

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS INC.,

Petitioner

U.S. Patent No. 7,190,698

**DECLARATION OF HENRY H. HOUE,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW**

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I, Henry H. Houh, 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. 7,190,698 (“the ’698 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 1-8 (“the Challenged Claims”) of the ’698 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 ’698 patent, Ex.1001;
- (2) Prosecution History of the ’698 patent, Ex.1002;
- (3) “Internet QoS: A Big Picture,” by Xiao et al. published by IEEE in 1999 (“Xiao”), Ex.1005;
- (4) US 6,678,264 to Gibson (“Gibson”), Ex.1006;
- (5) Paper titled “Resource sharing in advance reservation agents,” by Schelen *et al.*, (“Schelen-2”), Ex.1007; and

- (6) IEEE paper titled “An Agent-based Architecture for Advance Reservations,” by Schelen *et al.*, (“Schelen-1”), Ex.1032.

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. I received a Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology (“MIT”) in 1998. I also received a Master of Science degree in Electrical Engineering and Computer Science in 1991, a Bachelor of Science Degree in Electrical Engineering and Computer Science in 1989, and a Bachelor of Science Degree in Physics in 1990, all from MIT.

9. During my college studies, I focused on communications and data networking. I took specialized courses including graduate courses in telecommunications networks, optical communications, and data networking. I, along with other graduate students in a networking research group, maintained both the computer workstations and the networking devices in the research group.

10. I have worked in data networking and distributed networking systems on several occasions. As part of my doctoral research at MIT from 1991-1998, I worked as a research assistant in the Telemedia Network Systems (“TNS”) group at the Laboratory for Computer Science. The TNS group built a high-speed gigabit ATM network and applications which ran over the network, such as remote video capture (including audio), processing and display on computer terminals. In addition to helping design the core network components (such as the ATM switch), designing and building the high-speed ATM links, and designing and writing the device drivers for the interface cards, I also set up the group’s web server, which at the time was one of the first several hundred web servers in existence. Our high-speed data network carried multimedia data including video and audio data within ATM cells.

11. Like all ATM networks, interconnection of various endpoints in our ATM system required the setup of end-to-end virtual circuits which required, for each ATM switch in the connection path, the switch’s header remapping tables to

be configured for each virtual circuit required. I developed and implemented our system's protocol of controlling the content of these tables and the overall circuit setup.

12. The TNS group was the first group to initiate a remote video display over the World Wide Web. Vice President Al Gore visited our group in 1996 and received a demonstration of—and remotely drove—a radio-controlled toy car with a wireless video camera mounted on it; the video was encoded by TNS-designed hardware, streamed over the TNS-designed network and displayed using TNS-designed software.

13. I authored or co-authored twelve papers and conference presentations on our group's research. I also co-edited the final report of the gigabit networking research effort with Professor David Tennenhouse and Senior Research Scientist David Clark. David Clark is generally considered to be one of the fathers of the Internet Protocol and served as Chief Protocol Architect for the Internet. With its focus on networking, the group, including myself, set up and maintained the network and computer systems. These systems included the networking on the workstations and desktops, the distributed file system, desktops and workstations, setting up and maintaining the distributed file system (Network File System) and the authentication system (Network Information Service, formerly known as Yellow Pages).

14. I defended and submitted my Ph.D. thesis, titled “Designing Networks for Tomorrow’s Traffic,” in January 1998. As part of my thesis research, I analyzed local-area and wide-area flows to show a more efficient method for routing packets in a network, based on traffic patterns at the time. My thesis involved analyzing flows of data in the network and the routing efficiencies gained by labeling the flows at the edge of the network, and routing the data based on the label instead of the IP destination address. My analysis included different methods of setting up the granularity of the flows for the most efficient use of routing resources. This type of label switching became popular with Multiprotocol Label Switching (MPLS) later implemented in various commercial routers. I gathered a large amount of network traffic, used publicly available network traces, and broke the traffic into different types of flows using various parameters for classifying the flows. My flow analysis is applicable to the flow classification at the ingress to an MPLS domain. My thesis also addressed real-time streamed audio and video. The network traffic that I analyzed was IP protocol traffic, including UDP and TCP.

15. I have been involved in Voice over Internet Protocol (“VoIP”) data streaming technologies since 1997 and have specific experience in designing and testing VoIP networks.

16. From 1997 to 1999, I worked at NBX Corporation, which was acquired by 3Com Corporation in 1999. During this time, I was a Senior Scientist

and Engineer working in IP Telephony. NBX delivered the world's first fully featured business telephone system to run over a data network, the NBX100. NBX was one of the first business phone systems to be configurable via a web interface. Users and administrators had access to varying levels of configuration for the phone system.

17. As part of my work at NBX, I designed the core audio reconstruction algorithms for the telephones which depacketized the voice data and reconstructed the audio. In addition, I designed the voice data packet transmission algorithms. I created a system to capture and analyze network packets sent by devices in the NBX system for aid in testing and debugging. I also designed and validated the core packet transport protocol used by the phone system. In addition, I designed and oversaw the development of the underlying transport protocol used by the NBX100 phone system for reliable packet transport. That transport protocol is still used by the NBX100 system and its successors and is estimated to be used hundreds of millions of times daily. I wrote NBX's first demonstration IP software stack, which added the capability for utilizing the NBX100 phone system on an IP network. I also specified and prototyped the phone system's support for Differentiated Services. NBX first demonstrated a phone in the NBX100 system working over the Internet in 1998 at a trade show in Las Vegas, for which I acquired, set up, and configured Virtual Private Network tunnels to carry the traffic.

Ex.1003

I was later the lead architect in designing NBX's next-generation highly scalable system. After NBX was acquired by 3Com, I did some work with 3Com's cable equipment division, including demonstrating a working NBX IP phone system over 3Com's cable equipment infrastructure using an early version of DOCSIS at a trade show in 1999. The NBX100 was the market's leading business phone system to run on a data network for several years following its introduction. During that time, I became more familiar with the various standards relevant to Internet telephony as well as the problems which designers of commercial telephony operations were faced with in implementing VoIP.

18. I, along with two of NBX's founders, was awarded U.S. Patent No. 6,967,963 titled "Telecommunication Method for Ensuring On-Time Delivery of Packets Containing Time-Sensitive Data," for some of the work we did while at NBX.

19. After NBX, I worked at Teradyne, a test tool company primarily focused on semiconductors. Teradyne had recently acquired Hammer, a company that specialized in load and functional testing for telecommunications systems. The Hammer product is well known as a telecom test tool. Teradyne spun out Hammer and several other internal divisions into an independent company called Empirix. I became Chief Technologist of the Hammer division of Empirix. Empirix was a leader in VoIP network testing and monitoring.

20. At Empirix, I laid out a new multi-year product vision for data network testing, secured internal funding for the effort, and led a team to deliver a new technology platform to the market in February 2001. This new product, PacketSphere, initially emulated network behavior so that wide-area VoIP connections could be tested in a lab. A later release allowed PacketSphere to generate high volumes of VoIP calls, including media streams, and to monitor the quality of VoIP voice streams. PacketSphere was also used in the Storage Area Network area. Later, the core technology was added to other Empirix products such as Empirix's Hammer XMS to monitor thousands of VoIP media streams in real time to determine their quality. PacketSphere was Empirix's most successful new platform introduction at the time. Companies purchased the PacketSphere product to emulate an Internet Protocol network to see the effects of deploying their product on the Internet prior to launch. PacketSphere received several industry awards.

21. During my time at Empirix, I presented lectures on VoIP and data network testing to companies including Lucent Labs (formerly AT&T Bell Labs). I was also invited to present several guest lectures in a software engineering course at MIT. Since then, I have also participated twice as a unit lecturer in an experimental course that was taught by an Institute Professor (the highest award that a MIT Professor can achieve) and sponsored by the Chairman of the MIT Corporation (MIT's board of trustees).

22. From 2004 to 2008, I was employed by BBN Technologies Corp., a technology research and development company located in Cambridge, Massachusetts. BBN Technologies is a world-renowned company with expertise in acoustics, speech recognition, and communications technology. BBN Technologies staff have pioneered many internetworking technologies and Internet applications and have built some of the world's largest government and commercial data networks.

23. My duties and responsibilities at BBN Technologies generally included commercialization of the technologies developed by BBN Technologies, which included spinning off companies and growing commercial businesses in-house. More particularly, I was involved in utilizing the award-winning AVOKE STX speech recognition technology to create the public audio/video search engine EveryZing (formerly known as PodZinger) which was spun out into a stand-alone company now known as RAMP, Inc. PodZinger won the 2006 MITX Technology Award for best Web 2.0 Application and was also named the 2006 Forbes Favorite Video & Audio Search Engine, beating out Google, Yahoo, and other companies. After managing the creation of the initial prototype system, PodZinger built out a full streaming audio and video search solution when I was the Vice President of Operations and Technology there. I was also involved in the Boomerang Mobile Shooter Detection project as the Vice President of Engineering for the program. The

Boomerang system was deployed to Iraq and Afghanistan and was credited with saving many lives.

24. In 2012, I opened Einstein's Workshop, a 7,000 square foot facility for teaching science, technology, engineering, and math to children. I installed and configured the telephone system, designed and programmed the web site, and designed and configured the network, which has grown to roughly 100 computers, multiple WiFi access points, firewalls, multiple wireless networks, and multiple facilities. We also created an educational 3D Computer-Aided Design program, which we spun-out into a separate company, BlocksCAD. BlocksCAD has received grants from DARPA DSO and the USDA and has participated in the LearnLaunch, MIT Play Labs, and MassChallenge accelerator programs. BlocksCAD currently has over 150,000 registered users and is used in schools throughout the US.

25. From 1989 to 1990, I worked at AT&T Bell Laboratories on optical computers. This work generated six peer-reviewed papers, and multiple U.S. and European patent applications in which I was named as a co-author or inventor. I also interned at AT&T Bell Laboratories in 1987 and 1988. Additional relevant experience in the field of computer networking is listed in my *Curriculum Vitae*.

26. I am a named inventor on several patents and published patent applications that are related to VoIP technology including: U.S. Patent No.

6,967,963, entitled “Telecommunication Method for Ensuring On-Time Delivery of Packets Containing Time-Sensitive Data”; U.S. Patent Application Publication No. 20020015387, entitled “Voice Traffic Packet Capture and Analysis Tool for a Data Network”; U.S. Patent Application Publication No. 20020016708, entitled “Method and Apparatus for Utilizing a Network Processor as Part of a Test System”; U.S. Patent Application Publication No. 20020016937, entitled “Method and Apparatus for Utilizing a Network Processor as Part of a Test System”; and U.S. Patent No. 7,590,542, entitled “Method of Generating Test Scripts Using a Voice-Capable Markup Language.”

III. LEVEL OF ORDINARY SKILL IN THE ART

27. 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.

28. A POSITA in the field of the '698 patent, as of the earliest claimed priority date of April 13, 2000, would have been someone knowledgeable and familiar with packet-based communication network techniques available at the time. Such a POSITA would have a bachelor's degree in computer science, computer engineering, electrical engineering, or equivalent training, and

approximately two years of experience working in the field of network communications. Additional work experience can substitute for specific educational background, and vice versa.

29. 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 '698 patent.

IV. RELEVANT LEGAL STANDARDS

30. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '698 patent, I am relying on certain legal principles that counsel has explained to me.

31. I understand that prior art to the '698 patent includes patents and printed publications in the relevant art that predate the priority date of the '698 patent. For purposes of this Declaration, I am applying the earliest claimed priority date of April 13, 2000, as the priority date of the '698 patent, although it may not be entitled to such an early date.

32. 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.

33. 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.

34. 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

35. What follows is a brief background of the related technologies pertaining to the '698 patent, based on my experience and knowledge in the art. The '698 patent relates to establishing a virtual leased line (VLL) spanning multiple domains, including DiffServ and MPLS domains, with a bandwidth broker associated with each domain. *See Ex.1001, Fig. 4 (reproduced below); claim 1 ("to establish a virtual leased line, VLL, between a source (SRC) and a destination (DST) in different domains ... wherein the bandwidth broker (BB) is associated to each network domain."); claim 3 ("said domains comprise at least one Differentiated Services, DiffServ, domain and one Multiprotocol Label Switching, MPLS, domain.")*.

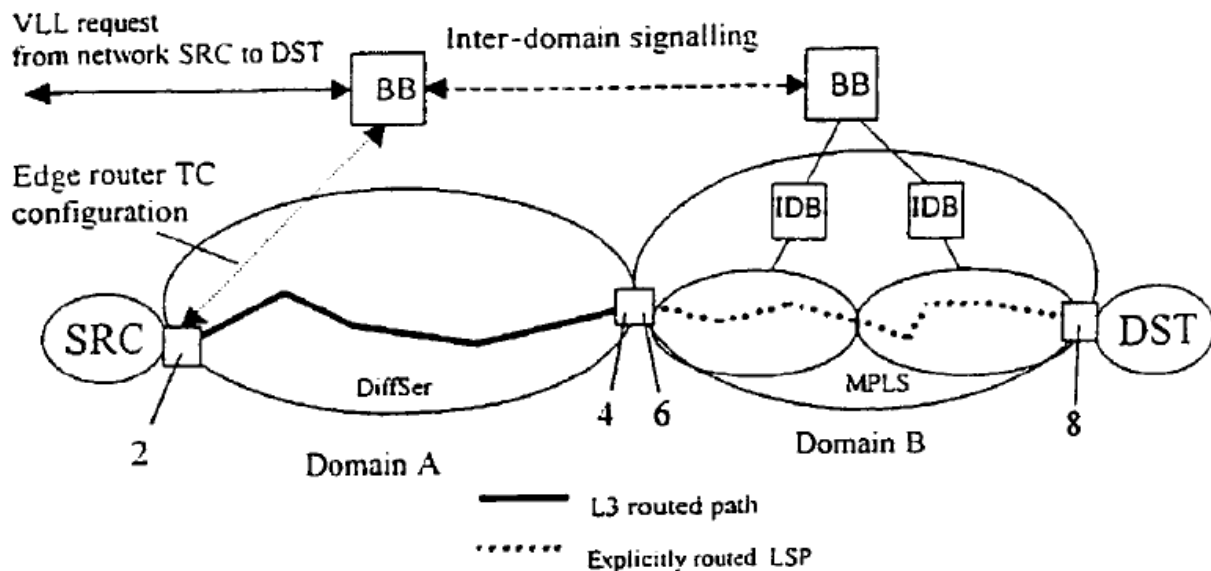


Fig. 4

'698 Patent, Fig. 4

36. These concepts were well known at the time of filing of the '698 patent.

A. Packet-based communications were known to span multiple domains

37. It was known before the '698 patent, for packet-based communications to span multiple domains. Users connected to the Internet through an access network domain of their Internet Service Provider ("ISP"). The ISP connected to the Internet backbone composed of multiple network domains of other providers. A user's data request to a particular destination would first cross the user's ISP access network domain, then one or more backbone provider domains, and finally arrive at the destination server's domain.

B. Bandwidth Broker ("BBs")

38. Bandwidth Broker ("BBs") are agents that manage policies for bandwidth resources in domains. Ex.1001, 2:48-49. BBs "can be configured with organizational policies, keep track of the current allocation of marked traffic, and interpret new requests to mark traffic in light of the policies and current allocation" within a specific administrative network domain. Ex.1033, 9.

39. BBs reduce state on individual routers by "keep[ing] state on an administrative domain basis, rather than at every router." Ex.1033, 10. In addition, BBs can be arranged hierarchically. Ex.1033, 10 ("BBs make it possible for

bandwidth allocation to follow organizational hierarchies.”). In order to provide particular end-to-end service parameters, a BB in one network domain communicates with other BBs in other network domains. Ex.1033, 10 (“BBs only need to establish relationships of limited trust with their peers in adjacent domains.”)

40. BBs receive requests for traffic provided according to a particular quality of service and configure boundary routers to police incoming traffic to conform with the agreed level of quality of service. These boundary routers between network domains ensure that labels are mapped appropriately. Ex.1033, 3 (“Adherence to the subscribed rate and burst size must be enforced at the entry to the network, either by the end-system or by the first-hop router.”) Thus, the BB architecture can be applied to other network domains that have internally consistent traffic treatment, such as in MPLS.

41. One or more BBs are needed for each routing domain. Ex.1032, 451 (“For each routing domain in the network, there will be a reservation agent responsible for admission control on behalf of the routers in the domain.”), 452 (“[W]e need at least one agent for each routing domain.”). Each BB knows the “topology of its routing domain to perform admission control on behalf of that domain.” Ex.1032, 452.

42. When BBs work to provide appropriate mappings between administrative network domains, an effective end-to-end path through the network's various domains may be established. Such an end-to-end path would be a path through the network that can be thought of as a virtual leased line through the network.

C. Differentiated Services ("DiffServ")

43. Differentiated Services ("DiffServ") refers to an enhancement to the Internet Protocol "to enable scalable service discrimination in the Internet." Ex.1022, 1. The differentiated services ("DS") field in an IP packet header is used to identify requested service parameters for the packet. Based on the DS field, a packet is prioritized over other standard "best-effort" traffic in the network. The DS field is set at network boundaries and specifies "how packets are forwarded by the nodes inside the network." Ex.1022, 1. Because individual routers forward the packets based on the DS field, processing is known as "per-hop behavior." Ex.1022, 4.

44. Processing of the DS field differs in different networks. To that end, the DS field is altered or mapped at administrative boundaries of networks. A portion of a network including individual routers that all process the DS field in the same way can be thought of as a network domain, though the network domain can itself be comprised of network domains operated by different service providers.

Ex.1003

D. Multi-Protocol Label Switching (“MPLS”)

45. Multi-Protocol Label Switching (“MPLS”) refers to a method of applying labels at the edge of a network and using the labels to perform switching within the network, in contrast to using IP addresses to route within a network. *See* Ex.1008, 5.

46. When a router uses an IP address to route within a network, it sorts through entries within a lengthy routing table to find an entry with the longest prefix matching the destination routing address. Ex.1008, 4 (“Each router analyzes the packet’s header, and each router runs a network layer routing algorithm [to]... independently choose[] a next hop.”). This is a computationally intensive process that must be performed by each individual router. In contrast, when a router uses label switching to route within a network, it identifies a predetermined path associated with an MPLS label assigned by the ingress router and forwards the packet along that path. Ex.1008, 5 (“In MPLS, the assignment of a particular packet to a particular [forwarding equivalence class] FEC is done ... as the packet enters the network.... At subsequent hops, there is no further analysis of the packet’s network layer header.”). Thus, the speed at which MPLS routers can process labelled packets is much faster than routers performing IP address-based routing.

47. When a packet arrives at an ingress router of an MPLS domain, an MPLS label is added based on the destination IP address. Ex.1008, 18 (“the ‘LSP

Ex.1003

Ingress' is an [label switch router] LSR which pushes a label onto [a] [packet] P[.].")

The label specifies (1) a predetermined path of routers from the ingress router to an egress router and (2) the quality of service requested for the packet. Ex.1008, 6 ("the label represents the combination of a FEC and a precedence or class of service."), 7 (an FEC is "a group of IP packets which are forwarded ... over the same path."). Each router of this predetermined path forwards the packet to the next router according to the label with the quality of service requested. Before the packet is forwarded to the egress router, the label is removed. Ex.1008, 19 (before sending the packet to the egress router "the label no longer has any function, and need no longer be carried."). The egress router then sends the original packet to the next router based on the destination IP address. *See* Ex.1008, 18.

E. DiffServ and MPLS were Used Together

48. It was known in the art how to implement DiffServ and MPLS domains together. Packets with a DS label arriving at an MPLS domain may be mapped appropriately to a specific label. Ex.1017, Fig. 7, 18 ("Ingress point may map DiffServ codepoint ... to a specific route by 'marking' with MPLS header."). If packets are received with DS values that indicate the same destination but different quality of service, they are mapped to different labels, each label specifying the same path through the MPLS domain, but different service parameters.

49. Because MPLS label switching is performed internally (i.e., the ingress router adds the MPLS label, and the penultimate or egress router removes the MPLS label), a network may include both MPLS and Diffserv domains such that a packet traverses both types of domains from the source to the destination. Ex.1020, 8 (“it is less important ... that all BBs support the same functionality within their individual domains, as long as the inter-domain requirements are met.”). **“MPLS can be used together with differentiated services to provide QoS.”** Ex.1005, 14. Xiao’s teaching is consistent with the understanding of a skilled artisan; namely, that “[i]n real-world use, it is unlikely that [DiffServ and MPLS] QoS protocols will be used independently, and in fact they are designed for use with other QoS technologies to provide top-to-bottom and end-to-end QoS between senders and receivers.” Ex.1017, 16. A skilled artisan at the time would have understood how to map DiffServ traffic onto MPLS LSPs.

As might be expected, because DiffServ and MPLS are similar with respect to the qualitative QoS they enable (i.e. classification), mapping DiffServ traffic on MPLS “pipes” (LSPs) is relatively simple. It is, but there are still DiffServ-specific considerations.

To support DiffServ’s per-hop model, an MPLS network operator needs to allocate a set of aggregate forwarding resources for each DiffServ forwarding class in each MPLS router (LSR) and assign labels.

Ex.1003

Ex.1017, 19; *see also* Ex.1025, 3, 17 (disclosing bandwidth brokers in DiffServ domains and that an MPLS domain may also include a bandwidth broker for “resource management” in and to “configure LSPs.”)

VI. THE '698 PATENT

A. Summary of the '698 Patent

50. The '698 patent, titled “Network Optimisation Method,” is based on a PCT application filed on April 6, 2001, and claims priority to a provisional application filed April 13, 2000. Ex.1001, Cover.

51. The '698 patent relates generally to a method of establishing a virtual leased line (“VLL”) between a source (“SRC”) and a destination (“DST”) in different domains. Ex.1001, 1:5-10. In particular, as shown in Figure 4 (reproduced below) the '698 patent describes a network “where a VLL span[s] two domains, A and B.” Ex.1001, 7:19-20.

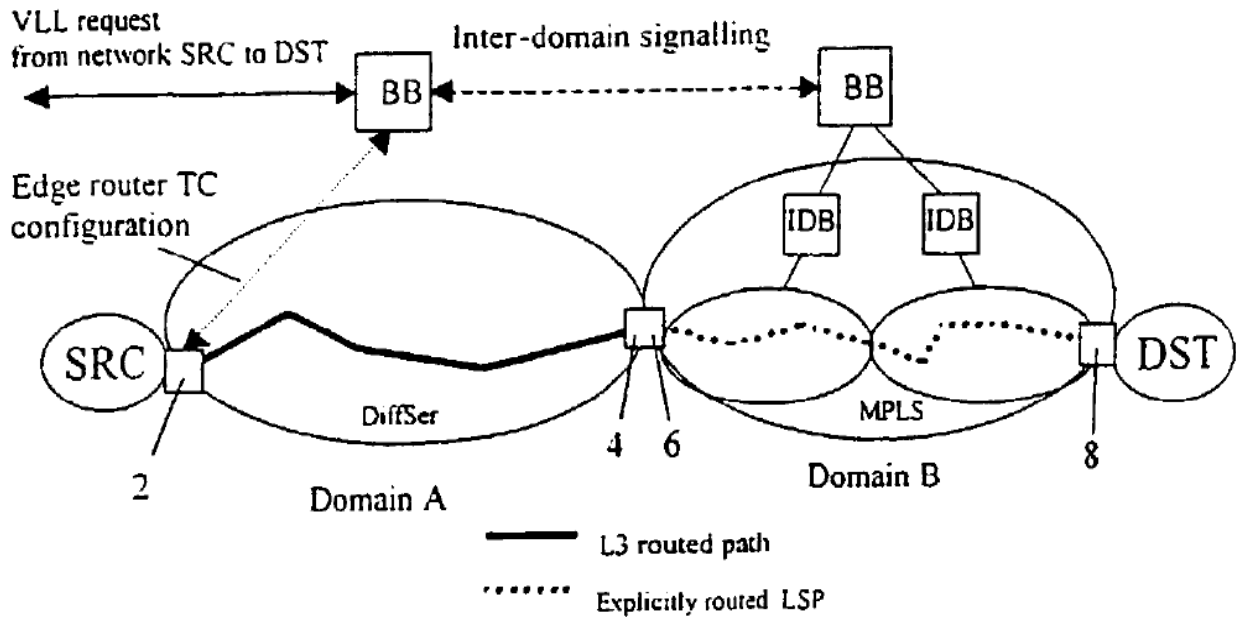


Fig. 4

Ex.1001, Fig. 4

52. In the above figure, domain A is a differentiated services (“DiffServ”) domain and domain B is Multi-Protocol Label Switching (“MPLS”) domain.

Ex.1001, 7:10-25. Inter-domain bandwidth brokers (“BB”) are associated with each domain and the MPLS domain B also includes intra-domain brokers (“IDBs”).

Ex.1001, 7:10-25, Figs. 3-4. The BBs communicate with each other to set up the VLL for packet transfer from the SRC to the DST. Ex.1001, 2:53-55.

53. Independent claim 1 of the ’698 patent is reproduced below:

Ex.1003

1. Method in a packet based communication network including network domains, wherein at least one domain is a Multiprotocol Label Switching MPLS domain, to establish a virtual leased line, VLL, between a source (SRC) and a destination (DST) in different domains in order to achieve packet transfer between the source (SRC) and the destination (DST), wherein the bandwidth broker (BB) is associated to each network domain and the bandwidth broker (BB) is configured to control a hierarchical routing domain, the method comprises the following steps:

- i) generate a request from an entity for a Virtual Leased Line, VLL, having a predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST) and apply the request to a Bandwidth Broker (BB) of a domain A, BB_A , associated to the source network;
 - ii) BB_A establishes the different domains involved to reach the destination network (DST);
 - iii) BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains regarding a VLL of the predefined QoS from ingress to egress of each domain;
 - iv) each involved bandwidth broker (BB) performs admission control in its domain; v) each involved bandwidth broker (BB) returns a result of the admission control to BB_A that passes it back to the requesting entity and if the request was admitted along all domains between the source (SRC) and the destination (DST) a VLL of the predefined QoS is granted,
- characterized in that step iv) comprises the following step: performing [LSP] Label Switched Path, LSP, setup and passing resource requests from the Bandwidth Broker (BB) to at least one intra-domain (1DB), wherein each intra-domain broker (1DB) is responsible for admission control and the Label Switched Path, LSP, setup.

B. Prosecution History of the '698 Patent

54. The '698 patent is based on PCT No. PCT/EP01/04062, filed on April 6, 2001, and claims priority to Provisional Application No. 60/197,006, filed on April 13, 2000.

