UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,

Petitioner,

- vs. -

CORRIGENT CORPORATION,

Patent Owner.

Case IPR2023-00447

U.S. Patent No. 9,118,602

DECLARATION OF SAMRAT BHATTACHARJEE, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES*
REVIEW OF U.S. PATENT NO. 9,118,602

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I, Samrat Bhattacharjee, Ph.D., hereby declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

1. I have been retained on behalf of Cisco Systems, Inc. ("Cisco") to provide my technical review, analysis, insights, and opinions concerning the validity of the claims of U.S. Patent No. 9,118,602 (EX1001; "the '602 Patent") entitled "Tunnel Provisioning with Link Aggregation." The patent is assigned to Corrigent Corporation ("Corrigent").

2. I am a tenured professor in the Computer Science Department at the University of Maryland. I am also an Affiliate Professor with the Department of Electrical and Computer Engineering at the University of Maryland. I have been an appointed faculty member at the University of Maryland since 1999.

3. I received a Ph.D. in computer science from the Georgia Institute of Technology in 1999. Before that I received a B.S. degree in Mathematics and Computer Science with Highest Distinction (Summa Cum Laude) and was recognized as the Outstanding Department Major at Georgia College and State University, Milledgeville, Georgia in 1994.

4. I have been involved in the research and development of computing systems for over two decades. I perform research and I teach in the areas of computer networks, distributed systems, computer security and operating systems, among others. A major theme of my research has been the development of technology to

improve the performance and security of data transfers on the Internet. My research has examined problems ranging from network and operating system support audio and video streaming, large scale Internet video distribution, the design of novel network architectures for better and secure content distribution, efficiency of content distribution over wireless networks, and so on.

5. For example, starting in the late 1990s, the focus of my research was the development of network and operating system technology to design a new network architecture that allowed for more efficient data transfer. Part of my Ph.D. research was to develop new and more efficient architectures for video delivery on the Internet, and I have published papers on this architecture during my graduate studies. I continued to work on video delivery as a faculty member, and have published various papers on video streaming, content delivery architectures, and on resilient large scale content delivery. During 2007, I was a visiting researcher at AT&T Labs, and one of the projects I focused on was a video content delivery platform. This work resulted in both publications and a granted US patent (US8,752,100 B2).

6. Along with working on research problems related to video distribution, I routinely taught this material in both graduate and undergraduate courses. A number of my papers in this domain are with students at the University of Maryland, many of whom started in this area after taking my classes.

7. I have authored or co-authored over 100 articles in peer-reviewed journals, conference proceedings, and workshops in the aforementioned areas of computer science and others. Over the years I have received several fellowships, prizes, and awards for teaching excellence and technical papers, including an Alfred P. Sloan Jr. Fellowship in 2004 and the National Science Foundation CAREER award in 2001. I have also received an award from the SIGCOMM foundation for a "Test of Time" paper (that is given to an influential paper published ten years ago). My research work has been supported by multiple grants from the US National Science Foundation, and the Department of Defense. I have also started a Joint Ph.D. program with the University of Maryland and the Max Planck Society in Germany, and co-founded the annual Cornell, Maryland, Max Planck Research School that provides research exposure to about 80 students from across the world during a week-long school.

8. I have served on numerous paper and proposal review panels and participated on program committees for ACM/IEEE groups, technical journals, and conferences in Networking, Security and Systems in the aforementioned areas of computer science. I have created research software for all of my projects, much of which is available online for others to build on.

9. I am a named inventor on three U.S. Patents. These patents are generally related to computer networking and the delivery of services over networks and video delivery systems.

10. I have served as an expert witness and technical consultant in litigation and *Inter Partes* Review matters concerning videoconferencing, data conferencing and screen sharing, voice over IP (VoIP) telephony, multimedia networking, distributed systems, operating systems, computer networks, and datacenter networking, among others. I have testified in several trials and depositions as an expert witness.

11. I attach as Exhibit 1003 my curriculum vitae, which includes a more detailed list of my qualifications. My curriculum vitae also contains a list of all other cases in which, during the previous 4 years, I testified as an expert at trial or by deposition. My work on this case is being billed at a rate of $700 per hour, with reimbursement for actual expenses. I have no direct financial interest in the dispute between the Cisco and Corrigent, and my compensation is not contingent upon the outcome of this *Inter Partes* review.

II. UNDERSTANDING OF THE GOVERNING LAW

A. Invalidity by Obviousness

12. I understand that obviousness is analyzed from the perspective of a person of ordinary skill in the art ("POSA") at the time of the alleged invention. I

also understand that a POSA is presumed to have been aware of all pertinent prior art at the time of the alleged invention.

13. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention as a whole would have been obvious to a POSA in view of the prior art, and in light of the general knowledge in the art at the time the invention was made. I also understand that the invention may be deemed obvious when a POSA would have reached the claimed invention through routine experimentation.

14. I understand that obviousness can be established by combining or modifying the disclosures of the prior art to achieve the claimed invention. It is also my understanding that where there is a reason to modify or combine the prior art to achieve the claimed invention, there must also be a reasonable expectation of success in so doing to render the claimed invention obvious. I understand that the reason to combine prior art references can come from a variety of sources, not just the prior art itself or the specific problem the patentee was trying to solve. I also understand that the references themselves need not provide a specific hint or suggestion of the alteration needed to arrive at the claimed invention; the analysis may include recourse to logic, judgment, and common sense available to a POSA.

15. I understand that when there is some recognized reason to solve a problem, and there are a finite number of identified, predictable solutions, a POSA

has good reason to pursue the known options within his or her technical grasp. If such an approach leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In such a circumstance, when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious.

16. I understand that when considering the obviousness of an invention, one should also consider whether there are any objective indicia that support the non-obviousness of the invention. I further understand that objective indicia of non-obviousness include failure of others, copying, unexpected results, information that "teaches away" from the claimed subject matter, perception in the industry, commercial success, and long-felt but unmet need. I also understand that in order for objective indicia of non-obviousness to be applicable, the indicia must have some sort of nexus to the subject matter in the claim that was not known in the art. I understand that this nexus includes a factual connection between the patentable subject matter of the claim and the objective indicia alleged. I also understand that an independently made invention that is made within a comparatively short period of time is evidence that the claimed invention was the product of ordinary skill.

17. Finally, I understand that patent examiners at the U.S. Patent and Trademark Office ("USPTO") rely upon certain exemplary rationales in reviewing

patent applications to understand whether the subject matter of the claims is obvious. I understand that the following is the list of exemplary rationales relied upon by patent examiners at the USPTO:

(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 similar devices (methods, or products) in the same way;

(D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;

(E) "Obvious to try" – Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

(F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and

(G) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art

reference or to combine prior art reference teachings to arrive at the claimed invention.

B. Interpreting Claims Before the Patent Office

18. I understand that *Inter Partes* Review is a proceeding before the United States Patent & Trademark Office ("USPTO") for evaluating the validity of issued patent claims. I understand that, in an *Inter Partes* Review, a claim term is interpreted in a manner consistent with the standard used in patent litigation, as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). That standard generally construes the claims according to their "ordinary and customary" meaning in view of the claim language, specification, and file history, and where applicable, relevant other evidence.

19. I understand that a patent's "specification" includes all the figures, discussion, and claims within the patent. I understand that the USPTO will look to the specification and prosecution history to see if there is a definition for a given claim term, and if not, will apply the ordinary and customary meaning from the perspective of a POSA at the time in which the alleged invention was made.

C. Materials Relied on in Forming My Opinions

20. In forming the opinions expressed in this declaration, I have relied on my own knowledge, experience, and expertise, as well as the knowledge of a POSA

in the relevant timeframe. In addition, I have reviewed and relied upon all documents referenced in this declaration and the following list of materials:

- U.S. Patent No. 9,118,602 ("the '602 Patent") (EX1001);
- Prosecution History of the '602 Patent (EX1002);
- U.S. Patent No. 7,466,697 ("Raz") (EX1006);
- U.S. Patent No. 7,277,386 ("Ferguson") (EX1007);
- Request for Comments 3031, *Multiprotocol Label Switching Architecture*, Rosen, E. et al., January 2001 (EX1008);
- Nadeau, Thomas D., Multi-Protocol Label Switching, MPLS Network Management, 2003 (EX1009);
- Request for Comments 3209, *RSVP-TE: Extensions to RSVP for LSP Tunnels*, Awduche, D. et al., December 2001 (EX1010);
- U.S. Patent No. 6,499,061 ("Benayoun") (EX1018); and
- U.S. Patent No. 7,606,235 ("Ayyangar") (EX1019).

III. BACKGROUND DISCUSSION COMPUTER NETWORKING TECHNOLOGY

21. To better understand my opinions on the validity of the claims of the '602 Patent, I provide below some background on computer networking with a particular focus on multi-protocol label switching ("MPLS") and link aggregation protocol ("LAG"). The concepts discussed in this section were well known and widely used well prior to the May 6, 2005 priority date for the '602 Patent.

A. Multi-Protocol Label Switching ("MPLS")

22. The transmission of packets across "packet switched networks" or "PSNs" is key method of communicating information in computer networks, such as "wide area networks" ("WANs") and "local area networks" ("LANs"). EX1018, Col. 1:15-17. "In most of these PSNs, each node is used as a switching node after the route for a flow of data from a source node to a destination node has been established by routers located at each node." EX1018, Col. 1:18-21. "The assignment of a particular packet to a particular flow of data is done only once as that packet enters the network." EX1018, Col. 1:21-23. "The flow to which the packet is assigned is associated with a short fixed length value known as a label." EX1018, Col. 1:23-24. "When a packet is forwarded to the next switching node, the label is sent along with it." EX1018, Col. 1:25-26. "At subsequent nodes, the label is used as an index into a table which specifies the next node in the flow such that a corresponding new label can be assigned." EX1018, Col. 1:26-29.

23. One technique for using a label in the transmission of information is called Multi-protocol Label Switching ("MPLS"). MPLS makes use of a label "to enable reservation of resources for packet flows from a source device to a destination device." EX1019, Col. 1:25-27. In MPLS, "a source device can request a path through a network, i.e., a Label Switched Path (LSP)." EX1019, Col. 1:27-30. "An LSP defines one or more distinct, dedicated, and guaranteed paths through the

network to carry MPLS packets from a source to a destination." EX1019, Col. 1:30-33. "An LSP identifier associated with a particular LSP is affixed to packets that travel through the network via the LSP." EX1019, Col. 1:33-34. "A given LSP may define one or more paths between the source and destination, and each path may be used to carry MPLS network traffic associated with the LSP." EX1019, Col. 1:35-37. A POSA would have understood a LSP to refer to "a defined set of one or more paths associated with a common flow of MPLS traffic." EX1019, Col. 1:37-41. Further, a POSA would have known that a LSP "may also be viewed as an MPLS tunnel having one or more paths." EX1019, Col. 1:41-42. A POSA would have understood that a "network tunnel" is a path through which packets can flow across the devices in a network.

B. Link Aggregation Groups ("LAG")

24. "In some environments, two network devices may be connected by multiple physical interconnects." EX1007, Col. 1:21-22. "For example, two network routers may be connected by multiple Ethernet links." EX1007, Col. 1:22-24. "Similarly, multiple physical interconnects may couple other devices, e.g., two switches, a switch and a server, two routers, a switch and an end user station, and the like." EX1007, Col. 1:24-26.

25. "The term 'link aggregation' refers to a technique by which the multiple physical interconnects are logically associated and treated as a single, aggregated

link." EX1007, Col. 1:27-30. The IEEE 802.3ad Working Group has developed a standard for implementing link aggregation. EX1007, Col. 1:30-32. An advantage of link aggregation, also referred to as a "link aggregation group" or "LAG," is that it provides "for increased link availability and bandwidth between the two devices." EX1007, Col. 1:32-34. "For example, bandwidth can be increased in linear increments, e.g., by adding individual interconnects to increase the bandwidth between the two devices." EX1007, Col. 1:34-36. "In addition, the multiple physical interconnects provide a degree of redundancy in that a failure in a single physical interconnect no longer inhibits direct traffic flow between the two devices." EX1007, Col. 1:36-40. "With link aggregation, traffic on a failed physical interconnect can be redirected to one of the other physical interconnects in the aggregated link." EX1007, Col. 1:40-42.

IV. OVERVIEW OF THE '602 PATENT

A. Specification of the '602 Patent

26. The methods and systems described in the '602 Patent relate "generally to communication networks, and particularly to methods and systems for performing link aggregation in tunneled networks." EX1001, Col. 1:19-21. As any POSA would have known at the time the application for the '602 Patent was filed, MPLS was a popular "method for efficient transportation of data packets over connectionless networks, such as Internet Protocol (IP) networks." EX1001, Col. 1:26-29. In MPLS,

information packets flow along a label-switched path ("LSP") as label-switching routers ("LSRs") pass them through a network. EX1001, Col. 1:34-56. "The flow of packets along a label-switched path (LSP) under MPLS is completely specified by the label applied at the ingress node of the path." EX1001, Col. 1:40-42. According to the '602 Patent, this means that "an LSP can be viewed as a tunnel through the network." EX1001, Col. 1:42-43.

27. Further, the '602 Patent discusses the well-known concept of link aggregation ("LAG") defining it as a "technique by which a group of parallel physical links between two endpoints in a data network can be joined together into a single logical link." EX1001, Col. 2:2-4. These groups of physical links are commonly referred to as "LAG groups." EX1001, Col. 2:4-5. "Traffic transmitted between the endpoints is distributed among the physical links in a manner that is transparent to the clients that send and receive the traffic." EX1001, Col. 2:5-7. For ethernet networks, link aggregation protocol has a defined "sub-layer, which interfaces between the standard Media Access Control ("MAC") layer functions of the physical links in a link aggregation group and the MAC clients that transmit and receive traffic over the aggregated links." EX1001, Col. 2:12-17.

28. The specification of the '602 Patent describes "[e]mbodiments of the present invention [that] provide tunnel provisioning with link aggregation." EX1001, Col. 2:29-30. More specifically, one aspect of the '602 Patent discloses a

"method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network" (the "First Method"). EX1001, Col. 2:31-34. Figure 1A of the '602 Patent (reproduced and annotated below) schematically illustrates an MPLS communication network such as the one disclosed in the First Method:

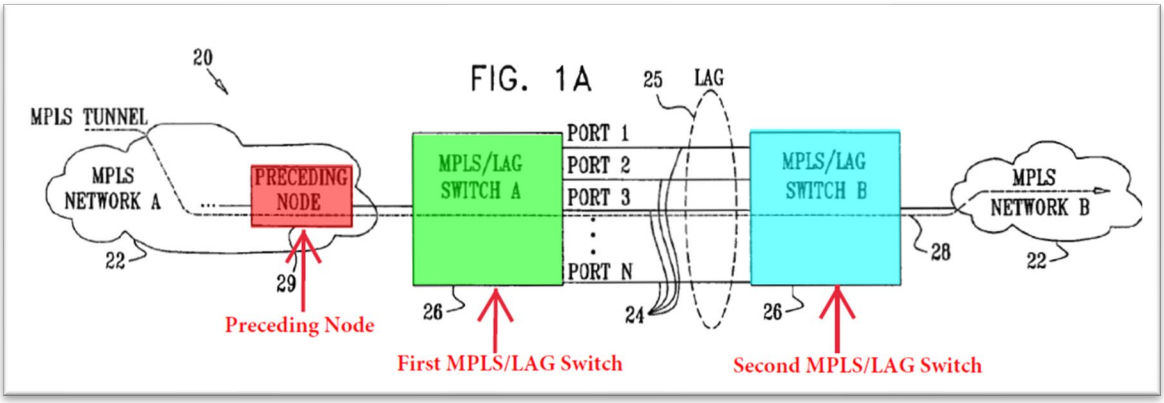

Figure 1A of the '602 Patent (Annotated)

EX1001, Figure 1A.

29. The First Method "includes the steps of, selecting, by a first MPLS/LAG switch [highlighted above in green], from a plurality of physical data ports in said first MPLS/LAG switch, a single physical tunnel port which meets a bandwidth requirement of a network tunnel, wherein said single physical tunnel port has a port serial number." EX1001, Col. 2:34-39. The single physical tunnel port is then assigned by the first MPLS/LAG switch to the network tunnel. EX1001, Col. 2:39-41. The first MPLS/LAG switch then prepares a "data packet label by which said single physical tunnel port may be identified." EX1001, Col. 2:41-43. When the

first MPLS/LAG switch receives "a data packet including said data packet label," the MPLS/LAG switch performs a "switching" of the "data packet to said single physical tunnel port according to said serial port number." EX1001, Col. 2:44-47. This sends the data packet to a second MPLS/LAG switch (highlighted above in blue) via the "physical tunnel port." EX1001, Col. 2:47-49.

30. As another aspect, the '602 Patent also discloses "a method for tagging a packet for transport through an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) located downstream from a preceding node [highlighted above in red] in a Multi-Protocol Label Switching (MPLS) network tunnel employing Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning (the "Second Method"). EX1001, Col. 2:50-54. RSVP-TE is "the well-known Resource Reservation Protocol ("RSVP"), allowing the establishment of explicitly-routed LSPs using RSVP as a signaling protocol." EX1001, Col. 1:50-52. In RSVP-TE, an "admission control" decision module is "used during reservation setup to determine whether a node has sufficient available resources to supply the requested quality of service." EX1001, Col. 1:57-60. Consequently, this means that the "admission control module is used in RSVP-TE for setting up MPLS tunnels." EX1001, Col. 1:60-61.

31. The Second Method "includes the steps of sending downstream to a MPLS/LAG switch, by the preceding node, an RSVP-TE PATH message." EX1001,

Col. 2:55-58. The RSVP-TE PATH message sent to the MPLS/LAG switch includes "a LABEL_REQUEST object requesting a network tunnel, and a bandwidth requirement." EX1001, Col. 2:59-60. The "preceding node" receives "a packet label sent by the MPLS/LAG switch" that contains "a serial number of a single physical tunnel port in the MPLS/LAG switch." EX1001, Col. 2:61-63. When the "single physical tunnel port meets the bandwidth requirement," the "preceding node" attaches "said data packet label to a data packet." EX1001, Col. 2:64-66. The data packet, with the data packet label, "is intended to be forwarded via the single physical tunnel port" and sent "downstream to the MPLS/LAG switch" by the "preceding node." EX1001, Col. 2:66-3:3.

