

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS INC.,

Petitioner

U.S. Patent No. 7,616,601

**DECLARATION OF R. MICHAEL BUEHRER,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW**

Ex.1003

CISCO SYSTEMS, INC. / Page 1 of 146

Table of Contents

I.	INTRODUCTION	4
II.	QUALIFICATIONS	5
III.	LEVEL OF ORDINARY SKILL IN THE ART	11
IV.	RELEVANT LEGAL STANDARDS	12
V.	OVERVIEW OF THE TECHNOLOGY	13
A.	Cellular Networks	14
B.	Quality of Service (“QoS”)	18
VI.	THE ’601 PATENT	23
A.	Summary of the ’601 Patent	23
B.	Prosecution History of the ’601 Patent	26
VII.	CLAIM CONSTRUCTION	27
A.	“ <i>Network Resource Manager (NRM)</i> ”	28
VIII.	DETAILED UNPATENTABILITY ANALYSIS	29
A.	Ground 1: Claims 1-8 are Obvious over Patel-225 in combination with Schelen-1999 and Schelen-1997	30
1.	Summary of Patel-225	30
2.	Summary of Schelen-1999 and Schelen-1997	36
3.	Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225	39
4.	Claim 1	62
5.	Claim 2	115
6.	Claim 3	116
7.	Claim 4	116
8.	Claim 5	117
9.	Claim 6	120
10.	Claim 7	123

11. Claim 8	125
B. Ground 2: Claims 2-5 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, and Patel-764	126
1. Summary of Patel-764.....	126
2. Reasons to Combine Patel-764 with Patel-225.....	128
3. Claim 2	130
4. Claims 3-4	133
5. Claim 5	133
C. Ground 3: Claim 9 is Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, and Degermark	135
1. Summary of Degermark.....	135
2. Reasons to Combine Degermark with Patel-225	137
3. Claim 9	139
D. Ground 4: Claims 1-8 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, and Patel-624	141
1. Summary of Patel-185 and Patel-624	141
2. Reasons to Combine Patel-185 and Patel-624 with Patel-225	142
3. Claim 1	144
4. Claims 2-8	145
E. Ground 5: Claims 2-5 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, Patel-624, and Patel-764	145
1. Claims 2-5	145
F. Ground 6: Claim 9 is Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, Patel-624, and Degermark	146
1. Claim 9	146
IX. DECLARATION.....	146

I, R. Michael Buehrer, Ph.D., do hereby declare as follows:

I. INTRODUCTION

1. I am making this Declaration at the request of Cisco Systems, Inc. in the matter of the *Inter Partes* Review of U.S. 7,616,601 (“the ’601 patent”).

2. I am being compensated for my work in this matter at my standard hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this proceeding. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

3. I have been asked to provide my opinions regarding whether the subject matter of claims 1-9 (“the Challenged Claims”) of the ’601 patent would have been obvious to a person having ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the prior art. I have reviewed the Petition and agree that the Challenged Claims would have been obvious to a POSITA.

4. In the preparation of this Declaration, I have studied:

- (1) The ’601 patent, Ex.1001;
- (2) Prosecution History of the ’601 patent, Ex.1002;
- (3) US 7,043,225 to Patel *et al.* (“Patel-225”), Ex.1005;
- (4) US 6,522,628 to Patel *et al.* (“Patel-628”), Ex.1006;
- (5) US 6,850,764 to Patel *et al.* (“Patel-764”), Ex.1007;
- (6) US 6,865,185 to Patel *et al.* (“Patel-185”), Ex.1008;

- (7) US 7,031,266 to Patel *et al.* (“Patel-266”), Ex.1009;
- (8) US 7,068,624 to Patel *et al.* (“Patel-624”), Ex.1010;
- (9) “Performance of QoS Agents for Provisioning Network Resources,” by Schelen *et al.* published by IEEE in 1999 (“Schelen-1999”), Ex.1011;
and
- (10) “Sharing resources through advance reservation agents,” by Schelen *et al.* published in Proceedings of IFIP Fifth International Workshop on Quality of Service (IWQoS'97), New York, May 1997 (“Schelen-1997”), Ex.1031.

5. In forming the opinions expressed below, I have considered: the documents listed above; the relevant legal standards, including the standard for obviousness; and my own knowledge and experience based upon my work in the field of wireless communications as described below, as well as any additional materials cited herein.

6. Unless otherwise noted, all emphasis in any quoted material has been added.

II. QUALIFICATIONS

7. The details of my background and education, and a listing of all publications that I have authored, are provided in my *Curriculum Vitae*, a copy of which is submitted as Ex.1004. The following is a brief summary of my relevant qualifications and professional experience.

8. My academic and professional background is in Electrical and Computer Engineering, and I have been working in those fields since the completion of my Ph.D. over 25 years ago. I received a B.S. in Electrical Engineering from The University of Toledo in 1991, an M.S. in Electrical Engineering from The University of Toledo in 1993, and a Ph.D. in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech) in 1996. The focus of my graduate work was wireless communication systems. My Ph.D. thesis involved the application of multiuser detection (an advanced signal processing approach to interference mitigation) to CDMA-based cellular systems.

9. After completion of my Ph.D. in 1996, I joined Bell Laboratories, the research division of Lucent Technologies, where I worked for five years as a Member of Technical Staff and later as a Distinguished Member of Technical Staff. My work there focused on developing advanced technologies for cellular telecommunication networks, including for 2G and 3G cellular standards. For example, while at Bell Labs, I developed and implemented algorithms for intelligent antenna systems which increased the voice capacity (i.e., number of simultaneous phone calls) and data capacity of cellular systems. These algorithms which allowed radio resource management to be done more efficiently were included in Lucent Technologies' 3G CDMA cellular base station. I also developed

techniques known as transmit diversity techniques which increased reliability (i.e., reduced the probability of a dropped call) of cellular systems. These transmit diversity techniques were standardized in the 3GPP2 cellular standard known as *cdma2000*. During that time, I supported the standardization of my ideas by writing contributions to the working groups developing the standards and attending standards meetings. In particular, I participated in the 3GPP2 standardization process. During that time, I worked with colleagues to include my ideas on the use of transmit diversity in CDMA systems in the 3GPP2 standard.

10. I am currently a Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Polytechnic Institute and State University, where I have taught and conducted research in the area of wireless communications for the past 21 years. Specifically, I have taught courses which cover wireless communications and signal processing (including the underlying concepts) at the undergraduate and graduate levels. For example, I teach a sophomore-level course which introduces the concepts of signals and systems, a junior-level course which introduces the basic concepts of communication systems, senior-level and graduate-level courses which cover advanced digital communication topics, and also graduate-level courses which teach the advanced technologies underlying the latest wireless systems, such as Fourth and Fifth Generation (4G/5G) cellular communication standards (e.g., LTE, LTE-Advanced, New Radio) and Wi-Fi. I

also teach graduate courses on advanced topics such as Information Theory, Machine Learning Applied to Communication Systems, Spread Spectrum Communications and CDMA.

11. I am also the director of *Wireless @ Virginia Tech*, a comprehensive research group focusing on wireless communications which consists of 14 faculty members and approximately 85 graduate students. My specific research focuses on advanced wireless communications, radar and geolocation techniques. This research has examined both advanced theoretical concepts as well as the application of these concepts to the latest wireless standards. As an example of the latter, I (along with my students) have conducted research applying multiuser/multi-antenna signal processing to LTE. I have also applied advanced geolocation techniques to LTE systems.

12. My research work has been funded by national agencies including the National Science Foundation (NSF), the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), the Army Research Lab, the Air Force Research Lab, as well as many industrial sponsors.

13. During 2009, I was a visiting researcher at the Laboratory for Telecommunication Sciences (LTS), a Federal Research Lab which focuses on telecommunication challenges for national defense. While at LTS, my research

focus was in the area of cognitive radio with a particular emphasis on statistical learning techniques.

14. I have authored and co-authored over 275 publications in my area of expertise, which have been published in the leading journals in my field including *IEEE Transactions on Communications*, *IEEE Transactions on Wireless Communications*, *IEEE Transactions on Information Theory*, *Proceedings of the IEEE*, and *IEEE Transactions on Signal Processing*, and at all of the major conferences in my field. This research has been cited more than 11,000 times. A complete list of my publications over the last 25 years is included in my Curriculum Vitae.

15. I am a Fellow of the IEEE (so named “for contributions to wideband signal processing in communications and geolocation”). In 2021 I (along with my student) received the Vanu Bose Best Paper Award at the IEEE Military Communications Conference (MILCOM). In 2010, I was awarded the Ellersick Best Paper Award in the Unclassified Technical Program, at the IEEE Military Communications Conference. I received the SDR Forum Best Paper Award in 2007 and the Outstanding Paper Award at the SDR Forum in 2008. I received the Dean’s Award for Teaching Excellence in April 2014 and the Dean’s Award for Outstanding New Assistant Professor, College of Engineering in 2003. While at Bell Laboratories, I was awarded the Bell Labs President’s Silver Award for

outstanding research contributions and the 1999 Best Paper Award in the Bell Labs Technical Journal.

16. As a consultant, I have examined in detail various aspects of the physical layer, MAC layer, RLC, and the control signaling of the standards for 2G, 3G, 4G and 5G cellular systems. I have also specifically studied the standardization process in 3GPP as it relates to the standardization of a particular aspect of 4G (LTE). I have also taught short-courses in the areas of cellular systems, geolocation and Wi-Fi communications.

17. I also hold 18 issued patents in the area of wireless communications, many of which relate to cellular communication systems.

18. From 2017-2022 I served as an area editor for *IEEE Transactions on Wireless Communications* supervising a team of 12 editors. I was formerly an associate editor for *IEEE Wireless Communications Letters*, *IEEE Transactions on Vehicular Technologies*, *IEEE Transactions on Communications*, *IEEE Transactions on Signal Processing*, and *IEEE Transactions on Education*. Additionally, I formerly served as the guest editor for the *IEEE Journal on Special Topics in Signal Processing* and *the Proceedings of the IEEE*. I served as the Technical Program Chair for the Signal Processing for Communications Symposium at the 2017 IEEE International Conference on Communications.

Previously, I was the Organizer and Technical Co-Chair for both the 2015 and 2016

IEEE Global Communications Conference Workshop on Localization and Tracking: Indoors, Outdoors and Emerging Networks (LION). I have also served on the technical program committees of several other conferences and workshops in my field.

III. LEVEL OF ORDINARY SKILL IN THE ART

19. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

20. I am familiar with the mobile telecommunication network art that is pertinent to the '601 patent. A POSITA in the field of the '601 patent, as of its earliest claimed priority date of January 16, 2001, would have been someone knowledgeable with the mobile telecommunication network techniques available at the time. Such a POSITA would include someone who had a bachelor's degree in computer science, computer engineering, electrical engineering, or an equivalent, and two years of experience working with wireless communication systems, including cellular networks that utilize IP based core networks. Lack of work experience can be remedied by additional education, and vice versa.

21. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my own experience and what a POSITA would have understood or known generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the relevant field as of the priority date of the '601 patent.

IV. RELEVANT LEGAL STANDARDS

22. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '601 patent, I am relying on certain legal principles that counsel has explained to me.

23. I understand that prior art to the '601 patent includes patents and printed publications in the relevant art that predate the priority date of the '601 patent. For purposes of this Declaration, I am applying the earliest claimed date of January 16, 2001, as the priority date of the '601 patent.

24. I have been informed by Cisco's counsel that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA. I have also been informed by Cisco's counsel that the obviousness analysis considers factual inquiries, including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

25. I have been further informed by Cisco's counsel that there are several recognized rationales for combining references or modifying a reference to show obviousness. These rationales include: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art or to combine prior art teachings to arrive at the claimed invention.

26. Also, I have been informed and understand that obviousness does not require physical combination/bodily incorporation, but rather consideration of what the combined teachings would have suggested to a POSITA at the time of the alleged invention.

V. OVERVIEW OF THE TECHNOLOGY

27. What follows is a brief background of the related technologies pertaining to the '601 patent, based on my experience and knowledge in the art.

A. Cellular Networks

28. Wireless networks or systems were known in the art. A wireless network typically covers a large area that is broken up into smaller areas called “coverage areas” (or “cells” in cellular systems), with each coverage area being served by a single access point (in WiFi) or base station (in cellular). Cellular base stations are fixed geographically and typically serve a large number of mobile or fixed remote nodes by providing these units access to a wireline network (e.g., the public switched telephone network, local wireline network, or the internet).

29. The first large scale commercial wireless communication systems were deployed in the 1980’s based on the above-mentioned cellular concept which was developed years earlier by Bell Laboratories. These first generation (“1G”) cellular systems were based on analog modulation and were focused on voice communications, essentially extending the telephone system to mobile users. The Advanced Mobile Phone System (“AMPS”) and the Nordic Mobile Telephone (“NMT”) are primary examples of 1G cellular in the US and Europe respectively.

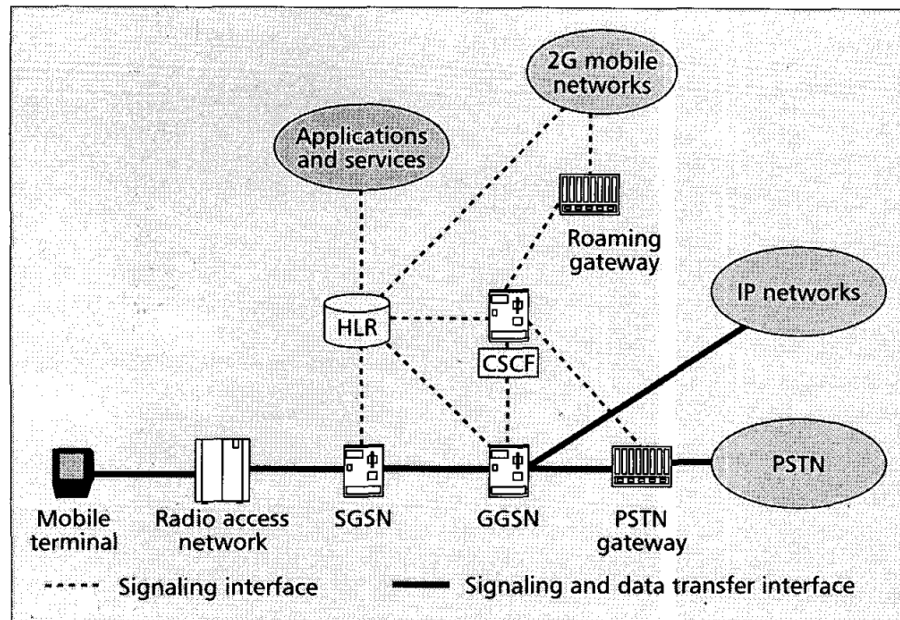
30. Second Generation (“2G”) systems were deployed in the 90’s and based on digital modulation techniques. These systems still focused on voice communications and are exemplified by Global System for Mobile communications (“GSM”), a pan-European system developed under the auspices of the European Telecommunication Standards Institute (“ETSI”). IS-54 or D-AMPS and IS-95

(“CDMA”) were contemporary US versions of 2G cellular telephony. I worked on IS-54 and IS-95 systems during my time at Bell Laboratories. GSM, in particular, fueled the development of a global standard for cellular which became a reality in later 4G cellular.

31. It should be noted both 1G and 2G cellular networks included a wireless radio portion and a wireline portion. Both the wireless and wireline portions were focused on circuit-switched connections similar to the public switched telephone network (“PSTN”). Specifically, 1G and 2G cellular networks relied on forms of Signaling System No. 7 (“SS7”) to set up and tear down circuit-switched connections. For reference, SS7 is an international telecommunication protocol standard for the PSTN, which specifies how information and control signals are exchanged.

32. By the late 1990’s the growth of cellular networks along with the growth of the Internet led to the realization that circuit-switched interfaces in cellular networks would not be efficient for the expected growth in traffic. Specifically, it was understood that Internet Protocol (“IP”) based packet switching would be beneficial in cellular networks to handle data service. This led to the development of General Packet Radio Service (“GPRS”) for GSM-based networks and Cellular Digital Packet Data (“CDPD”) for AMPS/IS-95/IS-136-based networks. GPRS was integrated into the existing GSM architecture by introducing

a new class of network nodes, called GPRS support nodes (GSNs). Ex.1017, 3-4. GSNs were responsible for the delivery and routing of data packets between the mobile stations and the external packet data networks (PDN). An overview of the GPRS network is shown in the figure below. Ex.1015, Fig. 1.



■ **Figure 1.** *The 3GPP IP reference architecture.*

Ex.1015, Figure 1.

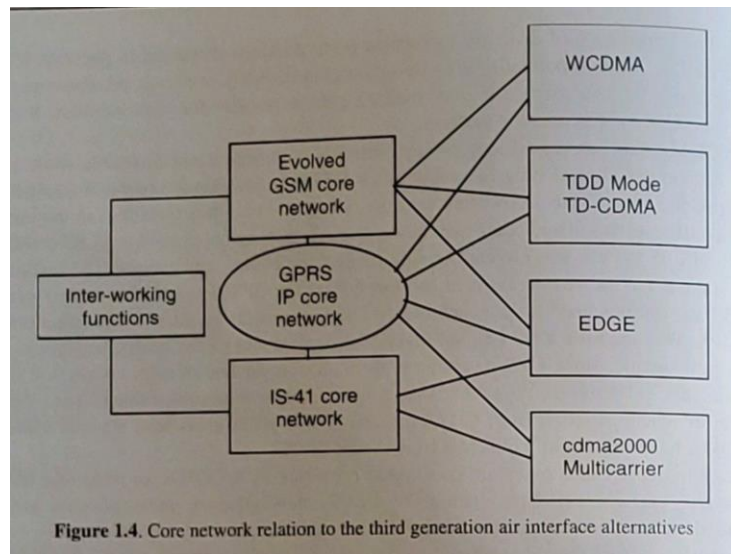
33. Third Generation (“3G”) telephony, which was developed in the mid to late 90’s, saw the more complete extension of cellular to data transmission in addition to voice communications. While these 3G systems, such as *cdma2000* in the US and the Universal Mobile Telecommunications System (“UMTS”) in

Europe¹, were intended to accommodate data communications, their focus on voice communications meant that they were still primarily based on voice-centric technologies such as circuit switching and an air interface based on CDMA. The air interface as well as technologies such as the transmit diversity techniques and intelligent antenna systems that my colleagues and I developed at Bell Labs in the late 90's helped increase both the voice capacity and the data capacity of such systems. Release '99 of the Third Generation Partnership Project (3GPP) provided the initial specification for UMTS, which were widely deployed in the early 2000's. On the other hand, *cdma2000* was developed by a parallel body known as 3GPP2. During my time at Bell Labs I contributed to the standardization of *cdma2000* by providing technical contributions and presentations at 3GPP2 meetings.

34. 3GPP-based 3G systems utilized a Radio Access Network ("RAN") and a Core Network ("CN") that supported a circuit-switch based network for voice traffic and a packet-switched network (based on the GPRS network) for data traffic. *See e.g.*, Ex.1013, 3:3-13 ("The general system architecture of UMTS/IMT 2000 includes User Equipment (UE), UMTS Terrestrial Radio Access Network

¹ UMTS is the more general term used for this group of specifications authored by 3GPP. However, it is often referred to as wideband CDMA (WCDMA) due to the air-interface used. *See* Ex.1013, 16:53-56 ("WCDMA (UMTS)").

(UTRAN) and the Core Network.”). It was understood that the advent of IP technologies, along with the tremendous growth in data traffic during the 1990’s, meant that the CN would support IP technology. Ex.1015, Introduction. This can be seen in the following figure which illustrates the relationship between emerging 3G air-interfaces and CN.



Ex.1018, Figure 1.4.

B. Quality of Service (“QoS”)

35. As cellular networks evolved from circuit switched to packet switched technology—becoming IP based—there was a need to provide Quality of Service (“QoS”) for cellular networks that paralleled IP networks. Quality of Service was guaranteed in circuit switched networks since each connection received guaranteed resources. This was not true in early packet switched networks based on IP. Early

IP networks were “best effort” networks where there were no guarantees. This is because the original TCP/IP protocol suite was built on the idea of fair and equitable access to all and no special treatment for any traffic. Also, the internal workings of early routers used a first-in, first-out queuing strategy. If more packets arrived than the router could handle and the queue filled up, newly arriving packets (the tail of the queue) were simply dropped. Ex.1016, 84.

36. However, in the mid-90’s the concept of QoS was introduced to IP-networks. In 1994, the Internet community began work to define an Integrated Services Architecture (“IntServ”) that would extend the existing IP architectural model to support both real-time and best-effort traffic flows. Ex.1016, 85. The IntServ architecture relied on a protocol known as the Resource Reservation Protocol (“RSVP”). With RSVP, the application source (the sender) transmitted a Path message along the routed path to the destination to both mark the routed path between the sender and receiver and to collect information about the QoS viability of each router along that path. Ex.1016, 85.

37. Upon receiving the Path message, the destination gauged what services the network could support and generated an RSVP reservation (“Resv”) message. The Resv message contained traffic and QoS objects that were processed by the traffic control component of each router as it followed the reverse path back to the sender. If each router had sufficient capacity, resources along the path back toward

Ex.1003

the receiver were reserved for that flow. If resources were not available, RSVP error messages were generated and returned to the receiver.

38. In certain instances, RSVP did not scale well, leading to the development of a QoS technique for IP networks known as Differentiated Services (“DiffServ”). The approach taken by DiffServ was to classify individual micro-flows at the edge of the network into one of several unique service classes (such as premium, gold, silver, bronze, etc.) and then apply a per-class service in the middle of the network. Ex.1005, 6:32-39. The classification is performed at the network ingress based on an analysis of one or more fields in the packet. The packet is then marked as belonging to a particular service class and injected into the network. The core routers that forward the packet examined the code points in the packet header to determine how the packet should be treated (for example, what transmission queue the packet should be placed in). Ex.1016, 85-87.

39. An early issue with DiffServe concerned the extension of DiffServ across network or ISP boundaries as it would require some form of bilateral agreement and coordination between networks. Ex.1016, 86. However, by the late 90’s it was understood that a solution to this problem was the use of a bandwidth broker in each domain to manage DiffServ policies and communicate that information across network/ISP boundaries to other bandwidth brokers of other domains. Ex.1005, 1:44-66. Such an approach was termed a two-tier resource

Ex.1003

management model which allowed individual administrative domains to independently perform internal resource management and QoS support. All aggregate traffic crossing domain borders was served according to bilateral agreements between domains. Overall end-to-end QoS support was achieved through the concatenation of such agreements. Ex.1021, 1-3.

40. A *bandwidth broker* was first introduced by Van Jacobson 1997 as the logical entity that may be centralized or distributed in a domain. Ex.1025, 5. A bandwidth broker was the locus of control for a domain's resource management, and had two specific roles: (1) Intra-domain resource allocation; and (2) Inter-domain resource allocation. Ex.1005, 1:44-66; Ex.1021, 4.

41. I note that the '601 patent uses the term "Network Resource Manager" ("NRM") to refer to a bandwidth broker. *See, e.g.*, Ex.1001, 7:46-66, Abstract. The '601 patent specification explains that the NRM "is further described in 'Schelen, O. Quality of Service Agents in the Internet, Doctoral Thesis, Department of Computer Science and Electrical Engineering, Division of Computer Communication, Luleå University of Technology, Luleå 1998,'" (filed as Ex.1012, "Schelen Thesis"). Ex.1001, 7:46-66, Ex.1012, ("Schelen Thesis"). Schelen, who is a named inventor, subsequently published in 1999 an IEEE paper, titled "Performance of QoS Agents for Provisioning Network Resources," (filed as Ex.1011, which explains that "a topology-aware QoS agent [is] also known as a

Ex.1003

bandwidth broker.” Ex.1011, Abstract. Thus, a POSITA would have understood that the ’601 patent’s “NRM” corresponds to and may be referred to as an “agent” or a “bandwidth broker.”

42. These technologies worked to provide end-to-end QoS in wireless and wireline IP-based networks. For example, in UMTS, the UMTS bearer handled QoS requirements through the entire UMTS network while the Radio Access Bearer Service provided QoS across the air interface and the Core Network Bearer Service provided QoS through the UMTS core network. Ex.1018, 10-15. To describe QoS requirements, UMTS defined four QoS classes: the conversational class, the streaming class, the interactive class, and the background class. Each class had its own bandwidth, delay and data integrity requirements. The conversational class had the most restrictive delay requirements, while the background class had the least restrictive delay requirements. Ex.1018, 10-15. It was well understood that for end-to-end QoS to be provided, QoS would need to be handled across multiple networks both wireless and wireline. This is seen in the illustration below which illustrates the UMTS Bearer Service as one link in the overall end-to-end QoS service from terminal equipment to terminal equipment.