55. On October 10, 2002, the Applicant submitted an IDS identifying a paper authored by Schelen et al., titled "Sharing Resources through Advance Reservation Agents," (submitted as Ex. 1031, herein). Ex.1002, 115-116. Without any office action on the merits, a telephonic Examiner interview was conducted on October 30, 2006, in which the Examiner suggested amending wording of claim 1. Ex.1002, 43 ("change the term 'adapted to' to 'configured to' and the term 'LSP' to 'Label Switched Path, LSP.'"). A Notice of Allowance subsequently issued on November 8, 2006. Ex.1002, 36-42. In the Notice of Allowance, the Examiner noted that the IDS "fails to comply with 37 CFR 1.98(a)(2) [because] applicant failed to provide a legible copy of the document." Ex.1002, 41. As a result, the document identified in the IDS was "not ... considered" by the Examiner. Ex.1002, 41.

56. Notably, as I demonstrate below, there is nothing novel about the claims of the '698 patent because all of the features were known in the art and it would have been obvious to combine the relevant prior art teachings as claimed.

VII. CLAIM CONSTRUCTION

57. It is my understanding that in order to properly evaluate the '698 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 *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.

58. I have reviewed the entirety of the '698 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. I have applied the so-called *Phillips* standard, which requires that 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 patentee has set forth a special meaning for a term. Below, for clarity, I discuss examples to provide context and understanding of the term “*bandwidth broker*.”

A. “*bandwidth broker*”

59. The ’698 patent states that “[a] bandwidth broker is an entity in a network domain that manages policies for bandwidth resources.” Ex.1001, 2:48-49. Exemplary policy management activity includes, “maintaining a database of the domain’s resources,” “provid[ing] admission control,” “configuring the network,” “communicat[ing] with bandwidth brokers in neighbouring domains,” among other policy management activities. Ex.1001, 2:27-55.

60. Thus, a POSITA would have understood that term “*bandwidth broker*” includes entities that manage policies for resources by, for example, maintaining database of resources, providing admission control, configuring the network, and communicating with neighboring bandwidth brokers to allocate resources across multiple domains.

VIII. DETAILED UNPATENTABILITY ANALYSIS

A. Summary of the Prior Art and Reason to Combine

1. Summary of Xiao

61. The primary reference that I rely upon is an IEEE article titled “Internet QoS: A Big Picture,” by Xiao *et al.*, (Ex.1005, “Xiao”). Xiao presents “a framework for the emerging Internet quality of service (QoS).” Ex.1005, Abstract. The framework addresses “differentiated services, multiprotocol label switching

(MPLS),” in an effort to “give the readers a grasp of the big picture of the emerging Internet QoS.” Ex.1005, Abstract.

62. Xiao begins by describing the operation of differentiated services, including how it provides different service classifications:

An Introduction to **Differentiated Services**

IPv4 header contains a Type of Service (TOS) byte. Its meaning was previously defined in [26]. Applications can set three bits in the TOS byte to indicate the need for low-delay, high-throughput, or low-loss-rate service. However, choices are limited. Differentiated services defines the layout of the TOS byte (DS field) and a base set of packet forwarding treatments (per-hop behaviors, or PHBs) [27]. By marking the DS fields of packets differently and handling packets based on their DS fields, several differentiated service classes can be created.

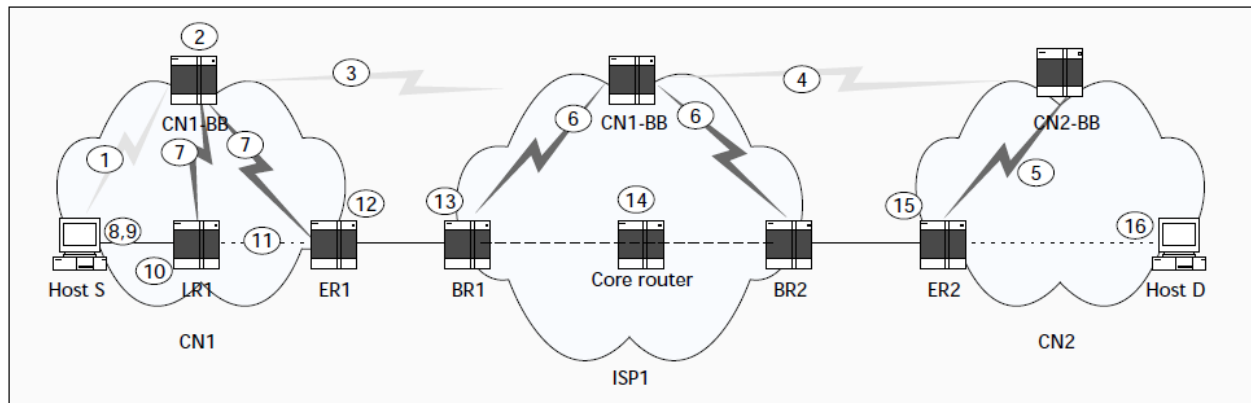
...

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

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Ex.1005, 10. Within the context of differentiated services, Xiao discloses the process for setting up “premium service” between a source “Host S” and a destination “Host D”:



■ Figure 4. The delivery process of premium service with a dynamic SLA.

Ex.1005, Fig. 4 (annotated).

In the above figure, bandwidth brokers “CN1-BB” and “CN2-BB” are associated with customer networks “CN1” and “CN2,” and bandwidth broker “ISP1-BB”¹ is associated with an internet service provider ISP1. Ex.1005, 12-14. Xiao’s “premium service” supports “virtual lease lines.” Ex.1005, 11-13. Ex.1005, 12-13 (Example 2).

¹ I note that Xiao’s Figure 4 appears to have a drawing error, since the specification’s disclosure of the bandwidth broker in the ISP1 network is denoted as “ISP1-BB,” while the figure labels the bandwidth broker “CN1-BB.”

63. Since the network in Figure 4 is capable of delivering “premium service,” it would have been obvious for the network (which is under the “Differentiated Services” section) to use differentiated service classes, and thus, for the network of Figure 4 to be a DiffServ communications network.

64. Note also that, like the ’698 patent, Xiao discloses utilizing DiffServ and MPLS together:

Although there are many papers on each of integrated services, RSVP, **differentiated services**, **MPLS**, traffic engineering, and constraint-based routing, to the best of the authors’ knowledge, they are never discussed together in a single paper. As a result, it is difficult for readers to understand the relationships among them and to grasp the big picture of the QoS framework.

In this article we give an introduction to integrated services, RSVP, differentiated services, MPLS, traffic engineering, and constraint-based routing. We describe how they differ from, relate to, and **work with each other** to deliver QoS on the Internet. Through this, we intend to present to readers a clear overview of Internet QoS.

Ex.1005, 8; *see also* Xiao Ex.1005, 14 (“**MPLS can be used together with differentiated services** to provide QoS.”).

65. Although Xiao states that “BBs may not be needed in MPLS-based ISP networks,” Xiao in no way discourages using BBs in the MPLS domain. Ex.1005,

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14. On the contrary, Xiao generally teaches that “admission control decisions can be made...by a BB” and that “it is technically better to have a BB to allocate resources.” Ex.1005, 11-12. Based on Xiao’s teachings, it would have been obvious to a person of skill in the art to utilize one or more BBs in the MPLS network.

2. Summary of Schelen-1

66. I also rely on a paper published by the IEEE titled “An Agent-based Architecture for Advance Reservations,” by Schelen *et al.*, (Ex.1032, “Schelen-1”). Schelen-1 discloses that “[f]or each routing domain in the network, there will be a reservation agent responsible for admission control.” Ex.1032, 451.

Typically there is one reservation agent responsible for each autonomous system (AS) in the Internet (an AS is an administrative domain containing a number of routers running a routing protocol internally)...[W]e need at least one agent [bandwidth broker] for each routing domain.

Ex.1032, 452.

67. I note that the “reservation agent” Schelen-1 would be understood to be a “bandwidth broker,” as the named author, Schelen, explained in other related papers. *See e.g.*, Ex.1011, 17 (“[W]e have designed a QoS architecture that can provide virtual leased lines over differentiated services by performing admission

control in agents (also known as bandwidth brokers)); Ex.1012, 25 (“The concept of a bandwidth broker is similar to our reservation agent.”)

68. Schelen-1 additionally describes implementing hierarchical routing within a network domain. According to Schelen-1, “[t]o support scaling, we use a hierarchical approach, i.e., agents [bandwidth brokers] register border points of their routing domains rather than specific endpoints.” Ex.1032, 454. In addition, “[i]nside an AS,” which Schelen-1 describes as “an administrative domain” (Ex.1032, 452), “there is a hierarchy of routing domains and there will be a corresponding hierarchy of reservation agents [bandwidth brokers] that aggregate reservations and register with the next highest level.” Ex.1032, 454. Additional teachings of Schelen-1’s bandwidth broker are described in the analysis below.

3. Summary of Schelen-2

69. The paper titled “Resource sharing in advance reservation agents,” by Olov Schelén and Stephen Pink (Ex.1007, “Schelen-2”) describes “an architecture where clients can make end-to-end resource reservations through agents.” Ex.1007, 213. Schelen-2 explains that “[a]n admission request can be directed to any agent, e.g., an agent that manages a user’s account.” Ex.1007, 215. “Each reservation request contains a bandwidth to be reserved, a source and a destination address.” Ex.1007, 215. In Schelen-2, the agent uses a “topology map of the domain” and routing information (such as link resources) to perform admission control in the

Ex.1003

71. Gibson's MPLS network has a management layer comprising admission managers (AM 30, 31) connection managers (CM 32, 33, 34) and an administrative server (admin server 35). Ex.1006, 6:11-16. These elements utilize "Common Open Policy Service (COPS) messaging protocol" to manage network policy. Ex.1006, 5:13-25; 17:24-26 ("COPS is a policy messaging protocol"). Gibson's admission manager, for example, "maintain[s] accurate topological information about at least part of the communications network," "build[s] up a map of all the reachable nodes on the MPLS network and their availability," and performs "admission control." Ex.1006, 7:25-57; *see also* Ex.1006, 8:16-54.

72. Gibson further describes how the administrative server and connection manager together set up new LSPs within local areas (clouds, 15, 16) of the MPLS network. Ex.1006, 8:16-9:10. Additionally, the connection manager receives INVITE messages passed by the admission manager and performs admission control in its managed area. Ex.1006, 10:12-34. The connection manager, in response to the INVITE message, determines whether it has sufficient resources to accommodate a new session and, if so, the connection manager will make a reservation. Ex.1006, 10:25-30. If there are insufficient resources or if an LSP is not available, the connection manager will respond with an error message. Ex.1006, 10:30-34. This process is repeated until the INVITE messages reach the destination

endpoint. Ex.1006, 10:33-34, Fig. 2. Additional teachings of Gibson are described in the analysis below.

5. Reasons to Combine Schelen-1 and Schelen-2 with Xiao

73. Xiao uses a bandwidth broker to perform admission control in different network domains. Ex.1005, 11-13. Xiao, however, provides limited bandwidth broker details. Schelen-1 and Schelen-2 provide implementation details regarding how a bandwidth broker performs admission control as contemplated by Xiao. For instance, Schelen-1 discloses using a bandwidth broker in each network domain, including hierarchical routing domains (limitations [1.0.2]-[1.0.4]). Schelen-1 provides more implementation details of how the bandwidth broker operates, including how it establishes the different bandwidth brokers and network domains involved to reach a destination network ([limitation [1.2]]), communicates reservation request with neighboring bandwidth brokers (limitations [1.3]-[1.5.2]) and performs admission control to establish a communication session from the source to the destination. Schelen-1 and Schelen-2 teach how the bandwidth broker performs admission control based on topology and routing information, as well as how the bandwidth broker stores reservation and accounting information (see claims 4-8). It would have been obvious to a POSITA to consider and apply the bandwidth broker details of Schelen-1 and Schelen-2, when implementing Xiao's bandwidth broker in order to achieve the results that Xiao is already describing.

74. Although this reason is sufficient to explain why one of ordinary skill in the art would have sought to combine the relevant teachings, additional reasons are provided below.

a. **Schelen-1 and Schelen-2 are Analogous Art**

75. Schelen-1 and Schelen-2, like Xiao, are analogous art to the '698 patent, because they disclose how a bandwidth broker performs admission control within a given domain. Ex.1001, 1:5-10, 3:64-4:2; Ex.1005, 11-13; Ex.1007, Abstract; Ex.1032, Abstract, 451-452. Thus, given the similar subject matter, a POSITA considering Xiao would have naturally considered Schelen-1 and Schelen-2, which merely provide additional bandwidth broker teachings directly applicable to Xiao, which also utilizes bandwidth brokers.

b. **Motivation to combine with Schelen-1**

76. A POSITA would have been motivated to combine the teachings of Schelen-1 and Xiao to produce numerous predictable and beneficial results.

i. **bandwidth broker is associated with each domain**

77. Xiao generally recognizes that “it is technically better to have a BB [bandwidth broker] to allocate resources.” Ex.1005, 11. Schelen-1, in the same vein, discloses that “[f]or each routing domain in the network, there will be a reservation agent [bandwidth broker] responsible for admission control.” Ex.1032, 451.

78. It would have been obvious to associate a bandwidth broker with each routing domain in Xiao, to provide admission control. Additionally, it was known that having a bandwidth broker associated with each domain provides scaling benefits. *See e.g.*, Ex.1025, 1 (“[H]aving a **Bandwidth Broker (BB) as the resource manager for each domain ... scale[s] well** in the global, heterogeneous Internet.”); Ex.1011, 17 (“For each routing domain in the network there is a [bandwidth broker] responsible for admission control in the domain...with **favorable scalability properties.**”). Thus, it would have been obvious to a POSITA to associate a bandwidth broker with each of Xiao’s domains to obtain scaling benefits. It was also known in the art that associating a bandwidth broker with each domain allows for “**minimiz[ing] reservation state and admission control overhead**” since “reservations from different sources to the same destination domain are aggregated in agents as their paths merge toward the destination.” Ex.1012, 3. This additional reason would have motivated a POSITA to associate a bandwidth broker with each of Xiao’s domains.

ii. *bandwidth broker controls a hierarchical routing domain*

79. Schelen-1 discloses that the bandwidth broker provides admission control in a routing domain that implements “hierarchical routing.” Ex.1032, 452. It was well known in that art that the “objective behind the use of hierarchical routing is to achieve some level of routing data abstraction, or summarization, to reduce the

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cpu, memory, and transmission bandwidth consumed in support of routing.”

Ex.1009, 3. Also, it was known in the art that implementing a domain to provide hierarchical routing “support[s] scaling.” Ex.1012, 45. It was also known that hierarchical routing is applicable to both DiffServ and MPLS domains. Ex.1032, 452, 454 (disclosing hierarchical routing for a DiffServ domain); Ex.1016, 4 (disclosing hierarchical routing for an MPLS domain); Ex.1021, 2; Ex.1029, 6.

80. Accordingly, it would have been obvious to a POSITA to implement Xiao’s domains as hierarchical routing domains, in view of Schelen-1. Such an implementation would support scaling and accommodate a network with a large topology. Ex.1038, 1 (using hierarchical routing within “the topology of large networks.”); Ex.1025, 2 (“...hierarchical approach to scalable bandwidth allocation support...”), 3 (“With this two-tier hierarchical approach, end-to-end QoS support can be achieved through a concatenation of inter- and intra-domain resource allocations”); Ex.1012, 45 (“To support scaling, we use a hierarchical approach.”); Ex.1030, 4 (hierarchical routing has “better scaling properties”) Additionally, a POSITA would have been motivated to implement Xiao’s domains as hierarchical routing domains to reduce resource utilization. Ex.1009, 3 (hierarchical routing “reduce[s] the cpu, memory, and transmission bandwidth consumed.”).

iii. request having predefined QoS

81. Schelen-1 discloses that the reservation request includes predefined QoS parameters for service between source and destination. Ex.1032, 451. The predefined QoS parameters may comprise “traffic descriptions.” Ex.1032, 453, 458.

82. It would have been obvious to a POSITA to include in Xiao’s PATH message request predefined QoS parameters describing the traffic from the source to the destination. This would allow the user to specify the required service (e.g., type of service, time of service, duration, etc.) for the bandwidth broker when performing admission control. Ex.1034, 30 (“[R]eservation requests may be immediate and open-ended or made in advance by including starting time and duration for the reservations.”). Because the user can specify, for example, advance reservation parameters such as the starting time and duration of service, resources could be more effectively scheduled. Ex.1032, 451 (“Support for advance reservations allows both the network and its users to more **effectively schedule resources** when the time of the future event needing reservations is known in advance.”). Also, utilizing parameter-based requests (with predefined QoS) would be beneficial since it would avoid undue signaling overhead as compared to measurement-based approaches. *See* Ex.1032, 453 (“To **avoid undue signaling overhead** and scalability problems, agents do not measure traffic dynamics. Admission control in agents is parameter-based.”); Ex.1034, 29 (“Agents do

parameter-based admission control...There is no signaling of traffic dynamics between routers and agents. **Admission requests contain the bandwidth to be reserved**, a source and a destination address.”).

iv. *bandwidth broker establishes the different domains involved to reach the destination*

83. Schelen-1 discloses that each bandwidth broker in the network “advertize themselves periodically on a well known multicast address, giving their identity and which routing domain (AS) they are responsible for” so that the other bandwidth brokers, which are listening, have this information for admission control. Ex.1032, 452. For example, this information is used to reserve bandwidth toward the destination. Ex.1032, Abstract (“Requests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path for the requested service.”).

84. It would have been obvious to a POSITA, in view of Schelen-1, for each of Xiao’s bandwidth brokers to communicate via a multicast address. This would allow for each bandwidth broker to establish the existence of all other bandwidth brokers and their respective domains. With this information, the bandwidth brokers would be able to cooperate and forward request messages to other bandwidth brokers for admission control to reserve resources along the path toward the destination network. Ex.1005, 12 (“[T]he BB in the customer domain

must also use some signaling protocol to request resources on demand from its ISP.” “CN1-BB sends the PATH message to ISP1-BB.” “ISP1-BB sends the PATH message to CN2-BB.”); Ex.1032, Abstract (“Requests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path for the requested service.”), 453 (“Agents [bandwidth brokers] can interoperate to support end-to-end advance reservation requests.”).

v. *bandwidth broker passes requests to all bandwidth brokers toward a destination*

85. Schelen-1 further teaches that “[r]equests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path for the requested service.” Ex.1032, Abstract, 451.

86. It would have been obvious to a POSITA, in view of Schelen-1 for Xiao’s bandwidth brokers to pass requests to all bandwidth brokers along the path toward a destination so that the bandwidth brokers perform admission control in their respective domains and end-to-end reservations are made for a communication session. Ex.1032, 453 (“Agents [bandwidth brokers] can interoperate to support end-to-end advance reservation requests.”). This would allow Xiao’s source and destination to communicate, thereby achieving Xiao’s objective. Ex.1005, 13 (“Host S sends packets... packets are delivered to host D.”).

vi. each bandwidth broker performs admission control in its domain

87. Schelen-1 discloses that for “each routing domain” there is a bandwidth broker “responsible for admission control.” Ex.1032, 451. “Requests involving several routing domains are forwarded for admission control” the bandwidth brokers “along the path” and to make “end-to-end” reservations. Ex.1032, 453, Abstract. It would have been obvious to a POSITA, in view of Schelen-1, for the bandwidth brokers along the path that receive the request message to perform admission control, so that end-to-end reservations may be made for the requested service, if resources are available. Because each bandwidth broker along the path would have reserved resources, Xiao’s source and destination would be able to communicate, thereby achieving Xiao’s objective. Ex.1005, 13 (“Host S sends packets... packets are delivered to host D.”).

vii. topology map and link-state routing information

88. Xiao discloses that a bandwidth broker performs admission control for an incoming RSVP PATH message. Ex.1005, 10-12; *see also* Ex.1005, 9 (“Admission control” is “[t]he decision process of whether to accept a request for resources (link bandwidth plus buffer space).”). Schelen-1 discloses that each bandwidth broker “must know the topology of its routing domain to perform admission control on behalf of that domain, and also to detect topology changes that

require re-computation of forwarding state setup in routers.” Ex.1032, 452.

Schelen-1’s bandwidth broker obtains routing information by participating in a link state routing protocol, such as OSPF (Open Shortest Path First). Ex.1032, 452; Ex.1034, 29 (“...a link state routing protocol (e.g., OSPF)”).

89. It would have been obvious to a POSITA, in view of Schelen-1, for Xiao’s bandwidth broker (see analysis at element [1.0.3]) use a topology map and routing information so to perform admission control for an incoming RSVP PATH message. This would enable Xiao’s bandwidth broker to determine whether there are sufficient resources along a specific path when performing admission control in response to receiving an incoming RSVP PATH message request (see analysis at elements [1.1.1]-[1.4]). Also, because the bandwidth broker participates in the routing protocol, it would be able to quickly recognize routing changes in the topology as fast as any router. *See* Ex.1007, 218 (“Agents [bandwidth broker] listen to the routing protocol and detect routing changes on average as fast as any router in the domain.”). Because the changes are recognized quickly, the bandwidth broker would be able to adjust the paths accordingly. *See* Ex.1007, 218 (“When changes occur, agents [bandwidth brokers] can schedule resources along new paths.”). This would be beneficial since it would avoid canceling a scheduled event, which is undesirable, should a path that was previously reserved no longer be available. *See*

Ex.1011, 18 (“It is unfortunate if a planned event has to be canceled with late notice because it turns out there are insufficient network resources.”).

viii. *bandwidth broker performs admission control for all links in the domain*

90. Schelen-1 discloses that “admission control and service commitments are all managed by” bandwidth brokers “in the domain.” Ex.1032, 451, 457. This includes “considering static link resources and traffic descriptions given in admission requests” and “setup resources along shortest paths” “between source and destination.” Ex.1032, 453. It would have been obvious to a POSITA, in view of Schelen-1’s teachings, for Xiao’s bandwidth broker manage all admission control commitments in its domain (including for all links) because, Xiao explains that “it is technically better to have a BB to allocate resources.” Ex.1005, 11. Also, having the bandwidth broker perform admission control for all links is beneficial since it frees up the routers from related computations. Ex.1032, 457 (“Our goal has been to relieve the routers from computation concerned with QoS contracts and put it in agents instead.”). Another benefit of the bandwidth broker performing admission control for all links is that it has visibility of the reserved and available resources so that it can schedule new reservations. *See e.g.*, Ex.1007, 220-221, Fig. 5. If the bandwidth broker performed admission control for only part of the links, then there would be the risk of over allocating resources on the path.

91. Also, since the bandwidth broker controls all the link allocations, then it can negotiate with neighboring bandwidth brokers to aggregate resources. *See* Ex.1025, 1 (“[B]ilateral service agreements are made for aggregate border-crossing traffic between neighboring administrative domains... by having a Bandwidth-Broker (BB) as the resource manager for each domain.”); Ex.1034, 29 (“[A]gents can do bulk reservations in advance with neighboring agents, thereby allowing aggregation over time.”). This approach simplifies administration. On the other hand, if other entities, e.g., a router, controlled part of the links, then there would be additional signaling between all the neighbors and that entity and would be more complex, both of which are undesirable.

ix. storage for granted requests and user-related data

92. Schelen-1 discloses that granted reservations (e.g., made for places where the host will be moving in the future) are maintained by bandwidth brokers. Ex.1032, 452, 457-458. Additionally, Schelen-1 discloses that the bandwidth brokers act as the user’s travel agent and “have records for managing accounting etc.” Ex.1032, 453.

93. It would have been obvious to a POSITA, in view of Schelen-1, for Xiao’s bandwidth broker to include storage to maintain granted reservation requests as was known in the art. *See e.g.*, Ex.1020, 18 (describing that the bandwidth broker’s components include a data store); Ex.1014, 10:47-50 (disclosing that the

Ex.1003

bandwidth broker “stor[es] bandwidth request information (e.g., bandwidth values) associated with recently admitted flows.”). Schelen-1 discloses that granted reservation information “will be needed for future packet forwarding.” Ex.1032, 452; Ex.1006, 15:20-23 (“[A]dmission manager [bandwidth broker] is able to correlate its successful requested path element that it sent with the actual path reserved, and store this for future use.”). Additionally, a POSITA would have understood that storing the granted reservation also allows the bandwidth broker to keep track of the reservation (e.g., whether the reservation is active, ended, or canceled). Ex.1011, 18 (“It is unfortunate if a planned event has to be canceled.”). When the reservation has ended or has been canceled, then any related allocated resources can be released, thereby freeing up additional bandwidth for new requests. Ex.1019, 4 (“Knowledge of [the reservation start and stop time] intervals is necessary for the admission control algorithm to determine which requests overlap and when the reserved resources will be released.”).

94. Moreover, it would have been obvious to a POSITA for Xiao’s bandwidth broker to keep accounting information in its storage so that the information is available for determining charges associated with all of the user’s granted reservations for billing purposes (like a travel agent). Ex.1016, 4 (describing “value add services such as billing...”); Ex.1025, 7 (“...billing...[should] closely reflect[] the actual resources used...”). Also, storing

Ex.1003

the accounting information (such as monetary cost for a route that will be charged to a user) would be useful when the bandwidth broker supports traffic engineering in the MPLS domain. *See e.g.*, Ex.1005, 13 (“MPLS is also a useful tool for traffic engineering.”), 15 (“Common route metrics in constraint-based routing are monetary cost...”).

c. Motivation to combine with Schelen-2

95. A POSITA would have been motivated to combine the teachings of Schelen-2 and Xiao (as modified in view of Schelen-1 and Gibson) to produce numerous predictable and beneficial results.

96. Xiao discloses performing admission control with a bandwidth broker. See analysis at element [1.0.3]. Schelen-2 provides implementation details regarding how a bandwidth broker performs admission control as Xiao suggests. The noted additional teachings are addressed below.

i. request includes bandwidth to be reserved

97. As analyzed at element [1.1.1], it would have been obvious to a POSITA for Xiao’s PATH message request to include predefined QoS parameters. Schelen-2 further teaches that for parameter-based admission control, the “reservation request contains a bandwidth to be reserved” from a source to a destination. Ex.1007, 215, 218. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao’s PATH message request to contain the bandwidth to be

reserved as part of the QoS parameters. By including the bandwidth to be reserved in the request, the bandwidth broker would know how much bandwidth is required for the reservation. This would allow the bandwidth broker to check if there is sufficient bandwidth available to grant the request and, if so, reserve sufficient resources to guarantee that the bandwidth is available. *See e.g.*, Ex.1007, 220-221 (“When a new admission request arrives, admission is granted if the new reservation would not cause the aggregate bandwidth to exceed the link bandwidth...The conditions are checked at all points...”), Fig. 5. Also, because the bandwidth broker knows how much bandwidth to reserve, it can plan and schedule advanced reservations for future use. Ex.1007, 221-222. Since the required bandwidth is known because it is included in the request, the risk over allocating resources is reduced. *See e.g.*, 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.”)

ii. topology map and link-state routing information

98. Schelen-2 discloses that the bandwidth broker uses a “topology map of the domain” and obtains routing information (e.g., by “participating in a link state routing protocol (e.g., OSPF)”), to perform path sensitive admission control. Ex.1007, 214-215; *see also* Ex.1007, 215 (“[A]dmission control is performed on the links from the starting point towards the destination.”), 218 (“Agents [bandwidth

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brokers] listen to the routing protocol and detect routing changes on average as fast as any router in the domain.”).

99. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao’s bandwidth broker (see analysis at [1.0.3]) use a topology map and routing information so to perform path sensitive admission control for an incoming RSVP PATH message. This would enable Xiao’s bandwidth broker to determine whether there are sufficient resources along a specific path when performing admission control in response to receiving an incoming RSVP PATH message request, reducing the risk of overallocation of resources. *See* analysis at element [1.1.1]-[1.4]. This would also allow for the bandwidth broker to choose the best path for a given request and also distribute load more evenly. Also, because the bandwidth broker participates in the routing protocol, it would be able to quickly recognize routing changes in the topology as fast as any router. *See* Ex.1007, 218 (“Agents [bandwidth broker] listen to the routing protocol and detect routing changes on average as fast as any router in the domain.”). Because the changes are recognized quickly, the bandwidth broker would be able to adjust the paths accordingly. *See* Ex.1007, 218 (“When changes occur, agents [bandwidth brokers] can schedule resources along new paths.”). This would be beneficial since it would avoid canceling a scheduled event, which is undesirable. *See* Ex.1011, 18 (“It is

unfortunate if a planned event has to be canceled with late notice because it turns out there are insufficient network resources.”).

iii. data structure to keep resource usage information

100. Schelen-2 discloses that the bandwidth broker has “data structures” to “keep information about the current reserved aggregate bandwidth” as well as “the aggregated bandwidth reserved in advance over time.” Ex.1007, 221. This includes “information about reserved resources on each link in its domain,” which are identified in the topology map. Ex.1007, 215.

101. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao’s bandwidth broker to comprise a data structure to keep resource usage information over time for each link in the network domain as defined by the topology map (see analysis at element [5.1]) so that it can plan ahead over time. The resource usage information would allow the bandwidth broker to determine how much resources are available so that a new reservation would not exceed the available bandwidth. *See e.g.*, Ex.1007, 220-221 (“When a new admission request arrives, admission is granted if the new reservation would not cause the aggregate bandwidth to exceed the link bandwidth...The conditions are checked at all points...”), Fig. 5; Ex.1020, 23, (“Each BB must keep track of all resources that are active, or allocated to a specific service. The status of resources must be updated.”) On the other hand, if resource usage information was not maintained by the

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bandwidth broker, then there would be a risk of over-allocating resources. *See e.g.*, 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.”).

102. Because in the combination Xiao’s bandwidth broker has resource usage information, scheduling for advance reservations can take place while also servicing immediate reservations when resources allow (based on a lookahead time), which may improve utilization. Ex.1007, 223 (“When there are scheduled events, advance reservations can improve the service and the utilization by ensuring that resources are allocated at an appropriate time.”); 213 (“An important parameter in the admission control algorithm is the so called lookahead time, i.e., the point at which we actually start making resources available for approaching advance reservations by rejecting immediate requests.”)

iv. bandwidth broker performs admission control for all links in the domain

103. Schelen-2 discloses the bandwidth broker “perform[s] admission control on the links from the starting point to an edge router in its domain” and “reserve[s] resources on each link in its domain.” Ex.1007, 215. It would have been obvious to a POSITA, in view of Schelen-2’s teachings, for Xiao’s bandwidth broker to perform admission control (see analysis at element [1.4])) for all links in

the path in its domain because, Xiao explains that “it is technically better to have a BB to allocate resources.” Ex.1005, 11. Also, having the bandwidth broker perform admission control for all links is beneficial since it frees up the routers from related computations. Ex.1032, 457 (“Our goal has been to relieve the routers from computation concerned with QoS contracts and put it in agents instead.”). Another benefit of the bandwidth broker performing admission control for all links is that it has visibility of all reserved and available resources, which allows it to schedule new reservations efficiently. *See e.g.*, Ex.1007, 220-221, Fig. 5. If the bandwidth broker performed admission control for only part of the links, then there would be the risk of over allocating resources on the path.

104. Also, since the bandwidth broker controls all the link allocations, then it can negotiate with neighboring bandwidth brokers to aggregate resources. *See* Ex.1025, 1 (“[B]ilateral service agreements are made for aggregate border-crossing traffic between neighboring administrative domains... by having a Bandwidth-Broker (BB) as the resource manager for each domain.”); Ex.1034, 29 (“[A]gents can do bulk reservations in advance with neighboring agents, thereby allowing aggregation over time.”). This approach simplifies administration. On the other hand, if other entities, e.g., a router, controlled part of the links, then there would be additional signaling between all the neighbors and that entity and would be more complex, both of which are undesirable.

v. storage for granted requests and user-related data

105. Schelen-2 discloses that “it is important to have data structures” to manage information related to granted reservations. Ex.1007, 221 For example, Schelen-2 discloses that the bandwidth broker maintains the reservation state and accounting information, which may be “stored in agents [bandwidth brokers] with plenty of memory and disk.” Ex.1007, 216.

106. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao’s bandwidth broker to comprise memory and disk with a data structure, where it stores the reservation state of all its granted requests. Storing the reservation state for granted requests would allow the bandwidth broker to “manage reservations efficiently.” *See* Ex.1007, 221, Fig. 5. Also, this would “allow quick admission control” and for new reservations to be planned in view of the status of granted reservations. Ex.1007, 221. Additionally, a POSITA would have understood that storing the reservation state of granted requests also allows the bandwidth broker to keep track of the reservation (e.g., whether the reservation is active, ended, or canceled) and “schedule[] resources over time.” Ex.1007, 213. Ex.1011, 18 (“It is unfortunate if a planned event has to be canceled.”). When the reservation state indicates that the reservation has ended or has been canceled, then the allocated resources can be released, thereby freeing up additional bandwidth for new requests. Ex.1019, 4 (“Knowledge of [the reservation start and stop time] intervals

Ex.1003

is necessary for the admission control algorithm to determine which requests overlap and when the reserved resources will be released.”).

107. Moreover, it would have been obvious to a POSITA for Xiao’s bandwidth broker to store accounting information in its storage (memory and disk) so that the information is available for determining charges associated with all of the user’s granted reservations for billing purposes. Ex.1016, 4 (describing “value add services such as billing...”); Ex.1025, 7 (“...billing...[should] closely reflect[] the actual resources used...”). Also, storing the accounting information (such as monetary cost for a route that will be charged to a user) would be useful when the bandwidth broker supports traffic engineering in the MPLS domain. *See e.g.*, Ex.1005, 13 (“MPLS is also a useful tool for traffic engineering.”), 15 (“Common route metrics in constraint-based routing are monetary cost...”).

d. Reasonable expectation of success

108. I note that the results would have been predictable and there would have been a reasonable expectation of success in the combination since Xiao, Schelen-1, and Schelen-2 all address the same technology, as analyzed above in the analogous art section. Also, a POSITA would have had a reasonable expectation of success since the teachings of Schelen-1 and Schelen-2 represent well known techniques, such as using a data structure and memory to store data, performing admission control based on stored information and topology and routing

information. Any modification needed to Xiao, in order to accommodate the bandwidth broker teachings of Schelen-1, and Schelen-2, would have been within the level of ordinary skill in the art, including implementing the combined teachings in hardware and software. *See* Ex.1005, 11 (describing that management elements may be implemented in hardware or software); Ex.1011, 25 (“The results show that it is feasible... a general purpose computer is powerful enough to run the agent software.”).

109. Lastly, I note that the proposed combinations rely on the teachings of the references—not on physical incorporation of the elements.

6. Reasons to Combine Gibson with Xiao

a. Gibson is Analogous Art

110. Gibson discloses performing admission control with an “admission manager” (which corresponds to a bandwidth broker) in the context of an MPLS network and is therefore analogous art to the ’698 patent which also performs admission control in an MPLS network. Ex.1001, 6:47-54, 7:10-25; Ex.1006, 7:25-57. Xiao similarly addresses MPLS networks. Ex.1005, 14. Accordingly, a POSITA considering Xiao would have found Gibson’s MPLS teachings relevant.

b. Motivation to combine with Gibson

111. A POSITA would have been motivated to combine the teachings of Gibson and Xiao to produce numerous predictable and beneficial results.

i. bandwidth broker is associated with the MPLS domain

112. Xiao discloses that “MPLS can be used together with differentiated services to provide QoS” and generally recognizes that “it is technically better to have a BB [bandwidth broker] to allocate resources.” Ex.1005, 11, 14.

113. Gibson also discloses an MPLS network with a “management layer” that includes “[a]dmission manager[s] [are] responsible for maintaining network topology information” and “provides admission control to the communication network”, using this to select a route across the network. Ex.1006, 6:14-16, 7:1-28, 7:46-48, Fig. 1. A POSITA would have understood Gibson’s admission manager corresponds to a “bandwidth broker,” in the ‘698 patent. Ex.1001, 2:27-55 (“A bandwidth broker is an entity...[that]... provides admission control.”), 9:22-25 (“A BB that performs path sensitive admission control must have correct topology and routing information.”). Gibson also provides additional implementation details regarding the admission manager’s operations in the MPLS network. *See e.g.*, Ex.1006, 7:25-58. Thus, it would have been obvious to a POSITA, in view of Gibson, to associate a bandwidth broker with Xiao’s MPLS network, to provide admission control for incoming requests for a new communication session. Ex.1006, 7:26-32, 7:54-57.

ii. request having predefined QoS

114. Gibson discloses that a user through an endpoint “request a communication session on the communications network” having “a pre-specified quality of service.” Ex.1006, 2:6-12, 6:65-7:1; *see also* Ex.1006, Abstract, 4:50-55 (“establishing a path for... which provides a guaranteed quality of service” between a source “first endpoint 10” and a destination “second endpoint 11,”).

115. It would have been obvious to a POSITA, in view of Gibson, to implement Xiao such that a request for a communication session has a pre-specified QoS, because this would allow the user to configure the QoS so that it is predictably maintained. For example, Xiao explains that its premium service supports “Internet telephony, videoconferencing...[and] virtual lease lines” and it was known in the art that for such communications, “it is essential that quality of service is configurable, predictable and maintainable.” Ex.1005, 11; Ex.1026, 2; *see also* Ex.1027, 4:46-47.

iii. bandwidth broker performs admission control in the MPLS domain

116. Gibson discloses that the “admission manager effectively provides admission control” in the MPLS network domain. Ex.1006, 7:42-48; *see also* 5:13-28. It would have been obvious to a POSITA, in view Gibson, for Xiao’s bandwidth broker in the MPLS network domain to perform admission control, so that end-to-

end reservations may be made for the requested service if resources are available.

See Ex.1006, 7:25-57; Ex.1006, Abstract (“Bandwidth along a chosen path is reserved...for the communication session.”); Ex.1032, 453, Abstract (“Requests involving several routing domains are forwarded for admission control” “to support end-to-end” reservations.). Because each of Xiao’s bandwidth brokers would have reserved resources in its respective network domain, the source and destination nodes would be able to communicate, thereby achieving Xiao’s objective. Ex.1005, 13 (“Host S sends packets... packets are delivered to host D.”).

*iv. intra-domain bandwidth broker responsible for setting up
 an LSP and admission control in the MPLS domain*

117. Xiao discloses that “[w]ith MPLS, LSPs are set up between each ingress-egress pair.” Ex.1005, 17. Gibson provides additional teachings of how to set up a new LSP in the MPLS network. For example, discloses that the MPLS network includes a “management layer” comprising “connection managers and administrative server.” Ex.1006, 6:14-16. The administrative server and connection manager together cooperate to set up “new high capacity label switch paths across the MPLS network.” Ex.1006, 8:16-9:10, Fig. 2 (process for setting up new LSP). Xiao further discloses that the connection manager performs admission control by determining whether to accept the resource request for new LSP (Ex.1006, 8:55-

9:10) and determining whether there are sufficient resources to accommodate the new session INVITE message (Ex.1006, 10:12-34).

118. It would have been obvious to a POSITA, in view of Gibson, for Xiao's MPLS network domain to include at least one administrative server (Ex.1006, 8:22-24) and at least one connection manager (Ex.1006, 8:4-7) to perform admission control and facilitate setting up LSPs in Xiao's MPLS network domain. See analysis at element [1.6.1]. By including an administrative server and connection manager are within Xiao's MPLS network domain, Xiao's bandwidth broker would be freed up to manage higher level communications with neighboring bandwidth brokers while the internal management elements handle internal resource reservations and admission control. Such an implementation would allow for scaling. *See e.g.*, Ex.1032, 454 ("To support scaling, we use a hierarchical approach... Inside...there will be...reservation agents [bandwidth brokers] that aggregate reservations [within the domain]...At the top level there are several...corresponding peer agents [bandwidth brokers].") Applying Gibson's teachings would be directly applicable to Xiao, which disclose that "[w]ith MPLS, LSPs are set up between each ingress-egress pair." Ex.1005, 17.

v. *topology map and link-state routing information*

119. Gibson discloses that the admission manager "determine[s] possible paths between the required endpoints" by maintaining "topological information."

Ex.1003

Ex.1006, 7:26-37. Topological information is maintained as “a map of all the reachable nodes on the MPLS network and their availability over time.” Ex.1006, 7:36-42. The “admission manager also monitors the bandwidth of connections to edge abstract nodes [routers].” Ex.1006, 7:28-46.

120. It would have been obvious to a POSITA, in view of Gibson, for Xiao’s bandwidth broker to maintain a topology map and routing information of its communication network, to be able to perform path sensitive admission control and to detect routing changes that require re-computation to select a new path. *See* Ex.1006, 7:46-48 (describing that the collected information is used to “effectively provide[] admission control to the communication network.”); Ex.1032, 452 (“Each reservation agent must know the topology of its routing domain to perform admission control... and also to detect topology changes that require re-computation.”)

vi. *storage for granted requests and user-related data*

121. Gibson discloses that the admission manager “store[s]...for future use” information for “successful request[s]” (e.g., “stores the session description”) and that storage includes “computer readable medium.” Ex.1006, 2:51-58, 15:20-23, 20:9-11. It would have been obvious to a POSITA, in view of Gibson, for Xiao’s bandwidth broker to include storage, e.g., computer readable medium, to store

granted reservation requests so that the information can be used in the future, e.g., when providing service per the granted request.

c. Reasonable expectation of success

122. I note that the results would have been predictable and there would have been a reasonable expectation of success in the combination since Xiao already discloses an MPLS domain and uses a bandwidth broker. Gibson simply provides additional implementation details with respect to how to manage the MPLS domain with bandwidth brokers, including how to set up an LSP and perform admission control, as analyzed above. A POSITA would have possessed the skills required to make the proposed combination, including being able to implement the combined teachings in corresponding hardware and software. *See* Ex.1005, 11 (describing that management elements may be implemented in hardware or software); Ex.1011, 25 (“The results show that it is feasible... a general purpose computer is powerful enough to run the agent software.”).

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

B. Ground 1: Claims 1-5 and 7-8 are Obvious over Xiao, Schelen-1, and Gibson

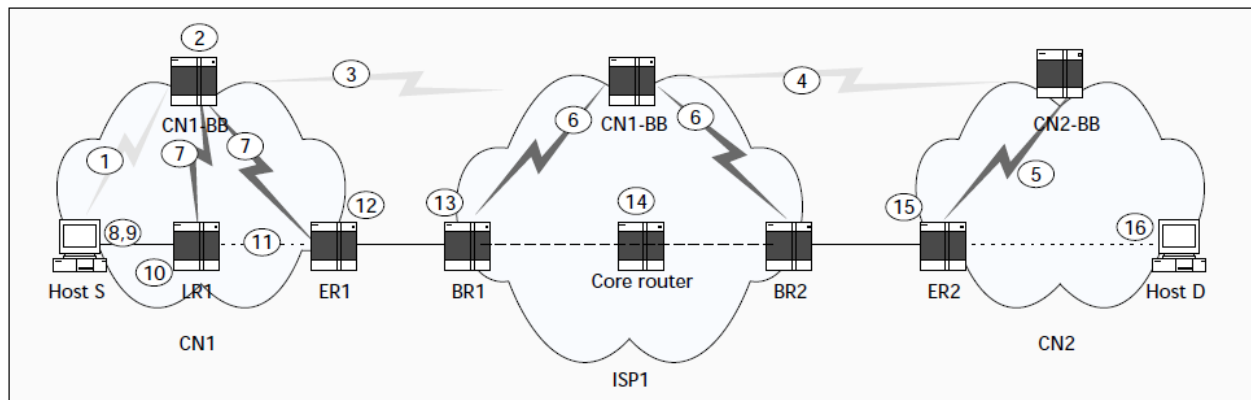
124. The combination of Xiao, Schelen-1, and Gibson renders obvious claims 1-5 and 7-8 as discussed below.

1. Claim 1

- a. [1.0.1] *Method in a packet based communication network including network domains, wherein at least one domain is a Multiprotocol Label Switching MPLS domain,*

125. To the extent the preamble is limiting, Xiao renders obvious a
“*[m]ethod in a packet based communication network including network domains, wherein at least one domain is a Multiprotocol Label Switching MPLS domain.*”

126. First, Xiao discloses a “**process of premium service**” for delivering “**packets**” in a communication network including multiple network domains, as illustrated at Figure 4. Ex.1005, 12-13 (Example 2).



■ Figure 4. The delivery process of premium service with a dynamic SLA.

Ex.1005, Fig. 4.

127. Xiao explains that “premium service” is available in a network that uses several differentiated service classes:

An Introduction to **Differentiated Services**

Ex.1003

IPv4 header contains a Type of Service (TOS) byte. Its meaning was previously defined in [26]. Applications can set three bits in the TOS byte to indicate the need for low-delay, high-throughput, or low-loss-rate service. However, choices are limited. Differentiated services defines the layout of the TOS byte (DS field) and a base set of packet forwarding treatments (per-hop behaviors, or PHBs) [27]. By marking the DS fields of packets differently and handling packets based on their DS fields, several differentiated service classes can be created.

...

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.1005, 10; *see also* Ex.1005, 13, (“Phase 2: Data Transmission... BR1 classifies and polices the premium traffic...Intermediate routers between leaf routers BR1 and BR2 (inclusive) perform BA classifications. BR2 also reshapes the premium traffic.”). Since the network in Figure 4 is capable of delivering “premium service,”

Ex.1003

it would have been obvious to a POSITA for the network (which is under the “Differentiated Services” section) to use differentiated service classes, and thus, for the illustrated network domains to be a differentiated services.

128. Xiao’s communication network of Figure 4 includes a source “corporate network 1” CN1, a destination “corporate network 2” CN2 and an internet service provider “ISP1.” Ex.1005, 10, 12-13, Fig. 4. The source corporate network CN1 and the destination corporate network CN2 are two different “**customer domains**” that are separated by at least ISP1, an ISP “**domain.**” *See* Ex.1005, 13 (“[E]ach customer domain will need a BB to request service on behalf of the domain and to allocate services inside the domain.”).

129. Importantly, I note that although only a single ISP domain is illustrated in Figure 4, Xiao contemplates that “**there are multiple ISPs between CN1 and CN2.**” Ex.1005, 13. Xiao also explains that “**MPLS can be used together with differentiated services to provide QoS.**” Ex.1005, 14. Xiao’s teaching is consistent with the understanding of a skilled artisan; namely, that “[i]n real-world use, it is unlikely that [DiffServ and MPLS] QoS protocols will be used independently, and in fact they are designed for use with other QoS technologies to provide top-to-bottom and end-to-end QoS between senders and receivers.” Ex.1017, 16.

130. It would have been obvious to a POSITA to implement multiple ISPs in the communications network of Figure 4, including ISPs that support different QoS protocols such as DiffServ and MPLS, since Xiao itself suggests this modification “to provide QoS.” Ex.1005, 14. Additional reasons to modify Xiao’s communications network of Figure 4, to use an MPLS ISP, are provided below.

131. Xiao teaches how ingress and egress routers modify headers of packets from a DiffServ domain, for forwarding through the MPLS domain:

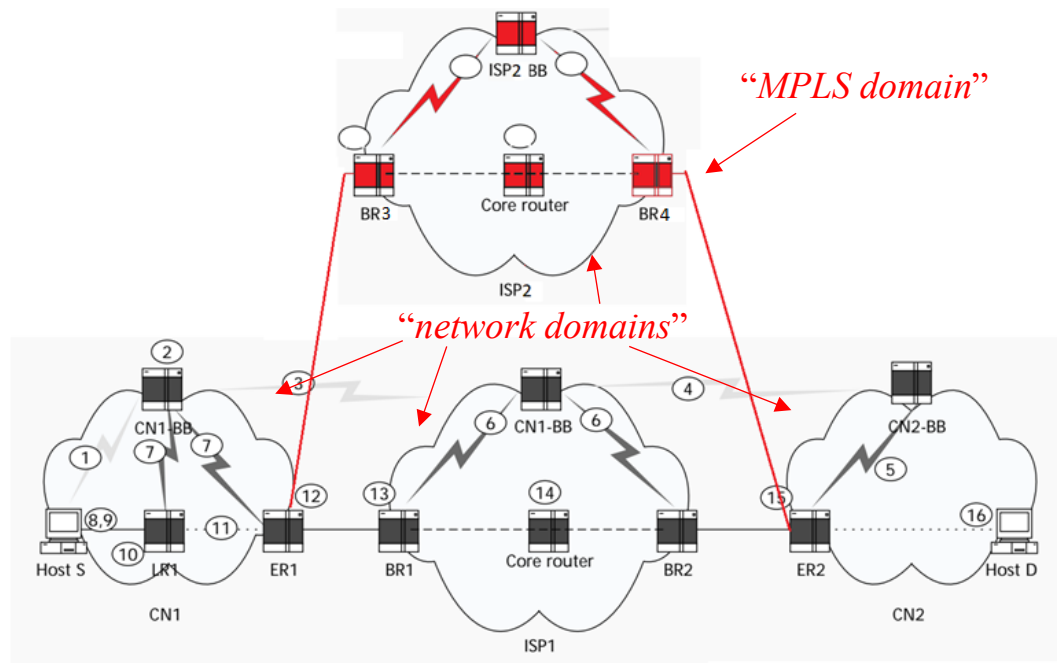
- At the ingress of the [MPLS] ISP network, in addition to all the processing described in the DS-field-based architecture, an MPLS header is inserted into the packet.
- Core routers process the packet based on its label and COS [class-of-service] field rather than its DS field.
- At the egress, unless interdomain LSPs are configured, the MPLS header is removed.

Ex.1005, 14.

132. Accordingly, a POSITA would have understood that an MPLS domain ISP may be readily implemented in Figure 4’s communications network so that it interoperates and processes DiffServ packets. Xiao’s express teachings of using DiffServ and MPLS together, coupled with the teachings of how the MPLS domain routers modify the packet headers, supports a reasonable expectation of success in implementing an MPLS ISP domain in Figure 4.

Parallel Differentiated Services and MPLS ISP Domains

133. To illustrate using DiffServ and MPLS domains together, I have provided below a modified Figure 4 with the two ISP domains in parallel:



■ Figure 4. The delivery process of premium service with a dynamic SLA.

Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

134. In modified Figure 4 above, the MPLS domain ISP (which I will refer to as "ISP2") includes border routers BR3 and BR4 (which would perform the MPLS header insertion and removal on packets transmitted via ER1 and ER2).

Ex.1005, 14. The MPLS domain ISP2 would also include a bandwidth broker

(which I will refer to as “ISP2-BB”). It would have been obvious to associate ISP2-BB with the ISP2 domain, since Xiao generally teaches that “admission control decisions can be made...by a BB” and that “[i]t is technically better to have a BB to allocate resources.” Ex.1005, 11-12; *see also* analysis at element [1.0.3], *infra*.

135. It would have been obvious to a POSITA to utilize parallel ISPs in Xiao’s Figure 4, as shown above, for redundancy. *See* Ex.1025, 2-3 (“[A] campus contracts one ISP (or a few for **redundancy**) to deliver its traffic...to *all* destinations.”); Ex.1035, 8 (“Each major institution [is] connected to **other Internet Service Providers (ISPs) in a highly redundant fashion.**”), Figure 4, (illustrating endpoints connected by parallel “network service providers”). Such an implementation would be beneficial since in the event that one ISP is unavailable, the customer would still be able to obtain service through the parallel ISP.

136. Another reason to utilize parallel ISPs is to reduce the chance of exceeding peak rates and thereby avoid dropping excess traffic. Xiao explains that the customer must not exceed a peak rate—which is defined by the service level agreement (“SLA”)—else the excess traffic would be dropped. Ex.1005, 11 (“The SLA specifies a desired peak bit-rate...The customer is responsible for not exceeding the peak rate; otherwise, **excess traffic will be dropped.**”). Xiao suggests that a solution to this issue may be to “provide more resources by upgrading the infrastructure.” Ex.1005, 15. A POSITA would have understood that

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a parallel ISP would be an upgrade to the infrastructure that would address this problem. For instance, if a host in the customer domain seeks a new connection and the bandwidth of the current ISP is approaching its peak rate, the new connection may be serviced via the parallel ISP. This would reduce the risk of exceeding peak rate and dropping excess traffic.

137. I also note that a parallel ISP may provide cost savings, in instances where one ISP has a cost structure more favorable. Xiao explains that ISPs provide different levels of service at different prices determined by the customer's SLA. Ex.1005, 8 ("...predictable Internet services for [those] willing to pay a certain price."). In a scenario where the customer needs to transfer packets that exceed a negotiated peak rate of the SLA, a customer could renegotiate a higher peak rate but at a potentially higher cost. If the customer domain has a parallel ISP domain, the bandwidth broker may select the ISP with the lowest cost based on the quality of service needed, the time of communication, or other factors.

138. Accordingly, it would have been obvious to a POSITA, based on Xiao's disclosure discussed above, to utilize ISPs in parallel in the architecture of modified Figure 4, to obtain numerous benefits discussed above. Ex.1005, 14.