32. Further, the '602 Patent discloses "an apparatus for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) located downstream from a preceding node in a Multi-Protocol Label Switching (MPLS) network tunnel employing Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning, the LAG having a first MPLS/LAG switch and a second MPLS/LAG switch." EX1001, Col. 3:4-11. Figure 1B of the '602 Patent (reproduced below) schematically illustrates an MPLS/LAG switch such as the one disclosed in the '602 Patent:

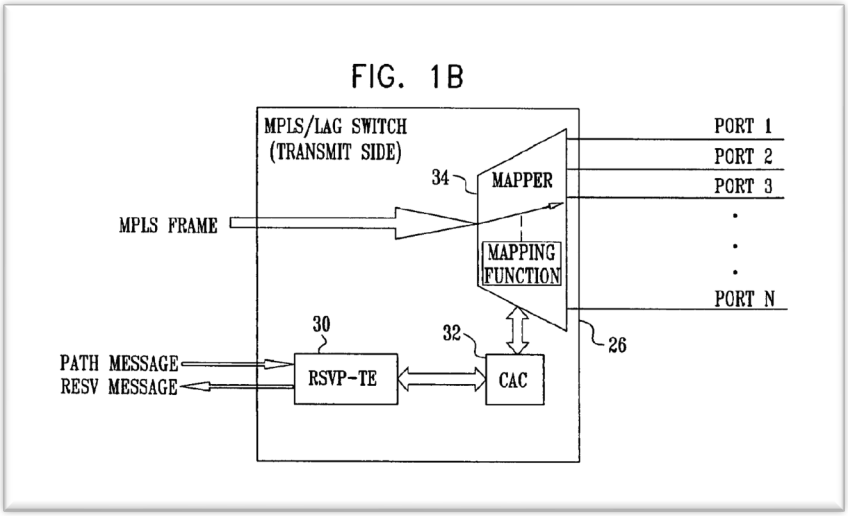

Figure 1B of the '602 Patent

EX1001, Figure 1B.

33. "The apparatus includes a processor, which is configured to receive a tunnel configuration request message from the preceding node." EX1001, Col. 3:11-13. The apparatus then makes "a selection from a plurality of physical data ports" in the first MPLS/LAG switch "of a single physical tunnel port which meets a bandwidth requirement of the network tunnel." EX1001, Col. 3:13-16. The "physical tunnel port has a port serial number." EX1001, Col. 3:16-17. The processor is also configured to "assign" the "single physical tunnel port to the network tunnel" and "prepare a data packet label, by which said single physical tunnel port may be identified." EX1001, Col. 3:17-20. The processor is further configured to "dedicate a sub-set of bits of" the "data packet label to encode" the "port serial number" of the

"single physical tunnel port" and "publish" the "packet label upstream." EX1001, Col. 3:20-22.

34. "The apparatus includes a mapper configured to receive a data packet from an upstream node, detect [the] data packet label in [the] data packet, and if [the] data packet contains [the] data packet label, to direct the first MPLS/LAG switch to switch [the] data packet to [the] single physical tunnel port, and send [the] data packet to the second MPLS/LAG switch via [the] single physical tunnel port." EX1001, Col. 3:23-29.

35. Figure 3 of the '602 Patent (reproduced below) illustrates a method disclosed by the '602 Patent. EX1001, Cols. 5:64-7:32. "The method of [Figure 3] begins when the preceding node asks to establish a part of tunnel 28 (having one or more hops) for sending MPLS packets to MPLS/LAG switch 26 A." EX1001, Col. 6:3-5. "The preceding node requests and then receives the MPLS label, which it will subsequently attach to all packets that are sent to MPLS/LAG switch 26 labeled A." EX1001, Col. 6:5-8. "The preceding node sends downstream an RSVP-TE PATH message augmented with a LABEL_REQUEST object, as defined by RSVP-TE, to MPLS/LAG switch A, at a label requesting step 60." EX1001, Col. 6:8-11. "The PATH message typically includes information regarding service properties that are requested for tunnel 28." EX1001, Col. 6:11-14. "The service properties may include a guaranteed bandwidth (sometimes denoted CIR—

Committed Information Rate) and a peak bandwidth (sometimes denoted PIR—Peak Information Rate), as well as a requested CoS (Class of Service—a measure of packet priority).” EX1001, Col. 6:14-19.

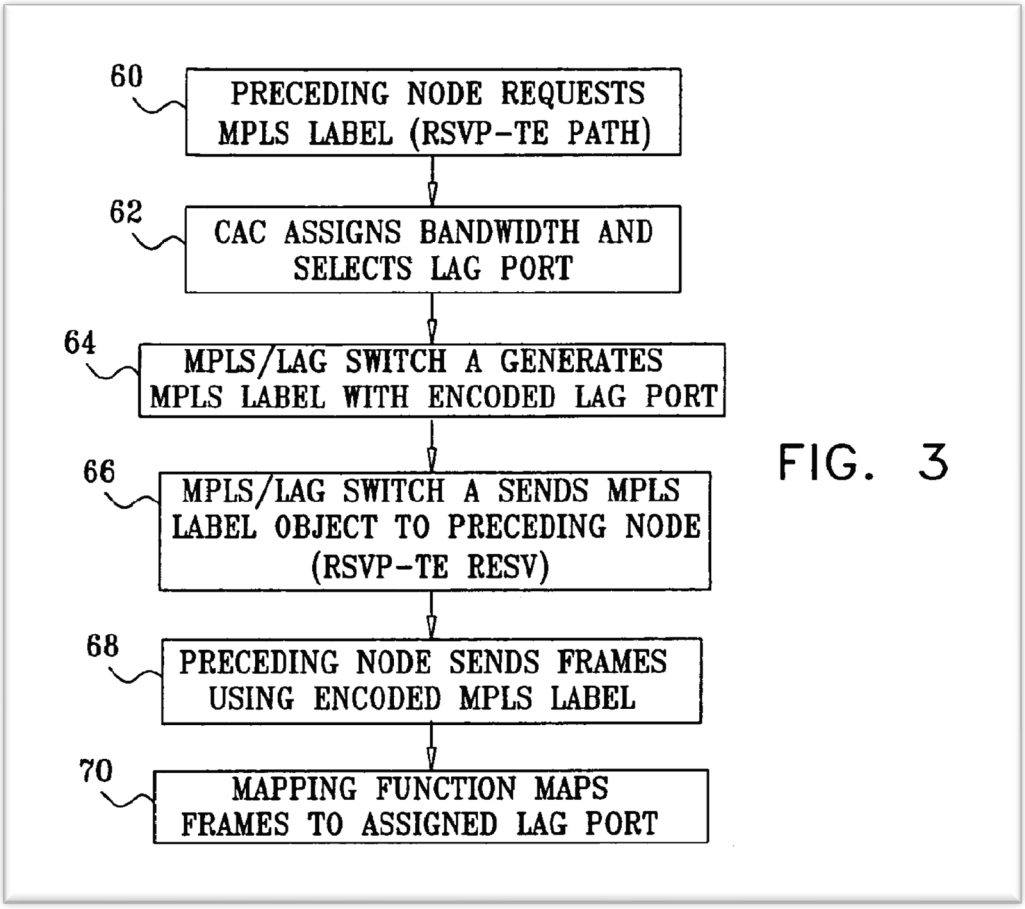

Figure 3 of the ’602 Patent

36. “CAC processor 32 of switch A receives the PATH message and extracts the requested service properties.” EX1001, Col. 6:20-21. “The CAC processor examines the available bandwidth of all ports 24 in LAG group 25 and selects a single physical port (‘the selected physical port’) on which to allocate bandwidth for MPLS tunnel 28, responsively to the requested service properties, at

a port selection step 62." EX1001, Col. 6:21-26. "The selected physical port should be capable of providing sufficient peak and average bandwidths, as requested by the preceding node (and, originally, by the ingress node)." EX1001, Col. 6:26-29.

37. "Regardless of the selection criterion used, the results of step 62 are that (1) a single physical port is explicitly selected and assigned to MPLS tunnel 28, and (2) sufficient bandwidth is allocated to tunnel 28, considering only the available bandwidth of the selected physical port, rather than the total available bandwidth of LAG group 25." EX1001, Col. 6:46-51. "All packets belonging to tunnel 28 will be switched through the same selected physical port, using the port coding technique described herein below." EX1001, Col. 6:51-53. "Having selected a physical port, RSVP-TE processor 30 of switch A now generates a suitable MPLS label, at a label generation step 64." EX1001, Col. 6:54-56. "The preceding node upstream of switch A will subsequently attach this MPLS label to all MPLS packets transmitted through tunnel 28 to switch A." EX1001, Col. 6:56-58. "The label is assigned, in conjunction with the mapping function of mapper 34, so as to ensure that all MPLS packets carrying this label are switched through the physical port that was selected for this tunnel at step 62." EX1001, Col. 6:58-62. "For this purpose, RSVP-TE processor 30 of switch A dedicates a sub-set of the bits of MPLS label 52 to encode the serial number of the selected physical port." EX1001, Col. 6:62-65.

38. "RSVP-TE processor of switch 26 sends the generated MPLS label upstream to the preceding node, using an RSVP-TE RESV message augmented with a LABEL object, at a label sending step 66." EX1001, Col. 7:4-7. "At this stage, the part of tunnel 28 between the preceding node and switch A is provisioned and ready for use." EX1001, Col. 7:7-9. "The preceding node attaches the aforementioned MPLS label to all subsequent MPLS packets that it sends downstream through tunnel 28 to MPLS/LAG switch A, at a packet sending step 68." EX1001, Col. 7:9-12.

39. Figure 4 of the '602 Patent (reproduced below) illustrates another method disclosed by the '602 Patent. EX1001, Cols. 7:34-8:47. "Similar to the method shown in [Figure 3] above, the method begins with the preceding node in MPLS network A asking to establish a part of MPLS tunnel 28 for sending MPLS packets to switch A." EX1001, Col. 7:36-39. "The preceding node sends downstream an RSVP-TE PATH message, at a label requesting step 80, which is identical to label requesting step 60 of [Figure 3 above]." EX1001, Col. 7:40-42. "CAC processor 32 of switch A receives the PATH message, extracts the requested service properties, and selects a physical port out of group 25, at a port selection step 82." "Step 82 is identical to port selection step 62 of [Figure 3] above." EX1001, Col. 7:42-46.

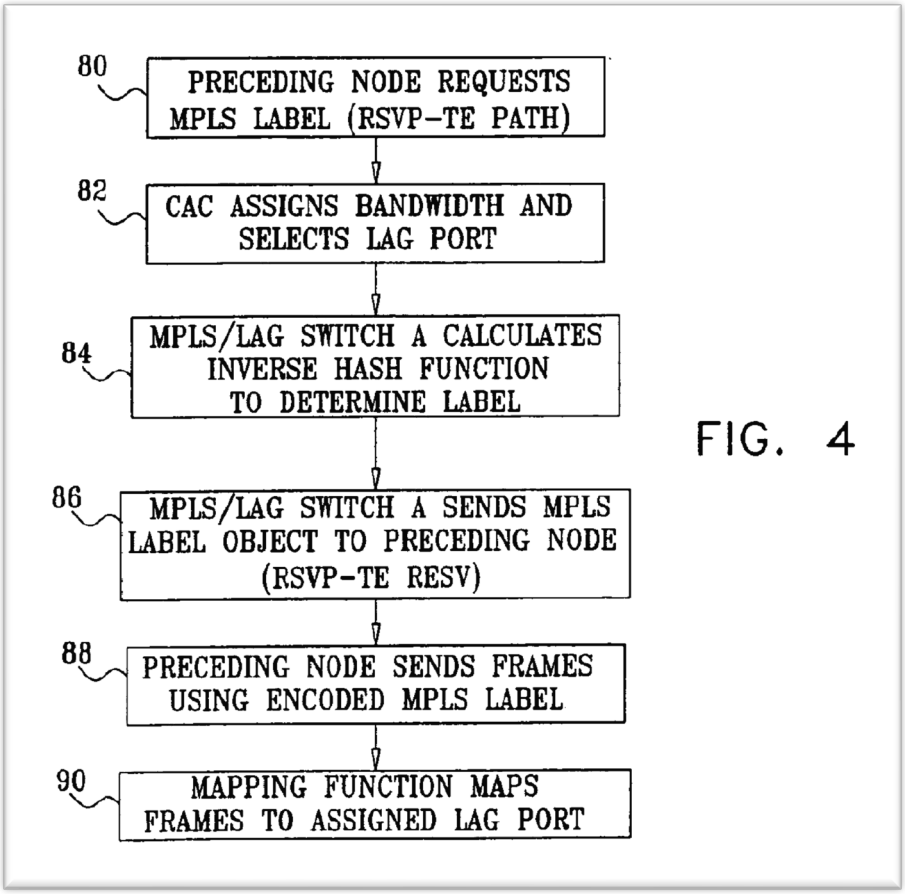

Figure 4 of the '602 Patent

40. In Figure 4, "RSVP-TE processor 30 of switch A takes the serial number of the selected physical port (selected at step 82) and generates MPLS label 52 by calculating an inverse of the hashing function, at an inverse calculation step 84." EX1001, Col. 7:66-8:3. "[T]the hashing function typically hashes the value of MPLS label 52 to determine the selected physical port, as the MPLS label uniquely identifies tunnel 28." EX1001, Col. 7:53-55. "Various hashing functions are known in the art, and any suitable hashing function may be used in mapper 34." EX1001, Col. 7:48-50.

41. "The purpose of [step 84] is to choose an MPLS label in a way that would cause the hashing function of mapper 34 to output the selected physical port (so that all subsequent packets carrying this label will be switched through this port)." EX1001, Col. 8:3-7. "Having generated the MPLS label, RSVP-TE processor of switch A sends the MPLS label upstream to the preceding node, at a label sending step 86, which is identical to label sending step 66 of [Figure 3] above." EX1001, Col. 8:28-31. "At this stage, the part of tunnel 28 between the preceding node and switch A is provisioned and ready for use." EX1001, Col. 8:31-33. "The preceding node attaches the aforementioned MPLS label to all subsequent MPLS packets, belonging to tunnel 28, that are sent downstream to MPLS/LAG switch A, at a packet sending step 88." EX1001, Col. 8:33-36.

42. As discussed in the claim analysis below in Paragraphs 94-407, a POSA would have been aware of prior art methods and systems that communicated performing link aggregation in tunneled networks.

B. The Claims of the '602 Patent

43. The '602 Patent includes 26 claims, and claims 1, 15, and 26 are independent claims. *See* EX1001, Cols. 9:23-12:36. Representative Claim 1 recites:

> 1. A method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network, the method comprising the steps of:

> assigning, by a first MPLS/LAG switch, a single physical tunnel port of a LAG to a network tunnel, wherein the single physical tunnel port of the LAG meets a bandwidth requirement of the network tunnel, and wherein said single physical tunnel port of the LAG has a port serial number;
>
> dedicating a sub-set of bits in a data packet label prepared by the first MPLS/LAG switch to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;
>
> sending, by said first MPLS/LAG switch, the data packet label, in which said port serial number of said single physical tunnel port is encoded, to a preceding node;
>
> receiving from the preceding node, by said first MPLS/LAG switch, a data packet comprising said data packet label, in which said port serial number of said single physical tunnel port is encoded; and
>
> sending said data packet from said first MPLS/LAG switch to a second MSPLS/LAG switch via said single physical tunnel port having the port serial number encoded in the data packet label.

EX1001, 9:23-47.

C. The Prosecution History of the ’602 Patent

44. The application that resulted in the ’602 Patent was U.S. Patent Application No. 13/969,520 (“the ’520 Application”). EX1001. The ’520 Application was filed with the USPTO on August 17, 2013. EX1001; EX1002 at 1-32. The ’520 Application was filed as a continuation of Application No. 13/116,696 (now U.S. Patent No. 8,537,682), which is a continuation of Application No. 11/123,801 (now U.S. Patent No. 7,974,202. EX1001. Application No. 11/123,801

was filed on May 6, 2005. EX1001. I understand that this is the date to which the '520 Application claims its earliest priority.

45. The USPTO issued a Non-Final Rejection of the '520 Application on December 4, 2013. EX1002 at 48-77. The Non-Final Rejection stated that Claims 1-26 – all the originally filed claims – were rejected. EX1002 at 48. Among other rejections, the Examiner rejected Claims 1-2, 7, 9, 11, 13 and 14 under pre-AIA 35 U.S.C. § 103 as obvious over U.S. Patent App. Pub. No. 2005/0083928 ("Sivabalan") in view of U.S. Patent App. Pub. No. 2005/0125490 ("Ramia"). EX1002 at 65-71. Further, Claims 3-6, 10 and 26 were rejected as obvious over Sivabalan in view of Ramia and further in view of an article titled "Link Bundling in MPLS Traffic Engineering" ("Kompella"). EX1002 at 71-73. In addition, Claim 8 was rejected as obvious over Sivabalan in view of Ramia and further in view of U.S. Patent App. Pub. No. 2004/0107285 ("Larson"). EX1002 at 73-74. Also, Claim 12 was rejected as obvious over Sivabalan in view of Ramia and further in view of U.S. Patent App. Pub. No. 2005/0090275 ("Wang"). EX1002 at 74-75.

46. The Applicant submitted a response to the Non-Final Office Action on March 4, 2014, with Claims 1, 15 and 26 being amended and new Claim 27 added.[1]

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[1] The Response also stated that "Claims 15-25 are being cancelled," but that was an inaccurate statement. EX1002 at 96.

EX1002 at 88-104. With respect to the obviousness rejections, the Applicant argued that Sivabalan makes use of RSVP, which the Applicant asserted "does not take physical link aggregation into account when reserving resources and treats aggregated parallel physical links only as a single logical link having the combined bandwidths of the separate physical links." EX1002 at 97. "In the case of aggregated physical links, therefore, the prior-art RSVP provisioning will either assign the logical link, or an arbitrary single physical link." EX1002 at 97. "In either of those cases, the resulting assignment may fail to operate properly; assigning the logical link to the network tunnel does not guarantee preservation of data packet arrival in order; and arbitrarily assigning a single physical link may conflict with previous assignments and may not provide sufficient bandwidth." EX1002 at 97.

47. Further, the Applicant argued, "In a similar manner, IEEE Ethernet Link Aggregation standards usually only specify that data packets with the same header attributes (such as packets belonging to the same network tunnel) be assigned to the same physical link." EX1002 at 97. "This, too, can fail to provide sufficient bandwidth." EX1002 at 97. By contrast, the Applicant asserted that "[t]he subject matter now recited in claim 1 provides a method for overcoming the restrictions of the prior art, by supplementing RSVP to particularly assign a single physical Ethernet data port for network tunnel traffic to guarantee that the single physical Ethernet data port offers available bandwidth to support the traffic." EX1002 at 97.