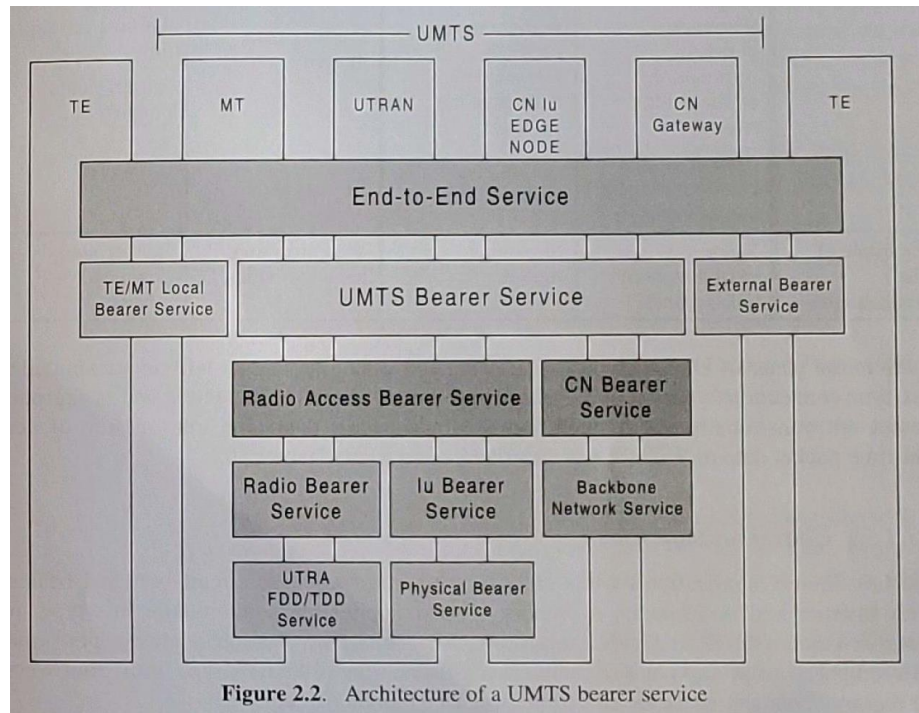


Figure 2.2. Architecture of a UMTS bearer service

Ex.1018, Figure 2.2.

VI. THE '601 PATENT

A. Summary of the '601 Patent

43. The '601 patent, titled “Network Resource Manager in a Mobile Telecommunication System,” is based on a PCT filed on December 20, 2001, and claims priority to a provisional application filed January 16, 2001. Ex.1001, Cover.

44. The '601 patent relates generally to a method and arrangement for providing end-to-end Quality of Service (QoS) within a mobile telecommunication system. Ex.1001, Abstract. More specifically, the '601 patent describes a “Network Resource Manager (NRM)” for facilitating end-to-end QoS across networks in “a mobile telecommunication system comprising at least one network means e.g. a

Ex.1003

Core Network (CN) connected to at least one Radio Access Network (RAN), using Internet Protocol (IP) based transmission.” Ex.1001, 1:15-24, 5:10-23.

45. The “NRM controls network resources in a limited part of a network, in a network domain.” 7:46-47. “In order to provide network resource management in large systems/networks where many NRMs are needed, NRMs can interact, i.e. signal resource request to each other.” Ex.1001, 7:51-54. “However, in some scenarios the NRMs are not required to be able to signal to each other, e.g. when there is no need for inter-domain communication and one domain is controlled by one NRM.” Ex.1001, 7:56-59.

46. “Preferred embodiments of the present invention” describe that the NRM provides the following functionality:

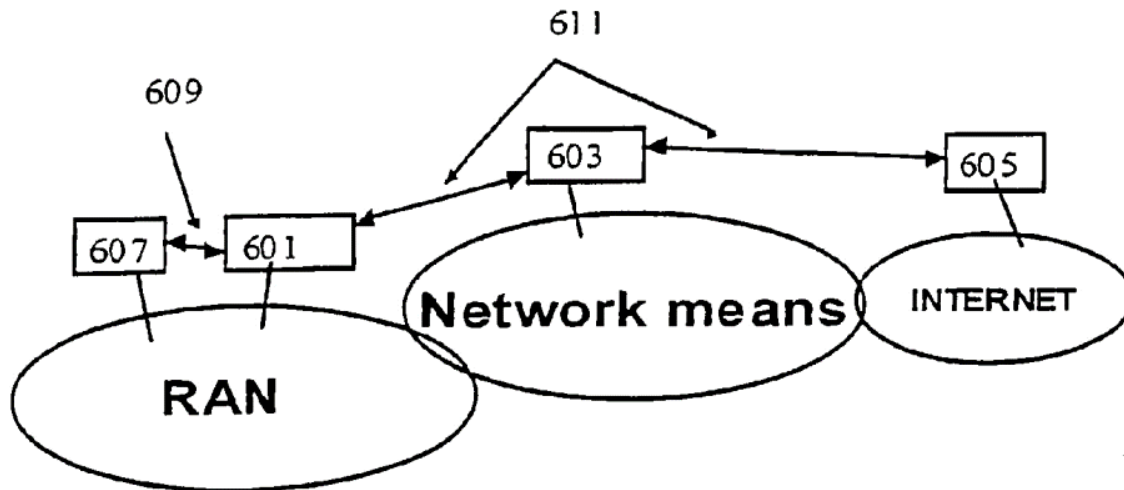
dynamic awareness of network topology and network characteristics,
path-sensitive call admission control, that is parameter and/or
measurement based,
scheduling of resources over time,
capability to handle resource requests for immediate and future use,
resource signalling between resource manager entities,
coupling of the described NRM entity with radio resource
management function/entity that manages the radio resources within
the RAN.

Ex.1001, 6:8-23; *see also* 6:44-7:24.

47. The system also uses a radio resource manager (also referred to as a bearer service manager) to manage radio resources within the RAN. Ex.1001, 3:1-5, 6:28-30, 8:32-34. “The NRMs and the bearer service manager, that controls the radio resources within the wireless part, communicate hence their resource needs between each other through the system in order to obtain end-to-end QoS.”

Ex.1001, 10:8-11.

48. Figure 6 illustrated below illustrates an embodiment where the system includes NRM 601, 603, and 605 that communicate with each other and a radio resource manager 607.



Ex.1001, Fig. 6.

49. Independent claim 1 of the '601 patent is reproduced below:

Ex.1003

1. A method for providing end-to-end Quality of Service (QoS) within a mobile telecommunication system comprising a Core Network (CN) connected to at least one Radio Access Network (RAN) using Internet Protocol (IP) based transmission, the method comprising the steps of:

handling radio resources within the RAN by using a radio resource manager;

controlling IP network resources by using a resource map in a Network Resource Manager (NRM) in order to provide said end-to-end QoS, the step of controlling the IP network resources including the steps of the NRM performing path-sensitive call admission control by using the resource map in the NRM, the NRM checking that resources are available along a path, and the NRM pre-allocating resources in an IP network;

scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM;

communicating resource information between the NRM and the radio resource manager; and

reserving the IP network resources along the path by the NRM to fulfill the end-to-end QoS.

B. Prosecution History of the '601 Patent

50. The '601 patent is based on PCT No. PCT/SE01/02847, filed on December 20, 2001, and claims priority to Provisional application No. 60/261,166, filed on January 16, 2001.

51. After numerous Office Actions and responsive amendments, the claims of the '601 patent were allowed by the examiner over the Schelén, O. Doctoral Thesis, "Quality of Service Agents in the Internet", Luleå Tekniska Universitet,

1998:26 ISSN: 1402-1544; pp. 39-42. and U.S. 6,631,122 to Arunachalam *et al.*,
with the following reason for allowance. Ex.1002, 38.

However, *Schelen*, *Arunachalam*, and the other prior art of record fail to teach
“communicating resource information between the NRM and the radio resource
manager and reserving the IP network resources along the path by the NRM to fulfill the
end-to-end QoS” in combination with the other limitations of claim **32**.

52. Notably, as I demonstrate below, there is nothing novel about the Challenged Claims of the '601 patent because all of the claimed features, including the features identified by the examiner, were known in the art and it would have been obvious to combine the relevant prior art teachings as claimed. Specifically, the primary reference Patel-225 discloses communicating resource information between the bandwidth broker and the radio resource manager (Ex.1005, 5:33-6:2, see analysis at limitation [1.7]) while *Schelen*-1999 and *Schelen*-1997 discloses that the bandwidth broker reserves IP network resources along the path to fulfill end-to-end QoS (Ex.1011, Abstract, Scope and layout; Ex.1031, 265-266, see analysis at limitation [1.8]). The features identified by the examiner were not novel.

VII. CLAIM CONSTRUCTION

53. It is my understanding that in order to properly evaluate the '601 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called

Ex.1003

Phillips standard, under which claim terms are given their ordinary and customary meaning as would have been understood by a POSITA in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. I have also been informed that claim terms only need to be construed to the extent necessary to resolve the obviousness inquiry.

54. I have reviewed the entirety of the '601 patent, as well as its prosecution history. It is my opinion that for purposes of applying the prior art presented herein to evaluate the patentability of the claims the claim terms do not require express construction. Accordingly, I have applied the so-called *Phillips* standard in the unpatentability analysis. Below, for clarity, I discuss examples to provide context and understanding of the term “*Network Resource Manager (NRM)*.”

A. “*Network Resource Manager (NRM)*”

55. The term “*Network Resource Manager (NRM)*” is recited in all the independent claims of the '601 patent. The '601 patent states that the “NRM is further described in ‘Schelen, O. Quality of Service Agents in the Internet, Doctoral Thesis, Department of Computer Science and Electrical Engineering, Division of Computer Communication, Luleå University of Technology, Luleå 1998’” (“Schelen Thesis,” Ex.1012). Ex.1001, 7:59-64. The Schelen Thesis describes the NRM as a Quality of Service agent, reservation agent, or bandwidth broker.

Ex.1012, 1, 25 (“Quality of Service Agents” “The concept of a bandwidth broker is

Ex.1003

similar to our reservation agent.”). Accordingly, a POSITA would have understood that the terms agent and bandwidth broker are synonymous with the ’601 patent’s NRM. As I have summarized above in the Overview of Technology section, the concept of bandwidth broker (or NRM) is not new and was known in the art prior to the ’601 patent.

56. I note also that according to the ’601 patent, the “NRM can be implemented in software or hardware and it can run as a standalone node or run on the same node as other functionality.” Ex.1001, 6:24-29. The NRM can also be “distributed to run on multiple nodes (e.g. the RAN, the CN and the Internet) and/or distributed geographically over a network.” Ex.1001, 6:40-43.

57. Thus, a POSITA would have understood term “*Network Resource Manager (NRM)*” to include a centralized or distributed agent or bandwidth broker.

VIII. DETAILED UNPATENTABILITY ANALYSIS

58. I have been asked to provide my opinion as to whether the Challenged Claims of the ’601 patent would have been obvious in view of the prior art. In rendering my opinion, I have considered the scope and content of the prior art and any potential differences between the claimed subject matter and the prior art. I have also considered the level of ordinary skill in the pertinent art as well as the knowledge of a POSITA as of the earliest claimed priority date of the ’601 patent: January 16, 2001.

59. As I discuss below, it is my opinion that the claimed subject matter of the Challenged Claims of the '601 patent would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA.

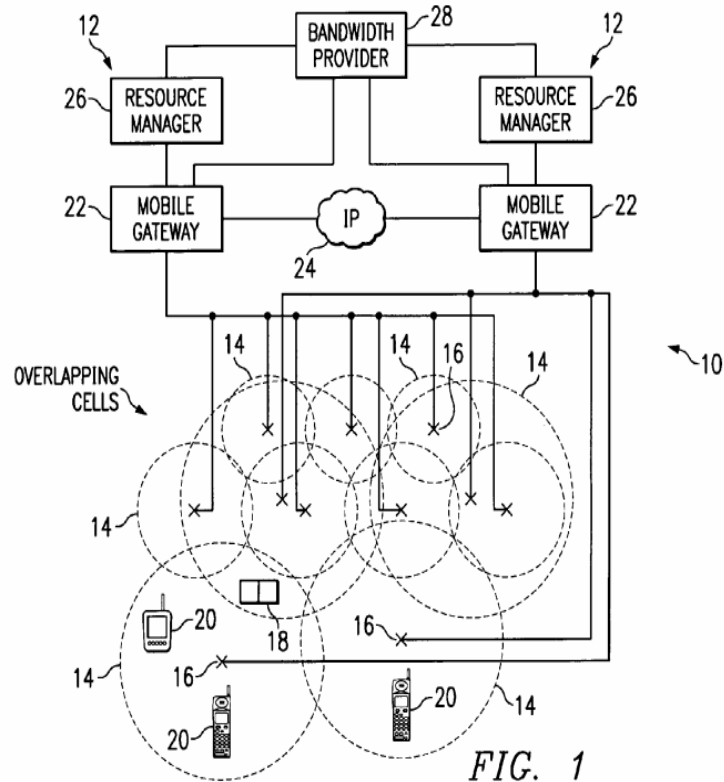
A. Ground 1: Claims 1-8 are Obvious over Patel-225 in combination with Schelen-1999 and Schelen-1997

1. Summary of Patel-225

60. The primary reference that I rely upon is U.S. 7,043,225 to Patel *et al.* (Ex.1005, "Patel-225"), which was filed by Cisco Systems, Inc. on February 25, 2000.

61. Patel-225 discloses a method and system for brokering bandwidth for mobile devices in a wireless communications network. Ex.1005, 2:6-14, 3:59-67, Abstract, Fig. 1. The wireless communications network of Patel-225 includes a wireless network and a wireline network which may be any suitable wired network which utilize Internet protocol ("IP") for communication. Ex.1005, 5:10-15.

62. Figure 1 of Patel-225 is reproduced below.



Ex.1005, Fig. 1.

63. The above figure illustrates the wireless communications network 10 of Patel-225. As illustrated, the wireless communications network 10 comprising one or more cellular networks 12 in which terrestrial and mobile wireless transmission originates in geographically delimited cells. Ex.1005, 3:59-64. The cellular networks 12 each cover an area defined by a series of overlapping cells 14 with a base station (or server) 16 that provide a radio frequency (“RF”) link for mobile devices 20. Ex.1005, 4:1-20, 4:25-28. The RF link is based on established standards. For example, RF links implement standards such as “IS-54 (TDMA), IS-

95 (CDMA), GSM and AMPS, 802.11 based WLAN, or new upcoming standards such as CDMA2000 and W-CDMA or proprietary terrestrial or mobile radio interfaces.” Ex.1005, 4:20-25.

64. The wireless communications network 10 further includes a radio resource manager 26 connected to mobile gateways 22 that are also connected to the base stations (or servers) 16. Ex.1005, 4:54-57, 5:31-60. The mobile gateways 22 may be used to allocate bandwidth within the cellular network 12, route traffic, and track the location of the mobile devices 20. Ex.1005, 4:54-5:5. The mobile gateways 22 provide connectivity from the wireless network 12 to a wireline network 24 via circuit switched and packet switched wireless data protocols, such as Internet protocol (“IP”). Ex.1005, 5:6-30. Specifics of the radio resource manager 26, which will be discussed in the claim analysis below, are provided in the context of Patel-225’s Figure 3. See Ex.1005, 4:39-42, 6:42-8:23, Fig. 3.

65. Patel-225 explains that it was known to use bandwidth brokers to manage the allocations of bandwidth within their network domain and communicate with bandwidth brokers of other network domains to negotiate QoS parameters to support transmission of data and voice traffic between mobile devices and a wireline IP network based on a specified QoS policy. Ex.1005, 1:29-36, 1:52-66, 2:43-49, 5:60-6:4. According to Patel-225, “one or more bandwidth providers 28...may be...a bandwidth broker.” Ex.1005, 5:61-6:2. Patel-225’s bandwidth

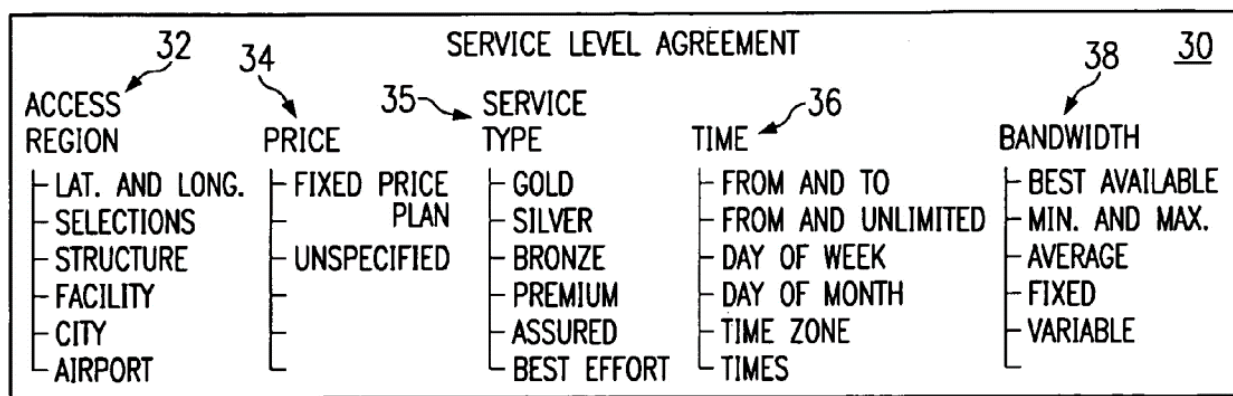
Ex.1003

broker communicates with the radio resource manager 26 to provision resources.

Ex.1005, 5:31-6:2.

66. The wireless communications network 10 utilizes a service level agreement (“SLA”). An exemplary SLA 30 is illustrated at Figure 2, reproduced below.

FIG. 2



Ex.1005, Fig. 2.

67. Patel-225 supports both immediate and advance scheduled reservations for bandwidth based on various parameters defined in the SLA 30. Ex.1005, 6:22-41. For example, the SLA 30 provides a time parameter 36 so that the customer can specify the desired start and stop time, among other schedule specifics. Ex.1005, 7:54-56, 8:60-67. The parameters may also include service type 35 to specify the class for QoS. Ex.1005, 6:32-35. A POSITA would have understood that premium may correspond to a service class for virtual leased lines. *See e.g.*, Ex.1020, 4

Ex.1003

(“Premium Service refers to a quantitative differentiated service which provides a guaranteed low loss and jitter...The Premium Service often is also described as ‘Virtual Leased Line (VLL)’”), 14 (“Premium service...may require that such a service be established on an End-to-End basis prior to sending data.”); Ex.1008, 10:16-17 (“The premium class may be a virtual leased line service.”).

68. Figure 5 is a screen diagram of a user interface that a potential customer may use to obtain wireless resources. Ex.1005, 5:45-48, 9:21-10:29.

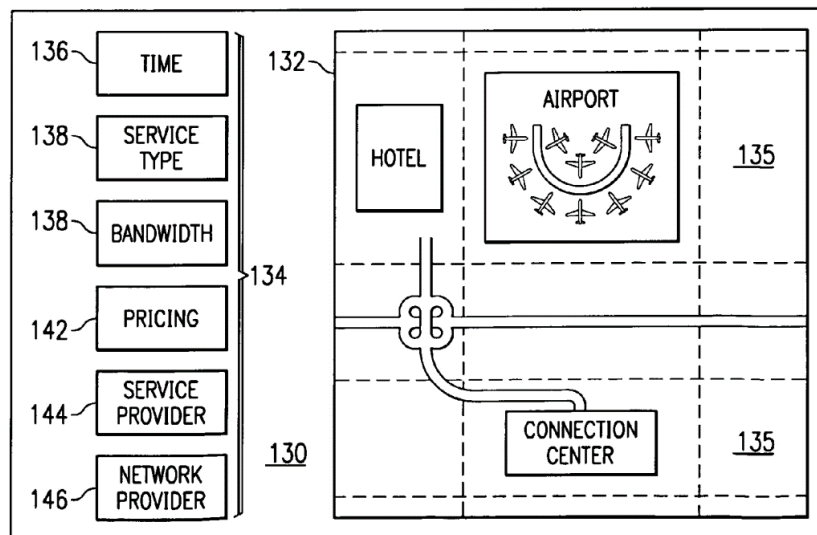


FIG. 5

Ex.1005, Fig. 5.

69. Operational details, including how the potential customer utilizes the interface to request wireless services is provided in the claim analysis below. Also, in my analysis below, I provide additional details regarding the operation of the

wireless communication system, along with how the bandwidth broker and radio resource manager work together to provide end-to-end QoS.

70. Patel-225 cites to and incorporates by reference a number of related U.S. patent applications.

- U.S. patent application Ser. No. 09/513,912, filed Feb. 25, 2000, entitled “Method and System for Queuing Traffic in a Wireless Communications Network,” which issued as U.S. 6,865,185 (“Patel-185,” Ex.1008)
- U.S. patent application Ser. No. 09/513,913, filed Feb. 25, 2000, entitled “Method and System for Managing Transmission Resources in a Wireless Communications Network,” which issued as U.S. 6,522,628 (“Patel-628,” Ex.1006)
- U.S. patent application Ser. No. 09/513,914, filed Feb. 25, 2000, entitled “Wireless Router and Method for Processing Traffic in a Wireless Communications Network,” which issued as U.S. 7,068,624 (“Patel-624,” Ex.1010)
- U.S. patent application Ser. No. 09/513,090, filed Feb. 25, 2000, entitled “Method and System for Configuring Wireless Routers and Networks,” which issued as U.S. 7,031,266 (“Patel-266,” Ex.1009)
- U.S. patent application Ser. No. 09/466,308, filed Dec. 17, 1999, entitled “Method and System for Allocating Bandwidth in a Wireless Communications Network,” which issued as U.S. 6,850,764 (“Patel-764,” Ex.1007)

Ex.1005, 1:5-19, 4:12-18, 4:58-64, 5:15-25.

2. Summary of Schelen-1999 and Schelen-1997

71. The IEEE in 1999 published a paper titled “Performance of QoS Agents for Provisioning Network Resources,” by named inventors Olov Schelén and Joakim Norrgård, among others (Ex.1011, “Schelen-1999”). Schelen-1999 describes an “agent-based architecture for quantitative service provisioning in differentiated services capable networks.” Ex.1011, Abstract. More specifically, Schelen-1999 describes the use of a “QoS agent (also known as a bandwidth broker)” to perform “topology aware” “end-to-end admission control within a” “link-state routing domain.” Ex.1011, Abstract.

72. Schelen-1999 cites to Schelen-1997, to explain how the QoS agents (also known as bandwidth brokers) perform admission control in IP networks. See Ex.1011, Introduction (citing O. Schelén and S. Pink paper titled “Sharing resources through advance reservation agents,” published in Proceedings of IFIP Fifth International Workshop on Quality of Service (IWQoS'97), New York, May 1997, and in Journal of High Speed Networks, Special issue on Multimedia Networks, vol 7, no 3-4, 1998, “Schelen-1997,” Ex.1031).

73. The QoS agents (bandwidth brokers) exist within each routing domain of a network and are responsible for performing “path-sensitive” admission control

in that domain. Ex.1011, Introduction. Performing path-sensitive admission control includes using knowledge of the topology and resources within the domain. Ex.1011, Introduction. Specifically, the QoS agents (bandwidth brokers) are topology aware and build resource maps to perform admission control by querying routers and maintaining a database. Ex.1011, Introduction.

74. The specific QoS agent (bandwidth broker) prototype described by Schelen-1999 includes functionality for (1) obtaining a topological database through the link-state routing protocol, (2) obtaining link bandwidths through SNMP, and (3) performing path-sensitive end-to-end admission control within a single link-state routing domain. Ex.1011, Introduction, Scope and layout. The QoS agents (bandwidth brokers) allow for two types of reservations to be made: (a) immediate (open-ended) reservations and (b) advance (time-limited) reservations that have a specific start/stop time. Ex.1011, Introduction, Scope and layout. Both immediate and advance reservations are illustrated in Figure 1 (replicated below).