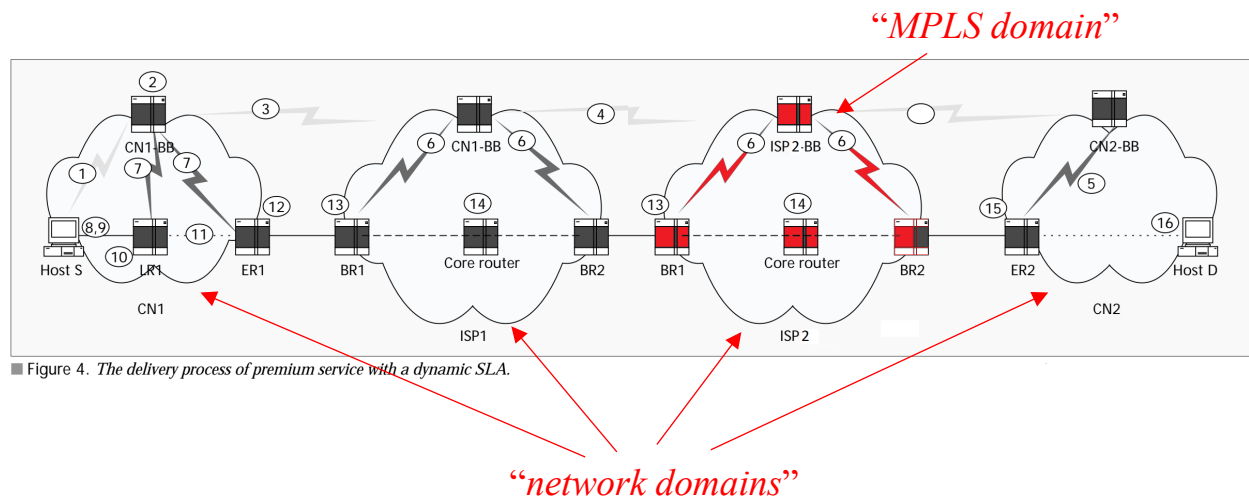
Series Differentiated Services and MPLS ISP Domains

139. Also, a POSITA would have understood that in Figure 4 the ISP domains may be positioned in series, such that the MPLS domain ISP2 is positioned

Ex.1003

before or after the DiffServ domain ISP1. *See e.g.*, Ex.1017, Figure 7 (illustrating differentiated services and MPLS domains in series, “Figure 7: Illustrates the possible use of different QoS technologies under development--RSVP, DiffServ, MPLS, COPS and Bandwidth Brokers’--working cooperatively in various strategies to enable end-to-end QoS”).

140. Below I illustrate using differentiated services and MPLS domains together in series:



Ex.1005, Fig. 4 (annotated and modified showing series ISPs).

141. It would have been obvious to utilize a series of ISP domains to provide service to destinations which are not directly connected to the same ISP domain as the source network. Ex.1025, 3 (“The local ISP in turn contracts its neighboring ISPs for delivery to those destinations that it does not directly connect to.”). This implementation represents potential “real-world” scenarios where

different QoS protocols (including DiffServ and MPLS) are used together. Ex.1017, 16, 18. Thus, it would have been obvious to a POSITA to also, or alternatively, utilize ISP domains configured in series, to allow for reaching destinations that are not directly connected to the same ISP domain as the source. I note that since in Xiao's Figure 4 the destination corporate network CN2 is directly connected to the same ISP as the source corporate network CN1, I will focus on the parallel ISP implementation.

142. I note that whether multiple ISPs are implemented in Xiao's Figure 4 in parallel or series (or both) is a mere design choice that would have been obvious to a POSITA, since these and combinations thereof are the only possible implementations.

143. A POSITA would have had a reasonable expectation of success in using both differentiated services domains and MPLS domains in the same communications network, in both parallel and series. As I noted above, Xiao teaches how the MPLS domain's border routers perform packet processing to account for differentiated services packets and explains that these two protocols **"can easily interoperate."** Ex.1005, 14. The expectation of success is also supported by the fact that it was generally known in the art that differentiated services and MPLS **"are not mutually exclusive** of one another. On the contrary, they **complement each other nicely."** Ex.1017, 5-6; *see also* Ex. 1017, 19 ("As

Ex.1003

might be expected, **because DiffServ and MPLS are similar** with respect to the qualitative QoS they enable (i.e. classification), mapping DiffServ traffic on MPLS ‘pipes’ (LSPs) is relatively simple.”).

144. Thus, in multiple ways,² Xiao discloses a process of premium service in a packet-based communications network (e.g., modified Figure 4) including multiple network domains (e.g., customer domains and multiple ISP domains), where at least one ISP domain is MPLS, which renders obvious a “[m]ethod in a packet based communication network including network domains, wherein at least one domain is a Multiprotocol Label Switching MPLS domain.”

- b. [1.0.2] to establish a virtual leased line, VLL, between a source (SRC) and a destination (DST) in different domains in order to achieve packet transfer between the source (SRC) and the destination (DST),**

145. To the extent this part of the preamble is limiting, Xiao renders obvious that the method is “to establish a virtual leased line, VLL, between a source (SRC) and a destination (DST) in different domains in order to achieve packet transfer between the source (SRC) and the destination (DST).”

² For the purposes of this declaration, I will focus on Xiao’s modified Figure 4 showing parallel ISPs, with the understanding that the analysis equally applies to a series implementation.

146. First, Xiao discloses a source “**Host S in corporate network 1 (CN1)**” and a destination “**Host D in corporate network 2 (CN2)**” in different “**customer domains**,” which renders obvious “*a source (SRC) and a destination (DST) in different domains.*” Ex.1005, 11-15, Figure 4.

147. Xiao further discloses that the process (discussed at [1.0.1]), for “[p]remium service is suitable ... for **creating virtual lease lines**,” between the source and the destination, which renders obvious “*establish[ing] a virtual leased line, VLL, between*” the source and the destination. Ex.1005, 11.

148. It would have been obvious to a POSITA that when implementing modified Figure 4 that both ISP1 and ISP2 would provide a path for premium service, including virtual lease lines. For instance, Xiao discloses that the source customer network CN1 uses premium service to send data to the destination customer network CN2:

Differentiated Services

....

An End-to-End Service Architecture

In this section a service architecture for differentiated services is presented. This architecture provides assured service and **premium service** in addition to best-effort service. It is mainly based on the architecture proposed in [28]. Other possible service architectures also exist [30].

Ex.1005, 10.

Example 2: Delivery of Premium Service with a Dynamic SLA — In Fig. 4, host S in **CN1 wants to use premium service to send data to host D in CN2**. CN1 has a dynamic SLA with ISP1.

Ex.1005, 12.

149. Additionally, Xiao discloses providing “**premium service in an MPLS-based architecture**.” Ex.1005, 14. To support premium service in MPLS, Xiao performs the following packet header processing at the ingress and egress of the MPLS domain ISP:

- At the ingress of the ISP network, in addition to all the processing described in the DS-field-based architecture, an MPLS header is inserted into the packet.
- Core routers process the packet based on its label and COS field rather than its DS field.
- At the egress, unless interdomain LSPs are configured, the MPLS header is removed.

Ex.1005, 14.

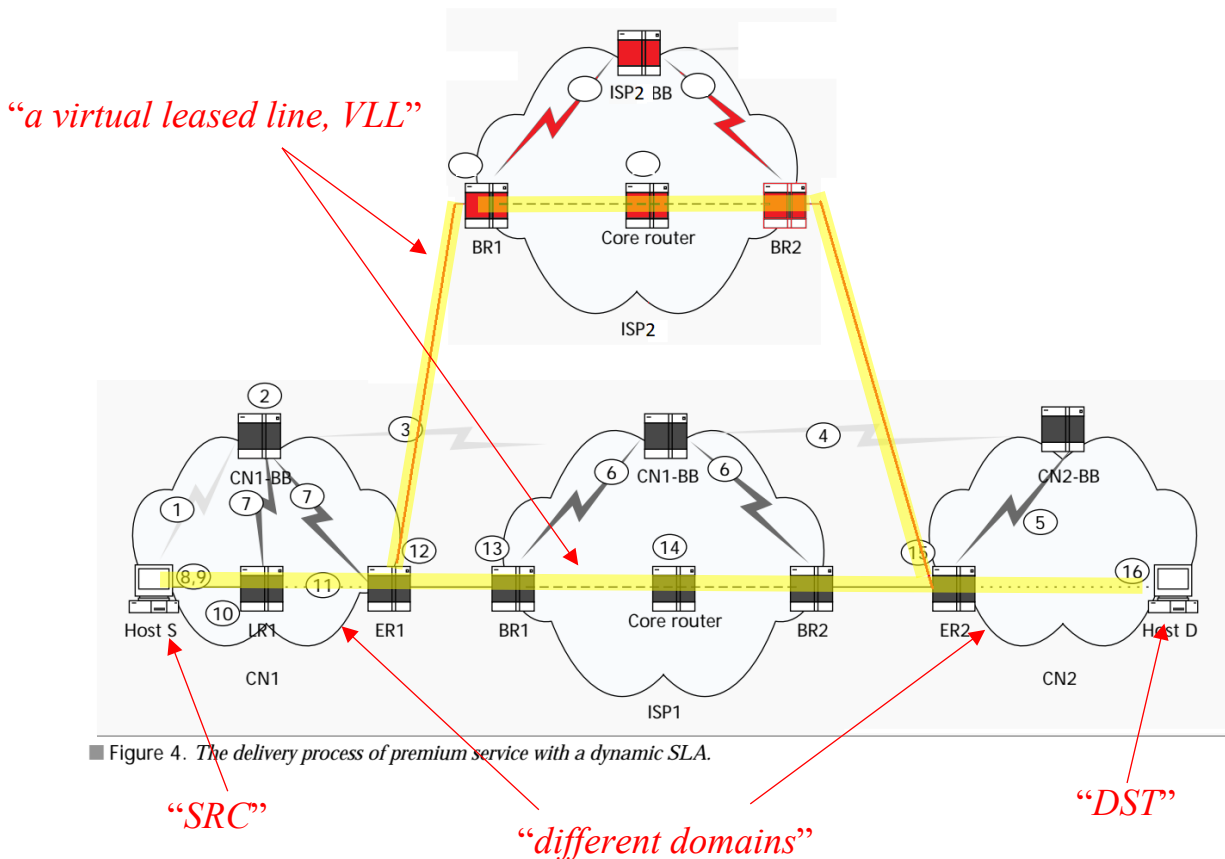
150. Because the MPLS domain ingress router receives premium service packets and processes them to be transported across the MPLS domain ISP2, a POSITA would have understood that the MPLS domain ISP2 supports premium

service. Thus, in the modified Figure 4 (see element [1.0.1]) both the DiffServ domain ISP1 and MPLS domain ISP2 support premium service. It would have been obvious to a POSITA to use premium service to establish a virtual lease line across both ISP domains to obtain numerous benefits, as discussed below.

151. It would have been obvious to a POSITA, in view of Xiao's teaching, to use premium service to establish a virtual lease line between the source Host S and the destination Host D to save the cost of building and maintaining a separate network. Ex.1033, 2 ("It is expected that Premium traffic would be allocated a small percentage of the total network capacity...to **create 'virtual leased lines', saving the cost of building and maintaining a separate network.**").

152. Additionally, a POSITA would have been motivated to establish virtual leased lines "for virtual private networks (VPNs)" when providing secure communications between the source and the destination. Ex.1005, 11 ("Premium service is suitable for...creating virtual lease lines for virtual private networks (VPNs)."); Ex.1012, 22 ("Virtual leased lines are uni-directional, connecting two network domains. Several lines can be combined to build virtual private networks."); Ex.1010, 2:29-31 ("To address the need for means of passing secure communications, 'virtual private networks' (VPNs) have been developed."). The noted benefits, separately and together, would have motivated a POSITA to make this implementation.

153. In making the implementation, a POSITA would utilize premium service to establish a VLL across the DiffServ domain ISP1, the MPLS domain ISP2, or both ISP domains, between the source Host S and the destination Host D. Modified Figure 4 (per the analysis at element [1.0.1]), illustrates this implementation. Ex.1005, 13-15.



Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

154. Thus, Xiao teaches using premium service to establish a VLL across the DiffServ domain ISP1 and the MPLS domain ISP2 between a source Host S and a destination Host D in different customer domains, which renders obvious

“establish[ing] a virtual leased line, VLL, between a source (SRC) and a destination (DST) in different domains.”

155. Second, Xiao discloses that the network provides “end-to-end service” (Ex.1005, 12, Abstract) and that premium service packets (which would include VLL packets) are transmitted between the source Host S and the destination Host D, which renders obvious that the virtual leased line is established in *“in order to achieve packet transfer between the source (SRC) and the destination (DST).”* Ex.1005, 13-15.

9 Host S sends packets to leaf router LR1.

10Leaf router LR1 performs an MF classification. If the traffic is nonconformant, LR1 will shape it. LR1 will also set the P-bits of the packets. All packets enter the PQ.

11Each intermediate router between LR1 and ER1 performs a BA classification, puts the packets into the PQ, and sends them out.

12ER1 performs a BA classification and reshapes the traffic to make sure that the negotiated peak rate is not exceeded. Reshaping is done for the aggregation of all flows heading toward BR1, not for each individual flow.

13BR1 classifies and polices the premium traffic. Excess premium packets are dropped.

14Intermediate routers between leaf routers BR1 and BR2 (inclusive) perform BA classifications. BR2 also reshapes the premium traffic.

15ER2 classifies and polices the premium traffic. Excess premium packets are dropped.

16The **premium packets are delivered to host D.**

Ex.1005, 13.

156. Note also that, as a technical matter, a VLL provides uni-directional packet transmission. *See* Ex.1027, 3:33-35 (“A Virtual Leased Line is a point-to-point data line with a guaranteed peak transmission rate.”), 4:46-47 (“Virtual Leased Line Service (10) guarantees a unidirectional reserved rate R_f for a point-to-point flow.”). Ex.1012, 22 (“Virtual leased lines are uni-directional, connecting two network domains.”). To the extent Patent Owner contends that the phrase “*between*” requires bi-directional transfer, then in the instance where Xiao’s VLLs support VPNs (as discussed above), bi-directional packet transfer would be achieved since several VLLs (between the source and destination) are combined to build the VPN. Ex.1012, 22 (“**Several [virtual leased] lines can be combined to build virtual private networks.**”). A POSITA would have understood that VPNs utilize several uni-directional VLLs for bi-directional communications between the respective endpoints. Ex.1020, 12 (“Two applications programs desiring bi-directional

resource reservation will need to create this from two uni-directional reservations.”).

157. Thus, Xiao discloses that the VLL is established in order to achieve packet transfer between source Host S and destination Host D, which renders obvious “*in order to achieve packet transfer between the source (SRC) and the destination (DST).*”

c. [1.0.3] *wherein the³ bandwidth broker (BB) is associated to each network domain and*

158. To the extent this part of the preamble is limiting, Xiao in combination with Schelen-1 and Gibson renders obvious “*wherein the bandwidth broker (BB) is associated to each network domain.*”

159. As explained in the claim construction section, according to the ’698 patent, “[a] bandwidth broker is an entity in a network domain that manages policies for bandwidth resources.” Ex.1001, 2:48-49.

160. First, Xiao discloses that bandwidth brokers “**CN1-BB**” and “**CN2-BB**” are associated with the customer domains and that a bandwidth broker “**ISP1-BB**” is associated with the differentiated services ISP1 domain. Ex.1005, 12-14.

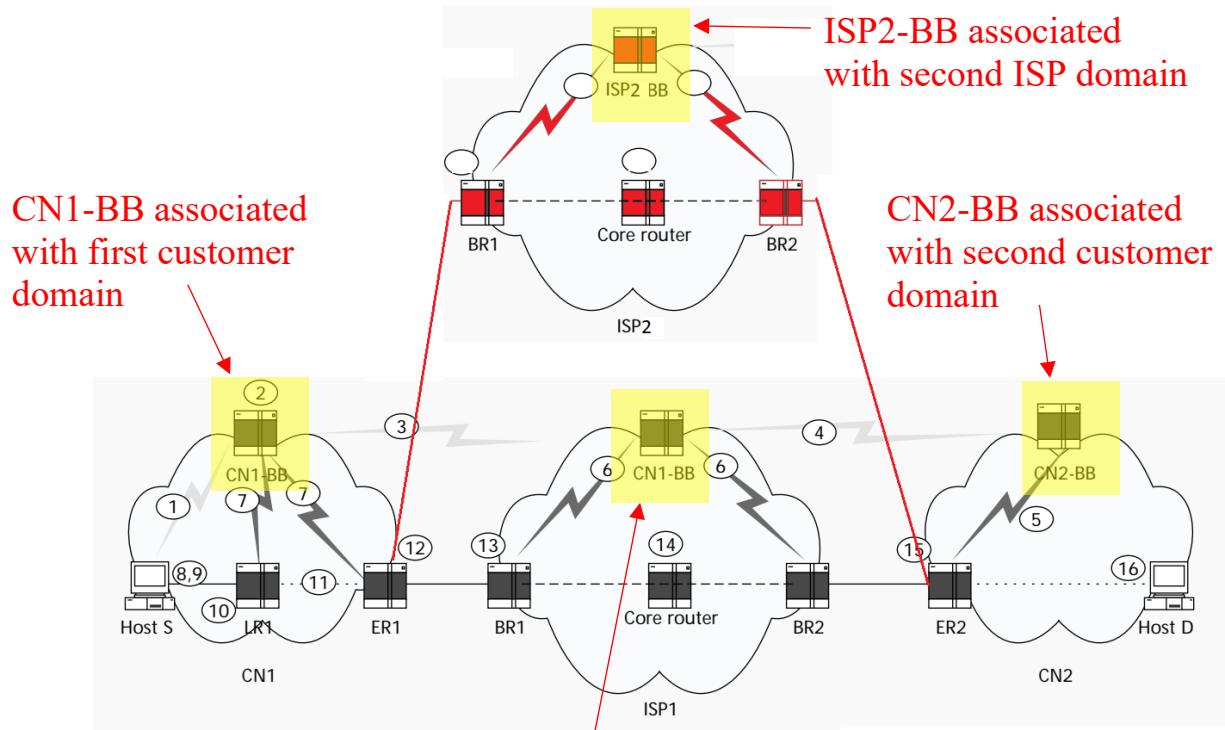
³ I note that the recitation of “*the bandwidth broker*” lacks antecedent basis and for purposes of this analysis I am addressing the language as “*a bandwidth broker.*”

161. Although Xiao recognizes that “BBs may not be needed in MPLS-based ISP networks,” a POSITA would have recognized that Xiao does not teach away from using a bandwidth broker in MPLS domains. Quite the contrary. Xiao recognizes that **“it is technically better to have a BB [bandwidth broker] to allocate resources.”** Ex.1005, 11, 14. Also, Xiao generally teaches that **“[a]t the ISP side, admission control decisions can be made...centrally by a BB.”** Ex.1005, 12. As additional evidence, in the context of Figure 5’s MPLS architecture, Xiao provides a bandwidth broker “ISP1-BB” that sends “the PATH message through an LSP to BR2.” Ex.1005, 14. In view of Xiao’s disclosure, it would have been obvious to a POSITA to associate a bandwidth broker with MPLS domain ISP2 in modified Figure 4, since it is better to have a bandwidth broker to allocate resources.

162. Moreover, Schelen-1 discloses that **“[f]or each routing domain in the network, there will be a reservation agent [bandwidth broker] responsible for admission control.”** Ex.1032, 451; *see also* 452 (“Typically there is one reservation agent [bandwidth broker] responsible for each autonomous system (AS) in the Internet (an AS is an administrative domain containing a number of routers running a routing protocol internally)...[W]e need at least one agent [bandwidth broker] for each routing domain.”).

163. Lastly, Gibson discloses an “MPLS network” with a “**management layer**” that includes “**[a]dmission manager[s]** **[] responsible for maintaining network topology information**” and “**provides admission control** to the communication network.” Ex.1006, 6:11-16, 7:1-28, 7:46-48, Fig. 1. A POSITA would have understood that an admission manager of the MPLS network, which is part of the management layer, maintains network topology, and provides admission control, corresponds to a “*bandwidth broker*,” in the ‘698 patent. Ex.1001, 2:27-55 (“A bandwidth broker is an entity...[that] provides admission control.”), 9:22-25 (“A BB that performs path sensitive admission control must have correct topology and routing information.”). *See also* analysis at element [1.4], where the “*bandwidth broker....performs admission control*,” and [5.1] where the “*bandwidth broker (BB) comprises a topology map*.”

164. Accordingly, in the instance where the communication network of Figure 4 was implemented with an MPLS domain ISP2 (see analysis at element [1.0.1]), it would have been obvious for a bandwidth broker (which I will denote as “ISP2-BB”) to be associated with the ISP2 MPLS domain. The noted bandwidth brokers are shown at modified Figure 4.



■ Figure 4. The delivery process of premium service with a dynamic SLA.

Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

165. A POSITA would have associated a bandwidth broker with the MPLS domain, in view of Xiao's disclosure that "it is technically better to have a BB [bandwidth broker] to allocate resources" and that at "the ISP side, admission control decisions can be made...by a BB [bandwidth broker]." Ex.1005, 11-12.

166. Also, in view of Schelen-1 and Gibson, it would have been obvious to associate a bandwidth broker with Xiao's MPLS ISP domain in modified Figure 4, to provide admission control within that network domain. Additionally, it was known that having a bandwidth broker associated with each domain provides

scaling benefits. *See e.g.*, Ex.1025, 1 (“[H]aving a **Bandwidth Broker (BB) as the resource manager for each domain ... scale[s] well** in the global, heterogeneous Internet.”); Ex.1011, 17 (“For each routing domain in the network there is a [bandwidth broker] responsible for admission control in the domain...with **favorable scalability properties.**”). Thus, a POSITA would have been motivated apply the bandwidth broker teachings of Schelen-1 and Gibson such that a bandwidth broker is associated with each of Xiao’s domains (including the MPLS domain) to provide admission control and to obtain scaling benefits.

167. Additionally, it was known that associating a bandwidth broker with each domain allows for “**minimiz[ing] reservation state and admission control overhead**” since “reservations from different sources to the same destination domain are aggregated in agents as their paths merge toward the destination.” Ex.1012, 3. This additional reason would have motivated a POSITA to associate a bandwidth broker with each of Xiao’s domains (including the MPLS domain). *See also* Reasons to Combine; analysis at element [1.0.4], *infra*, which discloses hierarchical routing.

168. A POSITA would have had a reasonable expectation of success in associating a bandwidth broker with each network domain in Xiao’s modified Figure 4, since Xiao already utilizes bandwidth brokers. Also, the prior art evidence

a reasonable expectation of success. Ex.1017, Fig. 7 (showing that a bandwidth broker is associated with each domain, including MPLS and DiffServ domains).

169. Thus, Xiao alone and in combination with Schelen-1 and Gibson discloses that a bandwidth broker (e.g., CN1-BB, CN2-BB, ISP1-BB, ISP2-BB) is associated with each network domain (e.g., source customer domain, destination customer domain, DiffServ domain ISP1, and MPLS domain ISP2), which renders obvious that a “*bandwidth broker (BB) is associated to each network domain.*”

d. [1.0.4] *the bandwidth broker (BB) is configured to control a hierarchical routing domain, the method comprises the following steps:*

170. To the extent this part of the preamble is limiting, Xiao in combination with Schelen-1 renders obvious that “*the bandwidth broker (BB) is configured to control a hierarchical routing domain.*”

171. First, as discussed above at elements [1.0.1]-[1.0.3], Xiao discloses that both customer domains and both ISP domains have an associated bandwidth broker.

172. Xiao further discloses that the bandwidth broker is configured to control resource allocation in the customer domains:

Service Allocation in Customer Domains — Given an SLA, a customer domain should decide how its hosts share

the services specified by the SLA. This process is called service allocation.

There are basically two choices:

- Each host makes its own decision as to which service to use.
- A **resource controller** called the **bandwidth broker (BB)** [28] makes decision for all hosts.

A BB can be a host, a router, or a software process on an exit router. It is configured with the organizational policies and manages the resources of a domain. A domain may also have backup BBs. Since all hosts must cooperate to share a limited amount of resources specified by the SLA, it is technically better to have a **BB to allocate resources**.

Ex.1005, 11.

173. Xiao further discloses that at “**the ISP side, admission control decisions can be made...by a BB [bandwidth broker].**” Ex.1005,12; *see also* Ex.1005, 12 (Example 2). Consistent with the analysis at element [1.0.3], it would have been obvious when implementing the communications network represented by modified Figure 4 for the bandwidth broker ISP2-BB of the MPLS domain to perform admission control for ISP2. Thus, Xiao renders obvious that “*the bandwidth broker (BB) is configured to control a... domain.*”

174. Second, Schelen-1 discloses that the bandwidth broker “**provide[s] admission control for it’s [sic] own routing domain**” that implements “**hierarchical routing**”:

Each reservation **agent [bandwidth broker]** must know the topology of its routing domain to perform admission control on behalf of that domain, and also to detect topology changes that require re-computation of forwarding state setup in routers, or renegotiation with adjacent reservation agents. This topology information can be obtained through a link state routing protocol that provides each node, including the agent, with a topology database. It is in the nature of **hierarchical routing** that an agent cannot have knowledge about the internals of remote autonomous systems and therefore can only **provide admission control for it’s [sic] own routing domain**. Thus, we need at least one agent for each routing domain.

Ex.1032, 452.

Hierarchical agents

To support scaling, we use a **hierarchical approach, i.e., agents [bandwidth brokers]** register border points of their routing domains rather than specific endpoints. The internal multicast tree and the local members of a routing domain are concealed by the reservation agent.

Adding another member to a session where members are sharing resources can be done internally. **Inside an AS there is a hierarchy of routing domains and there will be a corresponding hierarchy of reservation agents** [bandwidth brokers] that aggregate reservations and register with the next highest level. At the top level there are several ASes and corresponding peer agents. These agents [bandwidth brokers] should only register involved border routers of their autonomous systems with the rendezvous agent.

Ex.1032, 454.

175. I also note that the only description of “*hierarchical routing*” in the ’698 patent references the Schelen Olov Thesis (describing the bandwidth broker BB_{OLOV} in the ’698 patent) which matches Schelen-1’s description of hierarchical routing. *See* Ex.1001, 3:64-4:37; Ex.1012, 42, 45; Ex.1032, 452, 454; *see also* analysis at element [1.6.2], where the MPLS domain ISP2 utilizes a hierarchical routing architecture that is controlled by bandwidth brokers.

176. It would have been obvious to a POSITA to incorporate the hierarchical routing domain teachings of Schelen-1 when implementing Xiao, such that one or more, including all, of Xiao’s domains (see analysis at [1.0.1]) are hierarchical routing domains. Such an implementation would support scaling and accommodate a network with a large topology. Ex.1038, 1 (using hierarchical

routing within “the topology of large networks.”); Ex.1025, 2 (“...hierarchical approach to scalable bandwidth allocation support...”); Ex.1012, 45 (“To support scaling, we use a hierarchical approach.”); Ex.1025, 3 (“With this two-tier hierarchical approach, end-to-end QoS support can be achieved through a concatenation of inter- and intra-domain resource allocations”).

177. Additional benefits of hierarchical routing domains include achieving routing data abstraction and reducing resource utilization (e.g., CPU, memory, bandwidth) in support of routing. Ex.1009, 3 (“The objective behind the use of hierarchical routing is to achieve some level of routing data abstraction, or summarization, to reduce the cpu, memory, and transmission bandwidth consumed in support of routing.”). These benefits, separately and together, would have motivated a POSITA to implement Xiao’s domains as a hierarchical routing domain, per Schelen-1’s.

178. The result would have been predictable and a POSITA would have had a reasonable expectation of success in implementing one or more (or all) of Xiao’s domains as hierarchical routing domains. The reasonable expectation of success is evidenced by others that had implemented differentiated services and MPLS domains as hierarchical routing domains. Ex.1008, 13 (“MPLS supports a hierarchy.”); Ex.1021, 2 (“The Differentiated Services effort in IETF has developed

a simple model to differentiate packet delivery qualities.” “[T]oday’s Internet routing architecture follows a two-level hierarchical design.”).