48. In addressing Claim 1, the Applicant also stated that "Sivabalan does not disclose 'sending, by [a] first MPLS/LAG switch, a message comprising' information about the primary or secondary component links 'to a preceding node,' as recited in claim 1." EX1002 at 99. Applicant asserted that "[i]n fact, Sivabalan specifically emphasizes that 'switchover of LSP traffic to the secondary component link' occurs with 'no signaling to the head-end to implement the switch-over' and that '[t]he secondary component link information is preconfigured into the label forwarding table entry for the LSP so that the switchover can occur very quickly." EX1002 at 99-100. "Since Sivabalan's switchover to the secondary component link very clearly occurs with no signaling to the head-end, there would have been no reason to send information about the primary or secondary links to a 'preceding node,' as recited in claim 1." EX1002 at 100.

49. Moreover, Applicant asserted that "Ramia does not remedy Sivabalan's shortcomings in this regard." EX1002 at 100. Applicant acknowledged that Ramia does disclose "a device and method for handling MPLS labels" in which "'[g]enerally, labels are determined by downstream nodes and distributed upstream.'" EX1002 at 100. However, Applicant argued that "Ramia does not mention link aggregation groups, which is a focus of the subject matter of claim 1." EX1002 at 100. Applicant asserted that the discussion of downstream nodes determining labels in Ramia was a "fairly-generic disclosure" that "would not have

led a person of ordinary skill to implement the subject matter recited in claim 1." EX1002 at 101.

50. Applicant also argued that dependent Claims 2-14 were allowable for the same reasons, irrespective of Kompella, Larson, or Wang. EX1002 at 101-102. Lastly, the Response argued that since Claim 26 cited matter that was similar to the subject matter cited in Claim 1, Claim 26 was allowable. EX1002 at 101-102.

51. On June 5, 2014, the USPTO issued a Final Rejection that rejected claims 1-27 as obvious under 35 USC § 103. EX1002 at 113-129. Claims 1-2, 7, 9, 11, 13-15, 20 and 22-25 were rejected as being obvious over Sivabalan in view of Ramia. EX1002 at 115-121. Further, Claims 3-6, 10, 16-19, 21 and 26-27 were rejected as being obvious over Sivabalan in view of Ramia and further in view of Kompella. EX1002 at 121-124. Claims 8 and 12 were rejected again on the same grounds as in the Non-Final Rejection. EX1002 at 124-125. The Examiner addressed and disagreed with the Applicant's discussion of Sivabalan. EX1002 at 125-127. The Examiner stated that Sivabalan "selects a physical link that has sufficient bandwidth to support a label switched path (LSP), i.e. a network tunnel, in accordance to MPLS [refer to paragraph [0034] . . .." EX1002 at 126.

52. The Applicant submitted a response to the Final Office Action Accompanied By Request For Continued Examination on September 5, 2014, with Claims 1, 15 and 26 being amended. EX1002 at 138-153. With respect to the

obviousness rejection, Applicant stated that "Claim 1, for example, has been amended to introduce subject matter similar to the subject matter that ultimately led to the allowance of this application's parent [the '682 Patent] and this application's grandparent [the '202 Patent]." EX1002 at 148. The Applicant explained that the Sivabalan and Ramia references had been relied upon by the Examiner during the prosecution of the applications that led to the '682 and '202 Patents. EX1002 at 149. The Applicant argued that "[i]n this application's parent, the rejections based on Sivabalan and Ramia were overcome by amending claim 1 to indicate that preparing the data packet label included 'dedicating a sub-set of bits of said data packet label to encode [a] port serial number of [a] single physical tunnel port," and to recite 'sending, by [a] first MPLS/LAG switch, a message comprising said data packet label to a preceding node; [and] receiving, from the preceding node, by said first MPLS/LAG switch, a data packet comprising said data packet label." EX1002 at 148-149.

53. Further, the Applicant stated that "[i]n this application's grandparent, the rejections based on Sivabalan and Ramia were overcome by amending claim 33 (which became claim 1 in [the '202 Patent]) to specify that 'said single physical tunnel port has a port serial number,' and that preparing the data packet label included 'dedicating a sub-set of bits of said data packet label to encode said port serial number of said physical tunnel port.'" EX1002 at 149. Applicant argued that

"[f]or at least reasons similar to those expressed in and/or deemed compelling in this application's parent and grandparent, Sivabalan does not disclose or render obvious the subject matter now recited in claim 1. Moreover, Ramia does not remedy the shortcomings of Sivabalan in this regard." EX1002 at 150.

54. Applicant asserted that Claims 2-7 and 9-26 were allowable for the same reasons as those discussed above for Claim 1. EX1002 at 150-152. With respect to Claim 27, Applicant stated that the Final Office Action did not provide an explanation of the basis of rejection, and Applicant asserted without further discussion that Claim 27 was not disclosed or rendered obvious Sivabalan, alone or in combination with either Ramia or Kompella. EX1002 at 151-152.

55. On April 17, 2015, the USPTO issued a Notice of Allowance for the '520 Application. EX1002 at 155-162. The Notice of Allowance stated that Claims 1-26 of the '520 Application were allowed but that Claim 27 was cancelled. EX1002 at 159-160. The '520 Application issued as the '602 Patent on August 25, 2015. EX1001.

D. The Priority Date of the '602 Patent

56. I understand that the earliest-filed patent application to which the '602 Patent claims priority (U.S. Patent Application No. 11/123,801) was filed on May 6, 2005. EX1001. I have therefore been asked for purposes of this declaration to analyze obviousness as of May 6, 2005.

V. STATE OF THE ART PRIOR TO THE '602 PATENT

A. The Person of Ordinary Skill in the Art

57. As discussed above, the claims of the '602 Patent are directed to a method and apparatus for assigning and utilizing an Ethernet physical data port in an Ethernet LAG in a MPLS network to transmit data. EX1001, Abstract, 1:1-2, 9:23-25. Based on this, it is my opinion that, as of May 6, 2005, a POSA would have had a working knowledge of hardware and software for packet-switched networking, MPLS and LAG. A POSA also would have had a bachelor's degree in computer science, computer engineering, or an equivalent, and two years of professional experience. Further, it is my opinion that a person with additional education but less professional experience may still qualify as a POSA, and a person with additional professional experience but less education may still qualify as a POSA.

58. I believe that I would qualify as understanding the knowledge and skills of a POSA as of May 6, 2005, and that I have a sufficient level of knowledge, experience, and expertise to provide an expert opinion in the field of the '602 Patent.

B. Raz

59. Raz teaches a prior art system relating to "a link multiplexing mechanism utilizing path oriented forwarding." EX1006, Col. 1:6-8. Raz discloses "[a] subport forwarding and provisioning mechanism whereby a plurality of subports implemented using slower speed processors are used to perform the packet

processing for a higher speed packet stream." EX1006, Abstract, Cols. 1:66-2:3, 2:41-51, 6:24-27. "Outbound packets are assigned a subport based on their MPLS labels." EX1006, Abstract, Cols. 2:9-10, 6:34-35. "Once assigned, the packets are forwarded to a particular subport." EX1006, Abstract, Cols. 2:10-11, 6:35-36. "The output of all the subports is aggregated and combined into a single high speed packet stream and transmitted over the link." EX1006, Abstract, Cols. 2:11-13, 6:36-38.

60. Further, "[i]nbound packets are received by [a] high speed PHY and forwarded to one of a plurality of subports." EX1006, Abstract, Cols. 2:13-15, 6:38-40. "The subport chosen is the one having the same subport index as the one through which the packet was sent out over at the transmitting node." EX1006, Abstract, Cols. 2:15-16, 6:40-41. "Conventional layer 2 switches can also be used whereby reserved source MAC addresses are assigned to subports." EX1006, Abstract. "The switch forwards the inbound packets to one of the subports in accordance with the packet's source MAC address." EX1006, Abstract. "The invention also comprises a mechanism for provisioning protection tunnels and a method for allocating subport bandwidth to subports." EX1006, Abstract.

61. "To aid in understanding the invention, the example LSR shown [below in Figure 1] comprises a 10G interface that is composed of ten individual 1G packet streams." EX1006, Col. 7:7-9. "The ten subports are provided wherein each is adapted to handle a 1G packet stream." EX1006, Col. 7:9-10. "The overall aggregate

speed, however, is 10G." EX1006, Col. 7:10-11. "Due to the connection oriented approach of the MPLS protocol, the assignment of connections to subports can be done statically on an LSP basis." EX1006, Col. 7:11-14. "Note, that the high speed interface (e.g., 10G) may be trunked into any number of individual subports, e.g., 8, wherein 10 is used here by example only." EX1006, Col. 7:14-16.

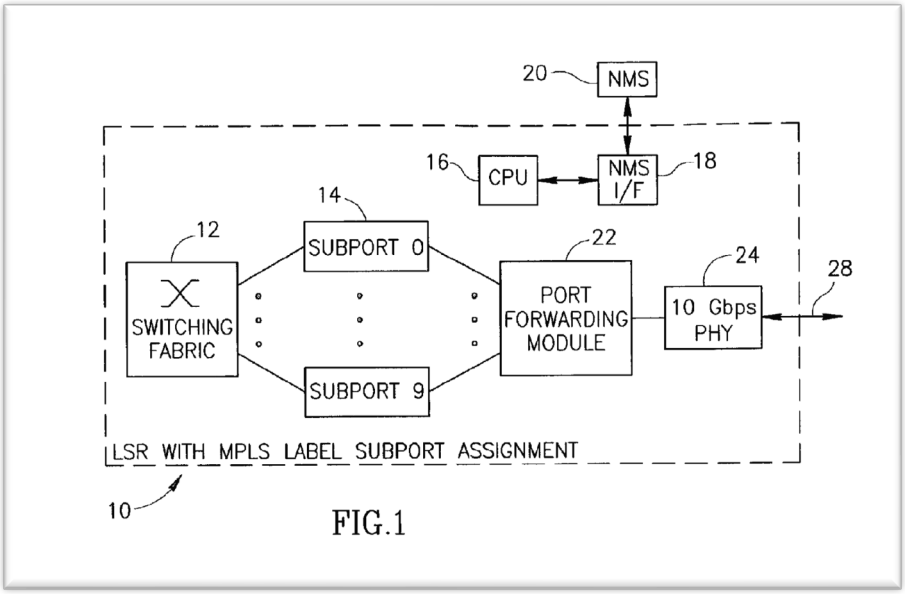

Figure 1 of Raz

62. "In accordance with the invention, the assignment of traffic to 1G subports is based on LSPs." EX1006, Col. 7:17-18. "Thus, the MPLS label is used in order to assign an incoming packet to one of the subports." EX1006, Col. 7:18-19. "The selected subport is the same for both sides of a 10G link." EX1006, Col. 7:20. "In the next link on the path, however, the subport may be different." EX1006, Col. 7:21-22. "This is because the next link may have other connections in addition

to the 10G link and therefore it may be the case that a different subport is the only subport (or the subport best suited) that can accept the LSP with the required bandwidth." EX1006, Col. 7:22-26. "Note that it is the downstream (i.e. receiving) node that determines the subport it wants to receive the LSP on." EX1006, Col. 7:26-27. "This decision is communicated to the upstream (i.e. sending) node via the label that is assigned to the LSP." EX1006, Col. 7:27-29.

63. "As an example, consider two LSRs, LSR A and LSR B, each with 10 subports wherein each subport is mapped to an 8K range of labels." EX1006, Col. 7:30-32. "An LSP is to be provisioned from LSR A to LSR B." EX1006, Col. 7:32-33. "When the LSP is signaled or provisioned through management, the CAC in LSR B decides to accept the LSP on subport 3 and thus assigns a label comprising an indication that subport 3 was selected." EX1006, Col. 7:33-36. "The label is communicated to LSR A which now knows that the output subport should be subport 3 (i.e. the same subport is provisioned)." EX1006, Col. 7:36-38.

64. "When a packet for the provisioned LSP is received over a link connected to LSR A, it is forwarded to subport 3 and subsequently out over the 10G link to LSR B with the previously assigned label indicating subport 3." EX1006, Col. 7:39-42. "The port forwarding module in LSR B examines the label in the received packet and in response thereto forwards the packet to subport 3 for packet processing." EX1006, Col. 7:42-45.

65. In Raz, "[t]he invention also comprises a mechanism to improve the ability to handle wide connections." EX1006, Col. 10:60-61. "Wide connections are connections that require a relatively large amount of CIR bandwidth." EX1006, Col. 10:61-63. "For example, a connection of 500 Mbps, 700 Mbps or even a connection of 1 Gbps may need to be supported." EX1006, Col. 10:63-65. "There remains, however, the problem of fragmentation." EX1006, Col. 10:65-66. "Consider, for example, 300 Mbps of CIR bandwidth that is already allocated on each of the ten subports of a 10G port." EX1006, Col. 10:66-67. "In this case, a connection of 800 Mbps cannot be allocated on it even though the 10G port has 5600 M of free bandwidth." EX1006, Col. 11:1-2.

66. "The invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for EIR traffic)." EX1006, Col. 11:3-8. "The central idea is to leave one or more subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. "The allocated bandwidth, however, is still distributed among the subports in such a way that EIR traffic is supported." EX1006, Col. 11:10-12.

C. Ferguson

67. Ferguson teaches a prior art system relating to "distribution of traffic within computer networks." EX1007, Col. 1:6-7. "The invention is directed to techniques for distributing label switched packets, such as multiprotocol label switched (MPLS) packets, associated with a common label switched path (LSP)." EX1007, Col. 1:57-60. "The techniques may, for example, be used to load balance label switched packets of an LSP across an aggregated link having two or more logically associated physical interconnects." EX1007, Col. 1:60-63. "In addition, the techniques may be used to distribute label switched packets of a common LSP across multiple data paths within a network device, such as a router." EX1007, Col. 1:63-66. "[T]he term path refers to any physical path for communicating data." EX1007, Col. 1:66-67. "In this manner, the term encompasses both external physical interconnects between network devices, and internal data paths within an individual network device." EX1007, Cols. 1:67-2:3.

68. "By distributing the MPLS packets across multiple data paths load balancing may be achieved, and the techniques may decrease packet latency through the network and the various communication devices." EX1007, Col. 2:54-57. "In addition, the techniques allow for the distribution of the MPLS traffic, while maintaining in-sequence delivery of packets of common data flows." EX1007, Col. 2:57-60. "In other words, those MPLS packets having common flow characteristics,

such as MPLS packets having common source and destination addresses and ports, as well as the same communication protocol, may be distributed to the same physical interconnect in accordance with the techniques." EX1007, Col. 2:60-65.

69. "In another embodiment, a method comprises receiving a data unit from a network device, determining a type of communication protocol for the data unit, and selecting a label based on the type of communication protocol." EX1007, Col. 2:19-22. "The method further comprises pre-pending the selected label to the data unit to form a label switched packet in accordance with a label switching protocol, and forwarding the packet along a label switched path in accordance with the label." EX1007, Col. 2:22-26.

70. Figure 1 of Ferguson (shown below) "is a block diagram illustrating an example system 2 in which customer networks 4A, 4B ('customer networks 4') are communicatively coupled via an intermediate provider network 6." EX1007, Col. 3:36-39. "Specifically, customer network 4A includes a customer edge ('CE') router 8A that is connected to a provider edge ('PE') router 10A via an aggregated link 12A." EX1007, Col. 3:39-41. "In other words, CE router 8A and PE router 10A communicate via two or more physical interconnects that are logically associated as an aggregated link." EX1007, Col. 3:42-44. "For example, CE router 8A and PE router 10A may communicate via two or more Ethernet links, Sonet links, or other physical interconnects." EX1007, Col. 3:44-47. "Similarly, customer network 4B

includes a CE router 8B that is connected to a PE router 10B via an aggregated link 12B." EX1007, Col. 3:47-49. "PE routers 10 communicate network traffic from and to customer networks 4 in accordance with a label switching protocol, such as the Multiprotocol Label Switching (MPLS) protocol, via one or more label switched paths (LSPs) 14." EX1007, Col. 3:49-53. "For example, CE router 8A receives network traffic originating from devices within customer network 4A, and pre-pends MPLS labels to the network traffic to form outbound MPLS packets." EX1007, Col. 3:53-56. "CE router 8A communicates the outbound MPLS packets to PE router 10A via aggregated link 12A." EX1007, Col. 3:56-58.

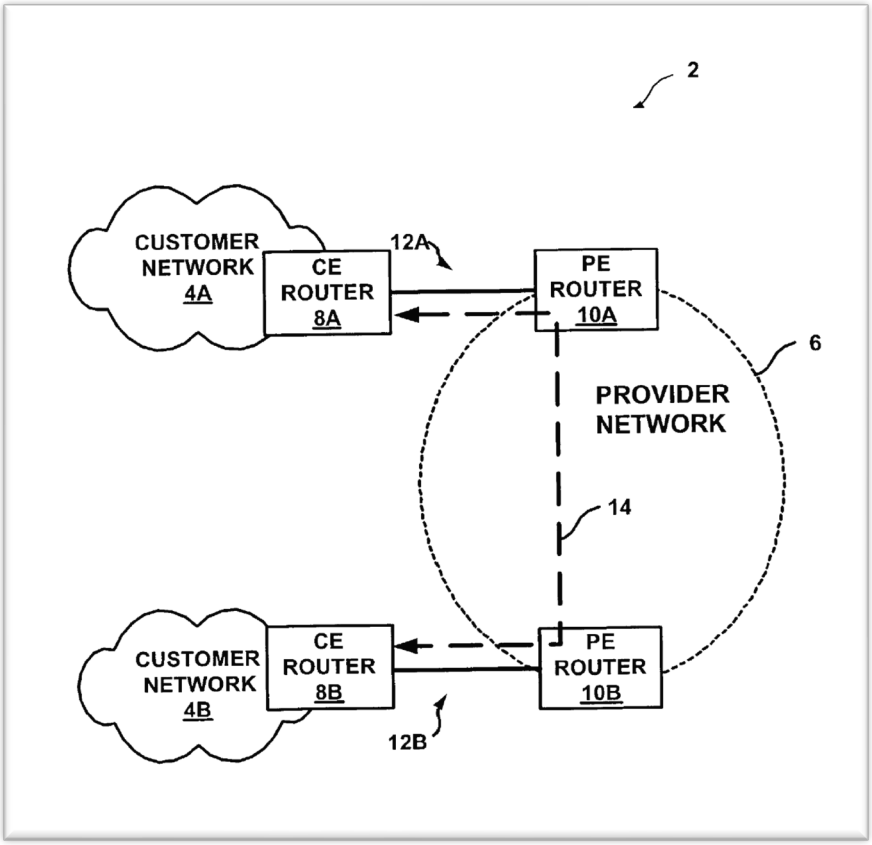

Figure 1 of Ferguson

71. "PE router 10A receives the MPLS packets, and forwards the MPLS packets to one or more intermediate routers (not shown) within provider network 6 for communication to PE router 10A via one of LSPs 14." EX1007, Col. 3:59-62. "PE router 10A may, for example, pre-pend additional MPLS labels to the traffic to form MPLS packets having multiple MPLS labels." EX1007, Col. 3:62-64. "In this manner, each MPLS packet traversing provider network 6 via LSPs 14 may be guaranteed to carry two or more MPLS labels." EX1007, Col. 3:64-67.