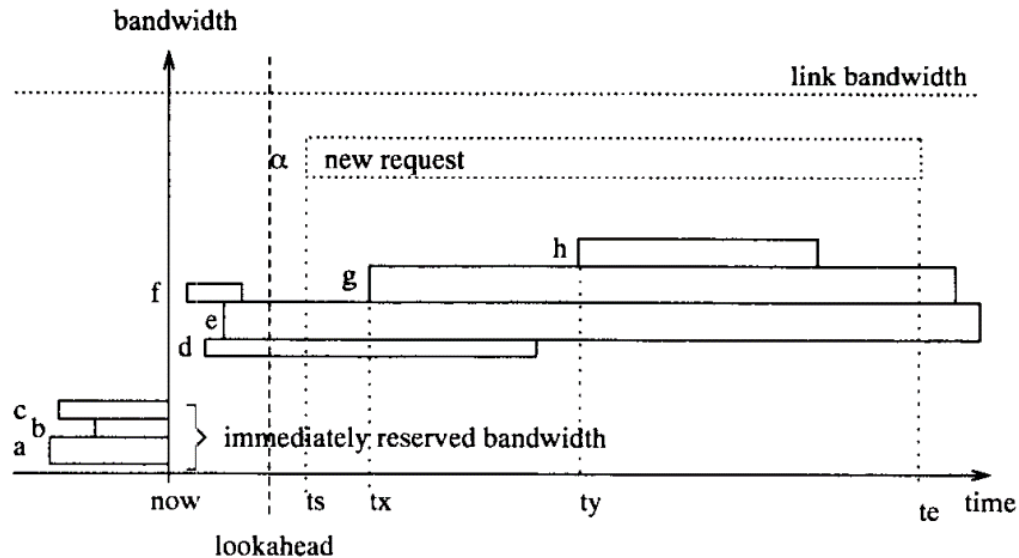


Figure 1: Advance reservations in a time-bandwidth domain

Ex.1011, Fig. 1 (annotated).

75. The schedule illustrated at Figure 1 has a “lookahead time,” which Schelen-1999 explains is covered in Schelen-1997. Ex.1011, Immediate admission control. Schelen-1997 describes that there is a risk of over-allocation because immediate reservations and advanced reservations share resources, and immediate reservations have unknown durations. Ex.1031, 268. Schelen-1997 describes using a “lookahead time” as a “pre-allocation time, i.e., the time for starting to set aside resources for advance reservations.” Ex.1031, 268. The pre-allocation (setting aside) of resources for a time before an advanced reservation mitigates the risk of over-allocation since immediate reservations are rejected if there are insufficient resources in the near future (leading up to the advance reservations). Ex.1031, 268.

Ex.1003

3. Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225

76. A POSITA would have been motivated to combine the teachings of Schelen-1999 and Schelen-1997 with Patel-225, as discussed below.

a. Analogous Art

77. Patel-225, Schelen-1999, and Schelen-1997 are analogous art to the '601 patent. Just like the '601 patent, as noted above in the prior art summaries, Patel-225, Schelen-1999, and Schelen-1997 generally pertain to allocating bandwidth. Ex.1005, 1:22-25, 5:31-6:8; Ex.1011, Abstract, Introduction; Ex.1031, 265-266. Further, the references also address the problem of allocating bandwidth immediately and in advance, as well as sharing several common elements in their solutions (allocating based on requested bandwidth, time, service class, etc.). Ex.1005, 6:22-41; Ex.1011, Introduction, Resource provisioning over time, Fig. 1; Ex.1031, 265-267, 273. Thus, given the similarities between the references and the fact that they address the problem of allocating bandwidth for immediate and advance reservations, a POSITA considering Patel-225 would have also considered the teachings of Schelen-1999 and Schelen-1997, which are informative.

b. Motivation to combine

78. A POSITA would have been motivated to combine the teachings of Schelen-1999 and Schelen-1997 with Patel-225 to successfully practice Patel-225's method and to produce numerous predictable and beneficial results.

79. Patel-225 discloses a bandwidth broker to perform admission control. Ex.1005, 1:29-63, 5:6-6:2. Abstract, Fig. 1. However, Patel-225 provides limited details pertaining to how the bandwidth broker performs admission control with respect to its IP network. Schelen-1999 and Schelen-1997 provide implementation details regarding how a bandwidth broker performs admission control to manage allocation of IP network resources as (already) suggested by Patel-225. For example, and consistent with the summary above and claim analysis below, Schelen-1999 and Schelen-1997 provide detailed teachings regarding how the bandwidth broker performs end-to-end admission control to manage IP network resources (limitations [1.2]-[1.5]), performs scheduling for immediate and advance reservations (limitation [1.6], and reserve end-to-end IP network resources for end-to-end QoS (limitation [1.8])). It would have been obvious to a POSITA, when implementing Patel-225's system, to apply the bandwidth broker admission control teachings of Schelen-1999 and Schelen-1997 because they provide more implementation details for achieving the results that Patel-225 is already describing. These implementation details would have allowed a POSITA to successfully

practice Patel-225's method of providing service to mobile devices, including providing premium QoS for the transfer of audio and other data. *See e.g.*, Ex.1005, 1:39-66, 6:32-34. I note that is sufficient to explain why a POSITA would have sought to combine the identified disclosures of Patel-225, Schelen-1999, and Schelen-1997. Nevertheless, below I provide additional reasons for combining the relevant teachings.

i. *Providing end-to-end QoS*

80. Patel-225 discloses that its wireless communications network (comprising a wireless network and a wireline IP network) supports different classes of quality of service ("QoS"). Ex.1005, 3:3-5, 6:32-34, Fig. 1. The QoS includes service better than "best effort," such as "premium." Ex.1005, 6:32-35. It was known at the time that "premium" service has predefined QoS characteristics (e.g., low-delay and low-jitter) with guaranteed bandwidth. *See e.g.*, Ex.1035, 11 ("Premium service provides low-delay and low-jitter service [and]... guarantees that the contracted bandwidth will be available when traffic is sent."); Ex.1033, 4 ("The Premium service implements a guaranteed peak bandwidth service.").

Because it was known in the art that premium QoS guarantees bandwidth with low-delay and low-jitter, a POSITA would have understood that end-to-end QoS (from source to destination) is provided when end-to-end bandwidth is reserved for premium service.

81. It was known in the art that premium service supports virtual lease lines and the transmission of real-time data (e.g., audio, video, etc.). *See e.g.*, Ex.1014, 1:25-26; Ex.1020, 4; Ex.1033, 4; Ex.1035, 11. It was also known that virtual lease lines and real-time data utilizes end-to-end QoS. *See e.g.*, Ex.1008, 3:53-61,10:15-16; Ex.1020, 14; Ex.1035, 11; *see also* Ex.1033, 4. In fact, in instances where transmission of real-time data has “**demanding quality of service (QoS) requirements**,” it was known that “**it is essential that quality of service is... maintainable on an end-to-end basis**.” Ex.1024, 2; Ex.1023, Abstract; *see also* Ex.1022, [0003]; Ex.1032, 1:31-37.

82. Patel-225’s method allows “consumers to obtain wireless resources” at a specified “QoS policy” (e.g., premium QoS) for “transmission of data and/or voice traffic between mobile devices and a wireline network.” Ex.1005, 1:39-66, 2:43-52, 6:32-35; *see also* Ex.1005, 3:59-64, 4:1-7, 5:6-15. It would have been obvious to a POSITA, implementing premium QoS in Patel-225, to provide the service end-to-end when transmitting real-time data (e.g., audio and other data that has high QoS requirements) since such data transmissions would benefit from (and in certain instances require) end-to-end QoS. Ex.1022, [0003] (“...various real time applications (IP Telephony, **Video** conferencing), streaming Services (audio or video), or high quality data Services (browsing with bounded down load delays)...[require] **QoS-enabled IP networks**.”); Ex.1024, 2 (“[For] the transfer of

Ex.1003

continuous media of digital audio and **video**, it is essential that quality of service is... **maintainable on an end-to-end basis.**”). Ex.1030, 2 (“...for a **video** conference...[it is important to] ensure that the **required QoS will be available...**”); Ex.1031, 1 (“Real-time applications such as audio and **video** conferencing may need resource reservations in the network to perform well.”); Ex.1032, 1:31-34 (“With the proliferation of multimedia services via the Internet-**Video**-conferencing, tele-medicine, telephony, Video-on-demand etc., there is an increasing demand to support **guaranteed Quality-of-Service (QoS)**”).

83. A POSITA would have looked to other references in order to successfully implement Patel-225’s method to provide premium QoS end-to-end, such as between a source and a destination. Notably, Schelen-1999 and Schelen-1997 provide such implementation details. Specifically, Schelen-1999 discloses that when providing “better than best-effort” (e.g., premium service) in an IP network, it is important “to make sure that the service commitments can be met.” Ex.1011, Introduction. To guarantee that QoS service commitments from source to destination are met, Schelen-1999 discloses that bandwidth brokers (which it refers to as “agents”) perform end-to-end admission control to reserve end-to-end resources in the IP network. Ex.1011, Abstract (“[A] topology-aware QoS agent (also known as a bandwidth broker) [is] responsible for... **end-to-end admission control** within a single link-state routing domain...[including] maintain[ing] per-

Ex.1003

link **resource reservations.**”); *see also* Ex.1031, 265-266 (disclosing “**end-to-end reservations.**”). A POSITA would have understood that the bandwidth broker performs end-to-end admission control, including reserving end-to-end IP network resources to meet end-to-end QoS service commitments.

84. It would have been obvious to a POSITA, when implementing Patel-225’s system, to perform end-to-end admission control, in view of Schelen-1999 and Schelen-1997, because it would allow for reserving end-to-end IP network resources to meet end-to-end QoS service commitments. The combined teachings, for example, would guarantee that Patel-225’s wireless communications network is able to provide end-to-end premium QoS (e.g., guaranteed end-to-end bandwidth with low-delay and low-jitter) to a mobile device.

85. Moreover, in instances where data transmission implicates multiple network domains, Patel-225 discloses that “bandwidth brokers... communicate with bandwidth brokers of other network domains to negotiate QoS parameters.” Ex.1005, 1:52-66. Schelen-1999 provides more implementation detail and discloses that admission control includes reserving end-to-end resources across several network domains toward the destination:

“For each routing domain in the network there is a QoS agent responsible for admission control in the domain. We have shown that path-sensitive admission control can be supported with favorable

scalability properties. This is because reservation state for virtual leased lines is aggregated in agents as their paths merge towards the destination domains. **Each agent along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent. Consequently, reservations form sink trees towards destination domains.**”

Ex.1011, Introduction.

86. In the same vein, Schelen-1997 discloses admission control where “**end-to-end reservations**...involving several routing domains are handled by cooperation between the involved” bandwidth brokers. Ex.1031, 265-266. A POSITA would have recognized that end-to-end admission control (including end-to-end reservations) provides end-to-end QoS across the different network domains. *See e.g.*, Ex.1025, 3 (“**[E]nd-to-end QoS support can be achieved** through a concatenation of inter- and intra-domain resource allocations.”); Ex.1032, 7:5-6 (“**[E]nd-to-end QoS is provided** through Service Level Agreements (SLA) between the networks.”). A POSITA would have understood that performing end-to-end admission control, for premium QoS, means that the overall system supports QoS end-to-end. *See e.g.*, Ex.1035, 12-13, Fig. 4 (Example 2: Delivery of Premium Service, where end-to-end resources have been reserved to provide end-to-end premium QoS during Phase 2: Data Transmission)

87. In view of Schelen-1999 and Schelen-1997, it would have been obvious to a POSITA to implement Patel-225 such that its bandwidth broker performs end-to-end admission control in the wireless communications network and—when other network domains are implicated—to cooperate with bandwidth brokers of other network domains to thereby provide end-to-end QoS from the source to the destination. Accordingly, it would have been obvious to a POSITA, implementing Patel-225’s wireless communications network, to apply the teachings of Schelen-1999 and Schelen-1997 to provide end-to-end premium QoS (e.g., guaranteed end-to-end bandwidth with low-delay and low-jitter) across all implicated network domains.

88. The combination of Schelen-1999 and Schelen-1997 with Patel-225 is merely combining prior art elements (e.g., end-to-end admission control, per Schelen-1999 and Schelen-1997, with Patel-225’s bandwidth broker) to yield the predictable result of providing end-to-end premium QoS (e.g., guaranteed end-to-end bandwidth with low-delay and low-jitter) across both single and multiple network domains. Additionally, the combination is nothing more than applying a known technique (e.g., performing end-to-end admission control, per Schelen-1999 and Schelen-1997) to improve the similar system of Patel-225 (e.g., provide end-to-end priority QoS for virtual lease lines and real-time audio and video data).

89. Additional reasons to apply the end-to-end admission control teachings of Schelen-1999 and Schelen-1997 to Patel-225 are provided below, which further support the motivation to combine.

ii. Controlling IP network resources

90. As analyzed above, Patel-225 in combination with Schelen-1999 and Schelen-1997, disclose a bandwidth broker that performs end-to-end admission control to provide end-to-end QoS. *See also* analysis at limitation [1.0.1]-[1.0.2], [1.8], *infra*.

91. Schelen-1999 provides further detail regarding end-to-end admission control that a POSITA would consider and implement when performing end-to-end admission control in Patel-225. Specifically, Schelen-1999 discloses that the bandwidth broker “performs path-sensitive admission control” in an IP network using a “resource map.” Ex.1011, Abstract, Introduction, Resource provisioning over time. Such a resource map would be highly beneficial by providing understanding of current allocations allowing better network resource control. Schelen-1999 further discloses that each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make “reservations... towards destination domains.” Ex.1011, Introduction. *See also*

Ex.1011, Introduction (“Path-sensitive admission control is possible as each QoS agent knows the topology and static link resources in its domain.”).

92. As part of path-sensitive admission control, the bandwidth broker “check[s] for sufficient resources so that both advance reservations and immediate reservations can be served.” Ex.1011, Immediate admission control; *see also* Ex.1011, Advance admission control, binary search tree over time (“...check whether the total aggregate plus the new requested bandwidth is still below the link bandwidth...”).

93. Not only does Schelen-1999 check for sufficient resources, it discloses a “lookahead” time to look “into the advance reservation state to find out about resources needed for advance reservations in the near future.” Ex.1011, Immediate admission control. According to Schelen-1999, the “lookahead time...issue is covered in” Schelen-1997. Ex.1011, Immediate admission control. As such a POSITA would look to Schelen-1997 for additional understanding of the lookahead time. On this issue, Schelen-1997 discloses that the “lookahead time” represents a “pre-allocation time, i.e., the time for starting to set aside resources for advance reservations.” Ex.1031, 268. In other words, when determining if there are sufficient resources for immediate reservations (which have unknown duration), Schelen-1997 pre-allocates (sets aside) resources before the beginning of the advance reservation, and only if other resources are available then the bandwidth

Ex.1003

broker grants the immediate reservation. On the other hand, “[i]f there are insufficient resources available in the near future, the request could be rejected instead of serviced.” Ex.1031, 268.

94. It would have been obvious to apply the above path-sensitive admission control technique to Patel-225 to obtain numerous benefits. First, Schelen-1999 explains that path-sensitive admission control provides “favorable scalability properties...[for] virtual leased lines” because the reservation state is “aggregated in agents [bandwidth brokers] as their paths merge towards the destination domains.” Ex.1011, Introduction. Patel-225 supports “premium” service class (Ex.1005, 6:32-35), and it was known in the art that premium service “may be a virtual leased line service.” Ex.1008, 10:16-17; *see also* Ex.1020, 4. Accordingly, in view of Schelen-1999’s teachings, it would have been obvious to a POSITA to implement Patel-225’s bandwidth broker such that it use the resource map to perform path sensitive admission control of IP network resources to provide end-to-end QoS because the technique has favorable scalability properties for virtual leased lines, which Patel-225’s premium service would support.

95. Implementing Patel-225’s bandwidth broker to use a resource map as Schelen-1999 teaches is also beneficial since the map information would enable the bandwidth broker to manage IP network resources to control congestion. Ex.1008, 14:48-65. This is because the resource map information allows the bandwidth

Ex.1003

broker to determine if a specific path has sufficient resources and decide whether or not to grant a specific request if the resulting grant does not over-allocate resources or choose an alternative path. Ex.1014, 9:28-32.

96. The technique represented by the proposed combination is consistent with and compliments Patel-225's system, which programs the bandwidth broker with current IP bandwidth allocation and uses resource maps for the wireless network. Ex.1005, 1:54-56, 7:17-22. In the combination, it would have been obvious for the IP network resource map (as taught by Schelen-1999) to be programmed in the memory of the bandwidth broker so that it may be easily accessed when performing path sensitive admission control in Patel-225's IP network thus controlling network resources.

97. Second, Schelen-1999's technique is also beneficial because it includes checking for sufficient resources along the path and setting aside resources per the lookahead time (referred to as pre-allocating) so that both advance reservations and immediate reservations can be served, thereby minimizing the risk of over-allocating resources. Ex.1031, 268 ("When immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation."). Because in the combination Patel-225's bandwidth broker would be implemented such that it checks for sufficient resources along the path and pre-allocates IP network resources by setting them

Ex.1003

aside for a period of time before the advance reservations start, the system would beneficially assure end-to-end QoS for both immediate and advance reservations, thereby furthering Patel-225's goal of assuring that the consumer is provided service. *See e.g.*, Ex1005, 8: 60-67 ("The wireless services may be requested in real-time for immediate use or requested for use at a specified future time... Thus, if the consumer is travelling to a remote geographic location, the consumer may first reserve wireless resources at that location to be assured of adequate coverage while at that location.").

98. On the other hand, if the sufficiency of resources was not checked or if sufficient resources were not set aside per the lookahead time, there would be a risk of over-allocating resources when granting immediate reservations and potentially having to cancel an advance reservation, which is undesirable. Ex.1031, 268; Ex.1011, Resource provisioning over time ("It is unfortunate if a planned event has to be canceled with late notice because it turns out there are insufficient network resources at the time."). Checking improves reliability since reservations have less risk of being canceled. Each of the above noted benefits, separately and together, would have motivated a POSITA to control the IP network resources of Patel-225 per the teachings of Schelen-1999 and Schelen-1997.

99. The combination of Schelen-1999 and Schelen-1997 with Patel-225 is merely the use of a known technique (controlling IP network resources by using a

Ex.1003

resource map in Patel-225's bandwidth broker to perform path sensitive admission control and provide end-to-end QoS, per the teachings of Schelen-1999 and Schelen-1997) to improve the similar system of Patel-225 (see above noted benefits) in the same way.

iii. Scheduling resources over time

100. Patel-225 explains that wireless service may be “requested in real-time for immediate use” or requested in advance for use “at a specified future time.” Ex.1005, 8:57-62. For example, wireless services may be scheduled by specifying a “from and to time,” as well as “date or dates and time of day or days.” Ex.1005, 2:35-40, 6:22-39.

101. Schelen-1999 and Schelen-1997 similarly disclose scheduling IP network resources over time, including supporting both immediate and advance reservations. Ex.1011, Introduction, Resource provisioning over time, Fig. 1. *See also* Ex.1031, 266 (“Admission control for both immediate and advance reservations could be performed by reservation agents.”). According to Schelen-1999 the bandwidth broker handles “[a]dvance reservations [that] are time-limited (i.e., they have a starting time and a finishing time).” Ex.1011, Scope and layout. Advance reservations “include timing information,” such as “a starting point and a finishing point” for “planning network resources over time.” Ex.1011, Resource provisioning over time; *see also* Ex.1031, 267 (“Durations must be specified for

Ex.1003

advance reservations. A duration includes the start time and the finish time for the requested service.”). “This also allows providers to schedule their resources over time and predict when the total capacity will be insufficient.” Ex.1011, Resource provisioning, Figure 1; Ex.1031, 274 (“By encouraging advance reservations for scheduled events, resources can be more accurately allocated over time.”).

102. Schelen-1997 at Figure 1 provides an example of using a schedule for scheduling IP network resources (e.g., bandwidth) over time for multiple requests (immediate: a, b, c and advanced: d, e, f, g, h, and new request α).

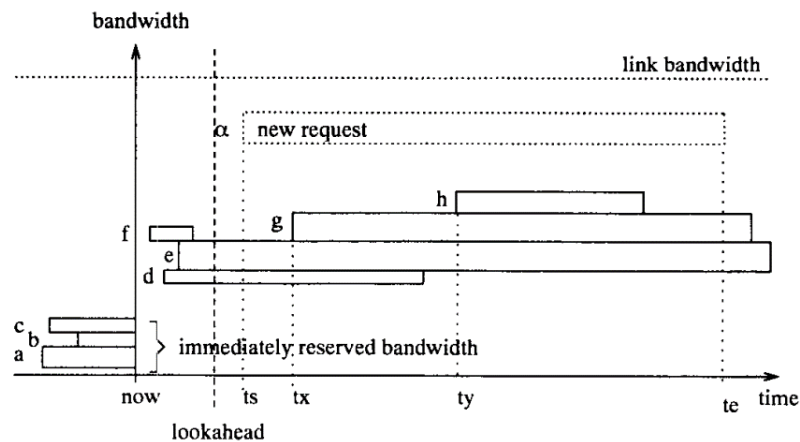


Figure 1: Advance reservations in a time-bandwidth domain

Ex.1011, Fig. 1.

103. It would have been obvious to a POSITA to combine the teachings of Schelen-1999 and Schelen-1997 when implementing Patel-225’s system to utilize a schedule (e.g., shown at Fig. 1) for reserving IP network bandwidth over time when servicing immediate and advance requests. Specifically, scheduling IP network

resources over time using a schedule would allow for Patel-225's system to "predict when the total capacity will be insufficient." Ex.1011, Resource provisioning over time. Because insufficient capacity would be predicted, new immediate reservations would not be admitted thereby reducing the risk of over-allocation. Ex.1031, 268 ("When immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation."). Also, not over-allocating IP network resources would reduce the risk of canceling planned events due to insufficient resources, which increases reliability. Ex.1011, Resource provisioning over time ("It is unfortunate if a planned event has to be canceled with late notice because it turns out there are insufficient network resources at the time."). Another benefit is that scheduling, as taught by Schelen-1999 and Schelen-1997, allows the IP network "resources [to be] more accurately allocated over time." Ex.1031, 275. Lastly, I note that scheduling IP network resources over time facilitates "long-term provisioning of trunk network capacity," which is "especially desirable." Ex.1011, Resource provisioning over time.

104. Each of the above noted benefits, separately and together, would have motivated a POSITA implementing Patel-225's system to use a schedule for scheduling IP network resources over time per Schelen-1999 and Schelen-1997.

105. The combination of Schelen-1999 and Schelen-1997 with Patel-225 is merely the use of a known technique (scheduling IP network resources over time using a schedule, per the teachings of Schelen-1999 and Schelen-1997) to improve the similar system of Patel-225 (see above noted benefits) in the same way.

iv. Reserving IP network resources

106. Schelen-1999 discloses that the bandwidth broker is responsible for “maintain[ing] per-link resource reservations in a link-state routing domain” that transmits “IP packet[s].” Ex.1011, Abstract, Introduction. This includes the bandwidth broker supporting “immediate and advance reservations” in the IP network, as noted above. Ex.1011, Introduction, Scope and layout. Further, Schelen-1997 describes that a bandwidth broker (which is referred to as a “reservation agent”) performs “resource reservations” in an IP network for “[r]eal-time applications such as audio and video conferencing.” Ex.1031, 265-266. “[A]dmission control for advance reservations is performed by agents [bandwidth broker] on behalf of the routers in their routing domains.” Ex.1031, 266. Admission control includes “the agents [bandwidth brokers] ... select[ing] suitable routes and reserv[ing] resources over the links in advance,” “allocat[ing] resources in the routers along the selected path and then periodically refresh[ing] those resource allocations through the duration of the reservation.” Ex.1031, 266.

107. Patel-225's bandwidth broker manages allocation of resources within the IP network and allows for immediate and advance reservations. Ex.1005, 1:29-30, 1:56-60, 8:57-67. It would have been obvious to a POSITA for Patel-225's bandwidth broker (as part of managing allocation of resources) to reserve IP network resources along the path from the source to the destination so as to provide end-to-end QoS and obtain the numerous benefits analyzed above. *See* discussion *infra*, "providing end-to-end QoS."