179. Thus, Xiao in combination with Schelen-1 discloses bandwidth brokers (e.g., CN1-BB, CN2-BB, ISP1-BB, ISP2-BB) configured to control in a hierarchical routing domain (e.g., one or more of customer domains and ISP domains), which renders obvious that “*the bandwidth broker (BB) is configured to control a hierarchical routing domain.*”

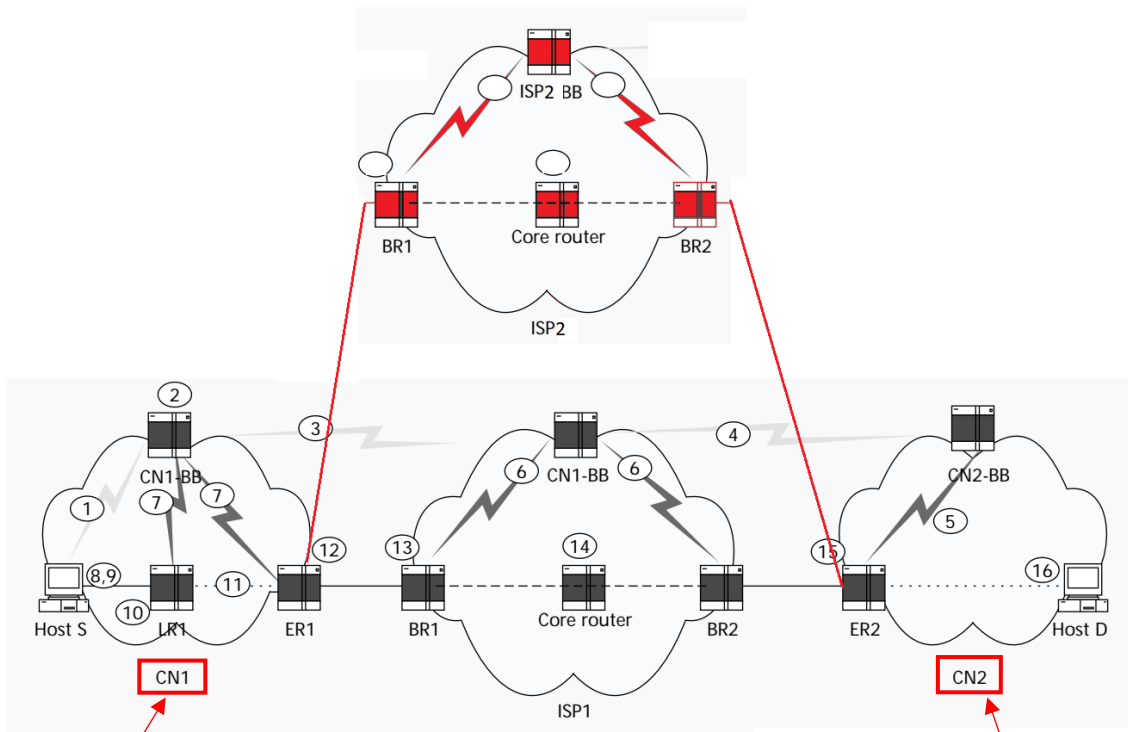
- e. [1.1.1] *i) generate a request from en equity⁴ for a Virtual Leased Line, VLL, having a predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST) and*

180. Xiao in combination with Schelen-1 and Gibson renders obvious “*generat[ing] a request from en equity for a Virtual Leased Line, VLL, having a*

⁴ Original PCT claims (PCT/EP01/04062), as well as the claims of the preliminary amendment dated October 10, 2002, recited “*generate a request from **an entity**,*” but in an Examiner’s Amendment with the Notice of Allowance dated November 8, 2006, the language appears to have been modified to “***en equity**,*” without explanation. For purposes in this declaration, I will address the “***en equity***” as “***an entity***.”

predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST)."

181. First, as explained at element [1.0.2], Xiao discloses using premium service to establish a VLL between the source Host S in a corporate network CN1 and the destination Host D in a corporate network CN2. Ex.1005, 12 ("...host S in **corporate network 1 (CN1)** wants to...send data to host D in **corporate network 2 (CN2)**..."). The source corporate network CN1 corresponds to "*a source network (SRC)*" and the destination corporate network CN2 corresponds to "*a destination network (DST)*."



■ Figure 4. The delivery process of premium service with a dynamic SLA.

“source network (SRC)”

“destination network (DST)”

Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

182. Furthermore, Xiao discloses that in step 1 of the “signaling process of dynamic premium service” the **“Host S sends an RSVP PATH message to its local domain BB CN1-BB,”** the message “specifying the characteristics of the traffic.” Ex.1005, 9, 12, 14. It would have been obvious to a POSITA that Host S sending the message requesting premium service, includes generating the message specifying the characteristics of the type of service that it requires, e.g., premium service for VLL. See Ex.1005, 12-13 (assured service in Example 1 and premium service in Example 2).

183. In the example, the RSVP PATH message is for premium service, which Xiao explains has predefined QoS characteristics (e.g., delay, jitter, bit rate, and guaranteed bandwidth).

Premium Service — Premium service provides low-delay and low-jitter service for customers that generate fixed peak bit rate traffic.... The ISP guarantees that the contracted bandwidth will be available when traffic is sent. Premium service is suitable for Internet telephony, videoconferencing, or for creating virtual lease lines for virtual private networks (VPNs) [33].

Ex.1005, 11.

184. In the '698 patent, delay is one characteristic of QoS. Ex.1001, 1:66-2:3 (“**delays...quality of service (QoS).**”); Ex.1026, 14 (“QoS demands...delay... jitter...”). As I already analyzed at [1.0.2], it would have been obvious to use premium service to establish a virtual leased line, which would as a result have the above noted predefined QoS characteristics (e.g., guaranteed bandwidth, low-delay and low-jitter) when the request specifies premium service.

185. Thus, Xiao discloses generating a premium service RSVP PATH message request from Host S for establishing a virtual leased line having a predefined QoS (e.g., delay, jitter, bit rate, and guaranteed bandwidth) from a source corporate network CN1 to a destination corporate network CN2, which

renders obvious “*generate a request from an entity for a Virtual Leased Line, VLL, having a predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST).*”

186. Second, to the extent Patent Owner contends that Xiao does not sufficiently disclose this element, the further combination with Gibson would render it obvious.

187. Gibson discloses that an “**endpoint is any node in the communications network through which a user may request a communication session on the communications network.**” Ex.1006, 6:65-7:1; *see also*, Ex.1006, 5:35-37. The request is for “establishing a connection between two endpoints in a communications network, such that the connection **provides a pre-specified quality of service, for a specified communication session.**” Ex.1006, 2:6-12; *see also* Ex.1006, Abstract, 6:9-13 (“establishing a path for [a communication session] which provides a guaranteed quality of service” between a source “first endpoint 10” and a destination “second endpoint 11,”), 4:49-55, 20:53-21:11, 22:12-24. It would have been understood by a POSITA that the user interacts with the endpoint so that it generates a request for a communication session with a pre-specified quality of service. The user or the endpoint, separately and together, correspond to “*an entity*” that generates a request.

188. It would have been obvious to a POSITA, in view of Gibson, to implement Xiao such that a user interacts with Host S to generate a request for a communication session having a pre-specified QoS, because this would allow the user to initiate an immediate session or schedule in advance a session for Internet telephony and videoconferencing, which have predefined QoS. Ex.1005, 8, (“...Internet telephony and videoconferencing.”); Ex.1026, 2 (“[F]or applications relying on the transfer of multimedia information, in particular the continuous media of digital audio and video, it is essential that **quality of service is configurable**, predictable and maintainable.”); *see also* Reasons to Combine. In the combination of Xiao and Gibson the generated PATH message request would be for a VLL (*see* analysis at element [1.0.2]) having a pre-specified QoS from the source corporate network CN1 to the destination corporate network CN2.

189. Thus, Xiao in combination with Gibson discloses generating a PATH message request from an entity (e.g., user or Host S, separately and together) for a VLL having a pre-specified QoS from a source corporate network CN1 to a destination corporate network CN2, which renders obvious “*generat[ing] a request from an entity for a Virtual Leased Line, VLL, having a predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST).*”

190. Third, additionally, the combination with Schelen-1 also discloses generating a reservation request from a user for service, with the request including predefined QoS parameters for service between source and destination:

Users can make reservation requests by contacting any reservation agent [bandwidth broker]. Reservation requests are forwarded to the agent responsible for the routing domain concerned by the request.

Ex.1032, 451.

Admission control in agents is **parameter-based, i.e., considering static link resources and traffic descriptions given in admission requests.** Agents may setup resources along shortest paths or perform **QoS routing based on the parameters in the admission requests...**

...

For reservation agents to find out which autonomous systems are on the path **between source and destination**, agents need access to routing information that resides in the border routers of their autonomous system.

Ex.1032, 453.

191. A POSITA would have understood that because the QoS parameters (providing traffic descriptions) are in the reservation request and the bandwidth

broker, based on the request, will “setup resources along the path,” the request “*ha[s] a predefined Quality of Service, QoS*” from the source to the destination.

192. It would have been obvious to a POSITA to include in Xiao’s PATH message request predefined QoS parameters describing the traffic from the source to the destination. This would allow the user to have greater control in specifying the service (e.g., type of service, time of service, duration, etc.) for the bandwidth broker when performing admission control. Ex.1034, 30 (“[R]eservation requests may be immediate and open-ended or made in advance by including starting time and duration for the reservations.”). Because the user can specify, for example, advance reservation parameters such as the time of service, resources could be more effectively scheduled. Ex.1032, 451 (“Support for advance reservations allows both the network and its users to more **effectively schedule resources when the time of the future event needing reservations is known in advance.**”).

193. Also, utilizing parameter-based requests (with predefined QoS) would be beneficial since it would avoid undue signaling overhead as compared to measurement-based approaches. *See* Ex.1032, 453 (“To **avoid undue signaling overhead** and scalability problems, agents do not measure traffic dynamics. Admission control in agents is parameter-based.”); Ex.1034, 29 (“Agents do parameter-based admission control...There is no signaling of traffic dynamics

between routers and agents. **Admission requests contain the bandwidth to be reserved**, a source and a destination address.”); *see also* Reasons to Combine.

194. In the further combination, with Schelen-1, Xiao’s user would interact with Host S to generate a PATH message request for a VLL having a pre-specified QoS (e.g., bandwidth, delay, jitter, start time, duration, etc.) from source corporate network CN1 to destination corporate network CN2.

195. Thus, additionally, Xiao in combination with Schelen-1 and Gibson renders obvious “*generate a request from an entity for a Virtual Leased Line, VLL, having a predefined Quality of Service, QoS, from a source network (SRC) to a destination network (DST).*”

f. **[1.1.2] *apply the request to a Bandwidth Broker (BB) of a domain A, BB_A, associated to the source network;***

196. Xiao in combination with Schelen-1 and Gibson renders obvious “*apply[ing] the request to a Bandwidth Broker (BB) of a domain A, BB_A, associated to the source network.*”

197. Xiao discloses that Host S “**send[s]**” the generated PATH message to the “**local domain BB CN1-BB,**” associated with the source corporate network CN1:

Example 2: Delivery of Premium Service with a Dynamic
SLA — In Fig. 4, host S in CN1 wants to use premium

service to send data to host D in CN2. CN1 has a dynamic SLA with ISP1.

Phase 1: Signaling

1 Host S **sends an RSVP PATH message to the local BB, CN1-BB.**

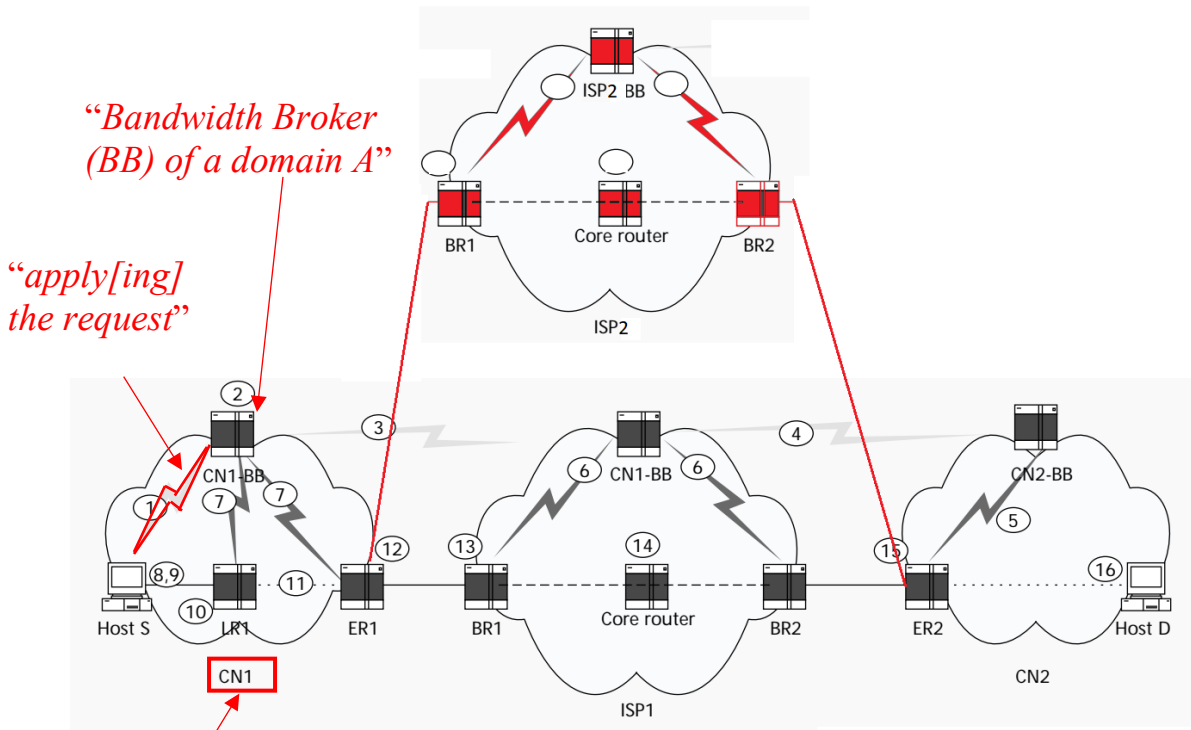
2 CN1-BB makes an admission control decision.

- If the request is denied, an error message is sent back to host S. The signaling process ends.

3 The **request is accepted by CN1-BB.** CN1-BB sends the PATH message to ISP1-BB.

Ex.1005, 12.

198. As illustrated below, Host S applies the PATH message to CN1-BB.



“source network (SRC)”

Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

199. Since the sent “request is accepted by CN1-BB” when performing admission control (*see also* analysis at elements [1.2]-[1.6], *infra*), it would have been obvious that the bandwidth broker CN1-BB received the request that was sent. Thus, Xiao renders obvious “*apply[ing] the request to a Bandwidth Broker (BB) of a domain A, BB_A , associated to the source network.*”

200. Second, Schelen-1 discloses applying the reservation request to the bandwidth broker:

Users can make reservation requests by contacting any reservation agent [bandwidth broker]. **Reservation requests are forwarded to the agent [bandwidth broker] responsible for the routing domain concerned by the request.**

Ex.1032, 451.

Admission control in agents is parameter-based, i.e., considering static link resources and traffic descriptions given in admission requests. **Agents [bandwidth brokers] may setup resources along shortest paths or perform QoS routing based on the parameters in the admission requests.**

Ex.1032, 453.

201. Additionally, Gibson discloses that the admission manager (“bandwidth broker”) “**recei[ves]...a request for a specified communication session**” that was sent by the endpoint. Ex.1006, 3:36-53, 7:25-57, Abstract.

202. It would have been obvious to a POSITA for Xiao’s CN1-BB to receive the request, per Schelen-1 and Gibson, to perform admission control so that premium service is set up based on the request. Ex.1005, 11-12. In the combination of Xiao, Schelen-1, and Gibson, the generated request would be sent to and received by bandwidth broker CN1-BB to perform admission control.

203. Thus, Xiao in combination with Schelen-1 and Gibson discloses that Host S sends the request and that the request is received by the bandwidth broker CN1-BB of the customer domain, associated with the source corporate network CN1, which renders obvious “*apply[ing] the request to a Bandwidth Broker (BB) of a domain A, BB_A , associated to the source network.*”

g. [1.2] ii) BB_A establishes the different domains involved to reach the destination network (DST);

204. Xiao in combination Schelen-1 renders obvious that the “ BB_A establishes the different domains involved to reach the destination network (DST).”

205. First, as explained at element [1.0.1] Xiao (per the modified Figure 4) discloses that the communication network comprises a DiffServ domain ISP1 and an MPLS domain ISP2. It would have been obvious to a POSITA that the ISP domains are involved to reach the destination corporate network CN2 from the source corporate network CN1.

206. For example, Xiao discloses that customers will have service level agreements (“SLAs”) with its ISP domains for premium service:

Customers will have SLAs with their ISPs. The SLAs will specify the amount of bandwidth allocated for the customers. Customers are responsible for deciding how their applications share that amount of bandwidth.

Ex.1005, 10.

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.**

Ex.1005, 11.

207. A POSITA would have understood that the SLA is an agreement that specifies the forwarding service a customer should receive from its ISPs. *See* Ex.1005, 9 (“Service level agreement (SLA) A service contract between a customer and a service provider [ISP] that specifies the forwarding service a customer should receive.”); Ex.1021, 4 (“[I]nitial resource agreements among neighboring domains are bootstrapped via some configuration...[for example] install some initial resource agreements among neighboring domains.”).

208. Based on SLA information, and since the destination is outside the CN1 domain, the bandwidth broker CN1-BB signals its ISP domain to request services for external communications.

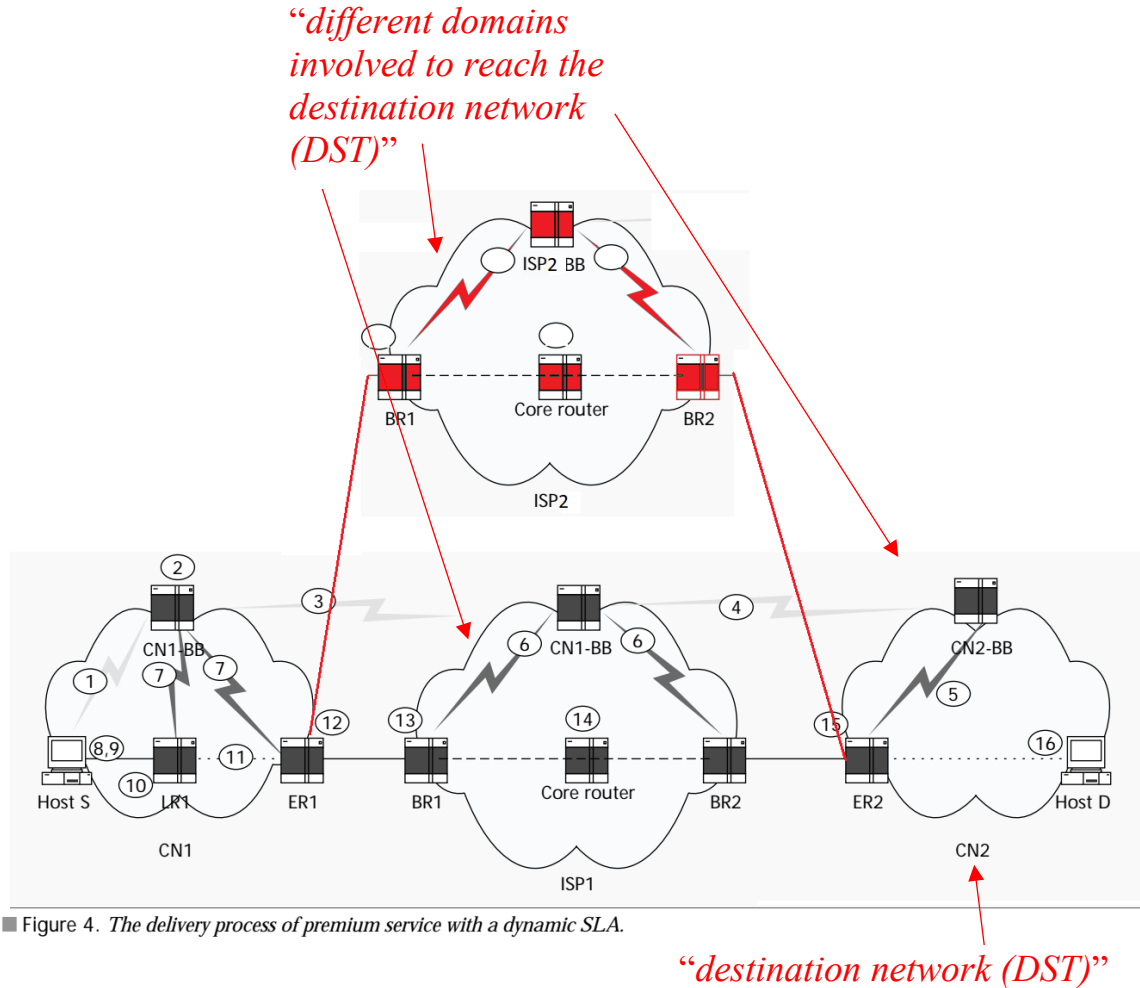
For a dynamic **SLA, resource allocation is closely related to the signaling process. The BB in the customer domain uses RSVP to request resources from its ISP.** At the ISP side, admission control decisions can be made in a distributed manner by the boundary routers, or centrally by a BB. If boundary routers are directly involved in the signaling process, they are configured with the

corresponding classification, policing, and shaping rules when they grant a request. If a BB is involved rather than the boundary routers, the BB must configure the boundary routers when it grants a request. Such procedures will be detailed in the next section.

Ex.1005, 12; *see also* Ex.1005, 12 (“In Fig. 4, host S in CN1 wants to use premium service to send data to host D in CN2. CN1 has a dynamic SLA with ISP1...Host S sends an RSVP PATH message to the local BB, CN1-BB...CN1-BB sends the PATH message to ISP1-BB.”)

209. It would have been obvious to a POSITA that for the bandwidth broker CN1-BB to send the PATH message to the bandwidth broker ISP1-BB of the ISP1 domain, the bandwidth broker CN1-BB would have established that the ISP1 domain was involved to reach the domain of the destination corporate network CN2.

210. Also, consistent with my explanation above at element [1.0.1], in the instance where there are multiple ISPs and the bandwidth broker CN1-BB has an SLA with each, it would have been obvious to a POSITA that bandwidth broker CN1-BB establishes that multiple ISP domains are involved to reach the domain of the destination corporate network CN2. Ex.1005, 14-15, Ex.1025, 2, 3. To illustrate the concept with respect to multiple ISP domains, provided below is modified Figure 4 (see analysis at element [1.0.1]).



Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

211. In the above figure, when the customer domain bandwidth broker CN1-BB receives the PATH message request from Host S for communication with destination Host D, it will establish that ISP1, ISP2, and the destination customer domains are involved (e.g., per SLAs) to reach corporate network CN2. See Ex.1025, 2 (“[A] campus contracts one ISP (or a few for redundancy) to deliver its traffic.”), 3 (“That is, the campus contracts one or a few ISPs for its data delivery

Ex.1003

services to *all* destinations.”). As further discussed at element [1.3], below, once bandwidth broker CN1-BB establishes the domains involved to reach the destination corporate network CN2, it would send the PATH message request (directly or indirectly) to the bandwidth brokers of the involved domains for admission control. *See* Ex.1005, 12-13 (Phase 1: Signaling).

212. Thus, Xiao’s disclosure that the customer domain bandwidth broker CN1-BB establishes the different domains involved to reach the outside destination corporate network CN2, renders obvious that the “*BB_A establishes the different domains involved to reach the destination network (DST).*”

213. Second, to the extent Patent Owner argues that the above cited teachings are insufficient, Schelen-1 discloses that a bandwidth broker listens to a well-known multicast address to establish the existence of bandwidth brokers of all other domains:

Typically there is one reservation agent [bandwidth broker] responsible for each...administrative domain containing a number of routers running a routing protocol internally). **Such reservation agents [bandwidth brokers] advertize themselves periodically on a well known multicast address, giving their identity and which routing domain (AS) they are responsible for. By listening to this well known multicast address, each top level agent [bandwidth broker] will know the existence of all other**

top level agents [bandwidth brokers]. Inside an AS there may be backup agents as well as a hierarchy of agents, e.g., different agents for different areas of the AS. Most agents are internal, i.e., not visible outside the AS, but if there is an agent failure, one of the backup agents is advertized instead.

Ex.1032, 452.

214. This information about bandwidth brokers of all other domains is used to reserve bandwidth toward the destination. Ex.1032, Abstract (“Requests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path for the requested service.”).

215. A POSITA would have understood that because the bandwidth brokers advertise their identities and the domain that they are responsible for, any other bandwidth broker listening on the well-known multicast address establishes all of the different domains involved to reach a given destination.

216. In view of Schelen-1’s disclosure, it would have been obvious to a POSITA for each of the bandwidth brokers associated with Xiao’s domains (see analysis at element [1.0.3]) to communicate via a multicast address. This would allow for each bandwidth broker to establish the existence of all other bandwidth brokers and their respective domains. With this information, in the present example, the customer domain bandwidth broker CN1-BB would become aware of the

involved bandwidth brokers (ISP1-BB, ISP2-BB, CN2-BB) and which ISP domains they are responsible for (DiffServ domain ISP1, MPLS domain ISP2, and destination customer domain CN2), so a PATH message request may be sent to reserve ISP resources toward the destination network. Ex.1005, 12 (“[T]he BB in the customer domain must also use some signaling protocol to request resources on demand from its ISP.” “CN1-BB sends the PATH message to ISP1-BB.” “ISP1-BB sends the PATH message to CN2-BB.”); *see also* analysis at element [1.3], *infra*.

217. Thus, Xiao in combination with Schelen-1 discloses that the customer domain bandwidth broker CN1-BB establishes (by listening to multicast channel) the different domains involved to reach the destination corporate network CN2, which renders obvious that the “*BB_A establishes the different domains involved to reach the destination network (DST).*”

- h.** [1.3] *iii) BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains regarding a VLL of the predefined QoS from ingress to egress of each domain;*

218. Xiao in combination with Schelen-1 and Gibson renders obvious that the “*BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains regarding a VLL of the predefined QoS from ingress to egress of each domain.*”

219. First, as explained at elements [1.1.1]-[1.1.2], Xiao in combination with Schelen-1 and Gibson discloses that the bandwidth broker CN1-BB receives a PATH message request for a VLL having predefined QoS from the source corporate network CN1 to the destination corporate network CN2. Further, as explained at element [1.2], the prior art discloses that the bandwidth broker CN1-BB establishes that ISP1, ISP2, and destination customer domains are involved to reach the destination corporate network CN2.