72. "PE router 10B receives the MPLS packets from provider network 6, and forwards the MPLS packets to CE router 8B via aggregated link 12B." EX1007, Col. 4:1-3. "PE router 10B may, for example, remove one or more MPLS labels from each of the inbound packets, and distribute the packets across the physical interconnects that are logically associated to form aggregated link 12B." EX1007, Col. 4:3-7. "Network traffic flows from customer network 4B to customer network 4A in similar manner." EX1007, Col. 4:7-8.

73. "In general, the devices of system 2, i.e., CE routers 8, PE routers 10, and intermediate routers (not shown) within provider network 6, utilize MPLS labels within pre-allocated ranges to convey protocol information for the payloads of the MPLS packets." EX1007, Col. 4:9-13. "In other words, the devices assign MPLS

labels of the pre-allocated ranges to the MPLS packets based on the type of payloads carried by the MPLS packets." EX1007, Col. 4:13-16. "The devices may make use of this protocol information to facilitate distribution of the MPLS packets across multiple paths, e.g., multiple physical interconnects of an aggregated link." EX1007, Col. 4:16-19.

74. "Generally, the label typically carries an index into a forwarding table, e.g., a forwarding table maintained by each of CE routers 8 and PE routers 10, which specifies the next hop for the packet." EX1007, Col. 4:34-37. "In this manner, these devices do not need to examine the label switched packets and perform next-hop routing tasks." EX1007, Col. 1:11-13. "In other words, the label associates the packet with an LSP, and carries the information that determines which path a packet should take." EX1007, Col. 1:11-13. "Forwarding decisions can be made based on a field in the packet or cell, i.e., the label, and the incoming interface, without requiring a route lookup." EX1007, Col. 1:11-13.

75. In Ferguson, "the devices of system 2 make use of the allocated ranges of MPLS labels to control the distribution of MPLS packets across multiple physical paths." EX1007, Col. 5:61-63. "Although the techniques have been described in reference to distribution of MPLS packets across parallel physical interconnects of an aggregated link, the techniques may be applied in a variety of environments." EX1007, Col. 5:63-67. "For example, the techniques may be readily applied to

internal parallel data paths within a device." EX1007, Cols. 5:67-6:2. "For example, the techniques may be used by a router to distribute packets across internal data paths that begin at the same input interface of the router and end at the same output interface of the router, but traverse through different internal, high-speed switch fabrics." EX1007, Col. 6:2-6. "A control unit for the router, for example, may implement the techniques to distribute received MPLS packets across multiple internal forwarding engines." EX1007, Col. 6:6-9.

76. Further, Ferguson explains that "[a]lthough the techniques are illustrated in reference to a router, the techniques may be readily applied to other network devices, such as switches, hubs, firewalls, gateways, proxy servers, and the like." EX1007, Col. 8:60-64. "In addition, the techniques may be applied to 'edge' devices that provide access to a large network, such as the Internet, or to high-speed 'core' devices within the network." EX1007, Col. 8:64-67.

VI. CLAIM CONSTRUCTION

77. For purposes of this declaration, it is my opinion that the terms in the claims of the '602 Patent do not require construction in order to evaluate the prior art discussed herein. Instead, in evaluating the prior art, I have applied the plain and ordinary meaning of the claim terms when read in light of the specification and prosecution history of the '602 Patent.

VII. GROUNDS OF INVALIDITY

A. <u>Ground 1</u>: Claims 1-13, 15-24 and 26 of the '602 Patent are obvious in view of Raz.

78. It is my opinion that a POSA would have found Claims 1-13, 15-24 and 26 of the '602 Patent to be obvious over Raz in view of the knowledge of a POSA.

a. Claim 1

[1.0] A method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network, the method comprising the steps of:

79. It is my opinion that Element [1.0] is obvious in view of Raz. EX1001, Col. 9:23-26.

80. As an initial matter, Raz discloses the communication of packets within a MPLS network, as evidenced by the following:

> **Multiprotocol Label Switching (MPLS)** based networks are becoming increasingly popular especially in traffic engineering IP networks. **MPLS** uses a label switching model to switch data over a **Label Switched Path (LSP)**. The route of an LSP is determined by the network layer routing function or by a centralized entity (e.g., a Network Management System) from the topology of the network, the status of its resources and the demands of the user. Any suitable link state routing protocol may be used such as Open Shortest Path First (OSPF) or Intermediate System to Intermediate System (ISIS) routing

protocol to provide the link state topology information needed by the network layer routing to engineer data traffic. It is also possible to use a local neighbor-discovery protocol and have a centralized management entity maintain the topology view. LSPs may be setup using any suitable signaling protocol such as RSVP-TE or CR-LDP or using the management plane (e.g., NMS setting the relevant MIB items that create the LSPs).

EX1006, Col. 1:40-55 (emphasis added); see EX1006, Abstract ("Outbound packets are assigned a subport based on their MPLS labels."). Figure 1 of Raz states that the system of Raz is implemented in an MPLS network:

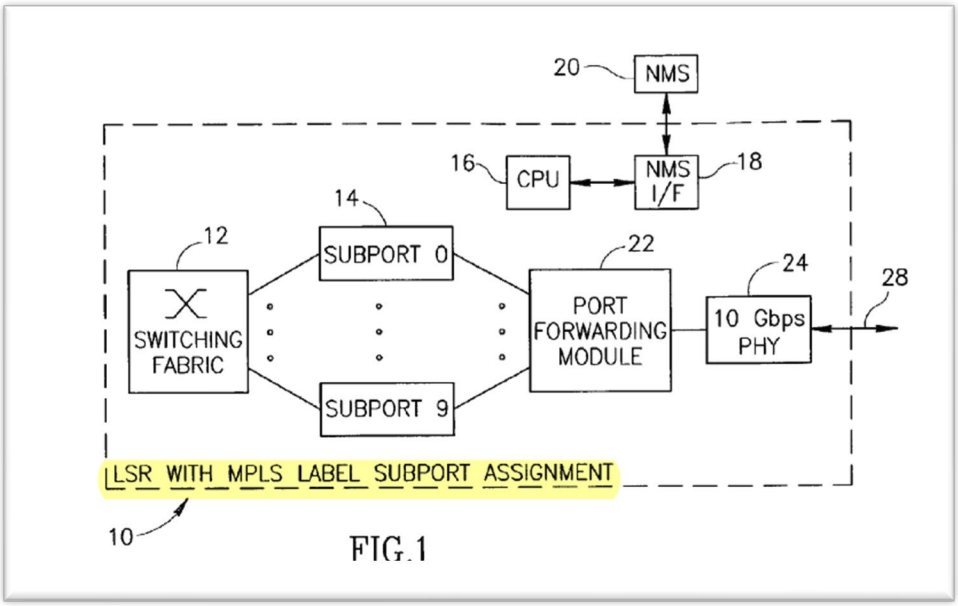

Figure 1 of Raz (Annotated)

The specification of Raz likewise indicates that its system is implemented in an MPLS network:

> In accordance with the invention, the assignment of traffic to 1G subports is based on **LSPs**. Thus, the **MPLS label** is used in order to assign an incoming packet to one of the subports. The selected subport is the same for both sides of a 10G link. In the next link on the path, however, the subport may be different. This is because the next link may have other connections in addition to the 10G link and therefore it may be the case that a different subport is the only subport (or the subport best suited) that can accept the **LSP** with the required bandwidth. Note that it is the downstream (i.e. receiving) node that determines the subport it wants to receive the **LSP** on. This decision is communicated to the upstream (i.e. sending) node via the **label** that is assigned to the **LSP**.

EX1006, Col. 7:17-29 (emphasis added); see Cols. 7:7-16, 9:9-48, 11:3-12, 14:30-32 (Claim 3), 14:50-52 (Claim 10), 16:63-65 (Claim 26), 17:14-16 (Claim 43).

81. Further, Raz discloses the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. Within the LSRs, individual packets from a high speed data stream are assigned to one of a plurality of subports for transportation through the LSR and then re-aggregated into the high

speed packet stream before being forwarded to the next node in a network (such as the next LSR):

> There is thus provided in accordance with the invention a method of forwarding a high speed packet stream to a plurality of subports of lesser speed in a label switching network, the method comprising the steps of assigning outbound packets to one of a plurality of subports in accordance with the label associated with each outbound packet, forwarding each outbound packet to its assigned subport, **aggregating the output of a plurality of subports into a high speed packet stream** and forwarding inbound packets from the high speed packet stream to a subport corresponding to the subport the inbound packet was originally sent out on.

EX1006, Col. 2:41-51 (emphasis added); see EX1006, Cols. 2:52-67, 6:34-45. Figure 1 of Raz (shown below) provides an example of ten subports (Subport 0-Subport 9) used to implement link aggregation within an LSR in an MPLS environment:

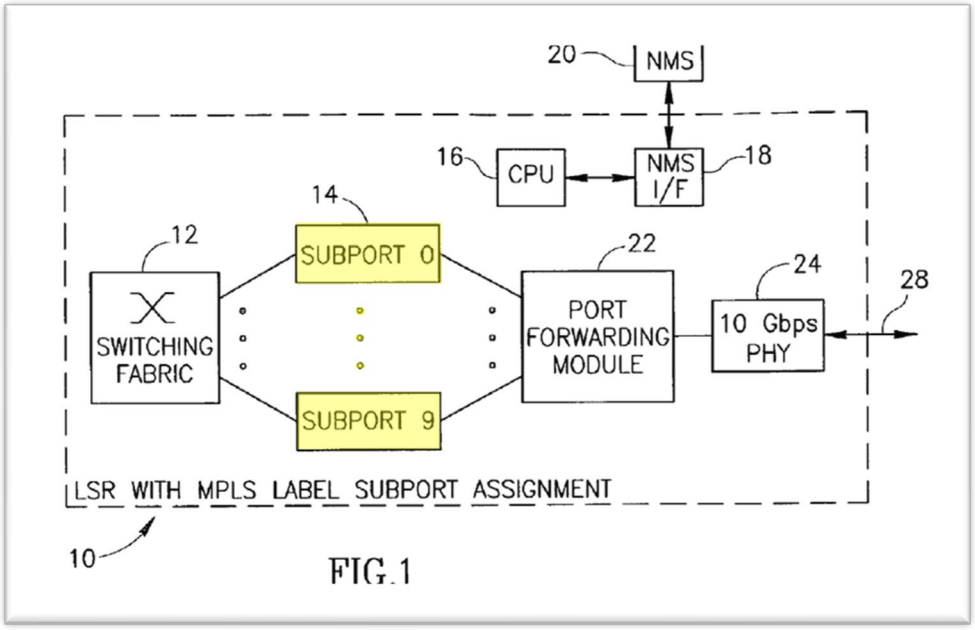

Figure 1 of Raz (Annotated)

The specification of Raz explains that the link aggregation is used to transport a high speed packet stream through a plurality of subports of lesser speed within a LSR:

> To aid in understanding the invention, the example LSR shown comprises a 10G interface that is composed of ten individual 1G packet streams. **The ten subports are provided wherein each is adapted to handle a 1G packet stream. The overall aggregate speed, however, is 10G.** Due to the connection oriented approach of the MPLS protocol, the assignment of connections to subports can be done statically on an LSP basis. Note, that the high speed interface (e.g., 10G) may be trunked into any number of individual subports, e.g., 8, wherein 10 is used here by example only.

EX1006, Col. 7:7-16 (emphasis added); see EX1006, Cols. 9:9-12 (disclosing that "some commercially available layer 2 switches can determine the destination port for a packet destined to a LAG (Link Aggregation Group) based on a CRC of the source MAC modulo the number of ports in the LAG."), 14:19-22 (Claim 1), 15:32-35 (Claim 17), 16:41-53 (Claim 33), 17:62-18:7 (Claim 50), 18:39-42 (Claim 52), 19:3-7 (Claim 55).

82. While Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet streams in an MPLS network, it is my opinion that a POSA similarly would have known to use Ethernet physical data ports of a router or switch in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concept of using aggregation to communicate individual packets of a high speed packet stream through subports in a LSR also applies to communicating individual packets through Ethernet physical data ports of routers or switches in a MPLS network. In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream. Further, a POSA would have found it obvious to apply the teachings of Raz to an Ethernet LAG because Ethernet was in widespread usage as of the priority date for the '602 Patent, and a POSA would have known to use Ethernet because it provides the ability to transmit packets at high speeds while maintaining reliable service. Indeed, Raz specifically references using its technology at speeds (such as

1G and 10G) that a POSA would have understood to be for Ethernet packet streams. See EX1006, Col. 7:7-29; see also EX1006, Cols. 1:16-19, 2:28-31, 13:16-19, 14:42-44, 15:56-58, 17:7-9.

83. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.0].

[1.1] assigning, by a first MPLS/LAG switch, a single physical tunnel port of a LAG to a network tunnel, wherein the single physical tunnel port of the LAG meets a bandwidth requirement of the network tunnel, and wherein said single physical tunnel port of the LAG has a port serial number;

84. It is my opinion that Element [1.1] is obvious in view of Raz. EX1001, 9:27-32.

85. Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR to communicate individual packets within a high speed packet stream:

> There is further provided in accordance with the invention an apparatus for forwarding a high speed packet stream to a plurality of subports of lesser speed in a label switching network, **comprising assignment means for assigning outbound packets to one of a plurality of subports in accordance with the label associated with each outbound packet**, a line interface adapted to transmit and receive a high speed packet stream, a plurality of subports, each subport of lesser speed than the line interface, a subport forwarding module in

> communication with the line interface and the plurality of subports, the subport forwarding module adapted to forward each outbound packet from its assigned subport to the line-interface and to forward inbound packets from the line interface to one of the plurality of subports in accordance with the label of each inbound packet.

EX1006, Col. 3:1-15 (emphasis added). Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1," which is reproduced below. EX1006, Col. 6:65-67; see Col. 7:17-19 ("In accordance with the invention, the assignment of traffic to 1G subports is based on LSPs. Thus, the MPLS label is used in order to assign an incoming packet to **one of the subports**.") (emphasis added), 7:26-27 ("Note that it is the downstream (i.e. receiving) node that determines the subport it wants to receive the LSP on.).

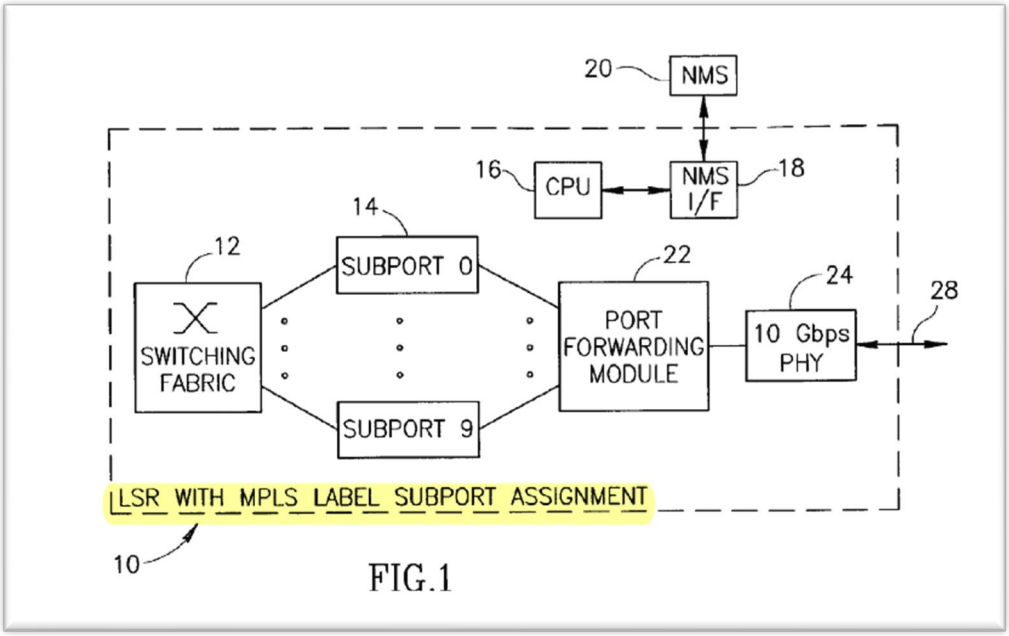

Figure 1 of Raz (Annotated)

86. Additionally, Raz provides an example of how the assignment process takes place, and the example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch:

> The CPU 16 in the LSR performs the conventional LSR functionality including the provisioning of LSPs. **In particular, the CPU functions to perform the assignment of subports to LSPs in response to LSP setup requests.** The CPU executes a bandwidth allocation algorithm, described in more detail infra, that controls the allocation of bandwidth of each subport. **Once a subport is assigned, a label is generated so as to indicate the subport assignment.** The label is then sent to the

> requesting node or to a management entity to complete the LSP setup process. In case the label is sent to a management entity, the management entity is adapted to send the label to the upstream node in order for the upstream node to know how to label packets belonging to this LSP. The LSR also comprises an NMS interface 18 for interfacing an external NMS 20 which is in communication with the network to the CPU 16.

EX1006, Col. 7:65-8:13 (emphasis added); see also EX1006, Cols. 7:30-38 (providing example in which the assignment of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. It would have been common knowledge to a POSA as of the priority date that a LSP could be used to implement a network tunnel and that the set of packets that are using a particular MPLS label form a network tunnel. See EX1008, Section 3.27.3 ("It is possible to implement a tunnel as a LSP, and use label switching rather than network layer encapsulation to cause the packet to travel through the tunnel.").

87. Further, a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR. EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels.

88. Raz also explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel):

> The invention provides a scheme for **allocating LSP bandwidth to subports** that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for EIR traffic). **The central idea is to leave one or more subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated.** The allocated bandwidth, however, is still distributed among the subports in such a way that EIR traffic is supported.

EX1006, Col. 11:3-12 (emphasis added); see EX1006, Cols. 2:23-25 ("In addition, the invention comprises an algorithm for allocating subport bandwidth to LSPs."), 7:22-26 ("This is because the next link may have other connections in addition to the 10G link and therefore it may be the case that **a different subport is the only**

subport (or the subport best suited) that can accept the LSP with the required bandwidth.") (emphasis added), 7:7-16, 11:13-12:9, Figure 5. Further, Claims 4-6, 20-22 and 37-39 of Raz require that each subport be "capable of handling" a traffic stream of a certain bandwidth. EX1006, Cols. 14:33-41, 15:47-55, 16:65-17:6.