108. Additionally, Schelen-1997 explains that an "advantage with an [bandwidth broker]-based approach is that advance reservations can be provided without having to maintain reservation state in the routers through periods when the reservations have no effect on packet forwarding." Ex.1031, 266. "Furthermore, the agent [bandwidth broker]-driven approach does not require the reserving endpoints to be present until the session for which resources have been reserved is starting." Ex.1031, 266. Another advantage of the bandwidth broker managing reservations is that "[r]eservations can also be made for remote locations, thereby supporting third party reservations and nomadic computing, i.e., reservations for places where the host will be moving in the future." Ex.1031, 266.

109. I also note that having the bandwidth broker reserve IP network resources along the path would allow for aggregating similar QoS types and provide good scaling properties. Ex.1005, 1:49-51; Ex.1011, Abstract, Introduction;

Ex.1003

Ex.1026, 4 (“Aggregation takes place in the agents because routers are not part of the admission control process... agents [bandwidth broker] can provide exact resource reservations with good scaling properties.”).

110. Each of the above noted benefits, separately and together, would have motivated a POSITA implementing Patel-225’s system to have the bandwidth broker—which manages allocation of resources—reserve IP network resources along the path from the source to the destination to thereby provide end-to-end QoS.

111. A POSITA would have considered the combination merely the use of a known technique (Patel-225’s bandwidth broker reserving IP network resources as taught by Schelen-1999 and Schelen-1997) to improve the similar system of Patel-225 (see above noted benefits) in the same way.

v. Monitoring topology changes

112. Schelen-1999 discloses that the bandwidth broker is “topology-aware” and maintains a “topology database” and retrieves routing information by “participating in a link-state routing protocol (OSPF)” and “SNMP” to collect information regarding the router interfaces. Ex.1011, Abstract, Introduction, Topology, Routing calculations; *see also* Ex.1011, Scope and layout (“In this paper we present a prototype implementation of a QoS agent [bandwidth broker]...includ[ing] functionality for: obtaining a topological database through the

link-state routing protocol.”); Framework (“The machine is configured as a passive router to obtain the topological database for its link-state routing domain (i.e., the machine does not advertise any routes but it receives link-state advertisements from other routers). For this, we use the OSPF [13] implementation as provided in the gated 3.5.8 distribution [6].”).

113. Schelen-1997 similarly discloses that “[b]y participating in a link-state routing protocol, the agents [bandwidth brokers] know the topology and the static link capacities of their domains and can therefore select suitable routes and reserve resources over the links in advance. ...[and] periodically refresh those resource allocations through the duration of the reservation.” Ex.1031, 266.

114. It would have been obvious to a POSITA, in view of Schelen-1999 and Schelen-1997, for Patel-225’s bandwidth broker to monitor topology changes so that it has up-to-date information for admission control. Ex.1011, Introduction, Routing calculations. The topology database complements the use of the resource map (as analyzed above) to enable the bandwidth broker to determine if sufficient resources are available on a specific link to accept new immediate reservations and to select suitable routes and reserve resources over the links for new advance reservations. Ex.1031, 266 (“[T]he [bandwidth brokers] know the topology and the static link capacities of their domains and can therefore select suitable routes and reserve resources over the links in advance.”); Ex.1011, Routing calculations

Ex.1003

(“From this [topology] database, a routing table is calculated by constructing a shortest-path tree.”). Having accurate topology and routing information is also beneficial since it makes “[p]ath sensitive admission control...possible.” Ex.1011, Introduction.

115. A POSITA would have understood that when immediate reservations and advance reservations share resources and it is determined based on the topology database and resource map that there are not sufficient resources to support new reservation requests on a given link, the requests would not be accepted thereby reducing the risk of over-allocation. Ex.1031, 268 (“When immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation.”). Accordingly, monitoring topology changes in an up-to-date topology database is beneficial since it helps reduce over-allocation risk, which also improves reliability.

116. Also, the teachings of Schelen-1999 and Schelen-1997 are beneficial to Patel-225’s bandwidth broker because retrieving routing information concerning the IP network allows for “recalculat[ing] routes quickly in the face of topological changes.” Ex.1011, Routing calculations. Based on the recalculated routes the bandwidth broker is able to reallocate IP network resources to match the current topology, thereby maintaining active reservations while reducing the risk of over-allocation of resources for new reservation requests. Reducing the risk of over-

Ex.1003

allocation has the notable effect of reducing the risk of canceling planned events due to insufficient resources. Ex.1011, Resource provisioning over time (“It is unfortunate if a planned event has to be canceled with late notice because it turns out there are insufficient network resources at the time.”).

117. Each of the above noted benefits, separately and together, would have motivated a POSITA implementing Patel-225’s system to have the bandwidth broker monitor topology changes (per Schelen-1999 and Schelen-1997) and use this information to perform admission control, including allocating and reallocating IP network resources on specific links based on the topology.

118. This is nothing more than the use of a known technique (Patel-225’s bandwidth broker monitoring topology changes and retrieving routing information concerning the IP network, per Schelen-1999 and Schelen-1997) to improve the similar system of Patel-225 (see above noted benefits) in the same way.

c. Reasonable expectation of success

119. I also note that the results would have been predictable and there would have been a reasonable expectation of success given the similarities in the references, including that Patel-225 utilizes a bandwidth broker to perform admission control and Schelen-1999 and Schelen-1997 provide implementation details regarding how a bandwidth broker performs admission control within an IP network (which Patel-225 also has). Ex.1005, 1:30-2:2 (“Wireline Internet protocol

Ex.1003

(IP) networks... the IP QoS architecture include supporting bandwidth brokers that control and allocate Internet or other network bandwidth...and communicate with bandwidth brokers of other network domains to negotiate QoS parameters.”); *see also* Ex.1005, 5:33-51, 5:61-6:4. Other similarities further support the reasonable expectation of success in the combination, including that the references support immediate and advance scheduled reservations, differentiated class of service, and aggregation.

120. Based on reviewing Patel-225 and the teachings of Schelen-1999 and Schelen-1997, it is my opinion that any modification needed to the system of Patel-225, in order to accommodate the teachings of Schelen-1999 and Schelen-1997, would have been within the level of ordinary skill in the art. A POSITA, for example, would have been able to implement a bandwidth broker (per the combination) as software running on a general purpose computer. Ex.1011, Conclusion (“The results show that it is feasible for an agent [bandwidth broker] to manage per-link resource reservations and perform path-sensitive admission control...a general purpose computer is powerful enough to run the agent [bandwidth broker] software.”)

121. Additionally, reasonable expectation of success is evidenced by others in the art that had implemented a bandwidth broker per the Schelen references. *See e.g.*, Ex.1014, 3:64-4:45 (“A current state of the art Bandwidth Broker (BB_{OLOV})

Ex.1003

system is described in .. Schelen... Using systems like these...it is possible to achieve dynamic QoS service.”), 5:13-15 (“The Bandwidth Broker BB_{OLOV} in...Schelen...enables planning of a VLL service over time.”). Therefore, it is my opinion that there would have been a reasonable expectation of success in combining the prior art teachings as discussed above and in the claim analysis below since the teachings of Schelen-1999 and Schelen-1997 represent state of the art bandwidth broker functionality applicable to Patel-225’s system, which also uses a bandwidth broker.

122. Lastly, I note that the proposed combination relies on the teachings of the references, and I do not suggest that physical incorporation of the elements of Schelen-1999 and Schelen-1997 into Patel-225 system is required.

4. Claim 1

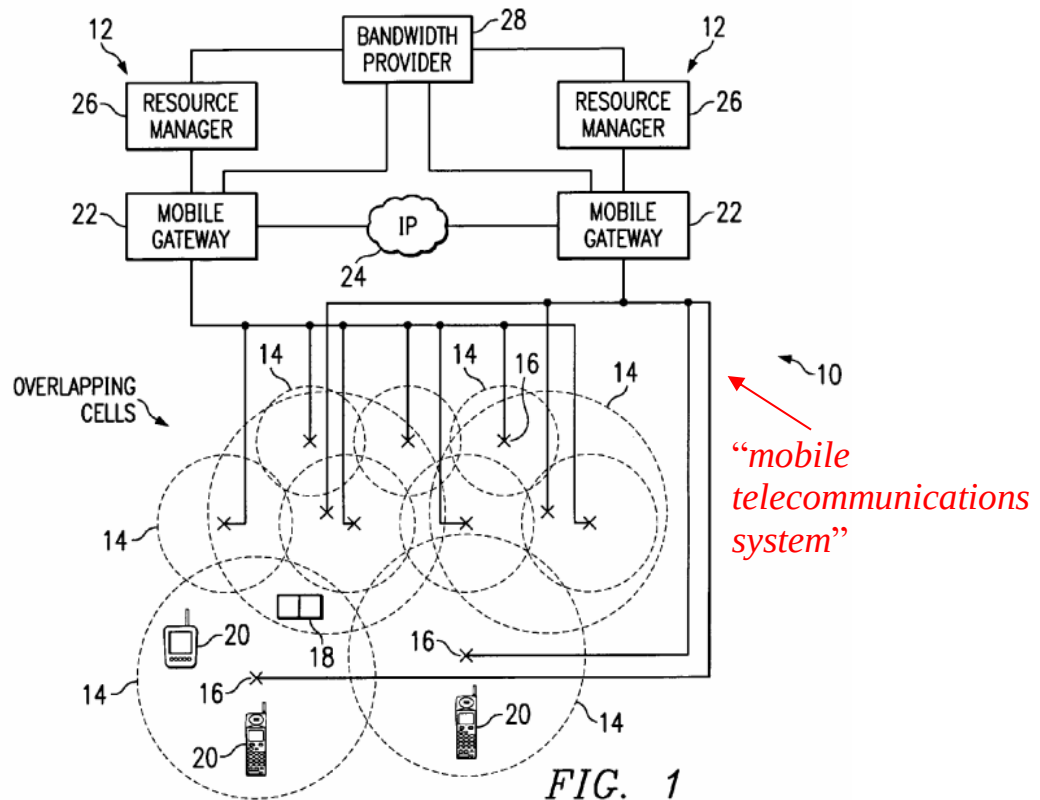
a. **[1.0.1] *A method for providing end-to-end Quality of Service (QoS) within a mobile telecommunication system comprising***

123. To the extent limiting, Patel-225 in further combination with Schelen-1999 and Schelen-1997 renders obvious a method for providing end-to-end Quality of Service (QoS).

124. **First**, Patel-225 discloses “a **method** and system for brokering bandwidth **in a wireless communications network [10]**” for “**mobile devices**” Ex.1005, 2:6-14, 3:59-4:11, Fig. 1. The wireless communication network 10

support established telecommunication standards such as “IS-54 (TDMA), IS-95 (CDMA), GSM and AMPS, 802.11 based WLAN, or new upcoming standards such as CDMA2000 and W-CDMA or proprietary terrestrial or mobile radio interfaces.” Ex.1005, 4:20-25. Accordingly, Patel-225’s method corresponds to a “[a] method for ...a mobile telecommunication system.”

125. As illustrated below at Figure 1, Patel-225 discloses a wireless communications network 10 that provides cellular service to mobile devices 20.



Ex.1005, Fig. 1 (annotated).

126. Also note that Patel-225’s wireless communications network 10 supports differentiated services, with “different class or quality of service (QoS) types such as gold, silver, bronze, premium, assured, and best efforts.” Ex.1005, 6:32-35. A POSITA would have understood that Patel-225 is describing a packet header marking protocol called “Differentiated Services”:

“Differentiated services (DS) field

The field in which the differentiated services class is encoded. It is the Type of Service (TOS) octet in the IPv4 header or the traffic class octet in the IPv6 header.”

Ex.1035, 9.

“Differentiated Services

An Introduction to Differentiated Services

...

Using the classification, policing, shaping, and scheduling mechanisms, many services can be provided, such as:

- Premium service for applications requiring low-delay and low-jitter service
- Assured service for applications requiring better reliability than best-effort service
- Olympic service, which provides three tiers of services: gold, silver, and bronze, with decreasing quality.”

Ex.1003

Ex.1035, 10. Also, a POSITA would have understood that Differentiated Services was specifically developed to enable end-to-end QoS. *See* Ex.1034, [0004] (“**The efforts to enable end-to-end QoS over IP networks have led to the development of...the Differentiated Services architecture.**”). Accordingly, a POSITA considering Patel-225’s disclosure would have naturally recognized that it seeks to provide end-to-end QoS within wireless communications network 10.

127. To illustrate the point. A POSITA would have known that “premium” class has predefined QoS characteristics (e.g., low-delay and low-jitter) with guaranteed bandwidth for end-to-end transmission within the network:

“Premium Service — **Premium service provides** low-delay and low-jitter service for customers that generate fixed peak bit rate traffic. Each customer will have an SLA with its ISP. The SLA specifies a desired peak bit-rate for a specific flow or an aggregation of flows. The customer is responsible for not exceeding the peak rate; otherwise, excess traffic will be dropped. The ISP **guarantees that the contracted bandwidth will be available when traffic is sent.**”

Ex.1035, 11; *see also* Ex.1033, 2 (“Premium service, not unlike a standard telephone line, is a capacity which the customer expects to be there when the receiver is lifted....The network contract is that the contracted bandwidth will be available when traffic is sent.”), 4 (“The Premium service implements a **guaranteed peak bandwidth service.**”); Ex.1020, 4 (“Premium Service refers to a

quantitative differentiated service which provides a **guaranteed low loss.**”).

Because premium QoS guarantees bandwidth with low-loss, a POSITA would have understood that end-to-end QoS (from source to destination) is provided when end-to-end bandwidth is reserved for premium service.

128. It was also known in the art that premium service supports creating virtual leased lines. Ex.1035, 11 (“Premium service is suitable for...creating virtual lease lines.”); *see also* Ex.1008, 10:15-17 (“The premium class may be a virtual leased line service.”); Ex.1020, 4 (“The Premium Service often is also described as ‘Virtual Leased Line (VLL)’”). And it was also known that virtual lease lines utilize guaranteed bandwidth for end-to-end QoS. *See e.g.*, Ex.1008, 3:53-61 (“...**end-to-end QoS** is assured for end-stations...”); Ex.1014, 1:24-26 (“...a **bandwidth guaranteed** service called Virtual Leased Line, or VLL.”); Ex.1020, 14 (“Premium service...may require that such a **service be established on an End-to-End basis** prior to sending data.”).

129. Additionally, premium service was known to be well suited for transmitting real-time data (e.g., “suitable for Internet telephony, videoconferencing.”). Ex.1035, 11; *see also* Ex.1033, 4 (“The Premium service...ha[s] a strong appeal for commercial applications, video broadcasts, voice-over-IP, and VPNs.”). And it was known that because transmission of such real-time data has high QoS requirements, it is essential that end-to-end QoS is

Ex.1003

maintained. *See e.g.*, Ex.1024, 2 (“**[For] the transfer of...audio... it is essential that quality of service is... maintainable on an end-to-end basis.**”); Ex.1023, Abstract (“High-end networked applications such as distance visualization, distributed data analysis, and advanced collaborative environments have demanding quality of service (QoS) requirements.”); Ex.1022, [0003] (“[A]pplications [that] have QoS requirements... include various real time applications (IP Telephony, video conferencing), streaming services (audio or video), or high quality data services (browsing with bounded download delays).”); Ex.1032, 1:31-37 (“[For] Internet-video-conferencing, tele-medicine, telephony, video-on-demand etc., there is an increasing demand to support guaranteed Quality-of-Service (QoS).”).

130. Accordingly, it would have been obvious to implement Patel-225’s method to provide end-to-end premium QoS (e.g., by guaranteeing end-to-end bandwidth with low-loss) to a mobile device, because: (1) premium class was specifically designed to provide end-to-end QoS, and (2) providing end-to-end QoS would support virtual leased lines and real-time data transmission (e.g., audio, video, etc.).

131. As a practical example, consider that Patel-225’s method allows “consumers to obtain wireless resources” at a specified “QoS policy” (e.g., premium QoS) for “**transmission of data and/or voice traffic** between mobile devices and a wireline network.” Ex.1005, 1:39-66, 2:43-52, 6:32-35; *see also*

Ex.1003

Ex.1005, 3:59-64, 4:1-7, 5:6-15. A POSITA considering this disclosure would have known that to transmit real-time data (e.g., voice traffic) as Patel-225 contemplates, it may be essential to provide end-to-end QoS. *See e.g.*, Ex.1024, 2 (“[For] the transfer of...continuous media of digital **audio and video, it is essential that quality of service is... maintainable on an end-to-end basis.**”). Accordingly, it would have been obvious to a POSITA to “*provid[e] end-to-end Quality of Service (QoS)*” within the mobile wireless communications network 10, per a QoS policy (e.g., premium QoS), because it would facilitate the transmission of real-time audio and other real-time data (e.g., video) between mobile devices and the wireline IP network.

132. On the other hand, a POSITA would have understood that if end-to-end QoS was not provided, audio communication may be unintelligible (e.g., broken or including dropouts) and the quality of other real-time data (e.g., video etc.) will also be degraded. Accordingly, it would have been obvious to a POSITA for Patel-225’s mobile wireless communication network 10 to provide end-to-end QoS to mobile devices receiving premium QoS (e.g., guaranteed end-to-end bandwidth with low-delay and low-jitter) when transmitting real-time data.

133. Furthermore, in instances where the communication indicates an external destination, Patel-225 discloses that a bandwidth broker negotiates QoS

parameters with other bandwidth brokers for service across multiple network domains:

“The bandwidth brokers can be programmed with an organization's policies, current allocation traffic, and new requests for allocations. The **bandwidth brokers manage the allocations of bandwidth within their network domain and communicate with bandwidth brokers of other network domains to negotiate QoS parameters.**”

Ex.1005, 1:54-60.

134. The QoS parameters are ultimately defined in a service level agreement (“SLA”) and described by Patel-225 as including the following:

“FIG. 2 illustrates wireless service terms for a service level agreement (SLA) 30 in accordance with one embodiment of the present invention. In this embodiment, the SLA 30 includes access region parameters 32, price parameters 34, service type parameters 35, time parameters 36, and bandwidth parameters 38. The access region parameters 32 include latitude and longitude, selections, structures, facilities, cities, airports, and any other suitable area that can be identified for provision of wireless services. The price parameters 34 include fixed price, variable price, price plans, discounts, and other suitable pricing strategies. **The service type parameters 35 include different class or quality of service (QoS) types** such as gold, silver, bronze, premium, assured, and best efforts. The time parameters 36 include a from and to time for services, if from an unlimited time for services, a day of the week and/or month for services, a time zone and any other suitable times at which

Ex.1003

wireless services may be provisioned. The bandwidth parameters 38 include best available, a minimum and maximum, an average, fixed, variable, or other suitable level of bandwidth.”

Ex.1005, 6:22-41; *see also* Ex.1005, 5:31-48 (“...a service level agreement... manages bandwidth and other suitable network resources... The agreed upon terms define a SLA and may specify a wireless region, price, time, type of service, bandwidth and other suitable conditions of service.”).

135. When multiple network domains are implicated by the request, it would have been obvious to a POSITA for the bandwidth broker of the wireless communications network 10 (Ex.1005, 1:54-60, 5:31-6:4) to negotiate QoS parameters with bandwidth brokers of other networks to provide end-to-end QoS across multiple domains, in accordance with a SLA (which specifies premium QoS), as known in the art. This was a commonly available functionality of bandwidth brokers. *See e.g.*, Ex.1032, 7:5-6 (“**[E]nd-to-end QoS** is provided through Service Level Agreements (SLA) between the networks.”); *See e.g.*, Ex.1014, 4:54-56 (“The **end-to-end issue is of great importance when service requests span multiple network provider domains.**”); Ex.1020, Abstract (“In addition to the BB [Bandwidth Broker] requirements, this document also proposes various deployment phases designed to provide a staged approach to providing the inter-domain communication necessary to **achieve end-to-end QoS.**”); Ex.1021,

Abstract (“[A] Bandwidth Broker (BB) acts as the resource manager for each administrative domain. Neighboring Bandwidth Brokers communicate with each other to establish Inter-domain resource agreements.” “The aggregate traffic crossing domain borders is served according to relatively stable, long-lived bilateral agreements. **End-to-end QoS support is achieved through the concatenation of such bilateral agreements.**”); Ex.1022, Abstract (“In a radio network, the implementation of IP signaling may be used to **provide end-to-end Quality of Service**. This may be accomplished by mapping corresponding parameters between the IP protocol and the radio network protocol in order to achieve the desired delay and bandwidth requirements.”); Ex.1025, 11 (“[A] BB [Bandwidth Broker] communicates with directly connected neighbor [bandwidth broker]...**end-to-end QoS support can be achieved** by concatenating these pair-wise SLA’s along the path from source to destination domains.”).

136. One of ordinary skill in the art would have looked to other references in order to successfully implement Patel-225’s method to provide end-to-end premium QoS across a single and multiple network domains.

137. Second, Schelen-1999 and Schelen-1997 provide additional implementation details of how to provide end-to-end QoS.

138. In more detail, according to Schelen-1999, when providing “better than best-effort” in an IP network, it is important “to make sure that the service

Ex.1003

commitments can be met.” Ex.1011, Introduction. A POSITA would have understood that “best-effort” represents the traditional delivery method for IP, which did not guarantee a QoS (e.g., specified delay constraints, specified bandwidth, etc.). Ex.1005, 1:29-34; Ex.1013, 2:35-36; Ex.1016, 84-85. On the other hand, it would have been understood by persons of skill that differentiated services provides “better than best-effort,” including enhanced services such as premium for virtual leased lines. Ex.1005, 1:29-34; Ex.1032, 1:55-58 (“The Diff-Serv architecture aims to provide scalable service discrimination and ‘better than best effort’ service.”); Ex.1033, 2 (“Premium service ... is fundamentally different from the Internet’s current best effort service... One use of such a service might be to create ‘virtual leased lines.’”).

139. Schelen-1999 discloses that bandwidth brokers (which it refers to as “agents”) perform end-to-end admission control to reserve IP network resources, thereby guaranteeing that QoS service commitments can be met:

“Service agreements involving a minimum expected level of service must involve some kind of **admission control to make sure that there are sufficient resources available in the network to meet the agreements**. Admission control gives the provider an opportunity to reject service to new clients so that those already granted admission obtain committed service.”

Ex.1011, Introduction.

“For each link-state routing domain in the network there is a topology-aware QoS agent (also known as a bandwidth broker) responsible for admission control. The architecture provides resource reservations for aggregated virtual leased lines between network domains. In this paper, we present performance measurements for resource provisioning in a prototype QoS agent. This includes an evaluation of two data structures for advance reservations and accompanying algorithms. We also compare the cost for on-demand route computations with pre-computation of routes. The objective in this paper is to evaluate the performance of **end-to-end admission control within a single link-state routing domain.** In a domain with 15 routers, 28 transition networks and 64 stub networks, our prototype performs approximately 25,000 end-to-end admission decisions per second. The results show that an ordinary PC can be used for running a QoS agent that performs path-sensitive admission control and maintains per-link resource reservations in a link-state routing domain.”

Ex.1011, Abstract.

140. Schelen-1999 also discloses that each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make **“reservations...towards destination domains.”** Ex.1011, Introduction. Similarly, Schelen-1997 (cited to by Schelen-1999), discloses that “audio and video conferencing may need resource reservations in the network to

Ex.1003

perform well” and that “**end-to-end reservations...involving several routing domains** are handled by cooperation between the involved reservation agents [bandwidth broker].” Ex.1011, Introduction; Ex.1031, 265-266.

141. A POSITA reading the above cited portions of Schelen-1999 and Schelen-1997 would have understood that the bandwidth broker (called QoS agent) performs end-to-end admission control in its network domain, including reserving end-to-end resources so that QoS service commitments can be met. Also, a POSITA would have understood that the bandwidth broker cooperates with bandwidth brokers of other network domains to make end-to-end reservations toward the destination. Because end-to-end resources are reserved in each network domain toward the destination, end-to-end QoS service commitments can be met when providing better than best-effort service (e.g., premium QoS) across multiple network domains.