220. Second, Xiao generally discloses that “the BB in the customer domain **must also use some signaling protocol to request resources on demand from its ISP.**” Ex.1005, 12. In the example of setting up premium service, the source customer domain bandwidth broker CN1-BB “sends the PATH message” “*directly*” to the bandwidth broker of the ISP domain and “*indirectly*” to the bandwidth broker of the destination domain:

Phase 1: Signaling

1 Host S sends an RSVP PATH message to the local BB, CN1-BB.

2 CN1-BB makes an admission control decision.

- If the request is denied, an error message is sent back to host S. The signaling process ends.

3 The request is accepted by CN1-BB. CN1-BB sends the PATH message to ISP1-BB.

4 ISP1-BB makes an admission control decision.

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- If the request is denied, an error message is sent back to CN1-BB. Sender S will be notified.
- If the request is accepted, **ISP1-BB sends the PATH message to CN2-BB**.

5 CN2-BB makes an admission control decision.

If the request is denied, an error message is sent back to ISP1-BB. Sender S will be notified.

Ex.1005, 12; *see also* Ex.1005, 13 (“[I]f there are multiple ISPs between CN1 and CN 2,” then the steps are “repeat[ed]...for each ISP[domain].”).

221. It would have been obvious to a POSITA that when there are multiple ISPs between CN1 and CN2 (per the analysis at [1.0.1]), the bandwidth broker CN1-BB would forward PATH message requests, directly or indirectly, to bandwidth brokers ISP1-BB and ISP2-BB of the involved ISP1 and ISP2 domains, respectively. In the parallel implementation, it would have been obvious that a PATH message request is “*directly*” sent to both ISPs, so that in the event one ISP is not available the other redundant ISP would still provide services. *See e.g.*, Ex.1025, 2 (“For example, a **campus contracts one ISP (or a few for redundancy)** to deliver its traffic; the ISP delivers the campus’ traffic either directly if the destinations are connected to the same ISP, or otherwise passes the packets to other ISPs for further forwarding.”). On the other hand, in the series implementation, it would have been obvious for the bandwidth broker of one ISP to

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forward the PATH message request to the downstream ISP to reserve resources in that network domain toward the destination. Ex.1005, 13 (“[I]f there are multiple ISPs between CN1 and CN 2,” then the steps are “repeat[ed]...for each ISP[domain].”). This would correspond to “*indirectly*” passing the request to the involved domain. *See* analysis at [1.0.1], providing more details regarding implementing parallel and series ISP domain in Xiao’s Figure 4.

222. Thus, Xiao renders obvious that the “*BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains.*”

223. Also, Schelen-1 also teaches that “[r]equests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path for the requested service.” Ex.1032, Abstract; *see also* Ex.1032, 453 (“Agents [bandwidth brokers] can interoperate to support end-to-end advance reservation requests in the global network.”).

224. A POSITA would have understood that, regardless of whether the domains are in parallel or in series, Schelen-1 generally teaches forwarding the request to the bandwidth broker of the involved routing domain to support end-to-end reservations. Accordingly, it would have been obvious to a POSITA, in view of Schelen-1, for the customer domain bandwidth broker CN1-BB to pass PATH message requests directly (for parallel ISPs) or indirectly (for series ISPs) to bandwidth brokers ISP1-BB, ISP2-BB, CN2-BB of the involved domains, so that

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end-to-end reservations may be made for the requested service if resources are available. Thus, Xiao in combination with Schelen-1 also renders obvious “*BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains.*”

225. Third, consistent with the analysis at elements [1.0.2] and [1.1.1], Xiao’s PATH message request from the source Host S is for premium service (e.g., for a VLL of the predefined QoS from the source corporate network CN1 to the destination corporate network CN2) and the customer CN1-BB forwards the PATH message request to each of the ISP domains’ bandwidth brokers ISP1-BB, ISP2-BB, and CN2-BB. Since the steps are repeated for each domain, it is obvious that each BB is managing bandwidth allocation for the portion of the communication path passing through the BB’s own domain, i.e., from ingress to egress. Ex.1005, 13 (“[I]f there are multiple ISPs between CN1 and CN 2,” then the steps are “repeat[ed]...for each ISP[domain].”). Accordingly, it would have been obvious to a POSITA that the forwarded request is “*regarding a VLL of the predefined QoS from ingress to egress of each domain.*”

“BB_A directly or indirectly passes requests to all Bandwidth Brokers (BB) of the involved domains”

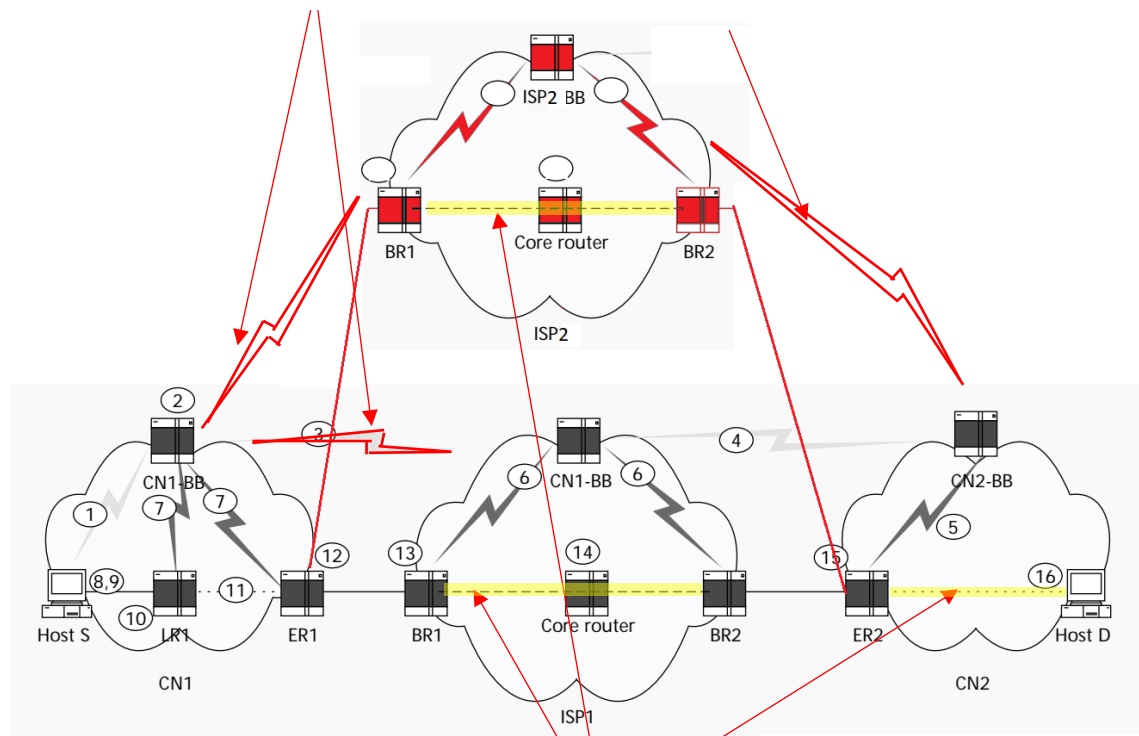


Figure 4. The delivery process of premium service with a dynamic SLA.

“regarding a VLL of the predefined QoS from ingress to egress of each domain”

Ex.1005, Fig. 4 (annotated and modified showing parallel ISPs).

226. Additionally, to the extent Patent Owner contends that Xiao is insufficient to show that the request is regarding “*from ingress to egress of each domain,*” Schelen-1 teaches that “[r]equests involving several routing domains are forwarded for admission control with agents [bandwidth brokers] along the path” “to support end-to-end” reservations. Ex.1032, 453, Abstract. A POSITA would have understood that supporting “end-to-end” reservations means

that resources are reserved from ingress to egress of each domain involved, per the request.

227. It would have been obvious to a POSITA, in view of Schelen-1, for Xiao's PATH message request, to regard reserving end-to-end resources (from ingress to egress) of each involved domain so that resources would be reserved and available to establish the VLL per the original request from source Host S. *See* analysis at elements [1.0.2] and [1.1.1].

228. Thus, Xiao in combination with Schelen-1 renders obvious that the PATH message is “*regarding a VLL of the predefined QoS from ingress to egress of each domain.*”

i. **[1.4] iv) *each involved bandwidth broker (BB) performs admission control in its domain;***

229. Xiao in combination with Schelen-1 and Gibson renders obvious that “*each involved bandwidth broker (BB) performs admission control in its domain.*”

230. First, as discussed at [1.2]-[1.3], Xiao in combination with Schelen-1 and Gibson renders obvious that a PATH message request is forwarded to bandwidth brokers (ISP1-BB, ISP2-BB, CN2-BB) of the involved domains.

231. Second, Xiao generally teaches that “[a]dmission control” is “[t]he decision process of whether to accept a request for resources (link bandwidth plus buffer space).” Ex.1005, 9. “**At the ISP side, admission control decisions can be**

made...centrally by a BB.” Ex.1005, 12. In the context of premium service, Xiao discloses that the involved ISP bandwidth broker and destination bandwidth broker performs admission control:

Phase 1: Signaling

1 Host S sends an RSVP PATH message to the local BB, CN1-BB.

2 CN1-BB makes an admission control decision.

- If the request is denied, an error message is sent back to host S.

The signaling process ends.

3 The request is accepted by CN1-BB. CN1-BB sends the PATH message to ISP1-BB.

4 ISP1-BB makes an admission control decision.

- If the request is denied, an error message is sent back to CN1-BB. Sender S will be notified.
- If the request is accepted, ISP1-BB sends the PATH message to CN2-BB.

5 CN2-BB makes an admission control decision.

If the request is denied, an error message is sent back to ISP1-BB.
Sender S will be notified.

Ex.1005, 12; *see also* Ex.1005, 13 (“[I]f there are multiple **ISPs between CN1 and CN 2,**” then the steps are “repeat[ed]... for each ISP[domain].”).

232. It would have been obvious to a POSITA that when there are multiple ISPs between CN1 and CN2 (per the analysis at [1.0.1]), both bandwidth brokers ISP1-BB and ISP2-BB of the involved ISP1 and ISP2 domains, respectively,

perform admission control. Because each involved bandwidth broker ISP1-BB, ISP2-BB, and CN2-BB performs admission control, a determination is made as to whether the request is accepted or denied, and Host-S is notified accordingly. Ex.1005, 12 (“Sender S will be notified.”). Also, because Host-S is notified, further appropriate action may be taken, e.g., in the instance where both ISPs deny the request with error messages, Host-S may renegotiate its SLAs for additional bandwidth. Ex.1005, 10 (“An SLA basically specifies the service classes supported and the amount of traffic allowed in each class.”)

233. Thus, Xiao discloses that each involved ISP1-BB, ISP-2BB, and CN2-BB performs admission control in its domain, which renders obvious that “*each involved bandwidth broker (BB) performs admission control in its domain.*”

234. Third, to the extent Patent Owner contends that Xiao’s disclosure is insufficient, Schelen-1 discloses that for “**each routing domain** in the network, there will be a **reservation agent [bandwidth broker] responsible for admission control.**” Ex.1032, 451. “Requests involving several routing domains are forwarded for **admission control to agents [bandwidth brokers]** along the path for the requested service” “**to support end-to-end**” reservations. Ex.1032, 451, 453, Abstract.

235. Also, Gibson discloses that an admission manager (“*bandwidth broker*” see analysis at [1.0.3]) performs admission control in the MPLS domain:

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An admission manager also monitors the bandwidth of connections to edge abstract nodes for the endpoint EP that it is associated with. (An edge abstract node is an abstract node that is positioned towards the edge of a communications network.) In this way an **admission manager effectively provides admission control to the communication network.**

Ex.1006, 7:42-48; *see also* 5:13-28.

236. A POSITA would have understood that, regardless of whether the domains are in parallel or in series, Gibson and Schelen-1 generally teach that the bandwidth broker of the involved routing domain performs admission control. Accordingly, it would have been obvious to a POSITA, in view of Schelen-1 and Gibson, for the involved bandwidth brokers ISP1-BB, ISP2-BB, and CN2-BB to perform admission control, so that end-to-end reservations may be made for the requested service if resources are available. *See also* Reasons to Combine.

237. Thus, Xiao in combination with Schelen-1 renders obvious that “*each involved bandwidth broker (BB) performs admission control in its domain.*”

- j. **[1.5.1] v) *each involved bandwidth broker (BB) returns a result of the admission control to BB_A that passes it back to the requesting entity and***

238. Xiao in combination with Schelen-1 and Gibson renders obvious that “each involved bandwidth broker (BB) returns a result of the admission control to BB_A .”

239. First, as discussed at element [1.4], Xiao in combination with Schelen-1 and Gibson discloses that each involved ISP1-BB, ISP2-BB, and CN2-BB performs admission control.

240. Second, Xiao discloses that the bandwidth broker of the involved ISP domain and destination customer domain returns a result (e.g., an error message if admission control denies the request) to CN1-BB which passes the result to Host S:

Phase 1: Signaling

1 Host S sends an RSVP PATH message to the local BB, CN1-BB.

2 CN1-BB makes an admission control decision.

- If the request is denied, an error message is sent back to host S. The signaling process ends.

3 The request is accepted by CN1-BB. CN1-BB sends the PATH message to ISP1-BB.

4 ISP1-BB makes an admission control decision.

- **If the request is denied, an error message is sent back to CN1-BB. Sender S will be notified.**

- If the request is accepted, ISP1-BB sends the PATH message to CN2-BB.

5 CN2-BB makes an admission control decision.

If the request is denied, an error message is sent back to ISP1-BB. Sender S will be notified.

Ex.1005, 12.

241. On the other hand, if the admission control admits the request, then a RESV message is returned to CN1-BB which passes the RESV message to the Host-S:

- **If the request is accepted**, CN2-BB will use LDAP or RSVP to set the classification and policing rules on router ER2. CN2-BB will then **send an RSVP RESV message to ISP1-BB.**

6 When ISP1-BB receives the RESV message, it will **configure the classification and policing rules on router BR1, and the policing and reshaping rules on router BR2. It will then send the RESV message to CN1-BB.**

7 When CN1-BB receives the RESV message, it will set the classification and shaping rules on router LR1, so that if the traffic of the admitted flow is nonconformant, LR1 will shape it. CN1-BB will also set the policing and reshaping rules on router ER1. **CN1-BB will then send the RESV message to host S.**

8 When host S receives the RESV message, it can start transmitting data.

Ex.1005, 12-13; *see also* Ex.1005, 13 (“[I]f there are multiple ISPs between CN1 and CN 2,” then the steps are “repeat[ed]...for each ISP[domain].”).

242. It would have been obvious to a POSITA that when there are multiple ISPs between CN1 and CN2 (per the analysis at [1.0.1]), both bandwidth brokers ISP1-BB and ISP2-BB of the involved ISP1 and ISP2 domains, respectively, perform admission control and return a corresponding result so that Host-S is notified accordingly. In instances where there are parallel ISPs and the Host-S is notified that only one ISP has granted the request, then Host-S know which ISP to use and may renegotiate its SLA with the ISP that denied the request. Also, for serial implementations, in the instance where the directly connected ISP denies the request, appropriate action may be taken, e.g., Host-S may renegotiate its SLAs for additional bandwidth. Ex.1005, 10 (“An SLA basically specifies the service classes supported and the amount of traffic allowed in each class.”).

243. Thus, Xiao discloses that each involved ISP1-BB, ISP2-BB, and CN2-BB returns a result of admission control to CN1-BB that passes it back to the requesting Host-S, which renders obvious that “*each involved bandwidth broker (BB) returns a result of the admission control to BB_A that passes it back to the requesting entity.*”

- k. **[1.5.2] if the request was admitted along all domains between the source (SRC) and the destination (DST) a VLL of the predefined QoS is granted,**

244. Xiao renders obvious that “*if the request was admitted along all domains between the source (SRC) and the destination (DST) a VLL of the predefined QoS is granted.*”

245. First, as analyzed at elements [1.0.2] and [1.1.1], the PATH message request is for premium service for a VLL of predefined QoS between source Host S and destination Host D.

246. Second, Xiao discloses that if the request is admitted along all the domains between the source Host-S and the destination Host-D, the bandwidth broker of each domain configures its boundary routers with classification, policing, and shaping rules:

If boundary routers are directly involved in the signaling process, they are configured with the corresponding classification, policing, and shaping rules when they grant a request. If a BB is involved rather than the boundary routers, the **BB must configure the boundary routers when it grants a request.**

Ex.1005, 12.

- **If the request is accepted**, CN2-BB will use LDAP or RSVP to set the classification and policing rules on router ER2. CN2-BB will then send an RSVP RESV message to ISP1-BB.

6 When ISP1-BB receives the RESV message, it will **configure the classification and policing rules on router BR1**, and the policing and reshaping rules on router BR2.

It will then send the RESV message to CN1-BB.

7 When CN1-BB receives the RESV message, it will **set the classification and shaping rules on router LR1**, so that if the traffic of the admitted flow is nonconformant, LR1 will shape it. CN1-BB will also set the policing and reshaping rules on router ER1. CN1-BB will then send the RESV message to host S.

Ex.1005, 12-13; *see also* Ex.1005, 13 (“[I]f there are multiple ISPs between CN1 and CN 2,” then the steps are “repeat[ed]...for each ISP[domain].”).

247. If the request was admitted along all domains for a given path between the source Host-S and the destination Host-D, all directly involved boundary routers are configured per the service request such that “[w]hen host S receives the RESV message, it can start transmitting data.” Ex.1005, 13.

248. A POSITA would have understood that configuring boundary routers with classification, policing, and shaping rules for premium service establishes the VLL (see analysis at element [1.0.2]). *See e.g.*, Ex.1027, 12:67-13:6 (“commands received and executed by ... packet transmission delivery mechanism support the classification of the data packets according to a prespecified service class level. In a typical example, the prespecified service class levels would be Virtual Leased Line

....”). Since the Host-S is able to start transmitting, it would have been understood that the requested premium service for VLL of the predefined QoS was granted.

249. It would have been obvious to a POSITA that when there are multiple ISPs between CN1 and CN2 (per the analysis at [1.0.1]), the bandwidth brokers ISP1-BB and ISP2-BB of these domains configure the directly involved boundary routers when the request was admitted. That is, in instances where there are parallel ISPs and Host-S is notified that only one ISP has admitted the request, then those boundary routers of that ISP are configured while the boundary routers of the other ISP are not configured. On the other hand, for serial instances, the boundary routers of both ISP domains are directly involved and therefore would be configured if the request was admitted.

250. Thus, Xiao discloses if the request was admitted along all domains between the source Host-S and the destination Host-D, a premium service that establishes a VLL of the predefined QoS is granted by configuring directly involved boundary routers, which renders obvious, *“if the request was admitted along all domains between the source (SRC) and the destination (DST) a VLL of the predefined QoS is granted.”*

- 1.** ***[1.6.1] characterized in that step iv) comprises the following step: performing [LSP] Label Switched Path, LSP, setup and***

251. Xiao in combination with Schelen-1 and Gibson renders obvious “characterized in that step iv) comprises the following step: performing [LSP] Label Switched Path, LSP, setup.”

252. First, as discussed at element [1.4], Xiao in combination with Schelen-1 and Gibson discloses that bandwidth broker ISP2-BB performs admission control in the MPLS domain.

253. Second, Xiao discloses that “[w]ith MPLS, LSPs are set up between each ingress-egress pair.” Ex.1005, 17. The “**LSP setup can be...data-driven (i.e., triggered by the request of a flow or traffic trunk).**” Ex.1005, 13. It would have been obvious to POSITA that because the LSP set up may be triggered by the request, the LSP set up is performed, at least in part, when the bandwidth broker performs admission control in response to the request (see analysis at element [1.4]). Thus, Xiao renders obvious “that step iv) comprises the following step: performing [LSP] Label Switched Path, LSP, setup.”

254. Third, Gibson discloses that its MPLS communications network includes “admission managers, connection managers and administrative server can be though [*sic*] of as a ‘management layer.’” Ex.1006, 6:14-16. As analyzed at element [1.0.3], the admission manager corresponds to a “bandwidth broker.”

255. Gibson discloses that the admission manager requests a new LSP route from an administrative server 35:

An **administrative server 35** is used to provision paths in the communications network upon initialisation [sic]. For example, this involves establishing the label switch paths that the SIP++ protocol routes over. It is also used to change the characteristics of an existing path or introduce a new one.

...

An Administrative Server may also add new paths or change the characteristics of an existing path during the operation of the network. This may either be initiated by the network provider or via a request mechanism which is now described.

The Administrative Server 35 has a COPS interface to all the admission managers at the edge of the network. This interface is **used by those admission managers to request new high capacity label switch paths across the MPLS network**, or to request a change in the capacity of an existing LSP.

Ex.1006, 8:16-54.

256. Gibson's process for dynamic LSP set up is shown at Figure 2, reproduced below:

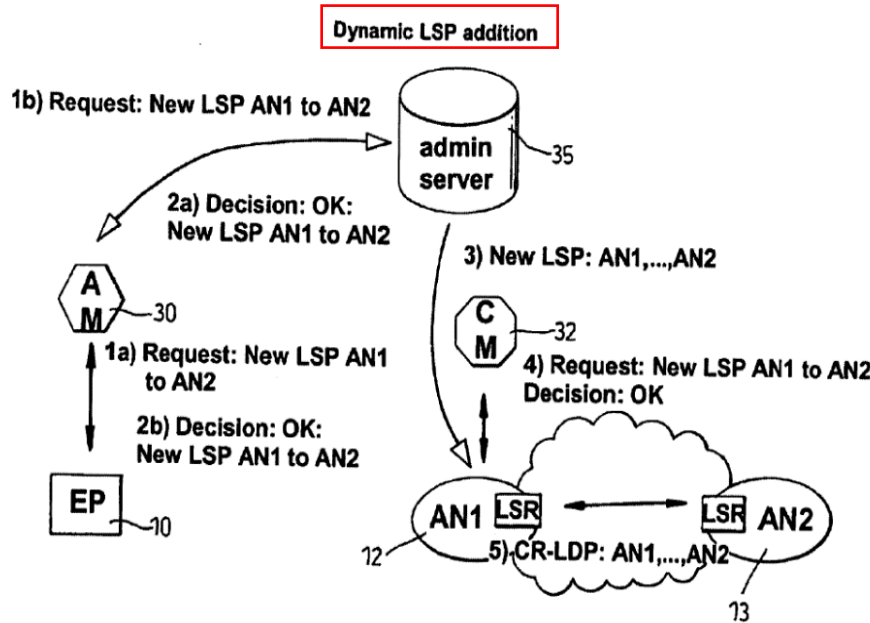


Fig. 2

Ex.1006, Fig. 2 (annotated).

257. In the context of the above figure, Gibson discloses that the administrative server works with a connection manager to set up the LSP, in response to the admission manager's request:

FIG.2 shows the process of requesting a new LSP. Either an Endpoint 10 or an **Admission Manager 35** issues a **Request for a new route** between two Abstract Nodes 12, 13 in the MPLS network. This is responded to by the Administrative Server, with the acceptance situation being illustrated in FIG. 2. The Administrative Server now signals to one of the specified abstract nodes AN1, 12 that it should set-up a path to the other abstract node AN2, 13. In the case that the abstract nodes represent a group of label

switch routers, the administrative server specifies a particular label switch router within each abstract node.

The first abstract node 12 then **registers the requested new path and its characteristics with its Connection Manager 32**. This is achieved by issuing a COPS Request message over the COPS interface. The connection manager 32 does not refuse this Request under normal operation and issues a COPS Decision message to this effect. Once a Decision is received by the first abstract node 12, this abstract node proceeds to use CR-LDP to establish the connection to the other specified abstract node. **Once the new route is established**, the connection manager 32 **begins to advertise its presence and the new route can be used immediately in the path for a new session**.

Ex.1006, 8:55-9:10; *see also* Ex.1006, 8:11-14 (“A connection manager also uses a COPS interface from the abstract node it is monitoring to allow **registration of new label switch paths** or a change in parameters of an existing label switch path.”).

258. In view of Gibson, it would have been obvious to a POSITA to dynamically set up an LSP as part of admission control in Xiao, because it would allow for creating an LSP path that provides services across the MPLS network domain ISP2. *See* analysis at element [1.0.1]. Also, a POSITA would have combined the teachings because Xiao discloses that its LSPs may be setup with “a generic *label distribution protocol* (LDP)” and Gibson provides additional details

on this implementation. Ex.1005, 13; Ex.1006, 1:60-63 (“Mechanisms such as CR-LDP allow MPLS the ability to set-up paths between two endpoints over a list of routers.”), 20:32-33 (“...CR-LDP protocol has set up the required path...”); *see also* Ex.1006, *Generally*; *see also* Reasons to Combine.

259. Thus, Xiao in combination with Schelen-1 and Gibson renders obvious “*that step iv) comprises the following step: performing [LSP] Label Switched Path, LSP, setup.*”

m. [1.6.2] *passing resource requests from the Bandwidth Broker (BB) to at least one intra-domain (IDB),*

260. In multiple ways, Xiao in combination with Schelen-1 and Gibson renders obvious “*passing resource requests from the Bandwidth Broker (BB) to at least one intra-domain (IDB).*”

261. First, Gibson teaches that the MPLS network includes “*at least one intra-domain (IDB).*”

262. In the context of the '698 patent, an exemplary “*intra-domain bandwidth broker*” corresponds to an “**MPLS traffic-engineering server,**” described in “a system known as Routing and Traffic Engineering Server (RATES).” Ex.1001, 3:49-63; 5:57-60 (“The present invention relates to a method using...RATES”); 6:60-64 (“For MPLS networks the LSP set-up mechanism used in RATES is used. This includes setting up FEC-associations in MPLS edge-

devices and to distribute labels for LSP-set-up in the MPLS core-devices.”);
Ex.1016, 8 (“**The RATES server** uses the client specific extension for **intra-domain** traffic engineering”); *see also* 9 (“RATES has components with functions similar to those needed in a bandwidth broker and is extensible for use as an **intra-domain bandwidth broker**.”).

263. Similarly, Gibson discloses that its MPLS communications network includes a “management layer” comprising “**connection managers and administrative server**.” Ex.1006, 6:14-16. The administrative server together with one or more connection manager, corresponds to “*at least one intra-domain (IDB)*,” as discussed below.

264. The administrative server communicate utilizes “standard CR-LDP (Constraint-based Routing Label Distribution Protocol) protocol” used to “allow **traffic engineering methods to be applied to an MPLS** network such that specific paths can be established through a set of chosen nodes with a particular Quality of Service.” Ex.1006, 17:45-55. The administrative server, for example, “uses CR-LDP over [an] interface to provision high capacity label switch paths” Ex.1006, 8:25-29. The administrative server also “has a much more detailed view of the **topology** of the intermediate MPLS network.” 8:32-34.

265. The connection manager works together with the administrative server to setup LSPs and perform admission control within different areas of the MPLS network, as analyzed in the paragraphs directly below.