89. In addition, Raz discloses that the assigned subport has a serial number. In discussing Figure 4, Raz explains that the MPLS label contains bits that "indicate the subport," which a POSA would have understood to mean that the subport has a serial number that is indicated by the bits:

> Consider an LSP to be setup through LSR A to LSR C. When the LSP is signaled, the CAC in LSR C decides to provision the LSP on subport 1 and therefore assigns the label 0x22003. With reference to [Figure] 4, each label 140 comprises 20 bits or 5 nibbles where the first three bits indicate 1 of 8 line interface cards, **bits 16 to 13 indicate the subport** and bits 12 to 0 indicate the actual label. In this example, the label 0x22003 indicates line interface card 1, subport 1 and label 3.

EX1006, Col. 9:41-48 (emphasis added) and Figure 4; see EX1006, Figure 1 (identifying subports numbered 0-9). A POSA would have understood that a serial number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number.

90. Further, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also would have been used to assign a physical tunnel port of a MPLS/LAG switch to a network tunnel. A POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. Specifically, a POSA would have known that an LSR could have been implemented as a router or switch that supports MPLS. See EX1009 ("A label switching router is any router or switch that supports the forwarding of MPLS-encapsulated packets based solely on the incoming interface and the information in the shim header."). Further, Raz explains that a LSR that supports MPLS can also implement a LAG. EX1006, Col. 7:7-16.

91. Moreover, as discussed above, Raz teaches that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS (which correlates to a network tunnel) is assigned to communicate packets from a high speed data stream. The same principles would have applied to forwarding packets between MPLS/LAG switches in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the MPLS/LAG switch to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols.

2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. A POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve the ability to communicate high speed packet streams that require increased bandwidth.

92. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.1].

[1.2] dedicating a sub-set of bits in a data packet label prepared by the first MPLS/LAG switch to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

93. It is my opinion that Element [1.2] is obvious in view of Raz. EX1001, 9:33-36.

94. Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) prepared by an LSR to encode the subport serial number of a physical subport of the LAG into the label. The block quote from Raz set out below provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. In the first example discussed in the block quote, LSR C (which corresponds to the first MPLS/LAG switch in that example) dedicates "bits 16 to 13 [to] indicate the subport" (which is subport 1) of a LAG through which a packet should be sent from LSR B to LSR C in Figure 3 of Raz. In the second example, LSR B (which corresponds to the first MPLS/LAG switch in that example) dedicates bits in the

label provides to LSR A to indicate the subport (which is subport 0) of a LAG through which a packet should be sent from LSR A to LSR B in Figure 3.

> Consider an LSP to be setup through LSR A to LSR C. When the LSP is signaled, the CAC in LSR C decides to provision the LSP on subport 1 and therefore assigns the label 0x22003. With reference to [Figure 4], each label 140 comprises 20 bits or 5 nibbles where the first three bits indicate 1 of 8 line interface cards, **bits 16 to 13 indicate the subport** and bits 12 to 0 indicate the actual label. In this example, the label 0x22003 indicates line interface card 1, subport 1 and label 3.
>
> The label generated by LSR C is communicated to LSR B which tells LSR B that the outbound subport (to LSR C) should be subport 1. **The CAC in LSR B determines that the best subport for receiving the LSP is on subport 0 on the inbound link and therefore assigns a label of 0x40005. This label indicates line interface card 2, subport 0 and label 5.** The label is communicated to LSR A who then knows by the output label that it is to assign the LSP to subport 0. The provisioned path indicating the LSR ports and subports is represented by the dotted line 53.

EX1006, Col. 9:41-58, Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR to indicate the subport through which a packet should be sent constitutes encoding the subport serial number in the label. As discussed above for Element [1.1], a serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

95. As discussed above for Elements [1.0] and [1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP to facilitate the forwarding of high speed packet streams.

96. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.2].

[1.3] sending, by said first MPLS/LAG switch, the data packet label, in which said port serial number of said single physical tunnel port is encoded, to a preceding node;

97. It is my opinion that Element [1.3] is obvious in view of Raz. EX1001, 9:37-39.

98. As I discussed above for Element [1.2], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. Raz explains that the label encoding the serial number of the subport is sent from an LSR that generates the label to an "upstream" or preceding node:

> Note that it is the downstream (i.e. receiving) node that determines the subport it wants to receive the LSP on. **This decision is communicated to the upstream (i.e. sending) node via the label that is assigned to the LSP**.
>
> As an example, consider two LSRS, LSR A and LSR B, each with 10 subports wherein each subport is mapped to an 8K range of labels. An LSP is to be provisioned from LSR A to LSR B. When the LSP is signaled or provisioned through management, the CAC in LSR B

> decides to accept the LSP on subport 3 and thus assigns a label comprising an indication that subport 3 was selected. **The label is communicated to LSR A which now knows that the output subport should be subport 3 (i.e. the same subport is provisioned)**.

EX1006, Col. 7:26-38; see EX1006, Figure 3. The LSR that generates the label corresponds to the claimed MPLS/LAG switch, and it sends the label to the preceding node. In the example quoted above, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node.

99. Column 8 of Raz also explains that the label encoding the serial number of the subport is sent to a preceding node:

> Once a subport is assigned, a label is generated so as to indicate the subport assignment. The label is then sent to the requesting node or to a management entity to complete the LSP setup process. In case the label is sent to a management entity, the management entity is adapted to **send the label to the upstream node in order for the upstream node to know how to label packets belonging to this LSP**.

EX1006, Col. 8:4-10 (emphasis added); see EX1006, Col. 9:49-58.

100. Further, as discussed above for Elements [1.0]-[1.2], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in

MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network to facilitate the transmission of packet streams.

101. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.3].

[1.4] receiving from the preceding node, by said first MPLS/LAG switch, a data packet comprising said data packet label, in which said port serial number of said single physical tunnel port is encoded; and

102. It is my opinion that Element [1.4] is obvious in view of Raz. EX1001, 9:40-43.

103. It is my opinion that Raz discloses receiving, from a preceding node, a data packet comprising the data packet label in which the port serial number of physical subport is encoded. Raz explains that a LSR receives a packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated:

> When a packet for the provisioned LSP is received over a link connected to LSR A, it is forwarded to subport 3 and subsequently out over the 10G link to LSR B with the previously assigned label indicating subport 3. The port forwarding module in LSR B examines the label in the received packet and in response thereto forwards the packet to subport 3 for packet processing.

EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, Figures 3-4. As discussed above for Element [1.2], the serial number for the physical tunnel subport is encoded within the data packet label. Raz further states that data packet label is sent to the "upstream node" in its LSP "in order for the upstream node to know how to label packets belonging to this LSP." EX1006, Col. 8:7-10. In addition, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and **received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet**." Exhibit 1006, Col. 14:23-26 (emphasis added).

104. As discussed above for Elements [1.0]-[1.3], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-

16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz to facilitate the transmission of packet streams.

105. Accordingly, it is my opinion that that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.4].

[1.5] sending said data packet from said first MPLS/LAG switch to a second MPLS/LAG switch via said single physical tunnel port having the port serial number encoded in the data packet label.

106. It is my opinion that Element [1.5] is obvious in view of Raz. EX1001, Col. 9:44-47.

107. It is my opinion that Raz discloses sending a data packet from a first MPLS/LAG switch to a second MPLS/LAG switch via a single physical tunnel port having the port serial number encoded in the data packet label. For example, LSR B in the example described in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. A POSA would have understood that the data packet in LSR B could be sent to another LSR (which corresponds to the claimed second MPLS/LAG switch) via a physical tunnel subport (subport 3) having the port serial number encoded in the data packet label, as shown below:

> The port forwarding module in LSR B examines the label in the received packet and in response thereto forwards the packet to subport 3 for packet processing.

EX1006, Col. 7:39-45; see EX1006, Cols. 7:17-29, 9:29-58, Figures 3-4. Further, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet." Exhibit 1006, Col. 14:23-26.

108. As discussed above for Elements [1.0]-[1.4], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. Also as discussed for elements [1.0] - [1.4], a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

109. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [1.5], and claim 1 as a whole is obvious in view of Raz.

b. Claim 2

[2] The method of claim 1, further comprising the step of receiving from a preceding node located upstream from said first MPLS/LAG switch, by said first MPLS/LAG switch, a request message requesting configuration of said network tunnel, the message further requesting said data packet label associated with said network tunnel.

110. It is my opinion that the element of Claim 2 is obvious in view of Raz. EX1001, Col. 9:48-53. Raz discloses that "the assignment of subports to LSPs" is performed "in response to LSP setup requests." EX1006, Cols. 7:65-8:1. A POSA would have understood that such requests would have come from a preceding node, because the preceding mode needs the information requested in order to transmit the packet in accordance with the disclosed methods. Further, Raz explains that:

> Once a subport is assigned, a label is generated so as to indicate the subport assignment. The label is then sent to the **requesting node** or to a management entity to complete the LSP setup process. In case the label is sent to a management entity, the management entity is adapted to **send the label to the upstream node in order for the upstream node to know to label packets belonging to this LSP**.

EX1006, Col. 8:4-10 (emphasis added). It is my opinion that a POSA would have understood from this disclosure in Raz that a preceding or "requesting" node upstream from the MPLS/LAG switch (discussed above in the analysis of Claim 1) sends a request message requesting configuration of the network tunnel (i.e. the LSP)

and requesting that the data packet label associated with the network tunnel be sent to the preceding node so that the preceding node knows the port of the MPLS/LAG switch to which the data packet should be routed through the network tunnel.

111. Accordingly, it is my opinion that Raz discloses and renders obvious the element of Claim 2.

c. Claim 3

[3] The method of claim 2, wherein said request message comprises an RSVP-TE PATH message augmented with a LABEL_REQUEST object.

112. It is my opinion that the element of Claim 3 is obvious in view of Raz and the knowledge of a POSA. EX1001, Col. 9:54-56. Raz states that "the principles of the present invention are described in the context of an MPLS based network employing any suitable routing such as OSPF-TE and signaling such as **RSVP-TE signaling** or uses management-plane based provisioning instead or in addition thereto." EX1006, Col. 6:46-50 (emphasis added). A POSA would have understood from this disclosure that the request message used to request the configuration of a network tunnel and to seek transmission of the data packet label associated with the tunnel would have been an RSVP-TE PATH message. Moreover, it would have been within the knowledge of a POSA that the RSVP-TE PATH message disclosed in Raz would have contained a LABEL_REQUEST object as part of the request message. As indicated by Raz, RSVP-TE signaling would have been a well-known signaling technique used in a MPLS environment, and a LABEL_REQUST object

would have been a technique that was well-known to a POSA for establishing an LSP tunnel used to transmit a data packet using RSVP-TE signaling. EX1006, Cols. 1:36-39 ("LSPs may be setup using any suitable signaling protocol such as RSVP-TE or CR-LDP or using the management plane (e.g., NMS setting the relevant MIB items that create the LSPs."), 5:10, 6:46-50; see EX1010, Section 4.2.4 (discussing the common use of a LABEL_REQUEST object to establish a LSP tunnel when using RSVP-TE).

113. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 3.

d. Claim 4

[4] The method according to claim 3, wherein said request comprises an indication of a service property, and wherein said selecting comprises identifying a physical port in compliance with said service property.

114. It is my opinion that the element of Claim 4 is obvious in view of Raz and the knowledge of a POSA. EX1001, Col. 9:57-60. A POSA would have understood from the disclosure in Raz that it would have been obvious to include an indication of a service property in the request message received from the node preceding the MPLS/LAG switch. For example, Raz explains that its "invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the

bandwidth of the link (e.g., for [Excess Information Rate] traffic)." EX1006, Col. 11:3-8. "The central idea is to leave one or more subports empty (i.e., no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. A POSA would have understood that Raz's focus on allocation of bandwidth to accommodate "a wide connection" is another way of saying that the request message has an indication of a service property (i.e., the amount of bandwidth needed to accommodate the wide connection). Further, Raz provides an example of its system being used to provide a network tunnel for traffic requiring a Committed Information Rate ("CIR"), which a POSA would have understood to be a service property. EX1006, Cols. 10:60-11:2; see EX1006 Cols. 1:59-61, 4:40, 11:55-59, Figure 5.

115. Further, a POSA would have understood from these disclosures in Raz that the physical port of the MPLS/LAG switch is selected based on whether it can comply with the required service property—i.e. provide the bandwidth needed. EX1006, Cols. 10:60-11:12, 11:55-59. Raz provides the example its system identifies and assigns a subport or port that has the bandwidth available to meet the required CIR, which is a service property. EX1006, Cols. 10:60-11:12.

116. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 4.

e. Claim 5

[5] The method according to claim 4, wherein said service property comprises at least one of: a guaranteed bandwidth; a peak bandwidth; and a class of service.

117. It is my opinion that the element of Claim 5 is obvious in view of Raz. EX1001, Col. 9:61-63. As discussed above for Claim 4, Raz discloses accommodation of "wide connections" that have a certain Committed Information Rate or CIR. EX1006, Cols. 10:60-11:2 see EX1006 Cols. 1:59-61, 4:40, 11:55-59, Figure 5. A POSA would have understood that the CIR is a service property, and CIR is another way of saying a guaranteed bandwidth.

118. Accordingly, it is my opinion that Raz discloses and renders obvious the element of Claim 5. Alternatively, it would have been within the knowledge of a POSA, in view of the discussion of bandwidth allocation in Raz, that the service property being accommodated would have been any one of a guaranteed bandwidth, a peak bandwidth or a class of service. EX1006, Cols. 10:60-11:12; see EX1006 Cols. 1:59-61, 4:40, 11:55-59, Figure 5.

f. Claim 6

[6] The method according to claim 1, wherein said selecting comprises selecting a single physical tunnel port having a maximum available bandwidth of said plurality of physical data ports.

119. It is my opinion that the element of Claim 6 is obvious in view of Raz. EX1001, Col. 9:64-67. A POSA would have understood that certain subports (or ports) are available and would be selected based on their ability to handle the

bandwidth required for a high speed packet stream. The selection of a support (or port) having the maximum available bandwidth would have been a straightforward thing to do for a POSA. Indeed, a POSA would have understood from the following disclosure in Raz to select a single physical tunnel port having the necessary available bandwidth from among the plurality of available physical data ports of an MPLS/LAG switch:

> The invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for EIR traffic). The central idea is to **leave one or more subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated**.

EX1006, Col. 11:3-10 (emphasis added). Further, Raz describes an embodiment of its method in Figure 5 and explains that, in the method, "the subport having the **most free bandwidth** is used." EX1006, Col. 11:13-59 (emphasis added), Figure 5. Moreover, it is my opinion that a POSA would have understood to select the subport or port with the most available bandwidth to handle a high speed packet stream requiring wide bandwidth.

120. Accordingly, it is my opinion that Raz discloses and renders obvious the element of Claim 6.

g. Claim 7

[7] The method according to claim 1, wherein said selecting comprises selecting a port having a minimum available bandwidth of said plurality of physical data ports which is not less than said bandwidth requirement of the network tunnel.

121. It is my opinion that the element of Claim 7 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:1-4. A POSA would have understood that certain subports (or ports) are available and must provide the minimum bandwidth needed to forward packets in a high speed data stream. The selection of a support (or port) having a minimum available bandwidth which is not less than the bandwidth requirement of the network tunnel would have been a straightforward concept for a POSA. Indeed, a POSA would have understood that Raz discusses a situation where the minimum available bandwidth of each of its subports needs to be sufficient to handle the bandwidth of a wide connection. EX1006, Cols. 10:60-11:12. Raz then discloses that its system is arranged to address this situation. For example, the system in Raz may "leave one or more of the subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. Further, Raz explains its "bandwidth allocation method" in connection with Figure 5 to demonstrate how a subport is selected that has a minimum available bandwidth available that is not less than the bandwidth required by the network

tunnel (i.e., the LSP). EX1006, Col. 11:13-59. As discussed above for Claim 1, a POSA would have understood from this disclosure in Raz to select a port of a MPLS/LAG switch that has a minimum available bandwidth that is not less than the bandwidth required by a network tunnel handling a high speed packet stream.

122. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 7.

h. Claim 8

[8] The method according to claim 1, wherein said switching said data packet is according to a mapping function.

123. It is my opinion that the element of Claim 8 is obvious in view of Raz. EX1001, Col. 10:5-6.

124. I note that Claim 8 is dependent on Claim 1, and Claim 8 refers to "said switching said data packet." I understand that this language would generally be used to refer back to switching of a data packet recited in Claim 1. However, Claim 1 does not specifically discuss switching of a data packet. As such, it is unclear what is meant when Claim 8 recites "said switching said data packet."

125. Nonetheless, however that phrase would be interpreted, a POSA would have understood that Raz renders it obvious to switch data packets "according to a mapping function." Raz discloses an example embodiment of its invention is which each of the LSRs has "10 subports wherein each subport is **mapped** to an 8K range of labels" and a POSA would have understood that the appropriate LSP for a high

speed packet stream is provisioned based on this mapping function. EX1006, Col. 7:30-48 (emphasis added).

126. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 8.

i. Claim 9

[9] The method according to claim 1, wherein said preparing comprises inserting into said data packet label a set of bits that identify said single physical tunnel port; and wherein said switching said data packet comprises extracting said set of bits to determine an identity of said single physical tunnel port.

127. It is my opinion that the element of Claim 9 is obvious in view of Raz for the same reasons as those discussed above for Elements [1.2] and [1.5]. EX1001, Col. 10:7-12.

128. I note that Claim 9 is dependent on Claim 1, and Claim 9 refers to "said switching said data packet." I understand that this language would generally be used to refer back to switching of a data packet recited in Claim 1. However, Claim 1 does not specifically discuss switching of a data packet. As such, it is unclear what is mean when Claim 8 recites "said switching said data packet."

129. Nonetheless, however that phrase would be interpreted, a POSA would have understood that Claim 9 is obvious in view of Raz. As explained above for Element [1.2], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) that identify a physical subport of the LAG:

> Consider an LSP to be setup through LSR A to LSR C. When the LSP is signaled, the CAC in LSR C decides to provision the LSP on subport 1 and therefore assigns the label 0x22003. With reference to [Figure], each label 140 comprises 20 bits or 5 nibbles where the first three bits indicate 1 of 8 line interface cards, **bits 16 to 13 indicate the subport** and bits 12 to 0 indicate the actual label. In this example, the label 0x22003 indicates line interface card 1, subport 1 and label 3.
>
> The label generated by LSR C is communicated to LSR B which tells LSR B that the outbound subport (to LSR C) should be subport 1. **The CAC in LSR B determines that the best subport for receiving the LSP is on subport 0 on the inbound link and therefore assigns a label of 0x40005. This label indicates line interface card 2, subport 0 and label 5.** The label is communicated to LSR A who then knows by the output label that it is to assign the LSP to subport 0. The provisioned path indicating the LSR ports and subports is represented by the dotted line 53.