142. My understanding is supported by contemporaneous prior art references, demonstrating that bandwidth brokers provided end-to-end QoS by establishing resource agreements with other bandwidth brokers for reservation of end-to-end resources toward the destination. *See e.g.*, Ex.1020, Abstract (“In addition to the BB [Bandwidth Broker] requirements, this document also proposes various deployment phases designed to provide a staged approach to providing the inter-domain communication necessary to **achieve end-to-end QoS.**”); Ex.1021,

Ex.1003

Abstract (“[A] Bandwidth Broker (BB) acts as the resource manager for each administrative domain. Neighboring Bandwidth Brokers communicate with each other to establish Inter-domain resource agreements.” “The aggregate traffic crossing domain borders is served according to relatively stable, long-lived bilateral agreements. **End-to-end QoS support is achieved through the concatenation of such bilateral agreements.**”); Ex.1022, Abstract (“In a radio network, the implementation of IP Signaling may be used to **provide end-to-end Quality of Service.** This may be accomplished by mapping corresponding parameters between the IP protocol and the radio network protocol in order to achieve the desired delay and bandwidth requirements.”); Ex.1025, 11 (“[A] BB [Bandwidth Broker] communicates with directly connected neighbor [bandwidth broker]...**end-to-end QoS support can be achieved** by concatenating these pair-wise SLA’s [Service Level Agreements] along the path from source to destination domains.”). Ex.1035, 12-13, Fig. 4 (Example 2: Delivery of Premium Service, where end-to-end resources have been reserved to provide end-to-end premium QoS during Phase 2: Data Transmission). Accordingly, a POSITA would have understood that the end-to-end admission control, per Schelen-1999 and Schelen-1997, which reserves end-to-end resources in each IP network domain toward the destination, provides end-to-end QoS. Further implementation details, regarding how to perform end-to-end

admission control per the proposed combination, are provided below in the context of the analysis at limitations [1.2]-[1.6], and [1.8].

143. It would have been obvious to a POSITA to implement Patel-225's bandwidth broker such that it performs end-to-end admission control, per Schelen-1999 and Schelen-1997, because it would guarantee that sufficient end-to-end IP network bandwidth is reserved for premium QoS, thereby providing end-to-end QoS. The combined teachings would "make sure that the service commitments can be met" when Patel-225's service is "better than best-effort," e.g., such as premium QoS. Ex.1011, Introduction. This would further Patel-225's goal of transmitting voice traffic between mobile devices and the wireline IP network, and other network domains when the destination is external. *See e.g.*, Ex.1024, 2 ("**[For] the transfer of...audio... it is essential that quality of service is... maintainable on an end-to-end basis.**"). Also, the combination would allow for Patel-225's method to support other real-time data (e.g., video) and virtual leased lines, which were known in the art to utilize end-to-end QoS. *See also* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

144. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses a method for providing end-to-end QoS within a mobile wireless communications network 10, which renders obvious "[a] method for providing end-to-end Quality of Service (QoS) within a mobile telecommunication system."

Ex.1003

b. [1.0.2] *a Core Network (CN) connected to at least one Radio Access Network (RAN) using Internet Protocol (IP) based transmission, the method comprising the steps of:*

145. To the extent the preamble is limiting, Patel-225 renders obvious that the mobile telecommunication system comprises a Core Network (CN) connected to at least one Radio Access Network (RAN) using Internet Protocol (IP) based transmission.

146. First, as discussed at limitation [1.0.1], Patel-225's mobile wireless communications network 10 may implement common standards, including W-CDMA. Ex. 1005, 4:20-28. It was known in the art that W-CDMA was another name for the UMTS air-interface and that this is a third-generation mobile communication standard that utilizes a CN as well as a RAN that used IP protocol-based transmission. See e.g., Ex.1013, 3:3-13 ("Standardization of third generation mobile communication systems [includes]... UMTS....The general system architecture of UMTS/IMT-2000 includes User Equipment (UE), UMTS Terrestrial Radio Access Network (UTRAN) and the Core Network."), 16:53-56 ("WCDMA (UMTS)"), 7:14-18 ("packet data based cellular systems...using IP network protocol.").

147. This prior art knowledge is also confirmed in the '601 patent's background section. Ex.1001, 2:19-27 ("FIG. 2, shows an example of a packet

switched wireless system 200, e.g. a third generation (3G) UMTS system. The system comprises a CN with IP based transmission that comprises IP routers...The system further comprises RANs that comprise a controlling unit 204, Base Stations BS and IP routers R.”). Accordingly, it would have been obvious to a POSITA that Patel-225’s mobile wireless communications network 10 includes a CN and a RAN since W-CDMA (UMTS) comprised such elements. Below I address how the various wireline and wireless networks of Patel-225 correspond to the CN and the RAN.

148. Second, Patel-225 discloses that the mobile wireless communications network 10 comprises “[a] **wireline portion 24,**” which “**may be the Internet, intranet, extranet, or other suitable local or wide area network**” that uses “**IP data connections.**” Ex.1005, 5:10-15. It would have been obvious to a POSITA to implement Patel-225’s wireline IP network 24 (which can be any suitable network) as a CN, at least because it would serve as the CN per the W-CDMA standard, which is a standard that Patel-225’s system supports. Ex.1005, 4:19-25; Ex.1013, 3:3-13. Accordingly, Patel-225’s wireline IP network 24 renders obvious a “*Core Network (CN).*”

149. Patel-225 further discloses that the mobile wireless communications network 10 has overlapping cellular networks 12 that provide radio frequency (“RF”) links for mobile devices 20:

“FIG. 1 illustrates a wireless network 10 in accordance with one embodiment of the present invention. In this embodiment, the wireless network 10 comprises a **plurality of overlapping cellular networks 12 in which terrestrial and mobile wireless transmission originates** in geographically delimited cells. It will be understood that the present invention may be used in connection with satellite and other suitable types of wireless and other dynamic bandwidth networks.”

Ex.1005, 3:59-67; *see also* Ex.1005, 2:6-14.

“Referring to FIG. 1, the cellular networks 12 each cover a contiguous area that is broken down into a series of overlapping cells 14. Each cell 14 has a base station, or server, 16 and may be subdivided into a plurality of geo-location areas 18.

...

Servers 16 provide a **radio frequency (RF) link for mobile devices 20** in a corresponding cell 14. The wireless RF link to the mobile devices 20 in the cell 14 may be based on established standards such as IS-54 (TDMA), IS-95 (CDMA), GSM and AMPS, 802.11 based WLAN, or new upcoming standards such as CDMA2000 and W-CDMA or proprietary terrestrial or mobile radio interfaces. The mobile devices 20 may be cell phones, data phones, data devices, portable computers, or any other suitable devices capable of communicating information over a wireless link.”

Ex.1005, 4:1-28.

150. It would have been obvious to a POSITA that since Patel-225's mobile wireless communications network 10 supports W-CDMA, cellular networks 12 correspond to a RAN per the standard. See Ex.1013, 3:3-13. One or more of Patel-225's cellular network 12 that provide wireless access via radio frequency links render obvious "*at least one Radio Access Network (RAN)*."

151. Patel-225's wireline IP network 24 is "*connected to*" the cellular network 12 via mobile gateway 22:

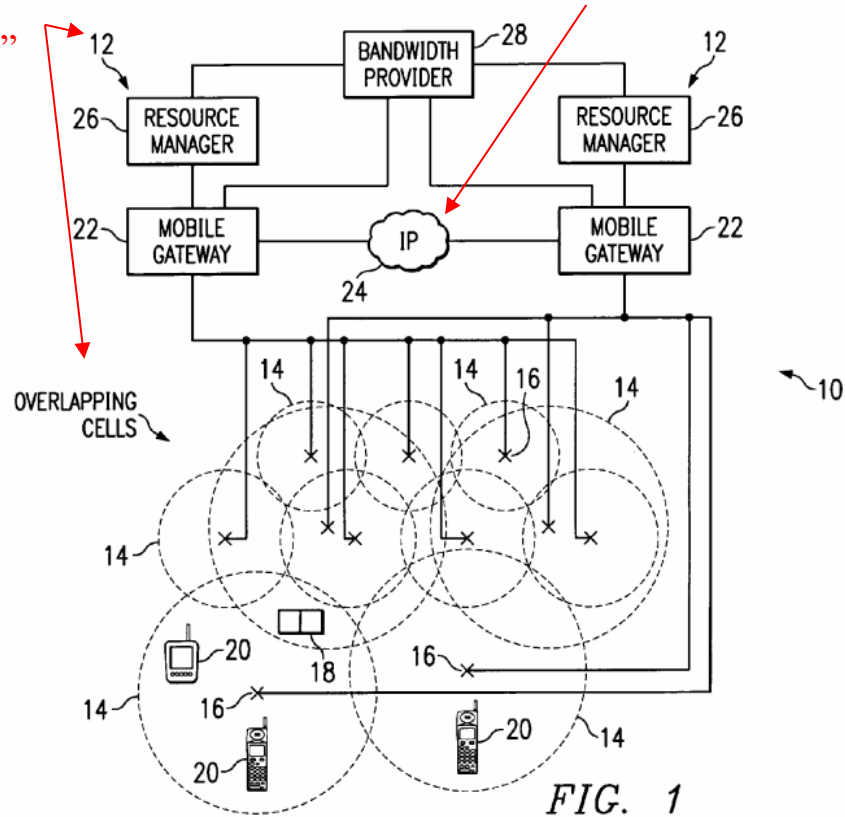
"The mobile gateways 22 in each cellular network 12 **provide connectivity from the wireless portion of the cellular network 12** to a wireline portion 24 of the wireless network 10 via circuit switched and packet switched wireless data protocols. The wireline portion 24 may be the Internet, intranet, extranet, or other suitable local or wide area network. For the Internet, the mobile gateways 22 provide an access, or entry point for all transport control protocol/ Internet protocol (TCP/IP) data connections to the wireless portion of the network 12."

Ex.1005, 5:6-15. Accordingly, Patel-225's wireline IP network 24 is connected to cellular network 12, which discloses that the CN is "*connected to*" the RAN.

152. As illustrated below at Figure 1, Patel-225's mobile wireless communications network 10 comprises a wireline IP network 24 ("*Core Network (CN)*") that is connected to at least one cellular network 12 with overlapping cells that provide radio access ("*at least one Radio Access Network (RAN)*").

“at least one
Radio Access
Network (RAN)”

“Core Network (CN)”



Ex.1005, Fig. 1 (annotated).

153. Moreover, in Patel-225 the mobile wireless communication network 10 (including the wireless network 12 and wireline network 24) utilize the IP protocol, which discloses “using Internet Protocol (IP) based transmission.” For example, Patel-225 discloses “[w]ireline Internet protocol (IP) networks” “[w]ireless communication networks [that] use the IP” and that its method supports “Internet protocol...data connections.” Ex.1005, 1:29-30, 1:61-63, 5:6-25. As such, it would have been obvious to a POSITA that Patel-225’s mobile wireless communications network 10, including wireline IP network 24 (“CN”) and wireless

Ex.1003

cellular network 12 (“*RAN*”) use IP based transmission, per the supported WCDMA standard or some other supported standard. *See e.g.*, Ex.1013, 7:14-18 (“packet data based cellular systems...**using IP network protocol.**”), 16:53-56 (“**WCDMA...**”). The ’601 patent itself recognizes that cellular network standards at that time (including those disclosed by Patel-225) utilized IP based transmission. Ex.1001, 2:17-35.

154. Thus, Patel-225 discloses that the mobile wireless communications network 10 comprises a wireline IP network 24 connected to at least one wireless network 12 using IP based transmission, which renders obvious “*a Core Network (CN) connected to at least one Radio Access Network (RAN) using Internet Protocol (IP) based transmission.*”

155. As I further analyze below, Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious the method “*comprising*” the claimed steps.

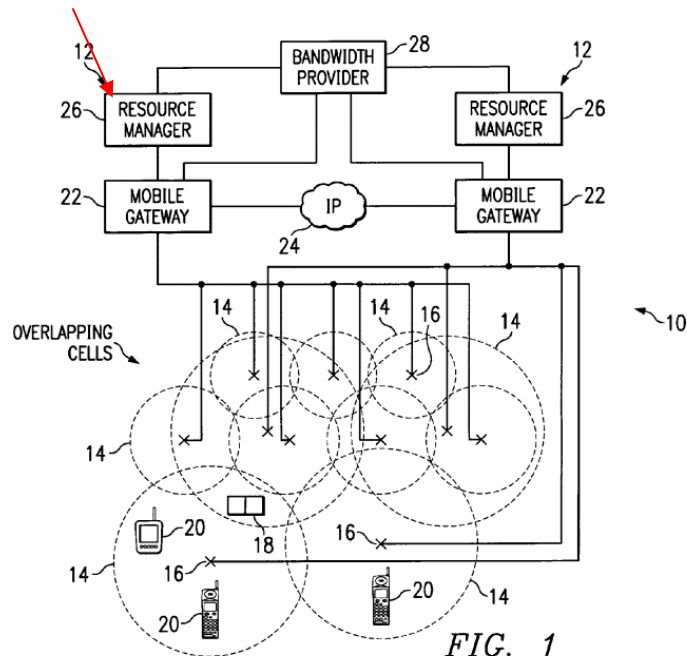
c. **[1.1] *handling radio resources within the RAN by using a radio resource manager;***

156. Patel-225 renders obvious handling radio resources within the RAN by using a radio resource manager.

157. First, as discussed at limitation [1.0.2], Patel-225 discloses “*the RAN.*”

158. Second, Patel-225 discloses that the wireless cellular network 12 (“*RAN*”) uses one or more “**resource manager 26.**” Ex.1005, 5:31-39, Fig. 1. Patel-225’s “resource manager 26,” separately and together, correspond to the claimed “*radio resource manager.*” Patel-225’s “resource manager 26” (“*radio resource manager*”) is illustrated below at Figure 1.

“radio resource manager”



Ex.1005, Fig. 1 (annotated).

159. Patel-225’s “FIG. 3 [illustrates] a block diagram illustrating details of the resource manager of FIG. 1.” Ex.1005, 3:39-41.

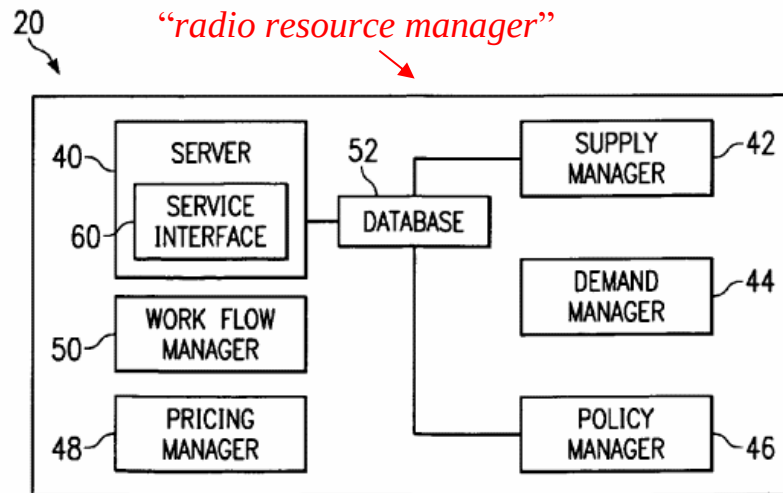


FIG. 3

Ex.1005, Fig. 3 (annotated).

“FIG. 3 illustrates details of the resource manager 26 in accordance with one embodiment of the present invention. In this embodiment, the resource manager 26 is implemented as a centralized system for controlling bandwidth within a cellular network 12. It will be understood that functionality of the resource manager 26 may be suitably distributed within the cellular network 12.”

Ex.1005, 6:42-48; *see also* Ex.1005, 6:49-65.

160. Patel-225 discloses that during operation the resource manager 26 manages bandwidth:

“In each cellular network 12, a service level agreement (SLA), or **resource manager 26 manages bandwidth and other suitable network resources** of the network provider. As described in more detail below, the resource manager 26 receives requests for wireless services from a consumer, service provider, bandwidth broker or other

Ex.1003

requester, determines resource availability based on the request, generates a response based on resource availability, and sends the response to the requester. The request and reply may each be an offer to accept or provide services, an acceptance of an offer, or a partial offer to accept or provide services including both specified and open terms. Based on the request and the response, additional negotiations may occur between the resource manager 26 and the requester in order to agree on terms at which the wireless service will be provided. The agreed upon terms define a SLA and may specify a wireless region, price, time, type of service, bandwidth and other suitable conditions of service. The SLA will be checked and enforced/ensured by the network elements during use of the wireless service as packets are transmitted over the cellular network 12.”

Ex.1005, 5:31-51; *see also* Ex.1005, 7:54-56. Additionally, Patel-225 discloses that “the resource manager 26...control[s] bandwidth within a cellular network 12.”

Ex.1005, 6:42-48. Managing and controlling radio bandwidth and other radio resources within the wireless cellular network 12 renders obvious “*handling radio resources within the RAN.*”

161. Further, it was well-known to a POSITA that a radio resource manager was part of cellular systems, including W-CDMA (UMTS). Ex.1018, 187 (“Radio Resource Management (RRM) is responsible for utilization of the air interface resources. RRM is needed to guarantee Quality of Service, to maintain the planned coverage area and to offer high capacity.”); Ex.1013, 11:26-32 (“The admission

Ex.1003

control function is part of a structure which consists of...a radio resource manager.”) It would have been obvious to a POSITA that, in the instance where Patel-225’s mobile wireless communications network 10 supports W-CDMA, resource manager 26 corresponds to a radio resource manager per the standard.

162. Thus, Patel-225 discloses handling radio resources (e.g., managing and controlling bandwidth and other radio resources) within the wireless cellular network 12 by using a resource manager 26, which renders obvious “*handling radio resources within the RAN by using a radio resource manager.*”

d. [1.2] controlling IP network resources by using a resource map in a Network Resource Manager (NRM) in order to provide said end-to-end QoS,

163. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious controlling IP network resources by using a resource map in a Network Resource Manager (NRM) in order to provide said end-to-end QoS.

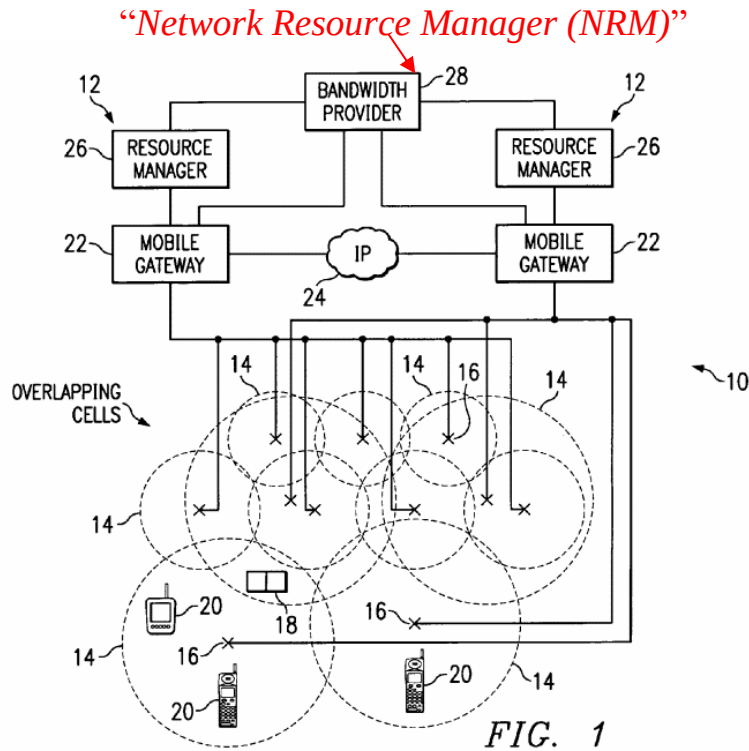
164. As I discussed in the Claim Construction section, a POSITA would have understood term “*Network Resource Manager (NRM)*” to include a centralized or distributed agent or bandwidth broker.

165. First, as discussed at [1.0.1], Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious “*providing end-to-end Quality of Service (QoS).*”

166. Second, consistent with the analysis at [1.0.1], Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that a bandwidth broker provides end-to-end QoS, which renders obvious “*a Network Resource Manager (NRM)...*[that] provide[s] said end-to-end QoS.”

167. Patel-225’s system includes a “**bandwidth provider [that] may be...a bandwidth broker.**” Ex.1005, 5:61-6:2. A POSITA would have understood that a “bandwidth broker” is a “a logical entity” and that “may take either a centralized or a distributed approach, or a combination of both.” Ex.1025, 5. For instance, it would have been obvious based on implementation specifics for Patel-225’s bandwidth broker to be distributed such that one bandwidth broker is used within the wireless network 12 and another bandwidth broker is used within the wireline IP network 24, as suggested by the disclosure of related Patel-764. *See* Ex.1007, 16:61-17:2 (“bandwidth broker...may be distributed.”); Ex.1003, ¶166

168. Accordingly, Patel-225’s bandwidth provider 28 (a “bandwidth broker”) illustrated at Figure 1 corresponds to “*a Network Resource Manager (NRM)*,” as analyzed in the Claim Construction section.



Ex.1005, Fig. 1 (annotated).

169. Furthermore, Patel-225 discloses that the “**bandwidth brokers [] control and allocate Internet or other network bandwidth.**” Ex.1005, 1:52-54. “The **bandwidth brokers manage the allocations of bandwidth within their network domain** and communicate with bandwidth brokers of other network domains to negotiate QoS parameters.” Ex.1005, 1:56-61; *see also* Ex.1005, 6:32-36 (“The service type parameters 35 include different class or quality of service (QoS) types such as gold, silver, bronze, premium, assured, and best efforts.”). Consistent with the analysis at the preamble [1.0.1] of “*providing end-to-end Quality of Service (QoS)*,” it would have been obvious for Patel-225’s bandwidth

Ex.1003

broker to perform end-to-end admission control, in view of Schelen-1999 and Schelen-1997, because it would guarantee that sufficient end-to-end IP network bandwidth is reserved for premium QoS.

170. Accordingly, the combined teachings of Patel-225, Schelen-1999, and Schelen-1997, disclose that the bandwidth broker performs admission control (including controlling, allocating, and reserving IP network resources) and negotiates QoS parameters with the bandwidth brokers of other domains to provide end-to-end QoS, which renders obvious “*controlling IP network resources...in order to provide said end-to-end QoS.*”

171. According to Patel-225, to control resources, the “bandwidth broker...[is] **programmed with...current allocation traffic, and new requests for allocations.**” Ex.1005, 1:54-56. A POSITA would have understood that the “current allocation traffic, and new requests for allocations” programed in the bandwidth broker’s memory represents a mapping of currently used or reserved bandwidth and therefore corresponds to “*a resource map in a Network Resource Manager (NRM).*” This is consistent with the ’601 patent, which discloses that “[t]he resource map contains information on how much resources (e.g. bandwidth)...are available and reserved.” Ex.1001, 7:7-9.

172. Nevertheless, to the extent Patent Owner contends that Patel-225 is insufficient, Schelen-1999 expressly discloses that the bandwidth broker (called

Ex.1003

agent) uses a “**resource map**” for “**end-to-end admission control**” in the IP network domain (which transmits “IP packet[s]”). Ex.1011, Abstract, Introduction, Resource provisioning over time. Further, and consistent with Patel-225, Schelen-1999 discloses that each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make “reservations... towards destination domains.” Ex.1011, Introduction. It would have been obvious to a POSITA that Schelen-1999’s disclosure of using a resource map to perform admission control includes controlling the IP network resources (e.g., making reservations) to provide end-to-end QoS from the source to the destination. *See also* analysis at [1.0.1] *supra*, [1.3]-[1.4], *infra*, detailing how the bandwidth broker controls IP network resources.

173. It would have been obvious to a POSITA, in view of Schelen-1999’s teachings, for Patel-225’s bandwidth broker to use a “*resource map*” for admission control, because the map information would be useful for identifying available paths and resources (e.g., bandwidth) that may be reserved to provide end-to-end QoS. Also, it would have been obvious to a POSITA for the resource map to be in the bandwidth broker (e.g., in the bandwidth broker’s memory along with the current bandwidth allocation, *see* Ex.1005, 1:54-56) so that the bandwidth broker

may easily access the relevant mapping information for access control. *See* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

174. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses controlling IP network resources by using a resource map in a bandwidth broker² in order to provide end-to-end QoS, which renders obvious “*controlling IP network resources by using a resource map in a Network Resource Manager (NRM) in order to provide said end-to-end QoS.*”

- e. [1.3] *the step of controlling the IP network resources including the steps of the NRM performing path-sensitive call admission control by using the resource map in the NRM,***

175. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious that controlling the IP network resources includes the steps of the NRM performing path-sensitive call admission control by using the resource map in the NRM.