266. Gibson explains that the “connection manager...allow[s] registration of new label switch paths or a change in parameters of an existing label switch path.” Ex.1006, 8:11-14. The connection manager also performs admission control, including determining if it has resources to allow a new session (Ex.1006, 10:11-24) and, if so, making a temporary reservation for the session (Ex.1006, 10:24-30), else denying the session and sending “error message” (Ex.1006, 10:30-34). If all of the connection managers along a path have sufficient resources, then the connection manager “converts its temporary reservation for the requested communication session into a permanent reservation.” Ex.1006, 10:66-11:6.

267. For example, in the context of Figure 1 below, provided is an example of Gibson’s’ admin server and connection managers, which are responsible for admission control in sub areas (clouds of nodes 15 and 16) of the MPLS network.

“at least one intra-domain (IDB)”

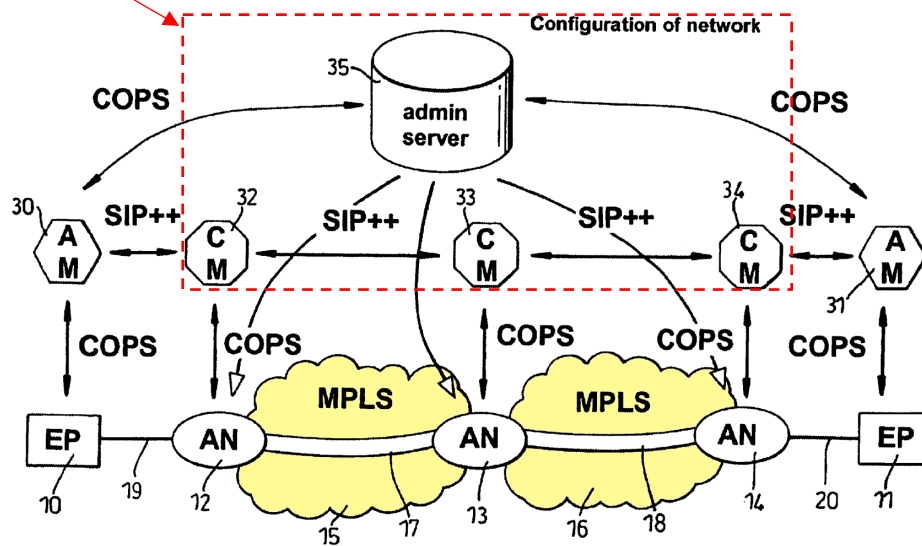


Fig. 1

Ex.1006, Fig. 1 (annotated).

Gibson also provides another example of how the connection manager performs admission control using CR-LDP. Ex.1006, 11:60-12:67.

268. Administrative server and the connection manager utilize “Common Open Policy Service (COPS) messaging protocol” to manage network policy. Ex.1006, 5:13-25; 17:25-27 (“COPS is a **policy** messaging protocol”).

269. Accordingly, Gibson’s administrative server (an MPLS traffic engineering server that manages policy, has topology information, and sets up LSPs) and connection manager (an administrative entity that manages policy, has topological information, sets up LSPs, and performs admission control within its MPLS area) together render obvious “*at least one intra-domain (IDB).*”

Ex.1003

270. I note that the intra-domain bandwidth broker of the '698 patent operates much in the same way. *See* Ex.1001, 3:49-63 (“MPLS traffic-engineering server,” described in “a system known as Routing and Traffic Engineering Server (RATES)”); 5:57-60 (“The present invention relates to a method using...RATES”); 7:16-18 (“Each intra-domain broker is responsible for admission control and LSP setup in an OSPF area (or other equivalent flat link state-domains).”).

271. A POSITA would have understood that the administrative server and the connection manager may be readily implemented together as a centralized entity, to the extent that is required. *See e.g.*, Ex.1005, 12 (disclosing that bandwidth brokers may be centralized); Ex.1016, 2 (describing that the server can be implemented in software using a “centralized paradigm”); Ex.1025, 5 (“The BB [bandwidth broker] is a logical entity; actual implementations may take either a centralized or a distributed approach, or a combination of both.”). Additionally, Gibson notes that although the administrative server is “pictured as a single entity in FIG. 1, an administrative server 35 may take the form of multiple servers that administer their local area.” Ex.1006, 8:22-24, Fig. 1. Since Gibson’s administrative server may take the form of multiple servers, it would have been obvious to implement one server for each communications manager, as depicted at Figure 2. For example, it was known that MPLS traffic engineering servers may be implemented with “software” and as such may be distributed (as Gibson teaches) to

be part of any network node or device. These are implementation details that would have been recognized and well within the skillset of a POSITA.

272. It would have been obvious to a POSITA, in view of Gibson, for Xiao's MPLS network domain ISP2 to include at least one administrative server (Ex.1006, 8:22-24) and at least one connection manager (Ex.1006, 8:4-7) to facilitate setting up LSPs in Xiao's MPLS network domain ISP2. See analysis at element [1.6.1]. Because the administrative server and connection manager are within the MPLS network domain, the admission manager ("*bandwidth broker*") would be free to manage higher level communications with neighboring bandwidth brokers while the internal management elements handle internal resource reservations and admission control. Such an implementation would allow for scaling, while also supporting fine grained resource allocation within the domain. *See e.g.*, Ex.1032, 454 ("To support scaling, we use a hierarchical approach... Inside...there will be...reservation agents [bandwidth brokers] that aggregate reservations [within the domain]...At the top level there are several...corresponding peer agents [bandwidth brokers]."); Ex.1021, 3 ("While Intra-domain resource allocation can be fined grained (per flow), we require that Inter-domain resource agreements are made for the aggregate traffic crossing domains.").

273. I note that there would have been a reasonable expectation of success in such an implementation, since this is merely utilizing prior art components (e.g.,

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administrative server and connection manager) in the same way. Expectation of success is also evidenced by others that had used intra-domain bandwidth brokers. *See e.g.*, Ex.1015, 11 (describing MPLS with “**intra-domain** implementation technology”) Ex.1016, 8-9 (describing MPLS domain with an “**intra-domain bandwidth broker.**”); Ex.1020, 8 (describing “**intra-domain BBs**”).

274. Second, as discussed below, Gibson discloses that the admission manager (“*bandwidth broker*”) passes various resource requests to the administrative server and the connection manager (“*at least one intra-domain (IDB)*”), which renders obvious “*passing resource requests from the Bandwidth Broker (BB).*”

- i. Gibson’s requests for new LSPs disclose “resource requests”

275. Gibson discloses that the “admission manager” (“*bandwidth broker*”) passes a resource request (e.g., for a new LSP) to the administrative server (“*at least one intra-domain (IDB)*”):

The Administrative Server 35 has a COPS interface to all the admission managers at the edge of the network. This interface is used by those admission managers to request new high capacity label switch paths across the MPLS network, or to request a change in the capacity of an existing LSP.

FIG.2 shows the process of requesting a new LSP. Either an Endpoint 10 or an Admission Manager 35 issues a Request for a new route between two Abstract Nodes 12, 13 in the MPLS network. This is responded to by the Administrative Server, with the acceptance situation being illustrated in FIG. 2.

Ex.1006, 8:49-65. Gibson's administrative server may be a "single entity [as] in FIG. 1, [or] ... may take the form of multiple servers that administer their local area." Ex.1006, 8:22-24, Fig. 1.

276. Furthermore, Gibson teaches that the resource request (e.g., for a new LSP) is also passed to a connection manager ("*at least one intra-domain (1DB)*"):

The first abstract node 12 then registers the requested new path and its characteristics with its Connection Manager 32. This is achieved by issuing a COPS Request message over the COPS interface. The connection manager 32 does not refuse this Request under normal operation and issues a COPS Decision message to this effect. Once a Decision is received by the first abstract node 12, this abstract node proceeds to use CR-LDP to establish the connection to the other specified abstract node. Once the new route is established, the connection manager 32 begins to advertise its presence and the new route can be used immediately in the path for a new session.

Ex.1006, 8:55-9:10; *see also* Ex.1006, 8:11-14 (“A connection manager also uses a COPS interface from the abstract node it is monitoring to allow registration of new label switch paths or a change in parameters of an existing label switch path.”).

277. As shown below at Gibson’s Figure 2, a “Request” for a new LSP is passed from the admission manager (“*bandwidth broker*”) to both the administrative server and also to the connection manager (collectively “*at least one intra-domain (IDB)*”):

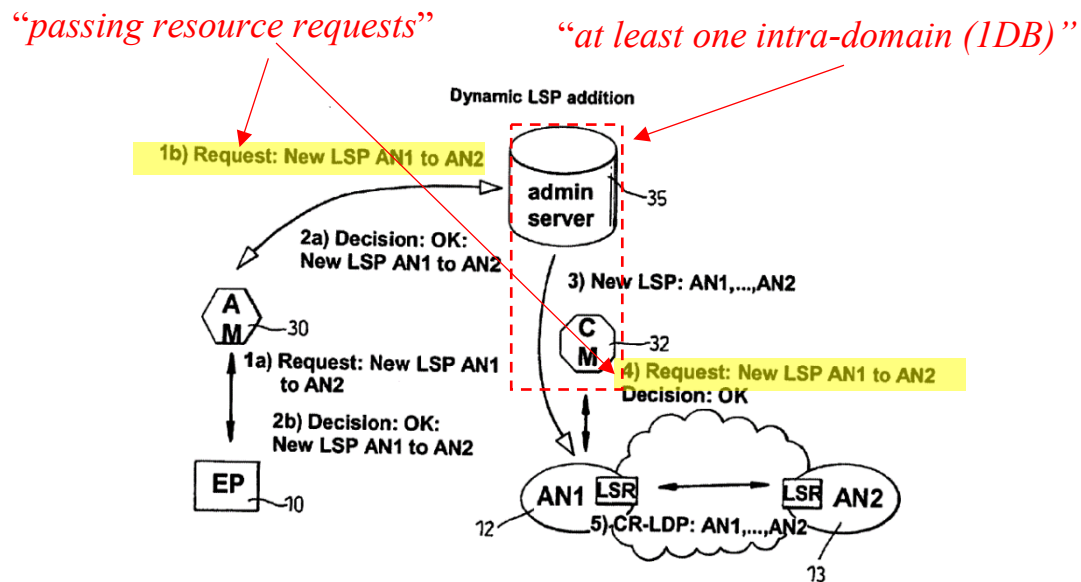


Fig. 2

Ex.1006, Fig. 2 (annotated).

I note that although Figure 2 above is simplified to illustrate a single connection manager 32, it would have been obvious to a POSITA that the MPLS network may include additional connection managers, as illustrated at Figure 1, when the MPLS network has multiple cloud areas. *See e.g.*, Ex.1006, 8:4-7 (“...other administrative

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elements [] such as other connection managers...”), Figs. 1, 4-5, 10 (illustrating more than one connection manager)

278. Additionally, it would have been obvious to a POSITA for the admission manager to pass a plurality of requests to set up a plurality of new LSP routes when sustaining a plurality of separate communications sessions. *See* Ex.1006, 3:24-35 (“Preferably, said communications network... is capable of sustaining a plurality of separate communication sessions. By provisioning the communications network in this way high capacity routes which act as ‘motorways’ are created.”). The requests for new LSPs passed to the administrative server and connection manager render obvious “*passing resource requests*,” as claimed.

279. It would have been obvious to a POSITA, in view of Gibson, for Xiao’s bandwidth broker ISP2-BB in the MPLS domain to send resources requests (e.g., to set up new LSPs) to an administrative server and to one or more connection managers. Because the resource request is for a new LSP, the administrative server and connection manager would have notice of the need. In response, they would cooperate to set up new LSPs for service from the source Host S to the destination Host D through the MPLS network domain ISP2. *See* analysis at element [1.0.1], [1.6.2], [1.7.1]; *see also* Reasons to Combine.

280. Thus, Xiao in combination with Schelen-1 and Gibson renders obvious “*that step iv) comprises...passing resource requests from the Bandwidth Broker (BB) to at least one intra-domain (IDB).*”

ii. Gibson’s INVITE messages disclose “resource requests”

281. Gibson also teaches that the admission manager (“*bandwidth broker*”) sends SIP++ INVITE messages to the connection manager:

The method of establishing a path for a communication session with a guaranteed quality of service is now described together with an overview of the SIP++ method. Full details of SIP++ are described later.

When a COPS Request is received at an admission manager (requesting a path for a communication session), then providing admission is granted by the admission manager, one or more **INVITE messages are sent out by the admission manager.**

...

The INVITE message is then sent to the connection manager associated with that reachable abstract node.
This is repeated for each INVITE message issued by the admission manager.

Ex.1006, 9:51-10:11.

282. The INVITE message “contains a **description of the requirements** for the desired communication session.” Ex.1006, 9:61-62. In response, the connection

manager determines if it has sufficient resources to reserve, as specified by the INVITE message's session requirements, and if there are insufficient resources it returns an error message:

When a connection manager receives an INVITE message, it examines the information about the session requirements and next abstract node to see if it has a path to that abstract node and if it can accommodate the new session.

...

The connection manager then makes a temporary reservation for the session and forwards the INVITE message to the next abstract node in the path description. (If there is more than one abstract node at the next stage of the path description, the INVITE message is “forked” as described below.) If there are insufficient resources or there is no label switch path to the next abstract node in the path description, the connection manager will respond with an error message. This process is repeated until the INVITE messages reach the destination endpoint.

Ex.1006, 10:12-34. A POSITA would have understood that the INVITE messages are “*resource requests*” because they contain a description of the requirements (e.g., resources to reserve) for a communication session.

Host D through the MPLS network domain ISP2. *See* analysis at element [1.0.1];
see also Reasons to Combine.

285. Thus, in this additional way, Xiao in combination with Schelen-1 and Gibson renders obvious “*that step iv) comprises...passing resource requests from the Bandwidth Broker (BB) to at least one intra-domain (IDB).*”

n. [1.7.1] wherein each intra-domain broker (IDB) is responsible for admission control and

286. Xiao in combination with Schelen-1 and Gibson renders obvious that “*each intra-domain broker (IDB) is responsible for admission control and the Label Switched Path, LSP, setup.*”

287. First, as discussed at element [1.6.2], the administrative server in combination with the connection manager renders obvious the “*to at least one intra-domain broker (IDB).*” Further, as discussed above, Xiao in combination with Schelen-1 and Gibson discloses passing requests (for new LSPs and INVITE messages) from the bandwidth broker ISP2-BB to a connection manager.

288. Second, Gibson discloses that the connection manager decides whether to accept the request for resources (e.g., new LSP):

The connection manager 32 does not refuse this Request under normal operation and issues a COPS Decision message to this effect. Once a Decision is received by the first abstract node 12, this abstract node proceeds to use

CR-LDP to establish the connection to the other specified abstract node. Once the new route is established, the connection manager 32 begins to advertise its presence and the new route can be used immediately in the path for a new session.

Ex.1006, 8:55-9:10; *see also* Ex.1006, 8:11-14 (“A connection manager also uses a COPS interface from the abstract node it is monitoring **to allow registration of new label switch paths** or a change in parameters of an existing label switch path.”).

289. A POSITA would have understood “admission control” as the “decision process of whether to accept a request for resources.” Ex.1005, 9. Gibson’s disclosure of the connection manager deciding whether to accept the resource request (for a new LSP) discloses that the “*intra-domain broker (IDB) is responsible for admission control.*” It would have been obvious to a POSITA, when the MPLS network includes more than one connection manager that receives a resource request, for each connection manager to perform admission control to determine whether to accept the request for the new LSP.

290. Additionally, Gibson discloses that the connection manager, in response to receiving an INVITE message requesting a new session, determines whether it has sufficient resources to accommodate the new session and makes a reservation, if not, then it will respond with an error message:

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When a connection manager receives an INVITE message, it examines the information about the session requirements and next abstract node to see if it has a path to that abstract node and **if it can accommodate the new session.**

...

The connection manager then makes a temporary reservation for the session and forwards the INVITE message to the next abstract node in the path description. (If there is more than one abstract node at the next stage of the path description, the INVITE message is “forked as described below.) **If there are insufficient resources or there is no label switch path to the next abstract node in the path description, the connection manager will respond with an error message.**

Ex.1006, 10:12-34.

291. Gibson further teaches that “[t]his process is repeated until the INVITE messages reach the destination endpoint.” Ex.1006, 10:32-34. It would have been obvious to a POSITA that the decision process is performed by each connection manager on the path toward the destination. Gibson’s disclosure of each connection manager determining whether to accept the INVITE request and reserve resources or respond with an error message discloses “*intra-domain broker (IDB) is responsible for admission control.*”

292. It would have been obvious to a POSITA, when implementing Xiao in combination with Gibson, for the connection manager to perform admission control, as discussed above, with respect to resource requests (e.g., new LSP and a new session). The connection manager has visibility of the MPLS network that it manages (Ex.1006, 7:66 - 8:15) so it would be well positioned to decide whether to accept or deny the request for a new LSP. Also, the connection manager is able to determine if there are sufficient resources for a newly requested communication session defined by the INVITE message, since it has visibility regarding available resources (Ex.1006, 7:66 - 8:15, 19:26-33) and is able to temporarily reserve the resources accordingly. Because in the combination the connection manager performs admission control within local areas of the MPLS network, Xiao's higher level bandwidth broker ISP2-BB would be free to communicate with neighboring bandwidth brokers outside the MPLS domain, which supports scaling. Ex.1032, 454 ("To support scaling, we use a hierarchical approach... Inside...there will be...reservation agents [bandwidth brokers] that aggregate reservations...At the top level there are several...corresponding peer agents [bandwidth brokers]."); *see also* Reasons to Combine.

- o. [1.7.2] *wherein each intra-domain broker (IDB) is responsible for...the Label Switched Path, LSP, setup.*

293. Xiao in combination with Schelen-1 and Gibson renders obvious that “*each intra-domain broker (IDB) is responsible for...the Label Switched Path, LSP, setup.*”

294. **First**, as discussed at element [1.6.1], Xiao in combination with Schelen-1 and Gibson renders obvious “*performing [LSP] Label Switched Path, setup.*” Further, as discussed at element [1.6.2], the administrative server in combination with the connection manager renders obvious the “*at least one intra-domain broker (IDB).*” Consistent with the above analysis, the administrative server and the connection manager collectively are responsible for setting up the LSPs across the MPLS network, which obvious that the “*each intra-domain broker (IDB) is responsible for...the Label Switched Path, LSP.*”

295. To illustrate, Gibson discloses that the administrative server initially provisions LSPs and sets up new LSPs via a request mechanism:

An administrative server 35 is used to provision paths
in the communications network upon initialisation. **For**
example, this involves establishing the label switch
paths that the SIP++ protocol routes over. It is also used
to change the characteristics of an existing path or
introduce a new one.

...

An Administrative Server may also add new paths or change the characteristics of an existing path during the operation of the network. This may either be initiated by the network provider or **via a request mechanism.**

Ex.1006, 8:16-46; *see also* Ex.1006, 8:46-9:10 (describing how the administrative server works with the connection manager to set up new LSPs).

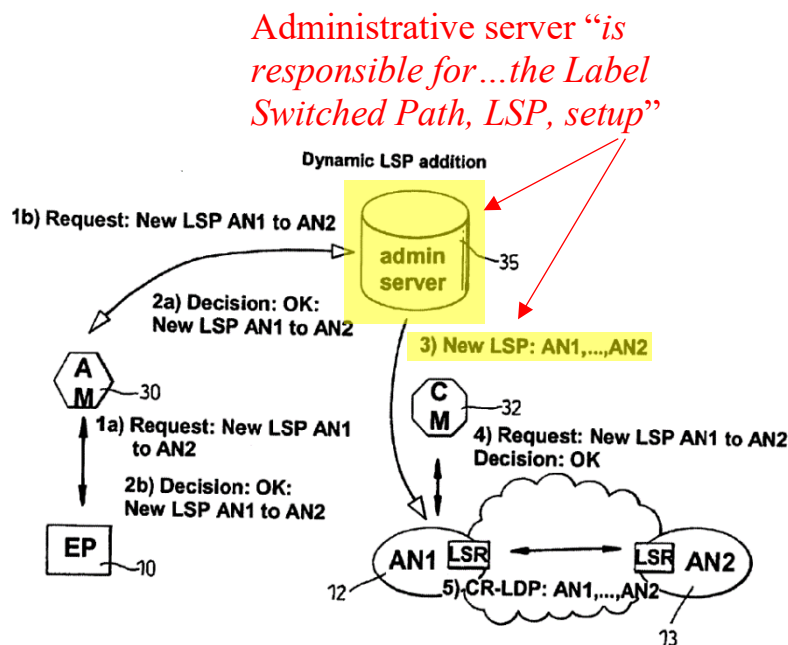


Fig. 2

Ex.1006, Fig. 2 (annotated).

296. Additionally, the connection manager is responsible for the LSP setup since it sends an “OK” decision message to the abstract node 12 to set up the LSP:

The connection manager 32 does not refuse this Request under normal operation and issues a COPS Decision message to this effect. **Once a Decision is received by the**

first abstract node 12, this abstract node proceeds to use CR-LDP to establish the connection to the other specified abstract node. Once the new route is established, the connection manager 32 begins to advertise its presence and the new route can be used immediately in the path for a new session.

Ex.1006, 8:55-9:10.

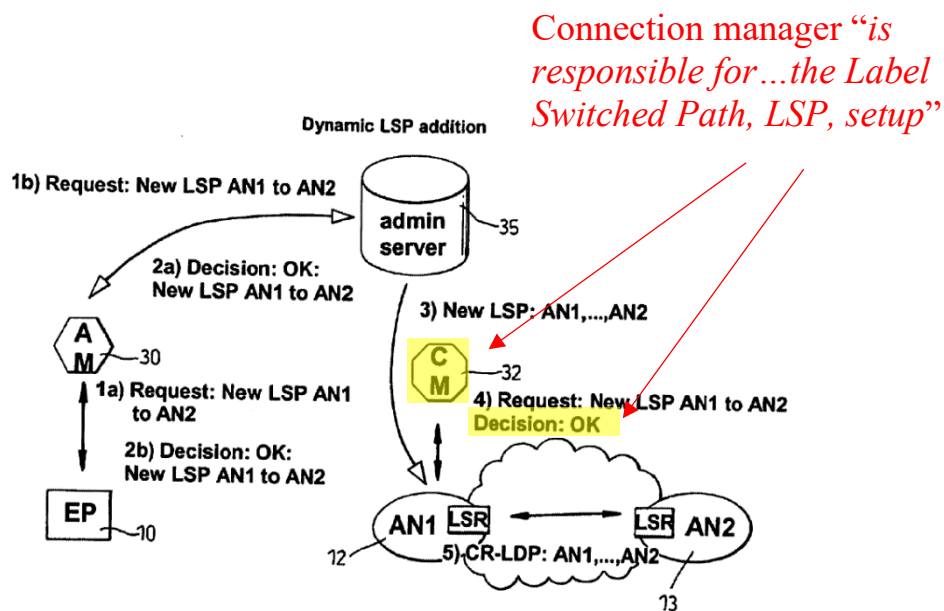


Fig. 2

Ex.1006, Fig. 2 (annotated).

297. A disclosure of either the administrative server or the connection manager being responsible to set up the LSP is sufficient to meet the claimed element, since, as mapped above at element [1.6.2], they collectively render obvious the “at least one intra-domain broker (IDB).”

298. A POSITA would have understood that the MPLS network, as shown at Figure 1 below, may comprise sub areas (or clouds 15, 16) and therefore may include additional connection managers (CM 32-34) along the path toward the destination.

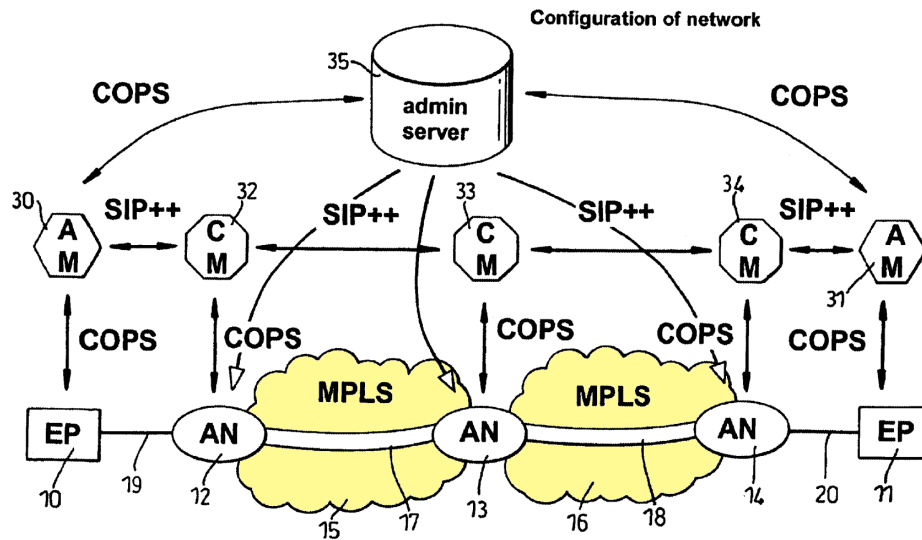


Fig. 1

Ex.1006, Fig. 1 (annotated).

299. In such instances, it would have been obvious to a POSITA for each of the connection managers (CM 32-34) in cooperation with the administrative server (35) to setup “new high capacity label switch paths across the MPLS network.” Ex.1006, 8:49-54.

300. It would have been obvious to a POSITA, when setting up an LSP in Xiao’s MPLS network domain ISP2 (see analysis at element [1.6.1]), for the administrative server and each connection manager along the path toward the

destination to cooperate to set up the LSP within its MPLS area, to thereby provide “new high capacity label switch paths across the MPLS network.” Ex.1006, 8:49-54; *see also* Reasons to Combine.

301. Thus, Xiao in combination with Schelen-1 and Gibson renders obvious that “*each intra-domain broker (IDB) is responsible for...the Label Switched Path, LSP, setup.*”

2. Claim 2

a. [2.0] Method according to claim 1,

302. See analysis at elements [1.0.1]-[1.7.2].

b. [2.1] characterized in that if said domains comprise at least one Differentiated Services, DiffServ, domain, the method comprises the following step to be performed after step v): vi) BB_A engages in Traffic Conditioners configuration in the ingress router for SRC in order to establish a VLL of the predefined QoS.

303. First, Xiao discloses that each intermediate router of the source corporate network CN1 domain “performs a BA classification.” Ex.1005, 13. Xiao’s Table 1 of “Frequently used terminologies” defines BA classification as “the process of sorting packets based only on the contents **of the [DiffServ] DS field.**” Xiao, p. 9. Therefore, in Figure 4, the source corporate network CN1 domain is a DiffServ domain, which corresponds to “*at least one Differentiated Services, DiffServ, domain.*”

304. Second, Xiao discloses that when the source bandwidth broker “**CN1-BB** receives the RESV message, it will **set the classification and shaping rules on router LR1**, so that if the traffic of the admitted flow is nonconformant, LR1 will shape it.” Ex.1005, 12. A POSITA at the time would have understood that configuring classification and shaping rules was an example of engaging in “*Traffic Conditioners configuration*.” Ex.1025, 5 (“border routers are **configured with traffic conditioners to police, shape, and mark** the data packets as appropriate.”). Therefore, Xiao renders obvious that the “*BB_A engages in Traffic Conditioners configuration in the ingress router for SRC in order to establish a VLL of the predefined QoS*.”