EX1006, Col. 9:41-58, Figure 4. In my opinion, a POSA would consider this to be the same as inserting the bits into the data packet label.

130. Further, a POSA would have understood from Raz to extract the bits from the label to identify the physical tunnel port onto which to switch the data packets from the high speed packet stream. Raz explains that its system examines the data packet label to determine the physical tunnel subport over which the packet should be forwarded from one LSR to another:

> When a packet for the provisioned LSP is received over a link connected to LSR A, it is forwarded to subport 3 and subsequently out over the 10G link to LSR B with the previously assigned label indicating subport 3. **The port forwarding module in LSR B examines the label in the received packet and in response thereto forwards the packet to subport 3 for packet processing**.

EX1006, Col. 7:39-45 (emphasis added); see EX1006, Cols. 7:17-29, 9:29-58, Figures 3-4. As discussed above, a sub-set of bits in the data packet label identifies the physical tunnel subport to be used. EX1006, Col. 9:41-58, Figure 4. Further, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet." Exhibit 1006, Col. 14:23-26. A POSA would have understood from these disclosures that the bits within the data packet label are extracted to determine the identity of the single physical subport to use for the transmission of the high speed packet stream.

131. Further, it is my opinion that it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of inserting a set of bits in MPLS label 140 and extracting bits from that label to identify a physical subport, and extend that to inserting a set of bits in an MPLS label and extracting bits from that label to identify the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

132. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 9.

j. Claim 10

[10] The method according to claim 1, wherein said preparing comprises storing said data packet label along with an identifier of said single physical tunnel port in a memory, and wherein said switching said data packet comprises retrieving said identifier from said memory responsively to said data packet label.

133. It is my opinion that the element of Claim 10 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:13-18. It is my opinion that a POSA would have known to store the data packet label along with an identifier of

the physical tunnel subport to be used to forward data packets in memory, which is a common element of computer network hardware. A POSA would have understood that label switching commonly requires storing a label and the associated subport (or port) to enable forwarding of received packets. Further, it would have been understood that, when a data packet label was received, an identifier would be retrieved from the memory so that it could be used to forward that data packet to the identified physical tunnel subport.

134. Further, it is my opinion that it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz relating to using a memory to identify a physical subport, and extend that to using a memory to identify the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

135. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 10.

k. Claim 11

[11] The method according to claim 1, further comprising the steps of: selecting a backup port from among the plurality of physical data ports, different from

said single physical tunnel port; and responsively to a service interruption of said single physical tunnel port, switching said data packet to said backup port and sending said data packet to said second MPLS/LAG switch via said backup port.

136. It is my opinion that the element of Claim 11 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:19-25. Raz discloses the uses of "rerouting" to change "the route of a traffic path" if there is a "fault on the working path":

> **Rerouting** is defined as a procedure for **changing the route of a traffic path**. Rerouting can serve as a recovery mechanism in which the broken path, the recovery path or segments of these paths are created dynamically after **the detection of a fault on the working path**. In other words, rerouting can serve as a recovery mechanism in which the recovery path is not pre-established. Rerouting can also serve as an optimization mechanism in which path routes are dynamically changed to ones that are better suited for current network conditions

EX1006, Col. 5:20-28 (emphasis added). Further, Raz explains that "[t]he recovery path is the path by which traffic is restored after the occurrence of a fault, i.e., the path over which the traffic is directed by the recovery mechanism." EX1006, Col. 5:51-53; see EX1006, Col. 10:12-56. Raz also discloses that "[a] switchover is the process of switching the traffic from the path that the traffic is flowing on onto one or more alternate path(s)." EX1006, Col. 5:27-59. "This may involve moving traffic

from a working path onto one or more recovery paths, or may involve moving traffic from a recovery path(s) on to a more optimal working path(s)." EX1006, Col. 5:59-62.

137. A POSA would have understood these disclosures in Raz to disclose the elements of Claim 11 of the '602 Patent. First, Claim 11 recites "selecting a backup port from among the plurality of physical data ports, different from said single physical tunnel port." EX1001, Col. 10:20-23. A POSA would have understood from the disclosure of "rerouting" in Raz that one way to address faults is to select a backup subport from the plurality of available physical data subports that can be used to transmit the high speed packet stream if the previously selected physical data subport suffers a fault. EX1006, Cols. 5:20-59, 10:12-56. A POSA would have known that the backup subport is different from the primary physical tunnel subport because the purpose of rerouting is to have the ability to send packets along an "alternate path" if the primary physical tunnel subport suffers a fault. EX1006, Cols. 5:20-28, 5:51-62, 10:12-56.

138. Second, Claim 11 recites "responsively to a service interruption of said single physical tunnel port, switching said data packet to said backup port and sending said data packet to said second MPLS/LAG switch via said backup port." EX1001, Col. 10:23-26. A POSA also would have understood this claim element to be taught by the disclosure of "rerouting" in Raz. EX1006, Cols. 5:20-59, 10:12-56.

A POSA would have understood the discussion of dealing with faults in Raz to be synonymous with a service interruption. EX1006, Col. 5:20-28, 5:51-53. A POSA would have known from Raz that, if a fault (i.e., service interruption) occurs with the primary physical data subport, the packets in the high speed packet stream would have been rerouted through a "switchover" process that uses the backup port in order to send the packets along an "alternate path" to the second MPLS/LAG switch. EX1006, Col. 5:20-62.

139. Further, it is my opinion that a POSA would have found it obvious that the discussion of rerouting between different subports to avoid a fault in Raz would have been applicable to rerouting between different ports on MPLS/LAG switches in an MPLS network. A POSA would have known to apply the same logic of identifying an alternate path for sending data packets through a backup port if a fault (i.e. a service interruption) occurs in the primary physical tunnel port through which the packets are normally sent.

140. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 11.

l. Claim 12

[12] The method according to claim 11, further comprising the step of responsive to a restoral of said service interruption of said single physical tunnel port, reverting switching of said data packet from said backup port and sending said data packet to said second MPLS/LAG switch via said single physical tunnel port.

141. It is my opinion that the element of Claim 12 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:26-31. In addition to the rerouting of traffic discussed above for Claim 11, Raz also discloses a "revertive mode" that operates as "a recovery mode in which traffic is automatically switched back from the recovery path to the original working path upon the restoration of the working path to a fault-free condition. EX1006, Col. 5:64-67. Further, Raz explains that "[a] switchback is the process of returning the traffic from one or more recovery paths back to the working path(s)." EX1006, Col. 5:62-63.

142. A POSA would have understood from these disclosures in Raz that, upon the elimination of a fault condition (i.e., the restoral of a service interruption), the system in Raz would revert to using the LSP through the primary physical data port to forward the high speed packet stream instead of using the backup port.

143. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 12.

m. Claim 13

[13] The method according to claim 1, wherein said first MPLS/LAG switch comprises a Label Switched Router (LSR).

144. It is my opinion that the element of Claim 13 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:32-34. Raz repeatedly discloses that the device used to switch high speed packet streams in a LAG in an MPLS environment is a LSR, as shown below in Figure 1 of Raz. See EX1006, Cols. 6:9-

20, 6:63-8:13, 10:33-48, Figure 3. Further, as discussed above for Element [1.1], a POSA would have understood that the LSR would have functioned as a MPLS/LAG switch.

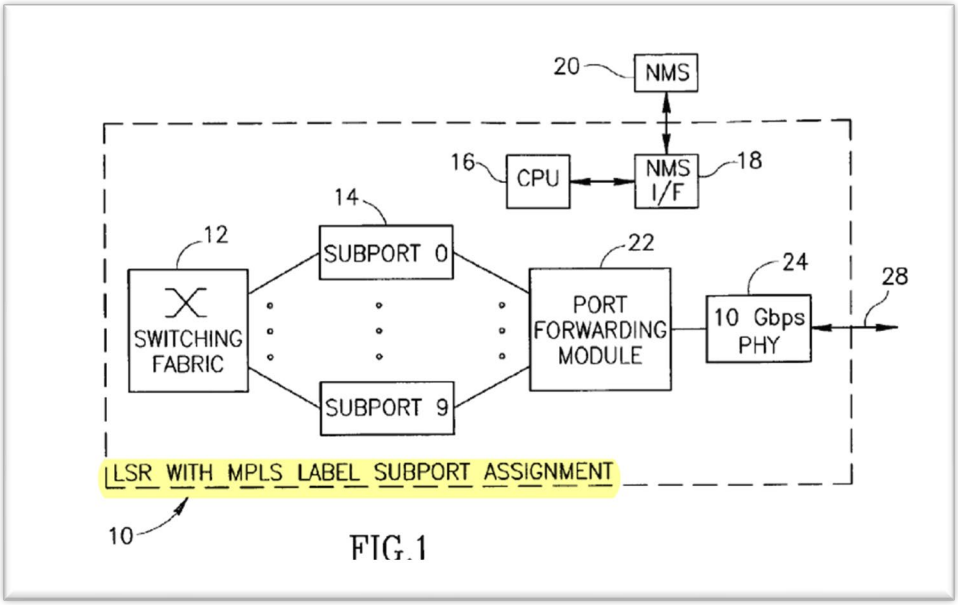

Figure 1 of Raz (Annotated)

145. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 13.

n. Claim 15

[15.0] An apparatus for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) located downstream from a preceding node in a MultiProtocol Label Switching (MPLS) network tunnel employing Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning, the LAG having a first MPLS/LAG switch and a second MPLS/LAG switch, the apparatus comprising:

146. It is my opinion that Element [15.0] is obvious in view of Raz. EX1001, Col. 10:41-48.

147. Raz discloses the use of an apparatus for implementing its system for communicating packets within a high speed packet stream. Specifically, Raz discloses that its system can be implemented using a processor, a FPGA, an ASIC, or a combination of those apparatuses. EX1006, Cols. 2:33-40, 7:54-8:13, 12:25-30, 12:57-31:1, 13:56-61.

148. Further, as discussed above for Element [1.0], Raz explains that its apparatus can be used to communicate packets within an MPLS network. EX1006, Abstract, Col. 1:40-55. Indeed, Figure 1 of Raz (shown below) demonstrates that the system of Raz is implemented in an MPLS network:

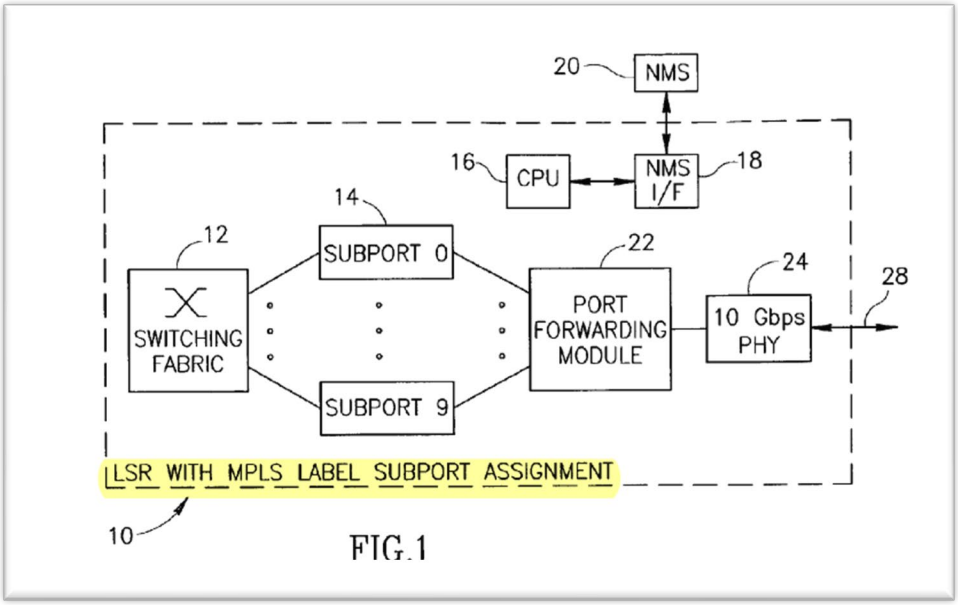

Figure 1 of Raz (Annotated)

Further, the specification and claims of Raz states that its system is implemented in an MPLS network tunnel. EX1006, Col. 7:17-29; see Cols. 7:7-16, 9:9-48, 11:3-12,

14:30-32 (Claim 3), 14:50-52 (Claim 10), 16:63-65 (Claim 26), 17:14-16 (Claim 43). Raz also discloses that its MPLS tunnel employs Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning:

> For illustration purposes, the principles of the present invention are described in the context of an **MPLS based network** employing any suitable routing such as OSPF-TE and signaling such as **RSVP-TE signaling** or uses management-plane based provisioning instead or in addition thereto.

EX1006, Col. 6:46-50 (emphasis added); see EX1006, Cols. 1:36-39, 5:10.

149. In addition, Raz teaches the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. Within the LSRs, individual packets from a high speed data stream are assigned to one of a plurality of subports for transportation through the LSR and then re-aggregated into the high speed packet stream before being forwarded to the next node in a network (such as the next LSR). EX1006, Cols. 2:41-67, 6:34-45. Figure 1 of Raz (shown below) provides an example of ten subports (Subport 0-Subport 9) used to implement link aggregation within an LSR in an MPLS environment:

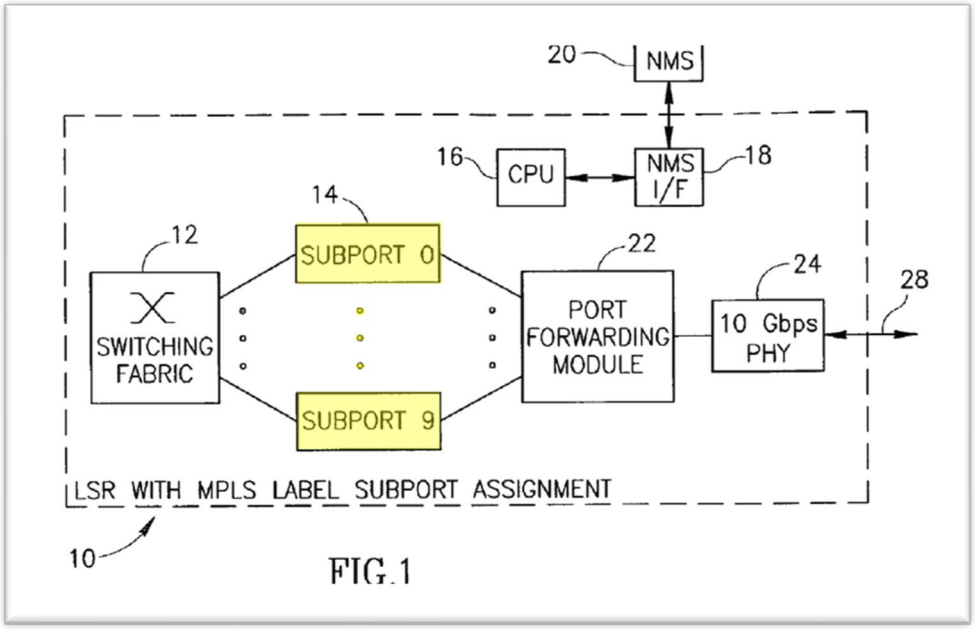

Figure 1 of Raz (Annotated)

The specification of Raz explains that the link aggregation is used to transport a high speed packet stream through a plurality of subports of lesser speed within a LSR. EX1006, Cols. 7:7-16, 9:9-12, 14:19-22 (Claim 1), 15:32-35 (Claim 17), 16:41-53 (Claim 33), 17:62-18:7 (Claim 50), 18:39-42 (Claim 52), 19:3-7 (Claim 55). In addition, Raz teaches that that its invention could be implemented in Ethernet networks. EX1006, Cols. 1:16-19, 2:28-31, 4:52, 13:16-19, 14:42-44, 15:56-58. For example, Raz discloses transmission speeds of 1G and 10G used by its system, which a POSA would have understood to be speeds used by Ethernet networks. See EX1006, Col. 7:7-29.

150. As discussed above for Element [1.0], while Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet

streams in an MPLS network, it is my opinion that a POSA similarly would have known to use Ethernet physical data ports of a router or switch that are downstream of a preceding node in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concepts used to communicate individual packets of a high speed packet stream through subports in a LSR also apply to communicating individual packets through Ethernet physical data ports of routers or switches in a MPLS network.[2] In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream.

151. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [15.0].

[15.1] a processor, which is configured to:

152. It is my opinion that Element [15.1] is taught by Raz. EX1001, Col. 10:49.

153. Raz discloses that its invention "is suited for implementation in hardware such as a network **processor** adapted to implement the mechanism of the present invention, software or a combination of hardware and software." EX1006,

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[2] As discussed above for Element [1.1], a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. See EX1009; EX1006, Col. 7:7-16.

Col. 2:33-36 (emphasis added); see EX1006, Cols. 2:36-40, 3:39, 7:54-8:13, 12:25-30, 12:57-31:1, 13:56-61.

154. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.1].

[15.2] assign a single physical tunnel port of a LAG to a network tunnel, wherein said single physical tunnel port meets a bandwidth requirement of the network tunnel, and wherein said single physical tunnel port has a port serial number.

155. It is my opinion that Element [15.2] is obvious in view of Raz. EX1001, Col. 10:50-54.

156. As discussed above for Element [1.1], Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR. EX1006, Col. 3:1-15 (discussing the assignment of "outbound packets to one of a plurality of subports in accordance with the label associated with each outbound packet."). Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1," which is reproduced below. EX1006, Col. 6:65-67; see Col. 7:17-19 ("In accordance with the invention, the assignment of traffic to 1G subports is based on LSPs. Thus, the MPLS label is used in order to assign an incoming packet to **one of the subports**.") (emphasis added), 7:26-27 ("Note that it is the downstream (i.e. receiving) node that determines the subport it wants to receive the LSP on.).