² *See also* analysis at [6.1], describing how the bandwidth broker in the proposed combination dynamically monitors topology changes, including retrieving routing information concerning the IP network.

176. First, as discussed at limitation [1.2], the prior art combination renders obvious “*controlling the IP network resources... by using the resource map in the NRM.*”

177. Second, Schelen-1999 discloses that “**admission control is performed as we initiate a call.**” Ex.1011, Resource provisioning over time. The “**bandwidth broker**” “**performs path-sensitive admission control,**” including using a “**resource map to perform admission control in [its] domain.**” Ex.1011, Abstract, Introduction; *see also* Ex.1011, Introduction (“Path-sensitive admission control is possible as each QoS agent knows the topology and static link resources in its domain.”), Conclusion (“The results show that it is feasible for an agent to manage per-link resource reservations and perform path-sensitive admission control in a link-state routing domain.”). It would have been obvious to a POSITA for the bandwidth broker to use the resource map within its memory to perform the path-sensitive admission control, since the bandwidth broker may be implemented as software running on a computer. Ex.1011, Conclusion. Accordingly, Schelen-1999 discloses “*the NRM performing path-sensitive call admission control by using the resource map in the NRM.*”

178. It would have been obvious to a POSITA, in the combination of Patel-225, Schelen-1999, and Schelen-1997, for the bandwidth broker to perform path-sensitive admission control using the resource map within its memory (see analysis

Ex.1003

at [1.2]), because it would allow for identifying a suitable path. Once the path is identified, IP network end-to-end resources would be reserved to provide end-to-end QoS. See analysis at [1.8], *infra*. This also applies to the circumstance where multiple network domains are implicated. See Ex.1011, Introduction (Each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make “reservations...towards destination domains.”); Ex.1031, 266 (“end-to-end reservations...involving several routing domains are handled by cooperation between the involved reservation agents.”); Ex.1035, 12-13, Fig. 4 (Example 2: Delivery of Premium Service, where end-to-end resources have been reserved to provide end-to-end premium QoS during Phase 2: Data Transmission); *see also* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

179. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that the step of controlling the IP network resources includes the bandwidth broker performing path-sensitive call admission control by using the resource map in the bandwidth broker, which renders obvious that “*the step of controlling the IP network resources including the steps of the NRM performing path-sensitive call admission control by using the resource map in the NRM.*”

f. **[1.4] *the NRM checking that resources are available along a path, and***

180. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious the NRM checking that resources are available along a path.

181. First, as discussed at limitation [1.2]-[1.3], the prior art renders obvious “*the NRM performing path-sensitive call admission control.*” It would have been obvious to a POSITA that performing path-sensitive call admission control includes checking that resources are available along the path.

182. Second, Schelen-1999 discloses that performing path-sensitive call admission control for new advance bandwidth requests includes “**check[ing]** whether the total aggregate plus the new requested bandwidth is still below the link bandwidth.” Ex.1011, Advance admission control, A binary search tree over time. Also, immediate admission control includes “**check[ing] for sufficient resources** so that both advance reservations and immediate reservations can be served.” Ex.1011, Immediate admission control. This allows “for an agent to manage per-link resource reservations and perform path-sensitive admission control in a link-state routing domain.” Ex.1011, Conclusion. Further, consistent with my analysis at the preamble [1.0.1] and limitations [1.2]-[1.3], it would have been obvious that in the instance where multiple network domains are implicated, each bandwidth broker checks that resources are available along a path within its network domain

such that there are sufficient end-to-end resources available that may be reserved to provide end-to-end QoS.

183. It would have been obvious to a POSITA, in view of Schelen-1999's teachings, to implement Patel-225's bandwidth broker such that it checks that sufficient resources are available along a path and to confirm that the path is not overly congested so that the resources may subsequently be reserved to provide end-to-end QoS (see preamble [1.0.1], limitation [1.8]). Checking that there are sufficient resources along the path reduces the risk of over-allocating resources for immediate and advance reservations. This is because when immediate and advance reservations share resources and the duration of immediate is not known, granting immediate reservations—without first checking—may result in over-allocation of resources. Ex.1005, 8:60-62 (“The wireless services may be requested in real-time for immediate use or requested for use at a specified future time.”); Ex.1031, 268 (“When immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation.”); *see also* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

184. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses the bandwidth broker checking that resources are available along a path,

which renders obvious “*the NRM checking that resources are available along a path.*”

g. [1.5] *the NRM pre-allocating resources in an IP network;*

185. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious the NRM pre-allocating resources in an IP network.

186. First, as discussed at limitation [1.2], the prior art combination renders obvious “*the NRM.*”

187. Second, Patel-225 discloses that “bandwidth brokers [] control and allocate Internet or other network bandwidth.” Ex.1005, 1:52-54; *see also* Ex.1005, 1:54-66. Bandwidth may be allocated “for immediate use” or in advance for use “at a specified future time” and location. Ex.1005, 7:49-56, 8:60-62. This assures that if the consumer is traveling to a remote location, there are sufficient resources. Ex.1005, 8:57-67.

188. Third, Schelen-1999 discloses how the “QoS agent (also known as a bandwidth broker)” performs admission control to allocate resources for immediate and advance reservations. Ex.1011, Abstract, Resource provisioning over time. The bandwidth broker performs admission control for immediate reservations using a “lookahead time”:

“Admission control for immediate reservations is performed by recording the aggregate bandwidth of all immediate reservations. In addition, **admission control looks ahead a short period of time** into the advance reservation state to find out about resources needed for advance reservations in the near future. The **lookahead time** depends on how much bandwidth that is requested for each advance reservation and the amount of bandwidth per time-unit that is returned by immediate reservations ending. In most cases the lookahead time is much shorter than the average duration of a reservation.”

Ex.1011, Immediate admission control.

189. The “lookahead” time is illustrated below at Figure 1.

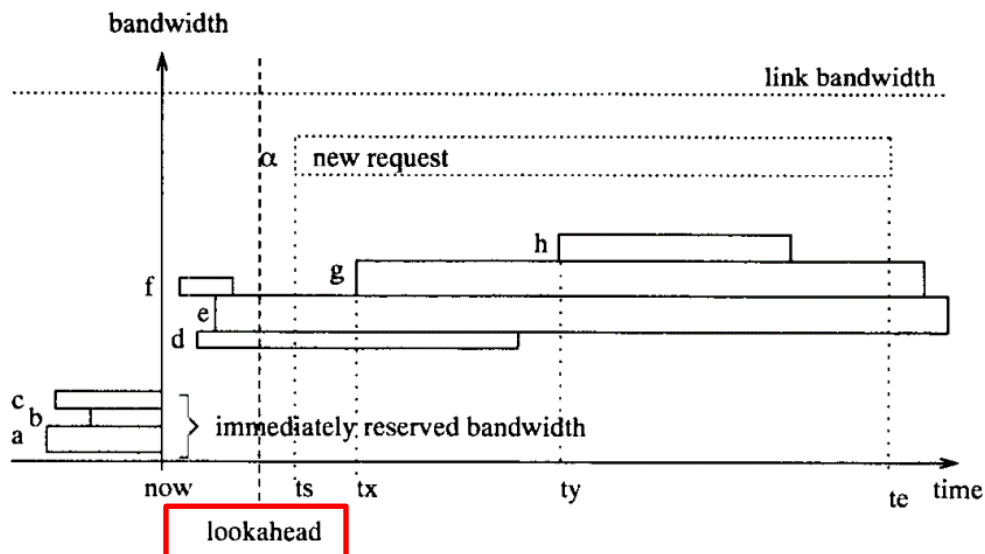


Figure 1: Advance reservations in a time-bandwidth domain

Ex.1011, Fig. 1 (annotated).

Ex.1003

Schelen-1999 explains that the “lookahead time...issue is covered in” Schelen-1997. Ex.1011, Immediate admission control. As such a POSITA would look to Schelen-1997 for additional understanding of the lookahead time.

190. Turning to Schelen-1997, it discloses that “[w]hen immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation.” Ex.1031, 268. To address the risk of over-allocation of IP network resources, the bandwidth broker utilizes a “lookahead time,” which represents a “**pre-allocation** time, i.e., the time for starting to **set aside resources for advance reservations.**” Ex.1031, 268. In other words, when determining if there are sufficient resources for immediate reservations (which have unknown duration), Schelen-1997 pre-allocates (sets aside) resources for the already scheduled advance reservation, and if other resources are available then it grants the immediate reservation. On the other hand, “[i]f there are insufficient resources available in the near future, the request could be rejected instead of serviced.” Ex.1031, 268. This would be analogous to reserving a table at a restaurant, where the table may be set aside for 1 hour (e.g., 1 hour lookahead time) before the start of advanced reservations, to ensure that the table will be available at the time of the reservation.

191. In view of Schelen-1999 and Schelen-1997, it would have been obvious to implement Patel-225’s bandwidth broker (when performing end-to-end

Ex.1003

admission control, *see* [1.0.1], [1.3]) to utilize a lookahead time to pre-allocate (set aside) IP network resources for advance reservations, so that resources are not over-allocated when immediate reservations and advance reservations share resources.

Ex.1031, 268 (“When immediate reservations and advance reservations share resources and the duration of each immediate reservation is unknown, there is a risk of over-allocation.”). The combined teachings would further Patel-225’s goal of assuring that the consumer traveling to a different location can make advance reservations and be assured of adequate coverage by reducing the likelihood and advanced reservation cannot be fulfilled. Ex.1005, 8:60-67; *see also* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

192. I note that the combined teachings are within the scope of the ’601 patent, which describes “pre-allocat[ing] network resources to prevent over-utilisation [sic]” when the consumer moves to a different location. Ex.1001, 9:1-3. Also, the ’601 patent characterizes pre-allocated resources as “resources [that are] set aside.” Ex.1001, 9:8-10.

193. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses the bandwidth broker pre-allocating (setting aside) resources in an IP network, which renders obvious “*the NRM pre-allocating resources in an IP network.*”

h. [1.6] *scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM;*

194. In multiple ways, Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM.

195. First, as discussed at limitation [1.2], the prior art combination renders obvious “*the NRM.*”

196. Second, Patel-225 explains that wireless service may be “requested in real-time for immediate use” or requested in advance for use “at a specified future time.” Ex.1005, 8:57-62. In one example, Patel-225 discloses that a potential consumer uses “graphical interface 130” to generate a request for wireless services that is sent to the bandwidth broker:

“Referring to FIG. 5, the graphical user interface 130 includes an interactive map 132 by which wireless access regions for a wireless service may be specified and a plurality of parameter buttons 134 by which additional parameters for the wireless service may be specified.
...

The **parameter buttons 134 allow the service requester to specify time**, service type, bandwidth, and pricing parameters for the wireless service at the identified geographic location. In particular, **the time button 136 allows the service requester to enter a time window or a start time for wireless services.**

...

Information entered into the graphical interface 130 is used to **generate a request** for transmission and evaluation by bandwidth providers. Responses from bandwidth providers may be displayed to the service requester in the graphical interface 130. In addition, the service requester may negotiate parameters.”

Ex.1005, 9:33-10:8, Fig. 5; *see also* Ex.1005, 8:26-28 (“a potential consumer **requests wireless services** from a bandwidth provider 28”). Further as already noted, the Patel-225’s bandwidth provider may be a bandwidth broker. Ex.1005, 5:61-6:4. Accordingly, the request for wireless services received by the bandwidth broker corresponds to “*a resource request handled by the NRM.*”

197. Patel-225’s Figure 5 shows graphical interface 130 for generating a request for wireless services (“*resource request*”), including using time parameter button 136 to specify a from time and to time (“*start and a stop time as a parameter*”) for scheduling bandwidth, etc., over time (“*scheduling resources over time*”). Ex.1005, 3:45-47, 9:33-10:29.

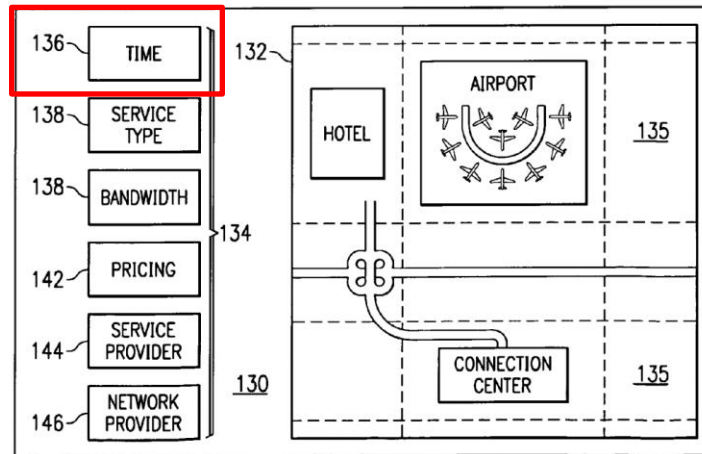


FIG. 5

Ex.1005, Fig. 5 (annotated).

198. Note that the time window has both a “**from and to time** for services.” Ex.1005, 6:22-39. Also, “the service requester may negotiate parameters through the graphical interface 130 with bandwidth providers [bandwidth brokers].” Ex.1005, 10:3-8. “Thus, services for a device can be obtained.” Ex.1005, 10:27-29.

199. Thus, Patel-225’s disclosure of scheduling resources over time by introducing a “from and to time” as a parameter (with time button 136) in a request for wireless services handled by the bandwidth broker, which renders obvious “*scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM.*”

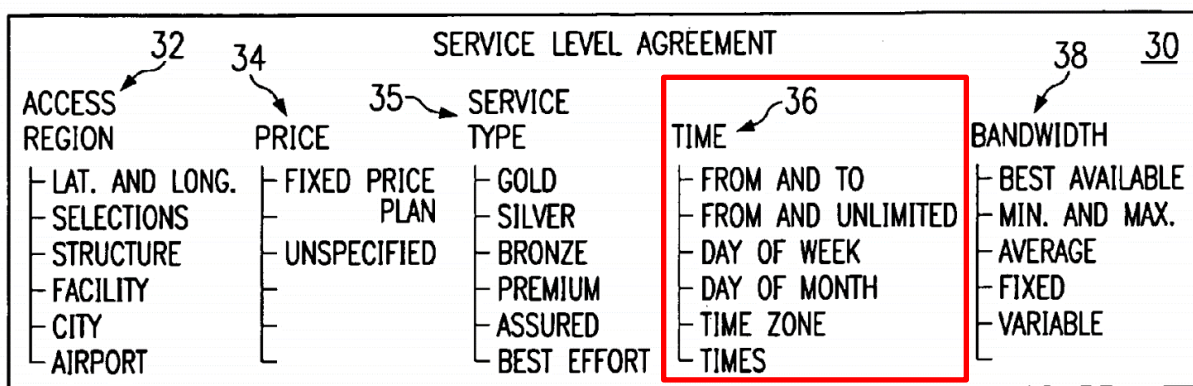
200. Additionally, Patel-225 discloses that the bandwidth broker transmits communications to the resource manager 26, including transmitting a request for wireless services and additional negotiations with service parameters (e.g., time,

bandwidth, etc.) to thereby define a “service level agreement (SLA) 30.” Ex.1005, 5:31-67 (“[T]he resource manager 26 receives requests for wireless services from a...bandwidth broker... Based on the request and the response, additional negotiations may occur...in order to agree on terms [of] service...The agreed upon terms define a SLA and may specify a wireless region, price, time, type of service, bandwidth and other suitable conditions of service.), 6:35-39 (“The time parameters 36 include a from and to time for services.”); *see also* 5:61-6:39, 7:54-56. This allows a consumer to be assured of coverage at a specific time of travel. Ex.1005, 8:64-67 (“Thus, if the consumer is travelling to a remote geographic location, the consumer may first reserve wireless resources at that location to be assured of adequate coverage while at that location.”). Patel-225’s disclosure of scheduling resources over time by introducing a requested from and to time as parameter in a communication (request for wireless services and additional negotiations) from the bandwidth broker to the resource manager discloses “*scheduling resources over time by introducing a start and a stop time as a parameter in a resource request.*”

201. As shown below at Patel-225’s Figure 2, the defined SLA 30, per the communication (“*resource request*”) from the bandwidth broker, includes a time parameter 36 with a from and to time (“*start and a stop time as a parameter*”) for scheduling bandwidth 38 over time (“*scheduling resources over time*”).

Ex.1003

FIG. 2



Ex.1005, Fig. 2 (annotated).

202. The resource request is “*handled by the NRM*” at least because the bandwidth broker handled the communication (i.e., request and additional negotiation) when communicating with the resource manager 26. Ex.1005, 5:33-67.

203. Thus, in this additional way, Patel-225 discloses scheduling resources over time by introducing a from time and to time as a parameter 36 in a resource request handled by the bandwidth broker, which in this additional way renders obvious “*scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM.*”

204. Third, to the extent Patent Owner argues that the above disclosure is insufficient, the combination of Patel-225 with Schelen-1999 and Schelen-1997 also renders obvious this limitation.

205. Schelen-1999 discloses that QoS “[a]gents [bandwidth brokers]... perform admission control in their domain.” Ex.1011, Introduction. A client’s new

Ex.1003

“**admission requests**” supported by the “QoS agent [bandwidth broker]” can include “both immediate and advance reservations” for resources. Ex.1011, Introduction, Resource provisioning over time, Scope and layout, Fig. 1. *See also* Ex.1011, The cost of request-reply transactions (“In reality, an agent [bandwidth broker] would receive reservation requests by using a reliable communication protocol. For this, we suggest using TCP for clients making frequent admission requests.”); Ex.1031, 266 (“Admission control for both immediate and advance reservations could be performed by reservation agents.”).

206. Accordingly, Schelen-1999 and Schelen-1997 disclose that new admission requests for resources are handled by the bandwidth broker, which renders obvious a “*resource request handled by the NRM.*”

207. Schelen-1999 further explains that “[a]dvance reservations [that] are time-limited (i.e., they have a **starting time and a finishing time**).” Ex.1011, Abstract, Introduction, Scope and layout. The “admission requests can include timing information,” such as “a starting point and a finishing point” for “planning network resources over time.” Ex.1011, Resource provisioning over time; *see also* Ex.1031, 267 (“Durations must be specified for advance reservations. A duration includes the **start time and the finish time** for the requested service.”). “This also allows providers to **schedule their resources over time** and predict when the total

capacity will be insufficient.” Ex.1011, Resource provisioning over time; Ex.1031, 267.

208. Schelen-1999 further explains that timing information (e.g., start and finish time) is provided as “**parameters**...[for example] requested durations... requested starting times...time is slotted with a granularity of five minutes.” Ex.1011, Evaluation of single-hop admission control speed. Accordingly, Schelen-1999 and Schelen-1997 disclose scheduling resources over time using a starting time and a finishing time parameter in a new admission request for resources handled by the bandwidth broker, which renders obvious “*scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM.*”

209. As illustrated below at Figure 1, Schelen-1999 uses a schedule for scheduling resources (bandwidth) over time (x-axis) by introducing a start time (“ts”) and a stop or time end (“te”) parameter in the new admission request.

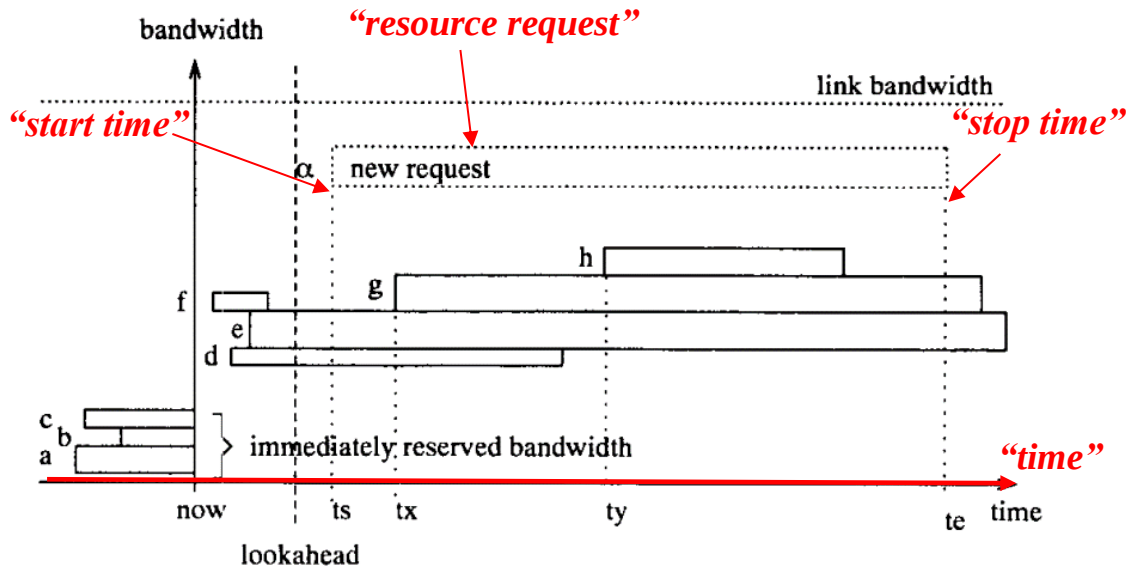


Figure 1: Advance reservations in a time-bandwidth domain

Ex.1011, Fig. 1 (annotated).

210. It would have been obvious to a POSITA to apply the teachings of Schelen-1999 and Schelen-1997 to Patel-225's system, such that it utilizes a schedule (e.g., as illustrated at Figure 1) for scheduling resources over time. Based on the schedule at Figure 1, the bandwidth broker would be able to predict when the total capacity will be insufficient to service a given request. Ex.1011, Resource provisioning over time ("This also allows providers to...predict when the total capacity will be insufficient."); Ex.1031, 267. Also, the schedule is beneficial since all of the necessary information is represented and the relationships; for example, the schedule includes the lookahead time, which would allow for pre-allocating network resources to facilitate end-to-end QoS and thereby obtain numerous

Ex.1003

benefits in Patel-225's system. See analysis at limitation [1.5]; see also Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

211. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses utilizing a schedule for scheduling bandwidth over time by introducing a start time and a stop time as a parameter in an admission request handled by the bandwidth broker, which also renders obvious “*scheduling resources over time by introducing a start and a stop time as a parameter in a resource request handled by the NRM.*”

i. [1.7] communicating resource information between the NRM and the radio resource manager; and

212. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious communicating resource information between the NRM and the radio resource manager.

213. First, as discussed at limitation [1.1]-[1.2], the prior art renders obvious “*the radio resource manager*” and “*the NRM.*”

214. Second, Patel-225 discloses that “**the resource manager 26 receives requests for wireless services from a ... bandwidth broker.**” Ex.1005, 5:33-39; see also Ex.1005, 5:61-6:2 (“One or more bandwidth providers 28 **communicate with the resource managers 26... to intelligently broker bandwidth** and other suitable wireless resources... The bandwidth providers may be... a bandwidth

broker.”). The bandwidth broker’s request may include “both specified and open terms” for wireless services. Ex.1005, 5:39-42.

215. The resource manager 26 “determines resource availability based on the request, generates a response based on resource availability, and sends the response” to the requesting bandwidth broker. Ex.1005, 5:25-39. Patel-225 further discloses that “additional negotiations may occur between the resource manager 26 and the requester [bandwidth broker] in order to agree on terms at which the wireless service will be provided.” Ex.1005, 5:42-45. The resulting agreed upon terms “define a SLA and may specify a wireless region, price, time, type of service, bandwidth and other suitable conditions of service.” Ex.1005, 5:45-51, Fig. 2.

216. Thus, Patel-225’s disclosure of communicating requests, responses, and additional negotiations (including specifying a wireless region, time, type of service, bandwidth and other conditions of service) between the bandwidth broker and the resource manger 26 to define an SLA, renders obvious “*communicating resource information between the NRM and the radio resource manager.*”

j. [1.8] reserving the IP network resources along the path by the NRM to fulfill the end-to-end QoS.

217. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious reserving the IP network resources along the path by the NRM to fulfill the end-to-end QoS.

