 1:22-cv-01331 (W.D. Tex.). The

'449 Patent is also subject to IPR in *Samsung Electronics Co., Ltd. v. Network System Technologies, LLC*, IPR2024-00338 (PTAB). Petitioner intends to join this IPR. These actions may affect, or be affected by, decisions in this proceeding. Nothing herein should be taken as an endorsement of NST's positions in the co-pending litigations.

C. Counsel Information

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D. Service Information

Please address all correspondence to lead and back-up counsel at the addresses shown above. Petitioners consent to electronic service by e-mail.

XI. PAYMENT OF FEES

The Board is authorized to charge Carlson Caspers Vandenburg & Lindquist, P.A.'s deposit account, No. 50-2880, for all fees required for filing this IPR.

XII. CERTIFICATION

Petitioner certifies that the '449 Patent is available for IPR and that Petitioner, in view of its concurrently filed motion for joinder, is not barred or estopped from requesting review of the challenged claims of the '449 Patent on the grounds identified herein. 37 C.F.R. § 42.122(b) ("The time period set forth in § 42.101(b) shall not apply when the petition is accompanied by a request for joinder.").

XIII. CONCLUSION

Petitioner requests institution of an IPR and cancellation of the Challenged Claims.

Dated: June 21, 2024

Respectfully submitted,

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Claims Listing Appendix

U.S. Patent No. 7,373,449

Challenged Claims 2, 6, 9-16 (PO has disclaimed claims 1, 3, 4, and 5)

Claim Element	Limitation
1[pre]	Integrated circuit comprising:
1[a]	a plurality of processing modules (M; I; S; T),
1[b]	network (N; RN), and
1[c]	at least one resource manager (RM) for managing resources of the network (N),
1[d]	wherein the modules, network and resource manager are disposed on a chip and arranged for providing at least one connection between a first and at least one second module,
1[e]	wherein the at least one connection comprises a set of communication channels each having a set of connection properties, the connection properties of the different communication channels of said connection being adjustable independently,
1[f]	wherein said connection supports transactions comprising at least one of outgoing messages from the first module to the second module and return messages from the second module to the first module,
1[g]	wherein the resource manager determines whether the at least one connection with said communication channels is available based on the connection properties being available.
2	Integrated circuit according to claim 1, further comprising: at least one communication manager (CM) for managing the communication between different modules.
3	The Integrated circuit of claim 1, further comprising at least one of a switch and a router.
4	The Integrated circuit of claim 1, further comprising a chip, wherein the processing modules and the network are disposed on said chip.
5	The Integrated circuit of claim 1, wherein the connection properties comprise at least one of data transport ordering, flow control, throughput, latency, and lossiness.
6[pre]	Integrated circuit according to claim 2,

6[a]	wherein said first module (M; I) is adapted to issue a request (REQ) for a connection with at least one of said second modules to said communication manager (CM),
6[b]	said communication manager (CM) is adapted to forward said request (REQ) for a connection with communication channels each having a specific set of connection properties to said resource manager (RM),
6[c]	said resource manager (RM) responding with the availability of the requested connection to said communication manager (CM),
6[d]	wherein a connection between the first and second module is established based on the available properties of said communication channels of said connection.
9	Integrated circuit according to claim 2, further comprising: at least one network interface means (NI), associated to each of said modules, for managing the communication between said modules and said network (N).
10[pre.1]	Method for exchanging messages in an integrated circuit comprising a plurality of modules,
10[pre.2]	the messages between the modules being exchanged over connections via a network,
10[pre.3]	wherein said connections comprises a set of communication channels each having a set of connection properties, any communication channel being independently configurable,
10[pre.4]	wherein said connection through the network supports transactions comprising at least one of outgoing messages from the first module to the second module and return messages from the second module to the first module and further comprising the steps of:
10[a]	the first module issuing a request for a connection with the second module to a communication manager,
10[b]	wherein the request comprises desired connection properties associated with the sets of communication channels;
10[c]	the communication manager forwarding the request to a resource manager;
10[d]	the resource manager determining whether a target connection with the desired connection properties is available;
10[e]	the resource manager responding with the availability of the target connection to the communication manager; and
10[f]	the target connection between the first and second module being established based on the available properties of said communication channels of said connection.

11	The method of claim 10, wherein the network manages traffic utilizing at least one of a switch and a router.
12	The method of claim 10, wherein the processing modules and the network are disposed on a chip.
13	The method of claim 10, wherein the connection properties comprise at least one of data transport ordering, flow control, throughput, latency, and lossiness.
14	The method of claim 10, further comprising the resource manager determining whether the target connection with the desired connection properties is available based on reading of a centralized or distributed property table comprising properties associated with the network.
15	The method of claim 10, further comprising the resource manager reserving the target connection after determining whether the target connection with the desired connection properties is available.
16	The method of claim 10, wherein the connection properties comprise at least one of throughput, latency and jitter.

CERTIFICATE OF COMPLIANCE

This petition complies with the type-volume limitations as mandated in 37 C.F.R. § 42.24, totaling 13,994 words. Counsel has relied upon the word count feature provided by Microsoft Word.

/J. Derek Vandenburg/
J. Derek Vandenburg (Reg. No. 32,179)

CERTIFICATE OF SERVICE

I certify that on June 21, 2024, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 7,373,449 and supporting exhibits to be served via overnight delivery on the Patent Owner at the following correspondence address of record as listed on PAIR:

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A courtesy copy was also sent via electronic mail to Patent Owner's litigation counsel listed below:

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