3. Claim 3

a. [3.0] Method according to claim 1,

305. See analysis at elements [1.0.1]-[1.7.2].

b. [3.1] *characterized in that said domains comprise at least one Differentiated Services, DiffServ, domain and one Multiprotocol Label Switching, MPLS, domain.*

306. As discussed at element [1.0.1] and [2.0], Xiao discloses a packet-based communications network (e.g., modified Figure 4) including at least one DiffServ domain (e.g., source corporate network CN1 and ISP1) and one MPLS domain (e.g., ISP2), which renders obvious a “*characterized in that said domains*

comprise at least one Differentiated Services, DiffServ, domain and one Multiprotocol Label Switching, MPLS, domain.”

4. Claim 4

a. [4.0] Method according to claim 1,

307. See analysis at elements [1.0.1]-[1.7.2].

b. [4.1] characterized in that said predefined QoS is a rate, R.

308. In the context of the '698 patent the rate, R, corresponds to a predefined bandwidth. Ex.1001, 7:32-36 (“Generation of a request for a Virtual Leased Line (VLL) of **rate (or bandwidth) R.**”).

309. As discussed at element [1.1.1], Xiao discloses that the service level agreement (SLA) predefines the peak-bit rate (bandwidth guaranteed):

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.1005, 11; *see also* Ex.1005, 11 (“The exit routers of the customer domain may need to reshape the traffic to make sure that the traffic does not exceed the **peak**

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rate specified by the SLA.”). A POSITA would have understood that the guaranteed bandwidth corresponds to a bit-rate measured, for example, in Mega bits per second (Mbps). *See e.g.*, Ex.1025, 12 (describing providing “10 Mbps Minimum Access”); Ex.1026, 133 (“...a bandwidth of 0.32 Mbps for...QoS...”).

310. Additionally, a POSITA at the time would have understood that implementation of a virtual leased line in general, described in Xiao as premium service, would include providing quality of service with “a rate, R .” Ex.1027, 3:33-35 (“A **Virtual Leased Line** is a point-to-point data line with a guaranteed peak transmission rate.”), 4:46-47 (“**Virtual Leased Line Service (10)** guarantees a unidirectional **reserved rate R_f** for a point-to-point flow.”).

311. Thus, Xiao discloses that premium service has predefined QoS including a peak-bit rate and bandwidth, which renders obvious a “[m]ethod according to claim 1, characterized in that said predefined QoS is a rate, R .”

5. Claim 5

a. [5.0] Method according to claim 1,

312. See analysis at elements [1.0.1]-[1.7.2].

b. [5.1] characterized in that the bandwidth broker (BB) comprises a topology map and routing information to be able to perform path sensitive admission control of incoming requests,

313. First, as analyzed at element [1.0.3], the prior art discloses the “*bandwidth broker (BB)*.”

314. Gibson further teaches that when an admission manager (“*bandwidth broker*”) “receives a request for a communication session” it will “determine possible paths between the endpoints.” Ex.1006, 7:28-34. In order to make this determination, the “admission manager needs to maintain accurate **topological information**.” Ex.1006, 7:34-37; *see also* Ex.1006, 7:26-28 (“admission manager is responsible for maintaining network topology information and using this to select a route across the network.”). To maintain topological information, the admission manager “**processes all the route advertisements it receives**” and uses this information “to **build up a map** of all the reachable nodes on the MPLS network and their availability over time.” Ex.1006, 7:28-42. The “admission manager also **monitors the bandwidth of connections to edge abstract nodes [routers]**.” Ex.1006, 7:28-46. The admission manager uses this collected information “**to select a route** across the network” to thereby “**effectively provide[] admission control to the communication network**.” Ex.1006, 7:46-48.

315. Gibson’s description of the admission manager maintaining topology map and obtaining routing information (e.g., bandwidth at edge routers) to be able to select a routing path during admission control of the request, renders obvious that “*the bandwidth broker (BB) comprises a topology map and routing information to*

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be able to perform path sensitive admission control of incoming requests.” See also analysis at element [1.4] (describing how the prior art teaches that the “bandwidth broker (BB) performs admission control”)

316. Second, additionally, Schelen-1 also teaches this element. In numerous instances, Schelen-1 explains that the agent (“bandwidth broker”) knows the topology and routing information to perform path-sensitive admission control for a request:

When the time to make resources available approaches, reservation **agents reserve resources in routers by setting up forwarding state along the path.** A routers primary task is packet forwarding, i.e., packet classification and scheduling. Agents are responsible for setting up appropriate forwarding state in the routers when it is needed.

...

Each reservation **agent must know the topology of its routing domain to perform admission control on behalf of that domain, and also to detect topology changes that require re-computation of forwarding state setup in routers,** or renegotiation with adjacent reservation agents. This topology information can be obtained through a link state routing protocol that provides each node, including the agent, with a **topology database.**

Ex.1032, 451-452. A POSITA would have understood that Schelen-1's topology information is a map of the communication network topology since it is obtained from a topology database and accurate enough to determine if the routing topology has changed.

317. Also, a POSITA would have understood that Schelen-1's bandwidth broker comprises routing information since it is responsible for reserving the paths in the specific router and because it participates in a link state routing protocol. *See also* Ex.1032, 452-453 (describing that link properties may be obtained through OSPF); Ex.1034, 29 ("...a link state routing protocol (e.g., OSPF)...").

318. Thus, Schelen-1's noted teachings render obvious that "*the bandwidth broker (BB) comprises a topology map and routing information to be able to perform path sensitive admission control of incoming requests.*"

319. It would have been obvious to a POSITA, in view of the teachings of Gibson and Schelen-1, for the bandwidth broker (see analysis at [1.0.3]) in Xiao to include a topology map and routing information of its communication network, to be able to perform path sensitive admission control of incoming RSVP PATH message. This would enable Xiao's bandwidth broker (e.g., CN1-BB, CN2-BB, ISP1-BB, and ISP2-BB) to have an understanding of the available paths and to choose the best path, when performing admission control in response to receiving

an incoming RSVP PATH message request. *See* analysis at element [1.1.1]-[1.4];
see also Reasons to Combine.

c. [5.2] *wherein the information is retrieved by peering as a link-state router.*

320. As discussed at element [5.1], Schelen-1's routing information is obtained by the agent participating in a "link state routing protocol" (e.g., OSPF), which renders obvious "*wherein the information is retrieved by peering as a link-state router.*"

321. In addition, the '698 patent's description of "peering as a link state router" states that peering as a link state router is a "straightforward method" and explicitly states that Schelen's bandwidth broker teaches it. Ex.1001, 4:17-20 ("Both RATES and BB_{OLOV} [(Schelen)] **use the straightforward method of peering as a link state-router**, which provides a dynamic and detailed view of the **routing topology.**"). The '698 patent's cited Schelen reference is submitted herein as Ex.1012.

322. It would have been obvious to a POSITA, in view of Schelen-1's teachings, for the bandwidth broker in Xiao (see analysis at [1.0.3]) to retrieve routing information by participating in a link-state routing protocol (e.g., OSPF) because this would allow the bandwidth broker to be informed regarding any link or router failure and take appropriate action (e.g., re-route) to remedy the failure. *See*

e.g., Ex.1032, 456 (“It is the job of the agent to re-route at link or router failure. If there is a link failure, routers next to the failed link will detect the problem first, e.g., through the OSPF HELLO messages. This will trigger a link state advertisement to other nodes...including the reservation agent. As the reservation agent finds that a link is broken, it will process the reservations on that link by recomputing routes, checking if there is capacity left for advance reservations through alternative routes.”); *see also* Reasons to Combine.

6. Claim 7

a. [7.0] *Method according to claim 1,*

323. See analysis at elements [1.0.1]-[1.7.2].

b. [7.1] *characterized in that a bandwidth broker (BB) in a specific domain performs admission control for all links in the path that belong to that domain.*

324. First, Xiao describes that the bandwidth brokers make admission control decisions for all hosts in their respective domains. According to Xiao, “[s]ince **all hosts** must cooperate to share a limited amount of resources specified by the SLA, it is technically better to **have a BB to allocate resources.**” Ex.1005, 11. To that end, in the corporate network CN1 example, the bandwidth broker “**makes decision for all hosts**” in the “**customer domain.**” Ex.1005, 11.

325. A POSITA would have understood that making admission control decisions (e.g., allocating resources) for all hosts in a domain included making

decisions for all links (resources) in the path within the domain because the links transport traffic to and from the hosts. Ex.1038, 1 (“transmission **links**” are “direct connections ... between switches or **routers**” and a host would correspond to a single router, “the typical **host** will be represented as a leaf **connected to a single router node.**”).

326. Thus, Xiao discloses a BB making admission control decisions for all links within the path within a specific domain, which renders obvious a “*that a bandwidth broker (BB) in a specific domain performs admission control for all links in the path that belong to that domain.*”

327. Second, Schelen-1 discloses that “**admission control and service commitments are all managed by agents [bandwidth brokers]**” “on behalf of the routers **in the domain.**” Ex.1032, 451, 457. This includes “**considering static link resources** and traffic descriptions given in admission requests” and “[**setting up**] **resources along shortest paths**” “between source and destination.” Ex.1032, 453. Schelen-1’s description of the bandwidth broker setting up all resources along the shortest link path on behalf of the routers in the domain renders obvious “*that a bandwidth broker (BB) in a specific domain performs admission control for all links in the path that belong to that domain.*”

328. It would have been obvious to a POSITA, in view of Schelen-1’s teachings, for Xiao’s bandwidth broker (e.g., CN1-BB of the customer domain) to

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perform admission control (see analysis at element [1.4]) for the user of all links in that domain, because Xiao recognizes that it is better for the bandwidth broker to perform admission control and because such an implementation would relieve the routers from related computations. *See* Ex.1005, 11 (“[I]t is technically better to have a BB to allocate resources.”); Ex.1032, 457 (“Our goal has been to relieve the routers from computation concerned with QoS contracts and put it in agents instead.”). A POSITA would have also understood that individual routers may also not have the requisite information (e.g., link resources or topology) to make such decisions appropriately. *See also* Reasons to Combine.

7. Claim 8

a. [8.0] *Method according to claim 1,*

329. See analysis at elements [1.0.1]-[1.7.2].

b. [8.1] *characterized in that a bandwidth broker (BB) comprises a storage, where it stores records of all its granted requests, and*

330. Schelen-1 discloses granting reservations and that “**reservations are maintained by agents [bandwidth brokers].**” Ex.1032, 458; *see also* Ex.1032, 452 (“We propose that agents, deployed in end systems, maintain state about reservations that will be needed for future packet forwarding.”). Similarly, Gibson discloses that the “admission manager [bandwidth broker] is able to correlate its **successful requested** path element that it sent with the actual path reserved, and

store this for future use” and that it includes storage, such as “**computer readable medium.**” Ex.1006, 2:54-59, 15:20-23.

331. It would have been obvious to a POSITA to maintain the reservation state for all granted reservations in the computer readable medium of the bandwidth broker since it will be needed for “for future use” such as “future packet forwarding.” Ex.1006, 15:20-23, 20:9-11; Ex.1032, 452. This understanding is also evidenced in the art. *See e.g.*, Ex.1020, 18 (describing that the bandwidth broker’s components include a data store); Ex.1014, 10:47-50 (disclosing that the bandwidth broker “stor[es] bandwidth request information (e.g., bandwidth values) associated with recently admitted flows.”). Additionally, maintaining all of the granted reservations allows for aggregating multiple reservations, releasing resources when reservation ends, and planning future allocations. Ex.1005, 13; Ex.1019, 4; Ex.1032, 457. Without maintaining all of the granted reservations, there would be the potential that new reservations will be granted without having sufficient resources. *See* Ex.1011, 18 (“Booking network resources should be part of this planning. 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.”), 17 (“Admission control gives the provider an opportunity to reject service to new clients so that those already granted admission obtain committed service.”).

332. It would, therefore, have been obvious to a POSITA, in view of Schelen-1 and Gibson, for Xiao's bandwidth broker to comprise storage where it stores reservation state of all granted requests for the reasons discussed above. *See also* Reasons to Combine. Thus, the combination of Xiao, Schelen-1, and Gibson renders obvious "*that a bandwidth broker (BB) comprises a storage, where it stores records of all its granted requests.*"

c. [8.2] *also user-related data such as policies or accounting information.*

333. First, Xiao discloses that the bandwidth broker configures routers with "[t]he classification, policing, and shaping rules" that "are derived from the SLAs." Ex.1005, 10. Xiao's SLA is described as "[a] service contract between a **customer** and a service provider that specifies the forwarding service a customer should receive." Ex.1005, 9. It would have been obvious for the bandwidth broker to store the SLA in its storage, so that it would have this information to configure the routers when a request is granted. *See e.g.*, Ex.1020, 23 ("The receiving (downstream) BB will check consistency with the **SLS information stored in [its] own database.**"); Ex.1020, 7 ("Service Level Specifications (SLS) [are] **specified in a SLA.**"). Thus, Xiao's renders obvious that the bandwidth broker stores an SLA, which corresponds to "*user-related data such as policies.*"

334. Second, Schelen-1 discloses that “**agents [bandwidth brokers] may already have records for managing accounting etc.**” Ex.1032, 453. It would have been obvious to a POSITA that the accounting records are user-related since the bandwidth broker manages its domain for the purposes of servicing the user, similar to a travel agent. Ex.1032, 453 (“A host requesting a reservation may consult any reservation agent, e.g., the local one or the favorite agent, just as one may use different travel agents for booking airline tickets.”)

335. It would have been obvious to a POSITA for Xiao’s bandwidth broker to manage accounting records by storing the records in its storage so that they are available as needed for billing the user. Also, storing the accounting records (such as monetary cost for a route that will be charged to a user) would be useful when the bandwidth broker supports traffic engineering in the MPLS domain. *See e.g.*, Ex.1005, 13 (“MPLS is also a useful tool for traffic Engineering.”), 15 (“Common route metrics in constraint-based routing are monetary cost...”); *see also* Reasons to Combine. Thus, Xiao in combination with Schelen-1 renders obvious that the bandwidth broker stores “*user-related data such as ... accounting information.*”

B. Ground 2: Claims 4-8 are Obvious over Xiao, Schelen-1, Gibson, and Schelen-2

1. Claim 4

a. [4.0] *Method according to claim 1,*

336. See analysis at elements [1.0.1]-[1.7.2].

b. [4.1] *characterized in that said predefined QoS is a rate, R.*

337. As already noted, in the context of the '698 patent the rate, R, corresponds to a predefined bandwidth. Ex.1001, 7:32-36 (“Generation of a request for a Virtual Leased Line (VLL) of **rate (or bandwidth) R.**”).

338. As analyzed at element [1.1.1], the prior art teaches that the request is parameter-based and includes a “*predefined QoS.*”

339. Schelen-2 teaches that “metrics used in parameter-based admission control are *traffic specifications* and static link resources.” Ex.1007, 218. For example, “[e]ach **reservation request contains a bandwidth to be reserved**, a source and a destination address.” Ex.1007, 215. A POSITA would have understood that the bandwidth is the bit rate reserved, for example, measured in Mega bits per second (Mbps)). *See e.g.*, Ex.1025, 12 (describing providing “10 Mbps Minimum Access”); Ex.1026, 133 (“...a bandwidth of 0.32 Mbps for...QoS...”). Thus, Schelen-2 renders obvious “*that said predefined QoS is a rate, R.*”

340. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao's PATH message request (see analysis at element [1.1.1]) to contain the bandwidth to be reserved as part of the QoS parameters, so that the bandwidth broker knows what resources to check for and reserve, as well as how to plan and schedule future reservations. *See also* Reasons to Combine.

8. **Claim 5**

c. **[5.0] *Method according to claim 1,***

341. See analysis at elements [1.0.1]-[1.7.2].

d. **[5.1] *characterized in that the bandwidth broker (BB) comprises a topology map and routing information to be able to perform path sensitive admission control of incoming requests,***

342. Schelen-2 discloses that the bandwidth broker has a “**topology map of the domain.**” Ex.1007, 215; *see also* Ex.1007, 214 (“[F]or each domain in the network there is an agent [bandwidth broker] responsible for admission control...[which] **knows the topology** and static link resources in the domain.”). Schelen-2 further explains that the bandwidth broker “is configured for passively participating in a link state routing protocol (e.g., OSPF).” Ex.1007, 214. “Agents [bandwidth brokers] listen to the **routing protocol and detect routing changes on average as fast as any router** in the domain.” Ex.1007, 218. Accordingly, Schelen-2's disclosure of the bandwidth broker knowing the topology map of the domain

and obtaining routing information per a routing protocol to detect routing changes renders obvious “*that the bandwidth broker (BB) comprises a topology map and routing information.*”

343. Schelen-2 further discloses that the topology map and routing information enables the bandwidth broker to perform path sensitive admission control on links:

If an agent finds that the starting point given in the request is in its domain, admission control is performed on the links from the starting point towards the destination, defined by the routing protocol. **This is possible since all routers and the agent have the same topology map of the domain. Thus, an agent [bandwidth broker] can perform admission control on the links from the starting point to an edge router in its domain.**

Ex.1007, 215; *see also* Ex.1007, 215 (“**[A]dmission control in an agent [bandwidth broker] maintains information about reserved resources on each link in its domain.** Agents perform immediate or advance admission control without involving the routers.”).

344. As another example, Schelen-2 describes the agents performing admission control when changes in routing information are detected to schedule resources along new paths. *See* Ex.1007, 218 (“**When changes [in routing] occur,**

agents [bandwidth brokers] can schedule resources along new paths.”).

Accordingly, Schelen-2’s noted teachings render obvious that the bandwidth broker uses a topology map and routing information “*to be able to perform path sensitive admission control of incoming requests.*”

345. It would have been obvious to a POSITA, in view of Schelen-2, for the bandwidth broker (see analysis at [1.0.3]) in Xiao to comprise a topology map and routing information so that it is able to perform path sensitive admission control of an incoming RSVP PATH message. *See also* Reasons to Combine.

e. [5.2] wherein the information is retrieved by peering as a link-state router.

346. As discussed at element [5.1], Schelen-2’s routing information is obtained by the agent participating in a “link state routing protocol (e.g., OSPF),” which renders obvious “*wherein the information is retrieved by peering as a link-state router.*” *See also* Ex.1007, 218 (“Agents listen to the routing protocol and detect routing changes on average as fast as any router in the domain.”).

347. It would have been obvious to a POSITA, in view of Schelen-2’s teachings, for the bandwidth broker in Xiao (see analysis at [1.0.3]) to retrieve routing information by participating in a link-state routing protocol because this was a standard protocol (e.g., OSPF) that would have been easily implemented and because it would inform the bandwidth broker of routing changes as quickly as any

router, allowing it to adjust paths accordingly. Ex.1007, 218. *See also* Reasons to Combine.

9. **Claim 6**

a. **[6.0] Method according to claim 4,**

348. See analysis at elements [1.0.1]-[1.7.2], and [4.1].

b. **[6.1] *characterized in that the bandwidth broker (BB) comprises a data structure which keeps resource usage information over time for each link in the topology which enables ability to plan ahead of time.***

349. Schelen-2 discloses that “it is important to have **data structures** that manage reservations.” Ex.1007, 221. Schelen-2’s data structure “keep[s] information about the **current reserved aggregate bandwidth**” as well as “**the aggregated bandwidth reserved in advance over time**.” Ex.1007, 221. Furthermore, Schelen-2 explains that the “**agent [bandwidth broker] maintains information about reserved resources on each link in its domain**” per a “**topology map of the domain**.” Ex.1007, 215. Accordingly, Schelen-2’s description of the bandwidth broker comprising a data structure which keeps reserved bandwidth information over time for each link in its domain (per the topology map), renders obvious “*that the bandwidth broker (BB) comprises a data structure which keeps resource usage information over time for each link in the topology.*”

350. Additionally, Schelen-2 at Figure 5 illustrates that the resource usage information is used to plan resources (bandwidth) for a new request over time, which renders obvious that the resource usage information “*enables ability to plan ahead of time.*” Ex.1007, 220-221; *see also* Ex.1007, 218 (Admission control for immediate and advance reservations)

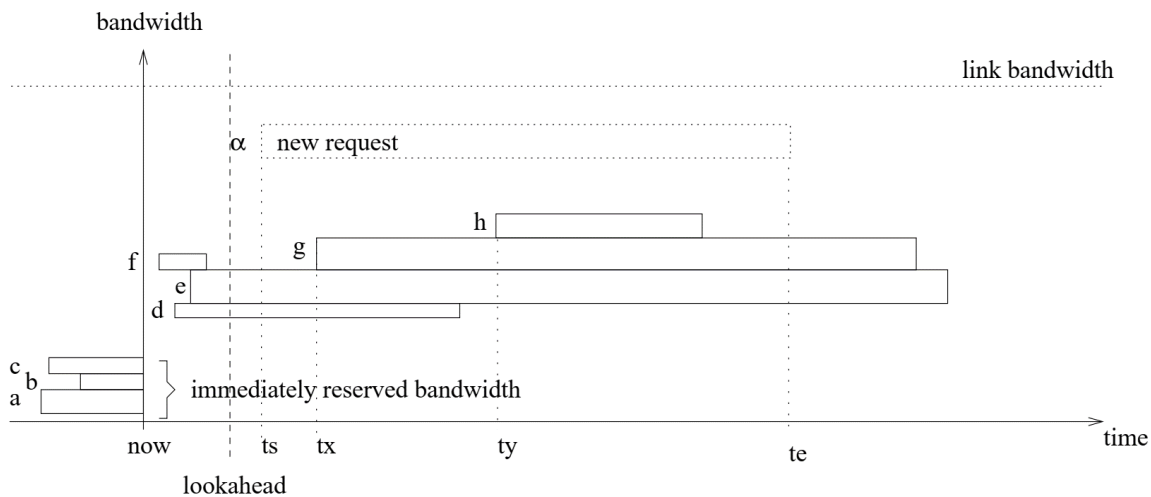


Figure 5: Snap-shot of reservations
Ex.1007, Fig. 5

351. It would have been obvious to a POSITA, in view of Schelen-2, for Xiao’s bandwidth broker to comprise a data structure to keep resource usage information over time for each link in the network domain as defined by the topology map (see analysis at element [5.1]) so that it can plan ahead over time and determine whether there are sufficient resources available when making immediate

and advanced reservations, while reducing the risk over allocating resources. *See also* Reasons to Combine.

10. Claim 7

c. [7.0] *Method according to claim 1,*

352. See analysis at elements [1.0.1]-[1.7.2].

d. [7.1] *characterized in that a bandwidth broker (BB) in a specific domain performs admission control for all links in the path that belong to that domain.*

353. Schelen-2 discloses that “an agent [bandwidth broker] can perform **admission control** on the links from the starting point to an edge router in its domain” and that the bandwidth broker “**maintains information about reserved resources on each link in its domain.**” Ex.1007, 215. Schelen-2, therefore, discloses “*that a bandwidth broker (BB) in a specific domain performs admission control for all links in the path that belong to that domain.*”

354. It would have been obvious to a POSITA, in view of Schelen-2’s teachings, for Xiao’s bandwidth broker to perform admission control (see analysis at element [1.4]) for all links in the path in its domain because Xiao recognizes that it is better for the bandwidth broker to perform admission control and because such an implementation would relieve the routers from related computations. *See also* Reasons to Combine.

11. Claim 8

e. [8.0] *Method according to claim 1,*

355. See analysis at elements [1.0.1]-[1.7.2].

f. [8.1] *characterized in that a bandwidth broker (BB) comprises a storage, where it stores records of all its granted requests, and*

356. Schelen-2 discloses that “[c]lients...that have been **granted a generalized reservation** can use it for any destination matching the prefix of the reservation.” Ex.1007, 218. Schelen-2 further explains that “it is important to have **data structures that manage reservations**” and that the “**reservation state is stored in agents [bandwidth borers] with plenty of memory and disk.**” Ex.1007, 221, 216.

357. It would have been obvious to a POSITA for the bandwidth broker’s memory and disk to store, in a data structure, the reservation state of granted requests so that the reservations can be managed. For example, Schelen-2 explains that the reservation state is maintained to “keep[] exact starting times and finishing times.” Ex.1007, 221; *see also* Ex.1007, 222, Fig. 5. As another example, when routing changes occur, the bandwidth broker would be able to schedule resources along new paths to service the granted requests. Ex.1007, 218 (“When changes occur, agents can schedule resources along new paths.”).

358. Also, it would have been obvious to store the reservation state of “*all*” of granted requests, so that the bandwidth broker can plan future allocations. At Figure 5, for example, Schelen-2 illustrates that the bandwidth of all granted requests is accounted for and considered when deciding whether to grant any new requests. Ex.1007, 220-222, Fig. 5. Without storing the reservation state for all granted requests, there would be the potential that new reservations will be granted without having sufficient resources. *See* Ex.1011, 18 (“Booking network resources should be part of this planning. 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.”), 17 (“Admission control gives the provider an opportunity to reject service to new clients so that those already granted admission obtain committed service.”).

359. In view of Schelen-2, it would have been obvious to a POSITA for Xiao’s bandwidth broker to comprise memory and disk with a data structure, where it stores the reservation state of all its granted requests. *See also* Reasons to Combine.

g. **[8.2]** *also user-related data such as policies or accounting information.*

360. Schelen-2 discloses that “**an agent [bandwidth broker] that manages a user’s account.**” Ex.1007, 215. Schelen-2 further explains that

“accounting information is aggregated” by the bandwidth broker. Ex.1007, 215.

It would have been obvious to a POSITA that the accounting information is user-related since it is used for determining “charges,” associated with the user’s reservation. Ex.1007, 215. It would have been obvious to a POSITA to store the accounting within the bandwidth broker’s storage (memory and disk as analyzed at [8.2]) so that it can be used for determining “charges” associated with the user’s reservation and thereafter to bill the user per the SLA. Ex.1007, 215; Ex.1005, 11 (“Because premium service is more expensive than assured service, it is desirable for ISPs to support both static and dynamic SLAs.”).

361. In view of Schelen-2, it would have been obvious to a POSITA for Xiao’s bandwidth broker to manage the user account and store accounting information in its storage (memory and disk as analyzed at [8.2]) so that the user’s charges are accounted for and billed. *See also* Reasons to Combine.

IX. DECLARATION

362. 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.

Declaration of Henry H. Houh, Ph.D.
Infer Partes Review of U.S. 7,190,698

Dated: 2/15/23

Henry H. Houh.
Henry H. Houh, Ph.D.