218. First, as discussed in [1.0.1]-[1.3], the prior art combination renders obvious that the “*NRM*” “*control[s] IP network resources*” by “*performing path-sensitive call admission control*” to “*provide said end-to-end QoS.*”

219. Second, Patel-225 discloses that the “**bandwidth brokers manage the allocations of bandwidth within their network domain.**” Ex.1005, 1:56-60. It would have been obvious to a POSITA for Patel-225’s bandwidth broker to “manage [bandwidth] allocations” within the network domain by reserving end-to-end bandwidth along the path in the wireline IP network 24 to provide end-to-end premium QoS for transmitting audio and other real-time data. *See* analysis at limitation [1.0.1], *infra*; Ex.1005, 1:56-63 (“Wireless communications networks use the IP QoS architecture to support transmission of data and/or voice traffic.”); Ex.1008, 3:53-61 (“**[E]nd-to-end QoS is assured** for end-stations.”); *see also* Ex.1024, 2 (“**[F]or... audio and video, it is essential that quality of service is...maintainable on an end-to-end basis.**” “Meeting quality of service guarantees in distributed multimedia systems is fundamentally an end-to-end issue...For...a sequence of audio and video...quality of service assurances should apply to the complete flow of media: from the remote server, across the network to the points of delivery.”). Nevertheless, to the extent Patent Owner argues that the disclosure is insufficient, the combination with Schelen-1999 and Schelen-1997 renders obvious this limitation, as discussed below.

220. Third, Schelen-1999 discloses that the bandwidth broker is responsible for “end-to-end” “path-sensitive admission control” in an IP network that transmits “IP packet[s].” Ex.1011, Abstract, Introduction. The bandwidth broker is responsible for “**maintain[ing] per-link resource reservations...** in a link-state routing domain.” Ex.1011, Abstract, Conclusion. The bandwidth broker supports “immediate and advance reservations,” where “**[i]mmmediate reservations** start as soon as they are granted.” Ex.1011, Scope and layout. As shown at Schelen-1999’s Figure 1, the bandwidth broker performs admission control by immediately reserving bandwidth for immediate reservations (a, b, and c).

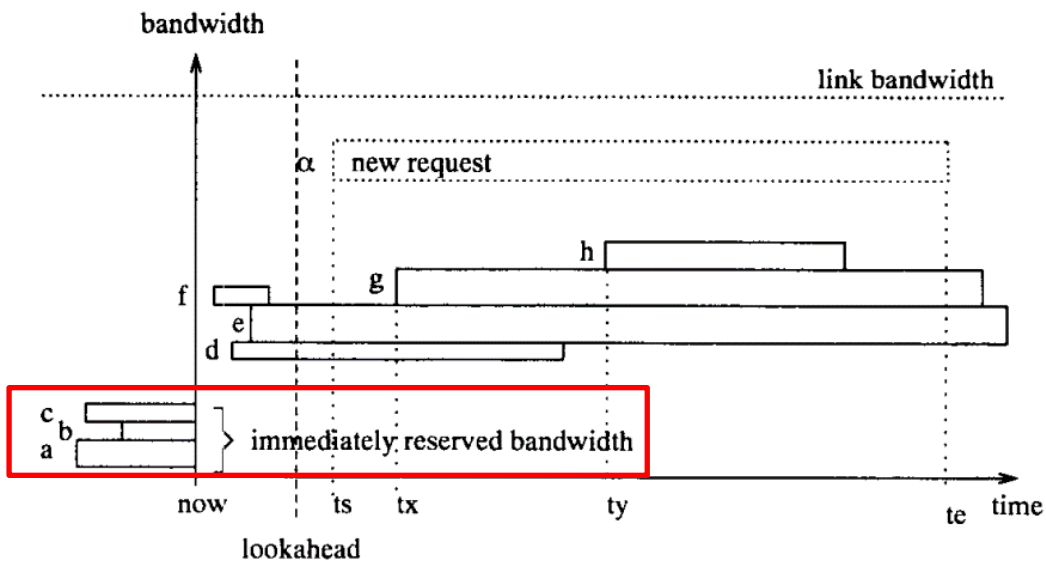


Figure 1: Advance reservations in a time-bandwidth domain

Ex.1011, Fig. 1 (annotated).

221. Schelen-1999 also explains that each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make “**reservations**...towards destination domains.” Ex.1011, Introduction. It would have been obvious to a POSITA that Schelen-1999’s bandwidth broker reserves the IP network resources along the path for immediate and advanced reservations to fulfill the end-to-end QoS from the source to the destination.

222. Additionally, Schelen-1997 describes the bandwidth broker performing admission control, including “**resource reservations**” in an IP network for “[r]eal-time applications such as audio and video conferencing.” Ex.1031, 265. According to Schelen-1997, “admission control for advance reservations is performed by agents [bandwidth brokers] on behalf of the routers in their routing domains.” Ex.1031, 266. The “**agents [bandwidth brokers]** know the topology and the static link capacities of their domains and can therefore **select suitable routes and reserve resources over the links** in advance.” Ex.1031, 266; *see also* Ex.1031, 266 (“The reservation agents [bandwidth brokers] will **allocate resources in the routers along the selected path** and then periodically refresh those resource allocations through the duration of the reservation.”).

223. Schelen-1997 explains that its bandwidth broker approach to reservations is advantageous since “advance reservations can be provided without having to maintain reservation state in the routers through periods when the reservations have no effect on packet forwarding.” Ex.1031, 266. “Furthermore, the agent-driven approach does not require the reserving endpoints to be present until the session for which resources have been reserved is starting.” Ex.1031, 266. Another advantage with the bandwidth broker managing the reservations is that “[r]eservations can also be made for remote locations, thereby supporting third party reservations and nomadic computing, i.e., reservations for places where the host will be moving in the future.” Ex.1031, 266. In this way, the bandwidth brokers support “**end-to-end reservations**” where “[r]equests involving several routing domains are handled by cooperation between the involved reservation agents.” Ex.1031, 266.

224. It would have been obvious to a POSITA that the bandwidth broker, directly within its own IP network, or indirectly through communications with other (downstream) brokers toward the destination, reserves IP network resources along the path to make “end-to-end reservations,” thereby fulfilling end-to-end QoS for “audio and video conferencing [applications which] may need resource reservations in the network to perform well.” Ex.1031, 265; *see also* Ex.1024, 2 (“[F]or...digital audio and video, it is essential that quality of service is...maintainable on an end-to-

Ex.1003

end basis.” “Meeting quality of service guarantees in distributed multimedia systems is fundamentally an end-to-end issue...For...a sequence of audio and video...quality of service assurances should apply to the complete flow of media: from the remote server, across the network to the points of delivery.”).

225. It would have been obvious to a POSITA, in view of Schelen-1999 and Schelen-1997, to implement Patel-225’s bandwidth broker to “manage [bandwidth] allocations” by reserving IP network resources (e.g., bandwidth), thereby making end-to-end reservations along the path from the source to the destination, to fulfill the end-to-end QoS for transmitting real-time audio and other data. *See* Ex.1005, 1:56-62 (“Wireless communications networks use the IP QoS architecture to support transmission of data and/or voice traffic.”); Ex.1008, 3:53-61 (“[E]nd-to-end QoS is assured for end-stations.”); *see also* Ex.1024, 2 (“[F]or... audio and video, it is essential that quality of service is...maintainable on an end-to-end basis.”); *see also* analysis at preamble [1.0.1]. Additionally, the above noted benefits articulated by Schelen-1997 (Ex.1031, 266), would have also motivated a POSITA to incorporate the bandwidth-reservation techniques of Schelen-1997 into the bandwidth broker of Patel-225 to reserve the IP network resources along the path. *See also* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

226. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses reserving IP network resources (e.g., bandwidth) along the path by the

Ex.1003

bandwidth broker to fulfill the end-to-end QoS, which renders obvious “*reserving the IP network resources along the path by the NRM to fulfill the end-to-end QoS.*”

5. Claim 2

a. [2.1] Method according to claim 1, wherein the NRM is used within the RAN and the CN.

227. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious that the NRM is used within the RAN and the CN.

228. First, as discussed at limitations [1.0.1]-[1.0.2], the prior art wireless network 12 and wireline IP network 24 render obvious “*the RAN and the CN.*” Further, as discussed at limitation [1.2], the prior art bandwidth broker renders obvious “*the NRM.*”

229. Second, consistent with the analysis at limitations [1.2] and [1.6], Patel-225 discloses that the bandwidth broker is used within the cellular network 12 at least because it is used to receive communication requests for wireless services from the mobile device 20 of the potential consumer and communicate with the RAN resource manager 26 to intelligently broker bandwidth, including setting up an SLA. Ex.1005, 5:61-6:2, 7:37-56, 8:24-9:20.

230. Furthermore, consistent with the analysis at limitations [1.2]-[1.5], and [1.7], Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that the bandwidth broker is used within IP network 24 (“CN”) at least because the

bandwidth broker is used to control IP network resources. As analyzed above, controlling IP network resources includes the bandwidth broker performing path-sensitive call admission control and pre-allocating and reserving IP network resources. Additionally, as discussed in the proposed combination above, the bandwidth broker is used within IP network 24 because it manages the IP network bandwidth allocations and because it is used to communicate with bandwidth brokers of other network domains to negotiate QoS parameters. Ex.1005, 1:52-60.

231. Thus, in multiple ways, Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious that “*the NRM is used within the RAN and the CN.*”

6. Claim 3

- a. [3.1] Method according to claim 1, wherein the NRM is used within the RAN.**

232. As discussed at limitation [2.1], the prior art renders obvious “*wherein the NRM is used within the RAN.*”

7. Claim 4

- a. [4.1] Method according to claim 1, wherein the NRM is used within the CN.**

233. As discussed at limitation [2.1], the prior art renders obvious “*wherein the NRM is used within...the CN.*”

8. Claim 5

- a. **[5.1] Method according to claim 1, the method comprising the further step of signalling resource information between the NRM and at least a second NRM used within at least a second network domain.**

234. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious signaling resource information between the NRM and at least a second NRM used within at least a second network domain.

235. **First**, as discussed at limitations [1.0.1]-[1.2], the prior art combination renders obvious “*the NRM.*”

236. **Second**, Patel-225 discloses that the “**bandwidth brokers manage the allocations of bandwidth within their network domain and communicate with bandwidth brokers of other network domains to negotiate QoS parameters.**”

Ex.1005, 1:56-61. A POSITA would have understood that Patel-225’s bandwidth broker is used within the mobile wireless communications network 10 and communicates by signaling to bandwidth brokers in other network domains to negotiate QoS parameters so that end-to-end QoS is assured. Additionally, a POSITA would have understood that “negotiat[ing] QoS parameters” includes signaling resource information (e.g., required and available bandwidth and service class, etc.) between the bandwidth brokers. Patel-225 explains that QoS parameter information “may include rate/pricing plans, a time window or start time, required

bandwidth, and/or type of service.” Ex.1005, 1:56-60; 7:54-56. Thus, Patel-225 discloses negotiating QoS parameters (e.g., required and available bandwidth and service class, etc.) between the bandwidth broker and bandwidth brokers of other network domains, which renders obvious “*signalling resource information between the NRM and at least a second NRM used within at least a second network domain.*”

237. Third, to the extent Patent Owner contends that Patel-225 is insufficient, Schelen-1999 and Schelen-1997 supplement the teachings of Patel-225 by disclosing that resource information is transmitted between the bandwidth broker in one domain and the bandwidth broker of another domain to make end-to-end reservations across the involved domains. Specifically, Schelen-1999’s “**agent-based [bandwidth broker] architecture... provides resource reservations for aggregated virtual leased lines between network domains.**” Ex.1011, Abstract. Each bandwidth broker “along the path performs admission control within its own domain and aggregates several commitments into one commitment (per destination domain) with the downstream agent” to make “reservations...towards destination domains.” Ex.1011, Introduction. Furthermore, Schelen-1997 (cited to by Schelen-1999), discloses that “**end-to-end reservations...involving several routing domains are handled by cooperation between the involved reservation agents [bandwidth broker].**” Ex.1011, Introduction; Ex.1031, 266. A POSITA would

Ex.1003

have understood that cooperation in making end-to-end reservations across several domains includes signaling resource reservation information (e.g., required and available bandwidth, etc.) between the involved bandwidth brokers.

238. Since Patel-225 already communicates QoS parameter information between the bandwidth brokers of different domains, it would have been obvious to a POSITA, in view of the teachings of Schelen-1999 and Schelen-1997, for the communication to include reservation information (e.g., requested bandwidth and available bandwidth) to make end-to-end reservations involving several domains, thereby assuring end-to-end QoS for the transmission of audio and other data. *See* Ex.1005, 1:61-63 (“Wireless communications networks use the IP QoS architecture to support transmission of data and/or voice traffic.”); Ex.1008, 3:53-61 (“[E]nd-to-end QoS is assured for end-stations.”); *see also* Ex.1024, 2 (“[F]or... audio and video, it is essential that quality of service is...maintainable on an end-to-end basis.”); Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

239. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses signaling QoS parameter information (e.g., required and available bandwidth, service class, etc.) between the bandwidth broker of the mobile wireless communications network 10 and at least a bandwidth broker used within a second network domain, which renders obvious “*signalling resource information between*

the NRM and at least a second NRM used within at least a second network domain.”

9. Claim 6

- a. [6.1] *Method according to claim 1, the method comprising the further step of monitoring topology changes by using the NRM, retrieving routing information concerning the IP network.***

240. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious monitoring topology changes by using the NRM, retrieving routing information concerning the IP network.

241. As an initial matter, in the '601 patent, the “NRM gains its dynamic topology awareness by retrieving routing information concerning the IP network” by “participat[ing] in the... link-state routing protocols” to “have the complete topology map.” Ex.1001, 6:44-53. The “routing protocols [include]... OSPF (Open Shortest Path First),” which “automatically detect network failures and set up new routes to avoid the failure.” Ex.1001, 3:30-36. Additionally, in “the case [of] static routing” “the routing information is retrieved by measurements such as trace route and/or the use of Simple Network Management Protocol (SNMP)... to collect information on the routers and their interfaces (e.g. the interface type and speeds)” “to complement the gained routing topology information and make sure that it has an accurate view of the routing topology.” Ex.1001, 6:57-7:3.

242. First, Schelen-1999, like the '601 patent, discloses that the bandwidth broker monitors topology changes by participating in a link-state routing protocol (e.g., OSPF) to collect information regarding the router interfaces. Specifically, Schelen-1999 discloses that “[f]or each link-state routing domain in the network there is a **topology-aware QoS agent [bandwidth broker]**.” Ex.1011, Abstract. Schelen-1999 explains that “each QoS agent knows the topology and static link resources in its domain” by “**participating in a link-state routing protocol (OSPF)** where each participating router has an identical topological database over the domain.” Ex.1011, Introduction. Schelen-1999 describes using OSPF to “maintains an identical database describing the topology of the domain” to be able to identify “**topological changes.**” Ex.1011, Routing calculations; *see also* Ex.1011, Scope and layout (“In this paper we present a prototype implementation of a QoS agent [bandwidth broker]...includ[ing] functionality for: obtaining a **topological database through the link-state routing protocol.**”); Framework (“The machine is configured as a passive router to obtain the topological database for its link-state routing domain (i.e., the machine does not advertise any routes but it receives link-state advertisements from other routers). For this, we use the OSPF [13] implementation as provided in the gated 3.5.8 distribution [6].”). Schelen-1997 discloses that “[b]y participating in a link-state routing protocol, the agents [bandwidth brokers] know the topology and the static link capacities of

Ex.1003

their domains and can therefore select suitable routes and reserve resources over the links in advance.” Ex.1031, 266. A POSITA would have understood that the bandwidth broker disclosed by Schelen-1999 and Schelen-1997 monitors topology changes and retrieves routing information about the IP network through participation in the link-state routing protocol.

243. Second, Schelen-1999 discloses that the “[a]gents [bandwidth brokers] retrieve link properties...by querying routers seen in the topological database” “us[ing] a network management protocol (SNMP).” Schelen-1999 also explains that SNMP is used to determine “the speed of the interfaces at the routers.” Ex.1011, Introduction, Topology; *see also* Ex.1011, Framework (“Link bandwidths are collected by an agent [bandwidth broker] from the routers by using SNMP.”). A POSITA would have understood that the bandwidth broker retrieves routing information concerning the IP network from the queried routers in the topological database, including speed and link properties to identify a link failure that affects the topology (i.e., identify topology changes from the failure).

244. It would have been obvious to a POSITA, in view of Schelen-1999 and Schelen-1997, for Patel-225’s bandwidth broker to monitor topology changes by retrieving routing information concerning the IP network (as discussed above) so that the bandwidth broker has an up-to-date topology database for admission control. Up-to-date topology information is beneficial since it allows the bandwidth

Ex.1003

broker to select suitable routes and reserve resources or recalculate routes and reallocate resources when the topology changes, thereby maintaining active reservations without risking over-allocation of resources. *See* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225; analysis at claim 7, *infra*.

245. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses monitoring topology changes by using the bandwidth broker to retrieve routing information concerning the IP network (e.g., participating in link-state routing protocol OSPF and retrieving routing information using SNMP), which renders obvious “*monitoring topology changes by using the NRM, retrieving routing information concerning the IP network.*”

10. Claim 7

- a. **[7.1] Method according to claim 6, wherein the topology is monitored in order to be able to reallocate the IP network resources.**

246. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious that the topology is monitored in order to be able to reallocate the IP network resources.

247. **First**, Schelen-1999 discloses that the topology database of the IP network allows for “a routing table [to be] calculated by constructing a shortest-path tree” and for “**recalculate[ing] routes quickly in the face of topological changes.**” Ex.1011, Routing calculations. Schelen-1999 also discloses that the

bandwidth broker “must be able to calculate shortest-path trees starting at any router in the domain.” Ex.1011, Routing calculations. A POSITA would have understood that topology changes are monitored to be able to recalculate the shortest-path routes and thereby be able to reallocate network resources (for already scheduled advanced reservations) along the new route.

248. Second, Schelen-1997 also discloses that “the agents [bandwidth brokers] know the topology and...can therefore select suitable routes and **reserve resources...[and] periodically refresh those resource allocations through the duration of the reservation.**” Ex.1031, 266. A POSITA would have understood that the bandwidth brokers’ periodically refreshing resource allocations based on the topology includes reallocating IP network resources since the refreshed resource allocations are either reallocated to the same IP network route in the instance where the topology does not change and, alternatively, resources are reallocated for new IP network routes in the instance where the topology changes.

249. It would have been obvious to a POSITA, in view of Schelen-1999 and Schelen-1997, to use the monitored topology information to reallocate IP network resources, including adjusting for link failure or other topological changes, so that a suitable route is utilized for a given reservation and the potential to over allocate resources is reduced. *See* Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

250. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that the topology is monitored to be able to reallocate the IP network resources, which renders obvious that “*the topology is monitored in order to be able to reallocate the IP network resources.*”

11. Claim 8

a. [8.1] Method according to claim 1, wherein the path-sensitive call admission control is parameter based.

251. Patel-225 in combination with Schelen-1999 and Schelen-1997 renders obvious that the path-sensitive call admission control is parameter based.

252. Consistent with my previous analysis at limitation [1.3]-[1.6], the prior art path-sensitive call admission control is based on “**QoS parameters**” including a start and stop “**time parameter**,” among others, which discloses that “*the path-sensitive call admission control is parameter based.*” Additionally, Patel-225 discloses other parameters for admission control, including “access region parameters” “price parameters” “service type parameters” and “bandwidth parameters.” Ex.1005, 6:22-41, Fig. 2; *see also* Ex.1005, 3:13-15, 7:49-56, 9:6-20, 10:58-62. Additionally, both Schelen-1999 and Schelen-1997 disclose that path sensitive call admission control is parameter based, e.g., start and stop time parameters. Ex.1011, Introduction, Fig. 1; Ex.1031, 267.

253. It would have been obvious to a POSITA, in view of Schelen-1999 and Schelen-1997, to use parameters when performing path-sensitive call admission control (see limitation at [1.3]), so that a suitable route is selected that can support the timing and bandwidth requirements, among other constraints defined by the parameters. See Reasons to Combine Schelen-1999 and Schelen-1997 with Patel-225.

254. Thus, Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that the path-sensitive call admission control is based on parameters (e.g., time, access region, price, service type, and bandwidth), which renders obvious that *“the path-sensitive call admission control is parameter based.”*

B. Ground 2: Claims 2-5 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, and Patel-764

1. Summary of Patel-764

255. Patel-225 cites to and incorporates by reference Patel-764 as noted above. Ex.1005, 4:12-18. Patel-764’s incorporated teachings disclose that the “bandwidth broker or QoS manager... intelligently broker[s] bandwidth based on time and space considerations such as the geo-location of the demand and supply.” Ex.1007, 16:47-52. This includes “[t]he QoS manager 320 [bandwidth broker] interact[ing] with QoS managers 332 of other network domains 334 to negotiate various QoS provisioning 336.” Ex.1007, 16:52-54. Figure 14 illustrates bandwidth

broker 320 used in first domain 322 and bandwidth broker 332 used in second domain the two-way arrow shows signaling QoS negotiations 336 therebetween .

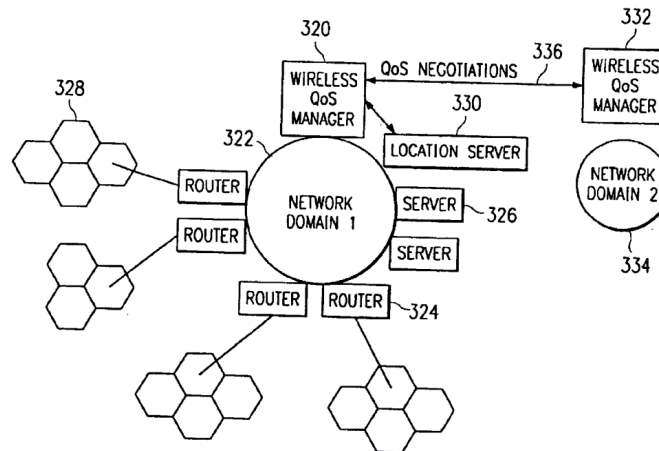


FIG. 14

Ex.1007, Fig. 14.

256. Further, Patel-764 recognizes that the “bandwidth broker...algorithms and functions may be distributed to various network elements such as application servers, routers and/or IP gateways, or cell sites to effectively allocate bandwidth.”
Ex.1007, 16:61-17:2.

2. Reasons to Combine Patel-764 with Patel-225

257. A POSITA would have been motivated to combine the teachings of Patel-764 with Patel-225 (as modified per Schelen-1999 and Schelen-1997) for the reasons discussed below.

258. As an initial matter, a POSITA would have considered and applied the teachings of Patel-764 because Patel-225 suggests the combination by expressly citing to and incorporating it by reference. Ex.1005, 4:12-18.

259. A POSITA would have been motivated to combine the teachings of Patel-764 with Patel-225 (as modified per Schelen-1999 and Schelen-1997) for the reasons discussed below.

260. As noted above, Patel-764 recognizes that the “bandwidth broker...algorithms and functions may be distributed to various network elements such as application servers, routers and/or IP gateways, or cell sites to effectively allocate bandwidth.” Ex.1007, 16:61-17:2. It would have been obvious to a POSITA, in view of Patel-764, to implement Patel-225’s bandwidth broker as distributed algorithms and functions in various network elements, including IP gateways of the wireline IP network 24 and wireless network 12 to effectively allocate bandwidth. Ex.1007, 16:61-66. Implementing the bandwidth broker in the IP gateway of Patel-225 is beneficial since its position, at the border of the wireline IP network 24 and wireless network 12, means that the bandwidth broker has

Ex.1003

visibility to the traffic flows and resource utilization of both networks which is valuable for performing admission control. Additionally, a POSITA would have understood that having visibility to the traffic flows and resources utilization across both networks supports measurement-based admission control, which is beneficial since more immediate reservations can be admitted and also because bandwidth utilization may be improved. *See* analysis at claim 9, *infra*. These benefits, separately and together, would have motivated a POSITA to combine the relevant teachings.

261. Furthermore, it would have been obvious to a POSITA, in view of Patel-764, to signal resource information between the bandwidth broker and at least a second bandwidth broker used within at least a second network domain in Patel-225. Ex.1007, 16:46-54. This would be beneficial since it would give notice to Patel-225's bandwidth broker if the neighboring domain had sufficient resources and allow for reserving bandwidth across multiple domains to provide end-to-end QoS, which as discussed above provides multiple benefits. Ex.1023, Abstract; Ex.1024, 2; Section VIII.A.3.b.i. I note that signaling resource information between neighboring domains is consistent with the Ground 1 combination of Patel-

225 with Schelen-1997 and Schelen-1999. Ex.1005, 1:56-61; Ex.1011, Abstract, Introduction; Ex.1031, 265-266.