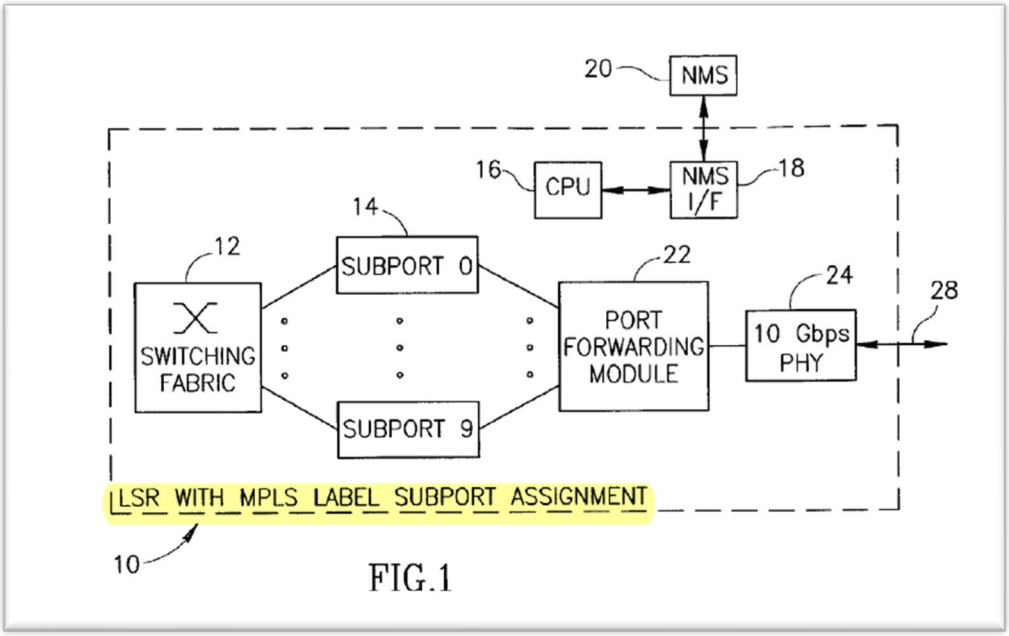


Figure 1 of Raz (Annotated)

157. Additionally, Raz provides an example of how the assignment process takes place, and that example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch:

> The CPU 16 in the LSR performs the conventional LSR functionality including the provisioning of LSPs. **In particular, the CPU functions to perform the assignment of subports to LSPs in response to LSP setup requests.** The CPU executes a bandwidth allocation algorithm, described in more detail infra, that controls the allocation of bandwidth of each subport. **Once a subport is assigned, a label is generated so as to indicate the subport assignment.** The label is then sent to the

> requesting node or to a management entity to complete the LSP setup process. In case the label is sent to a management entity, the management entity is adapted to send the label to the upstream node in order for the upstream node to know how to label packets belonging to this LSP. The LSR also comprises an NMS interface 18 for interfacing an external NMS 20 which is in communication with the network to the CPU 16.

EX1006, Col. 7:65-8:13 (emphasis added); see EX1006, Cols. 7:30-38 (providing example in which the assignment of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. A POSA would have understood that the set of packets that are using a particular MPLS label would form a network tunnel. As discussed above for Element [1.1], it would have been common knowledge to a POSA as of the priority date that a LSP could be used to implement a network tunnel. See EX1008, Section 3.27.3.

158. Further, as discussed above for Element [1.1], a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR.

EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels.

159. In addition, as discussed above for Element [1.1], Raz explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel). EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:22-26, 7:7-16, 11:13-12:9, Figure 5. Claims 4-6, 20-22 and 37-39 of Raz also require that each subport be "capable of handling" a traffic stream of a certain bandwidth. EX1006, Cols. 14:33-41, 15:47-55, 16:65-17:6.

160. Moreover, Raz discloses that the assigned subport has a serial number. In discussing Figure 4, Raz explains that the MPLS label contains bits that "indicate the subport," which a POSA would have understood to mean that the subport has a serial number that is indicated by the bits. EX1006, Col. 9:41-48 and Figure 4; see EX1006, Figure 1 (identifying subports numbered 0-9). As discussed above for Element [1.1], a POSA would have understood that a serial number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number.

161. Further, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also could have been used to assign a physical

tunnel port of a network device. Raz teaches that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS is assigned to communicate packets from a high speed data stream. The same principles would have applied to forwarding packets between network devices (such as MPLS/LAG switches) in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the network device to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As also explained in the discussion of element [1.1], POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve the ability to communicate high speed packet streams that require increased bandwidth.

162. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [15.2].

[15.3] dedicate a sub-set of bits in a data packet label to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

163. It is my opinion that Element [15.3] is obvious in view of Raz. EX1001, Col. 10:55-57.

164. As discussed above for Element [1.2], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. The block quote from Raz set out below provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. In the first example discussed in the block quote, LSR C (which corresponds to the first MPLS/LAG switch in that example) dedicates "bits 16 to 13 [to] indicate the subport" (which is subport 1) of a LAG through which a packet should be sent from LSR B to LSR C in Figure 3 of Raz. In the second example, LSR B (which corresponds to the first MPLS/LAG switch in that example) dedicates bits in the label provides to LSR A to identify the subport (which is subport 0) of a LAG through which a packet should be sent from LSR A to LSR B in Figure 3.

> Consider an LSP to be setup through LSR A to LSR C. When the LSP is signaled, the CAC in LSR C decides to provision the LSP on subport 1 and therefore assigns the label 0x22003. With reference to [Figure], each label 140 comprises 20 bits or 5 nibbles where the first three bits indicate 1 of 8 line interface cards, **bits 16 to 13 indicate the subport** and bits 12 to 0 indicate the actual label. In this example, the label 0x22003 indicates line interface card 1, subport 1 and label 3.

> The label generated by LSR C is communicated to LSR B which tells LSR B that the outbound subport (to LSR C) should be subport 1. **The CAC in LSR B determines that the best subport for receiving the LSP is on subport 0 on the inbound link and therefore assigns a label of 0x40005. This label indicates line interface card 2, subport 0 and label 5.** The label is communicated to LSR A who then knows by the output label that it is to assign the LSP to subport 0. The provisioned path indicating the LSR ports and subports is represented by the dotted line 53.

EX1006, Col. 9:41-58 (emphasis added), Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR to indicate the subport through which a packet should be sent constitutes encoding the subport serial number in the label. As discussed above for Element [1.1], a serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

165. As discussed above for Element [1.2] and [1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in physical tunnel ports of a network device in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be

allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

166. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [15.3].

[15.4] publish said packet label upstream;

167. It is my opinion that Element [15.4] is taught by Raz. EX1001, Col. 10:58.

168. As I discussed above for Element [15.3], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. Raz explains that the label encoding the serial number of the subport "is communicated to the **upstream (i.e. sending) node via the label that is assigned to the LSP**." EX1006, Col. 7:26-38 (emphasis added). Further, Raz explains in Column 8 "the management entity is adapted to **send the label to the upstream node in order for the upstream node to know how to label packets belonging to this LSP**." EX1006, Col. 8:4-10

(emphasis added); see EX1006, Col. 9:49-58. The LSR that generates the label corresponds to the claimed MPLS/LAG switch, and it sends the label to the preceding node. In the example described in Column 7 of Raz, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node. EX1006, Col. 7:26-38.

169. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.4].

[15.5] and a mapper, which is configured to:

170. It is my opinion that Element [15.5] is disclosed or obvious in view of Raz. EX1001, Col. 10:59.

171. As discussed above for Elements [1.1] and [15.2], Raz discloses that its apparatus can be implemented using a network processor, a FPGA, an ASIC or a combination of these. EX1006, Cols. 2:3-8, 2:33-40, 3:39, 6:27-29, 7:54-8:13, 12:25-30, 12:57-31, 13:56-61. A POSA would have understood from this disclosure that the apparatus of Raz includes a mapper which performs the functions recited below in Elements [15.6]-[15.8]. A POSA would have understood from Elements [15.6]-[15.8] that the purpose of the mapper is to receive a data packet, detect a data packet label within the data packet, and determine how to forward the data packet in accordance with the label. Raz discloses a forwarding module that performs these

functions and thus corresponds to the mapper recited in Element [15.5]. EX1006, Col. 7:30-58; see EX1006, Col. 9:29-58, Figures 3-4.

172. In view of the above, it is my opinion that Raz discloses or renders obvious Element [15.5].

[15.6] receive a data packet from an upstream node;

173. It is my opinion that Element [15.6] is taught by Raz. EX1001, Col. 10:60.

174. It is my opinion that Raz discloses receiving a data packet comprising the data packet label in which the port serial number of physical subport is encoded from an upstream node. Raz explains that a LSR receives a packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, Figures 3-4. In addition, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and **received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet**." Exhibit 1006, Col. 14:23-26 (emphasis added).

175. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.6].

[15.7] detect said data packet label in said data packet; and

176. It is my opinion that Element [15.7] is disclosed by Raz. EX1001, Col. 10:61.

177. Raz teaches that, when a LSR receives a data packet from an upstream node, the LSR detects the data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, Figures 3-4. Claim 1 of Raz further explains that its LSR detects the data packet label and "forward[s] inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport **in accordance with the label associated with said inbound packet**." Exhibit 1006, Col. 14:23-26 (emphasis added). It is my opinion that a POSA would have known from this disclosure that the data packet label in the data packet is detected by a mapper in Raz in order to forward the packet to a subport identified by the label.

178. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.7].

[15.8] if said data packet contains said data packet label, send said data packet to the second MPLS/LAG switch via said single physical tunnel port.

179. It is my opinion that Element [15.8] is obvious in view of Raz. EX1001, Col. 10:62-64.

180. As discussed above for Element [15.7], Raz discloses, when a data packet is received from an upstream node, the LSR detects the data packet label. Further, Raz explains that a packet received at a first LSR is forwarded to a second

LSR, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be forwarded. For example, LSR B in the example described in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. A POSA would have understood that a data packet in LSR B could be sent to another LSR (which corresponds to the claimed second MPLS/LAG switch) via a physical tunnel subport (subport 3), as shown below:

> The port forwarding module in LSR B examines the label in the received packet and in response thereto forwards the packet to subport 3 for packet processing.

EX1006, Col. 7:39-45; see EX1006, Cols. 7:17-29, 9:29-58, Figures 3-4. As discussed above for Element [15.3], the serial number for the physical tunnel subport is encoded within the data packet label. Further, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet." Exhibit 1006, Col. 14:23-26.

181. As discussed above for Elements [15.0] and [15.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the

bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

182. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [15.8].

o. Claim 16

[16] The apparatus according to claim 15, wherein the processor is configured to make said selection in compliance with a service property.

183. It is my opinion that the element of Claim 16 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 10:65-67. As explained above with respect to Claim 4, a POSA would have understood from the disclosure in Raz that it would have been obvious to include an indication of a service property in the request message received from the node preceding the MPLS/LAG switch. For example, Raz explains that its "invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for [Excess Information Rate] traffic)." EX1006, Col. 11:3-8. "The central idea is to

leave one or more subports empty (i.e., no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. A POSA would have understood that Raz's focus on allocation of bandwidth to accommodate "a wide connection" is another way of saying that the request message has an indication of a service property (i.e., the amount of bandwidth needed to accommodate the wide connection). Further, Raz provides an example of its system being used to provide a network tunnel for traffic requiring a Committed Information Rate ("CIR"), which a POSA would have understood to be a service property. EX1006, Cols. 10:60-11:2; see EX1006 Cols. 1:59-61, 4:40, 11:55-59, Figure 5. Claim 17 also explains that "service property" includes "guaranteed" bandwidth.

184. In addition, a POSA would have understood from these disclosures in Raz that the physical port of the MPLS/LAG switch is selected based on whether it can comply with the required service property. EX1006, Cols. 10:60-11:12, 11:55-59. Raz provides the example its system identifies and assigns a subport or port that has the bandwidth available to meet the required CIR, which is a service property. EX1006, Cols. 10:60-11:12.

185. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 16.

p. Claim 17

[17] The apparatus according to claim 16, wherein said service property comprises at least one of the group consisting of a guaranteed bandwidth, a peak bandwidth, and a class of service.

186. It is my opinion that the element of Claim 17 is obvious in view of Raz. EX1001, Col. 11:1-4. As discussed above for Claims 4 and 16, Raz discloses accommodation of "wide connections" that have a certain Committed Information Rate or CIR. EX1006, Cols. 10:60-11:2 see EX1006, Cols. 1:59-61, 4:40, 11:55-59, Figure 5. A POSA would have understood that the CIR is a service property, and CIR is another way of saying a guaranteed bandwidth.

187. Accordingly, it is my opinion that Raz discloses and renders obvious the element of Claim 17. Moreover, it would have been within the knowledge of a POSA, in view of the discussion of bandwidth allocation in Raz, that the service property being accommodated would have been any one of a guaranteed bandwidth, a peak bandwidth or a class of service. EX1006, Cols. 10:60-11:12; see EX1006, Cols. 1:59-61, 4:40, 11:55-59, Figure 5.

q. Claim 18

[18] The apparatus according to claim 17, wherein said processor is configured to make said selection of a port having a maximum available bandwidth of the plurality of ports.

188. It is my opinion that the element of Claim 18 is obvious in view of Raz. EX1001, Col. 11:5-7. As discussed above for Claim 6, a POSA would have understood from the following disclosure in Raz to select a single physical tunnel

port having the necessary available bandwidth from among the plurality of available physical data ports of an MPLS/LAG switch:

> The invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for EIR traffic). The central idea is to **leave one or more subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated**.

EX1006, Col. 11:3-10 (emphasis added). Further, Raz describes an embodiment of its method in Figure 5 and explains that, in the method, "the subport having the **most free bandwidth** is used." EX1006, Col. 11:13-59 (emphasis added), Figure 5. As discussed above for Claim 6, it is my opinion that a POSA would have understood to select the subport or port with the most available bandwidth to handle a high speed packet stream requiring wide bandwidth.

189. Accordingly, it is my opinion that Raz discloses and renders obvious the element of Claim 18.

r. Claim 19

[19] The apparatus according to claim 17, wherein said processor is configured to make said selection of a port having a minimum available bandwidth of the plurality of ports which is not less than said bandwidth requirement of the network tunnel.

190. It is my opinion that the element of Claim 19 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 11:8-12. As discussed above for Claim 7, Raz discusses a situation where the minimum available bandwidth of each of its subports needs to be sufficient to handle the bandwidth of a wide connection. EX1006, Cols. 10:60-11:12. Raz then discloses that its system is arranged to address this situation. For example, the system in Raz may "leave one or more of the subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. Further, Raz explains its "bandwidth allocation method" in connection with Figure 5 to demonstrate how a subport is selected that has a minimum available bandwidth available that is not less than the bandwidth required by the network tunnel (i.e., the LSP). EX1006, Col. 11:13-59. It is my opinion that a POSA would have understood from this disclosure in Raz to select a port of a MPLS/LAG switch that has a minimum available bandwidth that is not less than the bandwidth required by a network tunnel handling a high speed packet stream.

191. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 19.

s. Claim 20

[20] The apparatus according to claim 15, wherein said processor is configured to insert into said data packet label a set of bits which identify said single physical tunnel port; and wherein said mapper is configured to extract said set of bits to determine an identity of said single physical tunnel port.

192. It is my opinion that the element of Claim 20 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 11:13-17.

193. As explained above for Claim 9, Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) that identify a physical subport of a LAG. EX1006, Col. 9:41-58, Figure 4. It is my opinion that this is the same as inserting the bits into the data packet label. Further, a POSA would have understood from Raz to extract the bits form the label to identify the physical tunnel port onto which to switch the data packets from the high speed packet stream. Raz explains that its system examines the data packet label to determine the physical tunnel subport over which the packet should be forwarded from one LSR to another. EX1006, Col. 7:39-45; see EX1006, Cols. 7:17-29, 9:29-58, Figures 3-4. As discussed above, a sub-set of bits in the data packet label identifies the physical tunnel subport to be used. EX1006, Col. 9:41-58, Figure 4. Further, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet." Exhibit 1006, Col. 14:23-26. A POSA would have understood from these disclosures that the bits within the data packet label are extracted to determine the identity of the single physical subport to use for the transmission of the high speed packet stream.

194. Further, it is my opinion that it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of inserting a set of bits in MPLS label 140 and extracting bits from that label to identify a physical subport, and extend that to inserting a set of bits in an MPLS label and extracting bits from that label to identify the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

195. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 20.

t. Claim 21

[21] The apparatus according to claim 15, further comprising a memory, and wherein said processor is configured to store said data packet label along with an identifier of said single physical tunnel port in said memory, and wherein said mapper is configured to retrieve said identifier from said memory responsively to said data packet label.

196. It is my opinion that the element of Claim 21 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 11:18-23.

197. As discussed above for Claim 10, Raz states that its network device can include a memory for storing executable program code used to "assign outbound packets to one of a plurality of subports in accordance with the label associated with each outbound packet" and for forwarding packets based on the label. EX1006, Col. 3:16-32 (emphasis added); see EX1006, Cols. 12:30-41, 13:36-55, 17:46-18:7. It is my opinion that a POSA would have known to store the data packet label along with an identifier of the physical tunnel subport to be used to forward data packets in memory. A POSA would have understood that label switching commonly requires storing a label and the associated subport (or port) to enable forwarding of received packets. A POSA also would have understood that it would have been obvious that, when the data packet label was received, the identifier would be retrieved from the memory and used to forward that data packets to the identified physical tunnel subport.

198. Further, it is my opinion that it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz relating to using a memory to identify a physical subport,

and extend that to using a memory to identify the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

199. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 21.

u. Claim 22

[22] The apparatus according to claim 15, wherein said processor is further configured to select a backup port from among the plurality of physical data ports, different from said single physical tunnel port, and wherein said mapper is further configured, responsively to a service interruption of said single physical tunnel port, to direct the first MPLS/LAG switch to switch said data packet to said backup port, and send said data packet to the second MPLS/LAG switch via said backup port.

200. It is my opinion that the element of Claim 22 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 11:24-32. As discussed above for Claim 11, Raz discloses the uses of "rerouting" to change "the route of a traffic path" if there is a "fault on the working path." EX1006, Col. 5:20-28. Further, Raz explains that "[t]he recovery path is the path by which traffic is restored after the occurrence of a fault, i.e., the path over which the traffic is directed by the recovery mechanism." EX1006, Col. 5:51-53; see EX1006, Col. 10:12-56. Raz also discloses that "[a] switchover is the process of switching the traffic from the path that the traffic is flowing on onto one or more alternate path(s)." EX1006, Col. 5:27-59. "This may involve moving traffic from a working path onto one or more recovery paths, or may

involve moving traffic from a recovery path(s) on to a more optimal working path(s)." EX1006, Col. 5:59-62.