262. A POSITA would have considered the combination of Patel-764 with Patel-225 as merely the use of known techniques (using a distributed bandwidth broker and signaling resource information between bandwidth brokers of other domains, per Patel-764) to improve the similar system of Patel-225 (see above noted benefits) in the same way. The results would have been predictable and there would have been a reasonable expectation of success since Patel-225 incorporates these teachings into its own specification.

263. Lastly, I note that the proposed combination relies on the teachings of the references—not on physical incorporation of the elements.

3. Claim 2

a. [2.1] *Method according to claim 1, wherein the NRM is used within the RAN and the CN.*

264. Patel-225 in combination with Schelen-1999, Schelen-1997, and Patel-764 renders obvious that the NRM is used within the RAN and the CN.

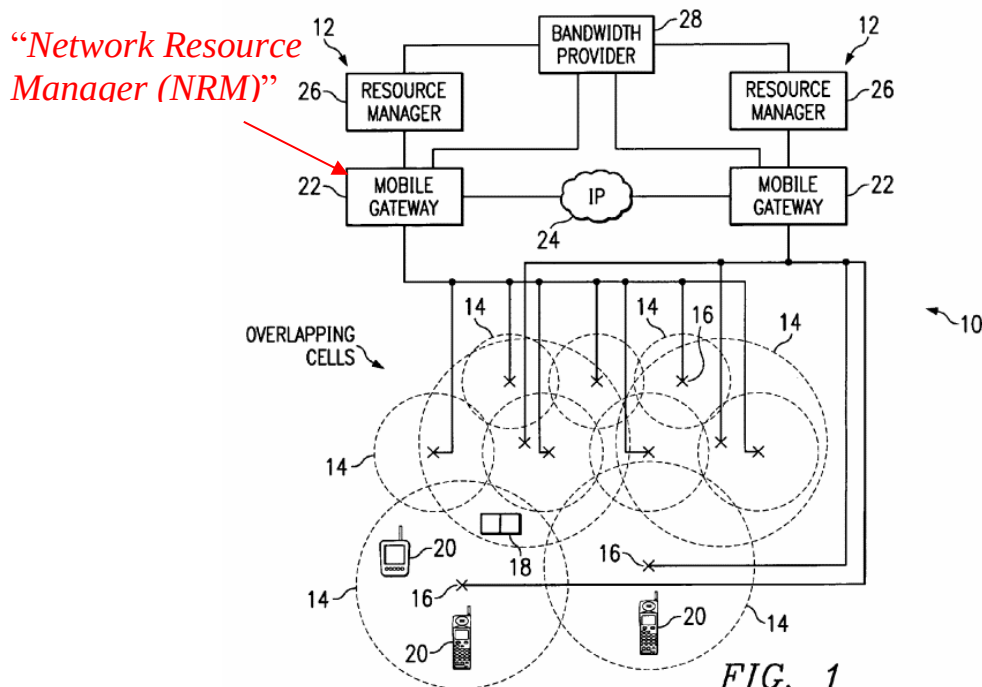
265. To the extent Patent Owner argues that the analysis at Ground 1 for Claim 2 is insufficient, the combination with the incorporated teachings of Patel-764 renders the claim obvious.

266. It was recognized by persons of skill in the art that the “BB [bandwidth broker] is a logical entity” and that “actual implementations may take either a centralized or a distributed approach, or a combination of both.” Ex.1025, 5. The incorporated teachings of related Patel-764 reflect this understanding, disclosing that the “**bandwidth broker...algorithms and functions may be distributed to various network elements such as application servers, routers and/or IP gateways, or cell sites to effectively allocate bandwidth.**” Ex.1007, 16:61-17:2. In view of Patel-764, it would have been obvious to a POSITA to implement Patel-225’s bandwidth broker as distributed algorithms and functions (since a bandwidth broker is merely a logical entity) in various network elements of the wireline IP network 24 (“CN”) and wireless network 12 (“RAN”) to effectively allocate bandwidth. *See* Reasons to Combine Patel-764 with Patel-225.

267. As a nonlimiting example, the bandwidth broker may be implemented in part within mobile gateway 22, which operates as an IP gateway within the wireline IP network 24 and the wireless network 12. *See* Ex.1005, 5:6-15 (describing that mobile gateway 22 provides “access...for all transport control protocol/Internet protocol (TCP/IP) data connections” between “the wireless portion of the cellular network 12 [and] a wireline portion 24.”); *see also* Ex.1008, 21:12-37 (mobile IP gateway includes “a plurality of QoS engine cards 352, and a plurality of network side peripherals 354” for “routing,” “processing and handling

Ex.1003

traffic received from the wireless portion of the network,” including “cards for connection to disparate wireline formats or different portions of the network...to receive traffic for use by the QoS engine 352.”); *see also* Ex.1008, 11:32-12:5. Since the bandwidth broker is distributed, at least in part, in the mobile gateway 22, it has visibility to the traffic on both the wireline IP network 24 and the wireless network 12, which is useful information for effectively allocating bandwidth.



Ex.1005, Fig. 1 (annotated).

268. The bandwidth broker is “used within” the wireline IP network 24 and the wireless network 12 at least because the distributed algorithms and functions are used within various elements of these networks to effectively allocate bandwidth

therein, as well as being used to perform various operations analyzed in Claim 1 (see also analysis at Claim 2 of Ground 1).

269. Thus, Patel-225 in combination with Schelen-1999, Schelen-1997, and Patel-764 discloses that the bandwidth broker is distributed in various elements (e.g., servers, routers, IP gateway) of the wireline IP network 24 and the wireless network 12 and used within the networks to allocate bandwidth and perform other operations, which renders obvious that “*the NRM is used within the RAN and the CN.*”

4. Claims 3-4

270. See analysis at Claim 2 of Ground 2.

5. Claim 5

- a. [5.1] *Method according to claim 1, the method comprising the further step of signalling resource information between the NRM and at least a second NRM used within at least a second network domain.***

271. Patel-225 in combination with Patel-764 renders obvious signaling resource information between the NRM and at least a second NRM used within at least a second network domain.

272. To the extent Patent Owner contends that the analysis at Ground 1 for Claim 5 is insufficient, the incorporated teachings of Patel-764 renders the claim obvious. Specifically, Patel-764 discloses that the bandwidth broker 320 of network

domain 322 interacts with the bandwidth broker 332 “of other network domains 334 to negotiate various QoS provisioning 336.” Ex.1007, 16:46-54. The provisioning is “**based on time and space considerations such as the geo-location of the demand and supply.**” Ex.1007, 16:48-52. Figure 14 illustrates signaling QoS provisioning 336 (“*resource information*”) between (shown by arrows) bandwidth broker 320 (“*the NRM*”) used in first domain 322 and bandwidth broker 332 (“*a second NRM*”) used in second domain 334 (“*a second network domain*”).

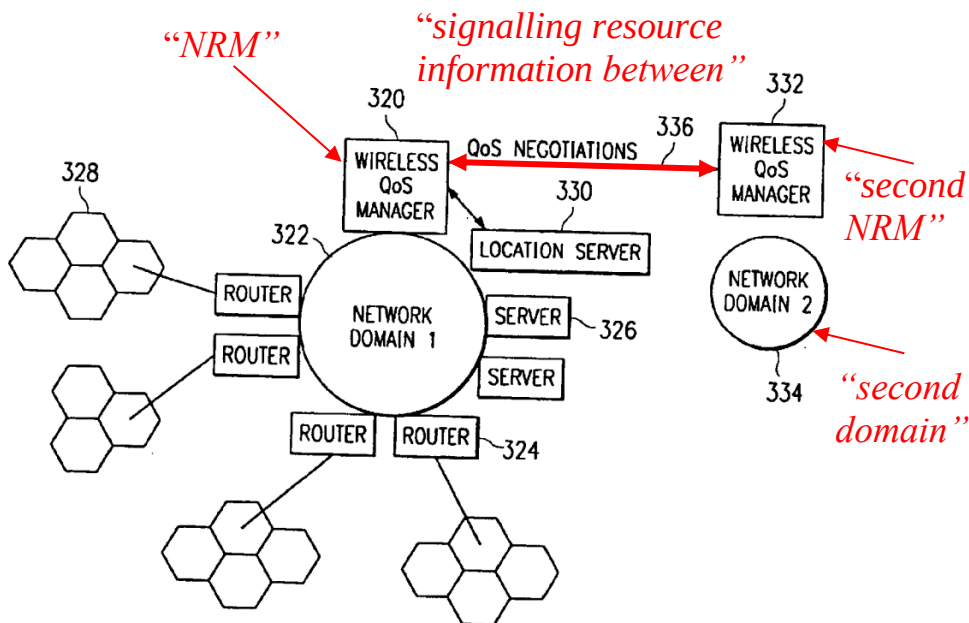


FIG. 14

Ex.1007, Fig. 14 (annotated)

273. It would have been obvious to a POSITA, in view of Patel-764, to signal resource information between Patel-222’s bandwidth broker and at least a

second bandwidth broker used within at least a second network domain, to reserve end-to-end bandwidth when the destination is in the second domain and thereby fulfill end-to-end QoS. *See* Reasons to Combine Patel-764 with Patel-225.

274. Thus, Patel-225 in combination with Schelen-1999, Schelen-1997, and Patel-764 discloses that the path-sensitive call admission control is measurement based, which renders obvious that “*the path-sensitive call admission control is measurement based.*”

C. Ground 3: Claim 9 is Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, and Degermark

1. Summary of Degermark

275. The paper titled “Advance Reservations for Predictive Service in the Internet,” by Mikael Degermark and Olov Schelén, among others (Ex.1019, “Degermark”) describes performing admission control “along the path of a flow” using “end-to-end resource reservation protocol. Ex.1019, Abstract, Framework. The technique utilizes “measurement-based admission control for advanced reservations” that is useful in “provid[ing] quality-of-service (QoS) for real time applications.” Ex.1019, Abstract, Introduction.

276. According to Degermark, the admission decision “is based on requested rates for flows that have not yet started and on measured rates for currently active flows.” Ex.1019, Admission Control Decision for Advance

Reservations. The measurement-based admission control is illustrated in Figure 1 (replicated below).

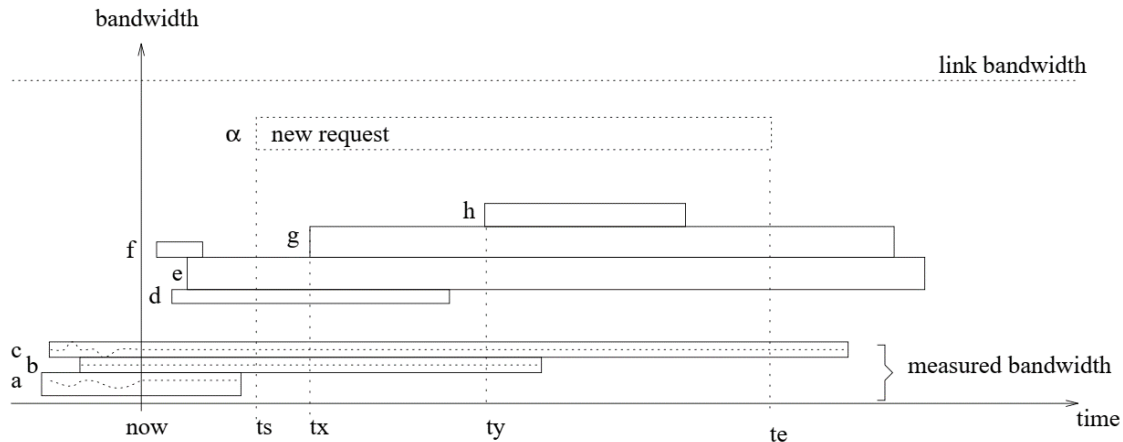


Fig. 1. Snap-shot of reservations

Ex.1019, Fig. 1.

277. Degermark explains that in the above figure, “[f]lows a, b and c are currently active and we have measurements of their rates and maximum delays which are used as predictions of their future behavior.” Ex.1019, Admission Control Decision for Advance Reservations. The admission “consider[s] flows that overlap with the new flow (b, c, d, e, g, h), using measured bandwidth if they have started or, otherwise, bandwidth requests.” Ex.1019, Admission Control Decision for Advance Reservations. “Thus, as we get closer in time to the point at which a flow with an advance reservation is to begin, we have a more accurate knowledge of the network load and more flows can be admitted [meaning that] [r]equests for immediate reservation can fill up the remaining bandwidth.” Ex.1019, Admission

Ex.1003

Control Decision for Advance Reservations. With this technique, a new admission “is granted if the new flow would not cause any delay bounds to be violated or bandwidth limits to be exceeded.” Ex.1019, Admission Control Decision for Advance Reservations.

2. Reasons to Combine Degermark with Patel-225

278. A POSITA would have been motivated to combine the teachings of Degermark with Patel-225 (as modified per Schelen-1999 and Schelen-1997) for the reasons discussed below.

279. First, Degermark is analogous art to the '601 patent, since it pertains to allocating bandwidth, including using agents (also known as bandwidth brokers). Ex.1019, Abstract, Introduction; Ex.1031, 265-266. Further, Degermark would be considered together with Patel-225 since both addresses allocating bandwidth immediately and in advance. Ex.1005, 6:22-41; Ex.1019, Abstract, Introduction, Admission Control Decision for Advance Reservations. Thus, a POSITA considering Patel-225 would have also considered the teachings of Degermark.

280. Second, Patel-225 (as modified per Schelen-1999 and Schelen-1997) performs path sensitive admission control for immediate and advance reservations. Degermark discloses measurement-based admission control, as summarized above. It would have been obvious to a POSITA to utilize a measurement-based admission control when performing path-sensitive call admission control in Patel-225 (as

Ex.1003

modified per Schelen-1999 and Schelen-1997) because it allows for estimating the network load accurately for the near future so that more immediate reservations can be admitted and fill up the remaining bandwidth. Ex.1019, Abstract, Admission Control Decision for Advance Reservations. These benefits, separately and together, would have motivated a POSITA to combine the relevant teachings.

281. Third, I note that the results would have been predictable and there would have been a reasonable expectation of success since the scheduling admission control approach of Degermark is very similar to and complements the approach in Patel-225 (as modified per Schelen-1999 and Schelen-1997). Also, a POSITA would have also known that measurement-based admission control may add signaling overhead in a centralized bandwidth broker approach, which may be addressed by implementing a distributed bandwidth broker that is within various network elements (e.g., routers, switches, etc.,) so that traffic measurements can be done directly. *See*, Ex.1007, 16:61-17:2; Ex.1031, 266. Both centralized and decentralized approaches would work, but a decentralized bandwidth broker obviates the need to transmit measurements. A POISTA would have known how to implement both approaches.

282. Lastly, I note that the proposed combination relies on the teachings of the references—not on physical incorporation of the elements.

3. Claim 9

- a. [9.1] *Method according to claim 1, wherein the path-sensitive call admission control is measurement based.***

283. Patel-225 in combination with Schelen-1999, Schelen-1997, and Degermark renders obvious that the path-sensitive call admission control is measurement based.

284. First, as discussed at limitations [1.2]-[1.5], Patel-225 in combination with Schelen-1999 and Schelen-1997 discloses that the bandwidth broker controls IP network resources by performing “*path-sensitive call admission control*” for immediate and advance reservations.

285. Second, Degermark discloses that admission control is “**measurement-based**,” as illustrated in Figure 1 (replicated below). Ex.1019, Abstract, Fig. 1.

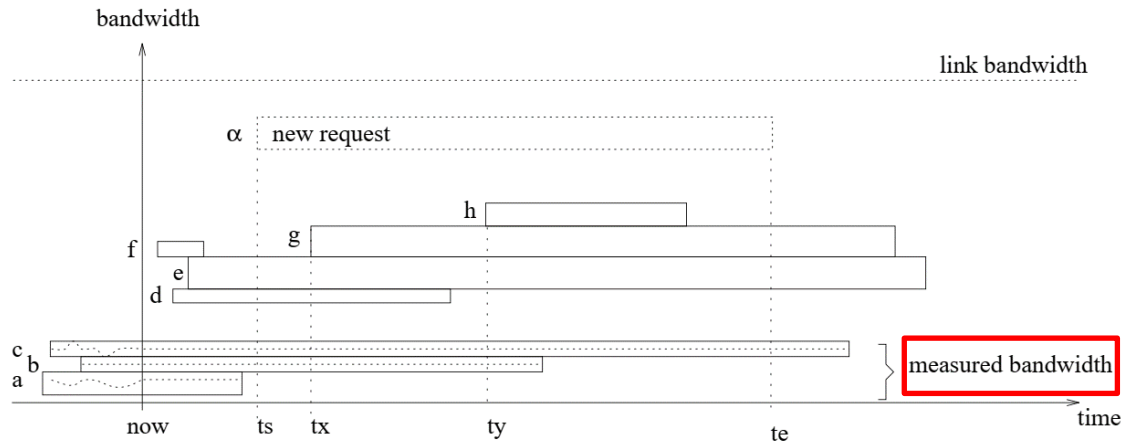


Fig. 1. Snap-shot of reservations

Ex.1019, Fig. 1 (annotated).

286. Degermark's "measurement-based" admission control technique "consider[s] flows that overlap with the new flow (b, c, d, e, g, h), using **measured bandwidth if they have started**" and otherwise it considers the bandwidth requests (which is parameter based). Ex.1019, Admission Control Decision for Advance Reservations; *see also* Ex.1019, Abstract ("We extend a **measurement-based admission control**...For flows that have not yet started, the requested values are used, and for those that have already started **measurements** are used."). This technique "allows [for] estimate[ing] the network load accurately for the near future," such that a new admission request "is granted if the new flow would not cause any delay bounds to be violated or bandwidth limits to be exceeded." Ex.1019, Abstract, Admission Control Decision for Advance Reservations.

287. It would have been obvious to a POSITA to utilize a measurement-based admission control when performing path-sensitive call admission control in Patel-225. *See* Reasons to Combine Degermark with Patel-225, because it would allow for estimating the load accurately for the near future admission requests.

288. Thus, Patel-225 in combination with Schelen-1999, Schelen-1997, and Degermark discloses that the path-sensitive call admission control is measurement based, which renders obvious that “*the path-sensitive call admission control is measurement based.*”

D. Ground 4: Claims 1-8 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, and Patel-624

1. Summary of Patel-185 and Patel-624

289. Patel-225 cites to and incorporates by reference Patel-185 and Patel-624, as noted above. Ex.1005, 1:5-19, 4:58-64, 5:15-26.

290. The incorporated teachings of related Patel-185 provide complementary disclosure, including teaching that the wireless communication system 10 (which is very similar to that of Patel-225) provides “improved wireless services” wherein “**end-to-end QoS is assured** for end-stations.” Ex.1008, 3:53-61, 5:30-6:33.

291. Also, the incorporated teachings of related Patel-624, discloses a wireless communication network 10 (very similar to that of Patel-225). Ex.1010,

5:25-6:45. Patel-624 explains that its “cellular and other wireless networks are implemented with wireless routers that provide an all-Internet protocol (IP) access network, distribute traffic processing functionality to the cells, and seamlessly interwork with the core IP network.” Ex.1010, 2:7-11. Also, Patel-624 explains that the wireline network corresponds to “the core IP network and may be the Internet, intranet, extranet, or other suitable local, wide area network, or combination of networks.” Ex.1010, 5:52-60.

2. Reasons to Combine Patel-185 and Patel-624 with Patel-225

292. A POSITA would have been motivated to combine the teachings of Patel-185 and Patel-624 with Patel-225 (as modified per Schelen-1999 and Schelen-1997) for the reasons discussed below.

293. As an initial matter, a POSITA would have considered and applied the teachings of Patel-185 and Patel-624 because Patel-225 suggests the combination by expressly citing to and incorporating them by reference. Ex.1005, 1:5-19, 4:58-64, 5:15-25.

294. Further, it would have been obvious to a POSITA, in view of Patel-185, to assure end-to-end QoS is provided in Patel-225 (as modified per Schelen-1999 and Schelen-1997) at least because it was known in the art that end-to-end QoS is useful (in certain instances essential) when transmitting audio and other real-time data. Additionally, each of the above noted motivations articulated in the

context of Ground 1 equally apply here for Ground 4. *See* Section VIII.A.3.b.i and analysis at preamble [1.0.1].

295. Furthermore, it would have been obvious to a POSITA, in view of Patel-624, to implement Patel-225's wireline portion 24 (which may be any suitable network) as a CN and use all IP based transmission in the instance where Patel-225's mobile wireless communications network 10 supports the W-CDMA standard (or another standard) that utilizes a CN and uses IP-based transmission. Ex. 1005, 4:20-28 ("...established standards...W-CDMA..."), 5:10-12 ("The wireline portion 24 may be the Internet, intranet, extranet, or other suitable local or wide area network."); Ex.1013, 3:3-13 ("The general system architecture....includes User Equipment (UE), UMTS Terrestrial Radio Access Network (UTRAN) and the Core Network."), 7:14-18 ("packet data based cellular systems...using IP network protocol."), 16:53-56 ("...WCDMA..."). Implementing Patel-225 per the incorporated teachings of Patel-624 would simply allow the system to function per the W-CDMA standard (or some other standard), which Patel-225 seeks to support.

296. This is nothing more than combining prior art elements (a CN per Patel-624 with Patel-225's wireline portion 24) according to known methods (using IP based transmission) to yield predictable results (allow the system to support established standards). The results would have been predictable and there would

have been a reasonable expectation of success since Patel-225 incorporates the noted teachings into its own specification.

297. Lastly, I note that the proposed combination relies on the teachings of the references—not on physical incorporation of the elements.

3. Claim 1

298. Other than the below identified limitations, the remaining Claim 1 analysis of limitations [1.0.1]-[1.8] in Ground 1 remains the same in Ground 4.

299. To the extent Patent Owner argues that “*end-to-end QoS*” is insufficiently taught in the Ground 1 analysis, the incorporated teachings of related Patel-185 discloses that “**end-to-end QoS is assured.**” Ex.1008, 3:53-61, 5:30-6:33. It would have been obvious to a POSITA, in view of Patel-185, for the method to provide end-to-end QoS in Patel-225’s wireless communication network 10, because it would improve the likelihood for successfully transmitting of “data and/or voice traffic between mobile devices and a wireline network.” Ex.1005, 1:39-66. Also, providing end-to-end QoS would support additional real-time data, such as video. *See* Reasons to Combine Patel-185 and Patel-624 with Patel-225.

300. To the extent Patent Owner contends that the identified disclosures in Ground 1 are insufficient to show “*a Core Network (CN)*” and “*using Internet Protocol (IP) based transmission,*” the incorporated teachings of related Patel-624 disclose that its “cellular and other wireless networks are implemented with

Ex.1003

wireless routers that **provide an all-Internet protocol (IP) access network**, distribute traffic processing functionality to the cells, and seamlessly interwork with the core IP network.” Ex.1010, 2:7-11. Also, Patel-624 explains that the wireline network corresponds to “**the core IP network** and may be the Internet, intranet, extranet, or other suitable local, wide area network, or combination of networks.” Ex.1010, 5:52-60. It would have been obvious to a POSITA, in view of Patel-624, to implement a CN and use all IP based transmission in Patel-225 when wireless communication network 10 supports a standard that requires such features (e.g., WCDMA). *See* Reasons to Combine Patel-185 and Patel-624 with Patel-225. In such an implementation, Patel-225’s wireline IP network 24 would correspond to the CN per Patel-624.

301. Thus, the combination of Patel-225, Schelen-1999, Schelen-1997, Patel-185, and Patel-624 renders obvious Claim 1.

4. Claims 2-8

302. See analysis at Claim 1 of Ground 4 and Claims 2-8 of Ground 1.

E. Ground 5: Claims 2-5 are Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, Patel-624, and Patel-764

1. Claims 2-5

303. See analysis at Claim 1 of Ground 4 and Claims 2-5 of Ground 2.

F. Ground 6: Claim 9 is Obvious over Patel-225 in combination with Schelen-1999, Schelen-1997, Patel-185, Patel-624, and Degermark

1. Claim 9

304. See analysis at Claim 1 of Ground 4 and Claim 9 of Ground 3.

IX. DECLARATION

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

Dated: 2/15/23



R. Michael Buehrer, Ph.D.