201. A POSA would have understood these disclosures in Raz to disclose the elements of Claim 22 of the '602 Patent. First, Claim 22 recites "wherein said processor is further configured to select a backup port from among the plurality of physical data ports, different from said single physical tunnel port." EX1001, Col. 11:24-27. A POSA would have understood from the disclosure of "rerouting" in Raz that one way to address faults is to select a backup subport from the plurality of available physical data subports that can be used to transmit the high speed packet stream if the previously selected physical data subport suffers a fault. EX1006, Cols. 5:20-59, 10:12-56. A POSA would have known that the backup subport is different from the primary physical tunnel subport because the purpose of rerouting is to have the ability to send packets along an alternate path if the primary physical tunnel subport suffers a fault. EX1006, Cols. 5:20-28, 5:51-35, 10:12-56.

202. Second, Claim 22 recites "wherein said mapper is further configured, responsively to a service interruption of said single physical tunnel port, to direct the first MPLS/LAG switch to switch said data packet to said backup port, and send said data packet to the second MPLS/LAG switch via said backup port." EX1001, Col. 11:27-32. A POSA also would have understood this claim element to be taught by the disclosure of "rerouting" in Raz. EX1006, Cols. 5:20-59, 10:12-56. A POSA

would have understood the discussion of dealing with faults in Raz to be synonymous with a service interruption. EX1006, Col. 5:20-28, 5:51-53. A POSA would have known from Raz that, if a fault (i.e., service interruption) occurs with the primary physical data subport, the packets in the high speed packet stream would have been rerouted by a mapper through a "switchover" process that uses the backup port in order to send the packets along an "alternate path" to the second MPLS/LAG switch. EX1006, Col. 5:20-62.

203. Further, it is my opinion that a POSA would have found it obvious that the discussion of rerouting between different subports to avoid a fault in Raz would have been applicable to rerouting between different ports on MPLS/LAG switches in an MPLS network. A POSA would have known to apply the same logic of identifying an alternate path for sending data packets through a backup port if a fault (i.e. a service interruption) occurs in the primary physical tunnel port through which the packets are normally sent.

204. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious the element of Claim 22.

v. Claim 23

[23] The apparatus according to claim 15, wherein said first MPLS/LAG switch comprises a Label Switched Router (LSR).

205. It is my opinion that the element of Claim 23 is obvious over Raz in view of the knowledge of a POSA. EX1001, Col. 11:33-35. As discussed above for

Claim 13, Raz discloses that the device used to switch high speed packet streams in a LAG in an MPLS environment is a LSR, as shown below in Figure 1 of Raz. EX1006, Cols. 6:9-20, 6:63-8:13, 10:33-48, Figure 1. Further, as discussed above for Element [1.1], a POSA would have understood that the LSR would have functioned as a MPLS/LAG switch. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Claim 23.

w. Claim 24

[24] The apparatus according to claim 15, wherein said processor comprises a network processor.

206. It is my opinion that the element of Claim 24 is obvious in view of Raz. EX1001, Col. 11:36-37. Raz states in multiple places that its invention was invention could have been implemented on a network processor. EX1006, Cols. 1:65-2:8, 2:33-40, 6:24-33, 7:54-62, 11:24-29, 12:25-41, 12:51-53, 12:66-13:19, 13:56-61, 14:46-49, 15:59-62, 17:10-13. Accordingly, it is my opinion that Raz discloses and renders obvious Claim 24.

x. Claim 26

[26.0] A method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network, the method comprising the steps of:

207. It is my opinion that Element [26.0] is obvious in view of Raz. EX1001, Col. 12:4-7.

208. As discussed above for Element [1.0], Raz discloses the communication of packets within a MPLS network. EX1006, Abstract, Col. 1:40-55. Figure 1 of Raz states that the system of Raz is implemented in an MPLS network:

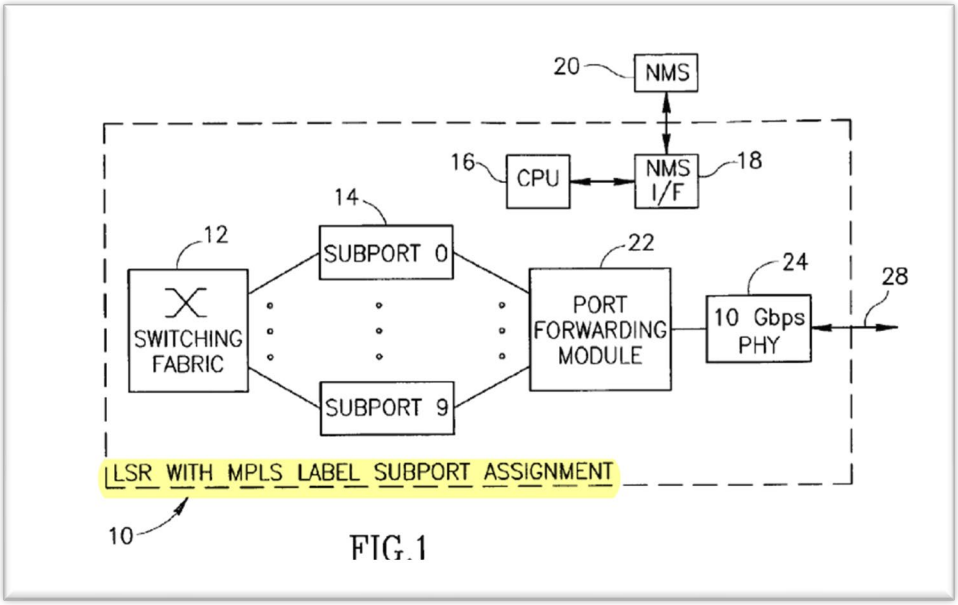


Figure 1 of Raz (Annotated)

The specification and claims of Raz likewise indicate that its system is implemented in an MPLS network. EX1006, Cols. 7:7-29, 9:9-48, 11:3-12, 14:30-32 (Claim 3), 14:50-52 (Claim 10), 16:63-65 (Claim 26), 17:14-16 (Claim 43).

209. Further, Raz discloses the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. Within the LSRs, individual packets from a high speed data stream are assigned to one of a plurality of subports for transportation through the LSR and then re-aggregated into the high

speed packet stream before being forwarded to the next node in a network (such as the next LSR). EX1006, Cols. 2:41-67, 6:34-45. Figure 1 of Raz (shown below) provides an example of ten subports (Subport 0-Subport 9) used to implement link aggregation within an LSR in an MPLS environment:

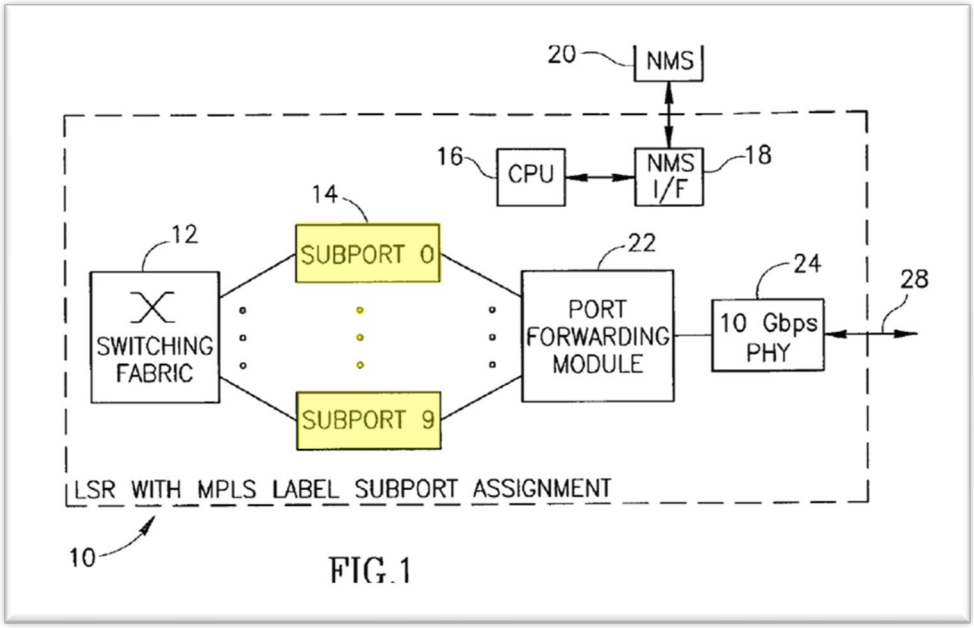


Figure 1 of Raz (Annotated)

The specification of Raz explains that the link aggregation is used to transport a high speed packet stream through a plurality of subports of lesser speed within a LSR. EX1006, Cols. 7:7-16, 9:9-12, 14:19-22 (Claim 1), 15:32-35 (Claim 17), 16:41-53 (Claim 33), 17:62-18:7 (Claim 50), 18:39-42 (Claim 52), 19:3-7 (Claim 55). Further, Raz specifically references using its technology at speeds (such as 1G and 10G) that a POSA would have understood to be for Ethernet packet streams. See EX1006, Col.

7:7-29; see also EX1006, Cols. 1:16-19, 2:28-31, 13:16-19, 14:42-44, 15:56-58, 17:7-9.

210. As discussed above for Element [1.0], while Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet streams in an MPLS network, it is my opinion that a POSA similarly would have known to use Ethernet physical data ports of a router or switch in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concept of using aggregation to communicate individual packets of a high speed packet stream through subports in a LSR also applies to communicating individual packets through Ethernet physical data ports of routers or switches in a MPLS network. In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream.

211. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.0].

[26.1] receiving from a preceding node located upstream from a first MPLS/LAG switch, at said first MPLS/LAG switch, a request message requesting configuration of a network tunnel, the message further requesting a data packet label associated with said network tunnel, said request message specifying a bandwidth requirement;

212. It is my opinion that Element [26.1] is obvious in view of Raz. EX1001, Col. 12:8-13.

213. As discussed above for Claim 2, Raz discloses that a preceding node located upstream of an LSR will send a request message seeking a label that will provide the configuration of the subports that form the network tunnel.[3] EX1006, Col. 7:65-8:13. Further, it is my opinion that Raz's focus on ensuring that the subports have sufficient bandwidth for communicating the packet in a high speed packet stream demonstrates that it would have been obvious that the request message would specify a bandwidth requirement. EX1006, Cols. 2:23-25, 7:7-26, 11:3-12:9, 14:33-41, 15:47-55, 16:65-17:6, Figure 5.

214. Further, as discussed above for Elements [1.0]-[1.1] and Claim 7, it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending

[3] As discussed above for Element [1.1], a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. See EX1009; EX1006, Col. 7:7-16.

a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

215. In view of the above, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.1].

[26.2] assigning, at the first MPLS/LAG switch, a single physical tunnel port of a LAG to the network tunnel wherein the single physical tunnel port of the LAG, which meets the specified bandwidth requirement, wherein said single physical tunnel port of said LAG has a port serial number;

216. It is my opinion that Element [26.2] is obvious in view of Raz. EX1001, 12:14-19.

217. As discussed above for Element [1.1], Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR to communicate individual packets within a high speed packet stream. EX1006, Col. 3:1-15. Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1," which is reproduced below. EX1006, Col. 6:65-67 (emphasis added); see EX1006, Col. 7:17-19, 7:26-27.

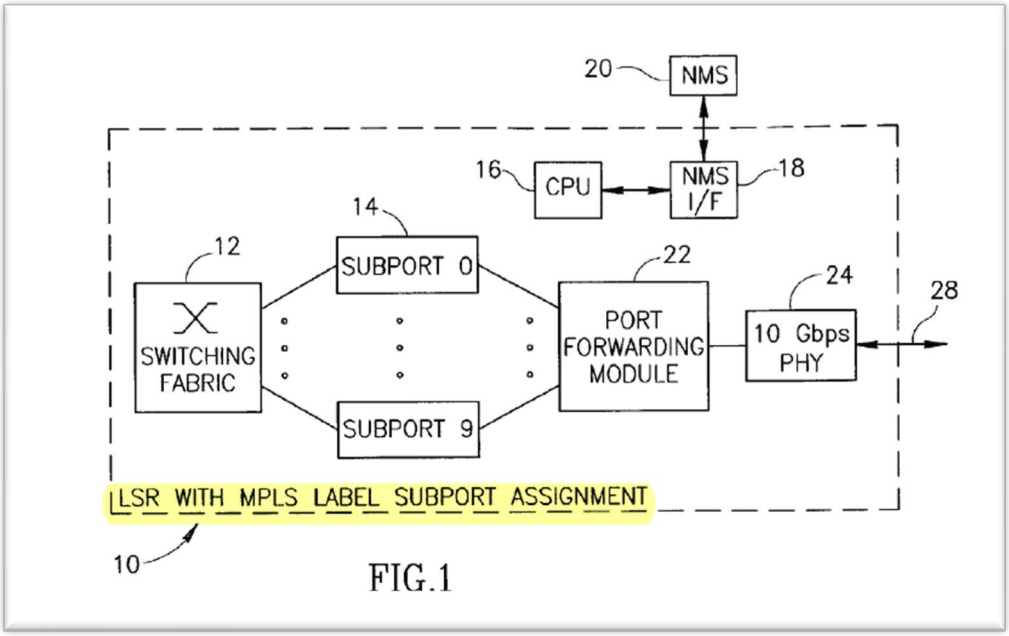


Figure 1 of Raz (Annotated)

Raz also provides an example of how the assignment process takes place, and that example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch. EX1006, Col. 7:65-8:13; see EX1006, Cols. 7:30-38 (providing example in which the assignment of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. As discussed above for Element [1.1], it would have been common knowledge to a POSA as of the

priority date that a LSP could be used to implement a network tunnel. See EX1008, Section 3.27.3.

218. Further, as discussed above for Element [1.1], a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR. EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels.

219. Moreover, as discussed above for Claims 4 and 5, Raz explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel). EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-26, 11:13-12:9, Figure 5. Further, Claims 4-6, 20-22 and 37-39 of Raz require that each subport be "capable of handling" a traffic stream of a certain bandwidth. EX1006, Cols. 14:33-41, 15:47-55, 16:65-17:6.

220. In addition, Raz discloses that the assigned subport has a serial number. In discussing Figure 4, Raz explains that the MPLS label contains bits that "indicate the subport," which a POSA would have understood to mean that the subport has a serial number that is indicated by the bits. EX1006, Col. 9:41-48, Figure 1, 4. As discussed above for Element [1.1], a POSA would have understood that a serial

number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number.

221. Moreover, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also could have been used to assign a physical tunnel port of a MPLS/LAG switch to a network tunnel. As discussed above for Element [1.1], a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch.

222. Moreover, as discussed above in Element [1.1], Raz teaches that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS (which correlates to a network tunnel) is assigned to communicate packets from a high speed data stream. The same principles would have applied to forwarding packets between MPLS/LAG switches in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the MPLS/LAG switch to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. A POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve

the ability to communicate high speed packet streams that require increased bandwidth.

223. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.2].

[26.3] dedicating a sub-set of bits in a data packet label prepared by said first MPLS/LAG switch to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

224. It is my opinion that Element [26.3] is obvious in view of Raz. EX1001, 12:20-23.

225. As discussed above for Element [1.2], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. EX1006, Col. 9:41-58, Figures 3-4. Raz provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. EX1006, Col. 9:41-58, Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR (which corresponds to the claimed MPLS/LAG switch) constitutes encoding the subport serial number in the label. A serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

226. Further, as discussed above for Elements [1.0]-[1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

227. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.3].

[26.4] sending, by said first MPLS/LAG switch, said data packet label, in which said port serial number of said single physical tunnel port is encoded, to the preceding node;

228. It is my opinion that Element [26.4] is obvious in view of Raz. EX1001, 12:24-26.

229. As discussed above for Element [1.2], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. As discussed above for Element

[1.3], Raz also explains that the label encoding the serial number of the subport is sent to an "upstream" or preceding node. EX1006, Col. 7:26-38. Column 8 of Raz also explains that the label encoding the serial number of the subport is sent to a preceding node. EX1006, Col. 8:4-10; see EX1006, Col. 9:49-58. The LSR that generates the label corresponds to the claimed MPLS/LAG switch, and it sends the label to the preceding node. In the example described in Column 7 of Raz, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node. EX1006, Col. 7:26-38.

230. Further, as discussed above for Elements [1.0]-[1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

231. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.4].

[26.5] receiving from the preceding node, at said first MPLS/LAG switch, a data packet that includes said data packet label, in which said port serial number of said single physical tunnel port is encoded; and

232. It is my opinion that Element [26.5] is obvious in view of Raz. EX1001, 12:27-30.

233. As discussed above for Element [1.4], it is my opinion that Raz discloses receiving, from a preceding node, a data packet comprising the data packet label in which the port serial number of physical subport is encoded. Raz explains that a LSR receives a packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, Figures 3-4. As discussed above for Element [1.2], the serial number for the physical tunnel subport is encoded within the data packet label. Raz further states that data packet label is sent to the "upstream node" in its LSP "in order for the upstream node to know how to label packets belonging to this LSP." EX1006, Col. 8:7-10. In addition, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and **received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet**." Exhibit 1006, Col. 14:23-26 (emphasis added).

234. As discussed above for Elements [1.0]-[1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG

switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz.

235. Accordingly, it is my opinion that that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.5].

[26.6] sending said data packet from said first MPLS/LAG switch to a second MSPLS/LAG switch via said single physical tunnel port having the port serial number encoded in the data packet label.

236. It is my opinion that Element [26.6] is obvious in view of Raz. EX1001, Col. 12:31-34.

237. As discussed above for Element [1.5], it is my opinion that Raz discloses sending a data packet from a first MPLS/LAG switch to a second MSPLS/LAG switch via a single physical tunnel port having the port serial number encoded in the data packet label. For example, LSR B in the example describe in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. A POSA would have understood that a data packet in LSR B is sent to another LSR (which corresponds to the claimed second MPLS/LAG switch)

via a physical tunnel subport (subport 3) having the port serial number encoded in the data packet label. EX1006, Cols. 7:17-45, 9:29-58, Figures 3-4. Further, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet." Exhibit 1006, Col. 14:23-26.

238. As discussed above for Elements [1.0]-[1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

239. Accordingly, it is my opinion that Raz in view of the knowledge of a POSA discloses and renders obvious Element [26.6].

B. <u>Ground 2</u>: Claims 1-26 of the ’602 Patent are obvious over Raz in view of Ferguson.

240. It is further my opinion that a POSA would have found Claims 1-26 of the ’602 Patent to be obvious over Raz in view of Ferguson and the knowledge of a POSA.

a. Claim 1

[1.0] A method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network, the method comprising the steps of:

241. It is my opinion that Element [1.0] is obvious in view of the combination of Raz and Ferguson.

242. With respect to Element [1.0], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. For example, Raz discloses the communication of packets within a MPLS network, as shown below in Figure 1 of Raz. EX1006, Abstract, Cols. 1:40-55, 7:7-29, 9:9-48, 11:3-12, 14:30-32, 14:50-52, 16:63-65, 17:14-16, Figure 1.

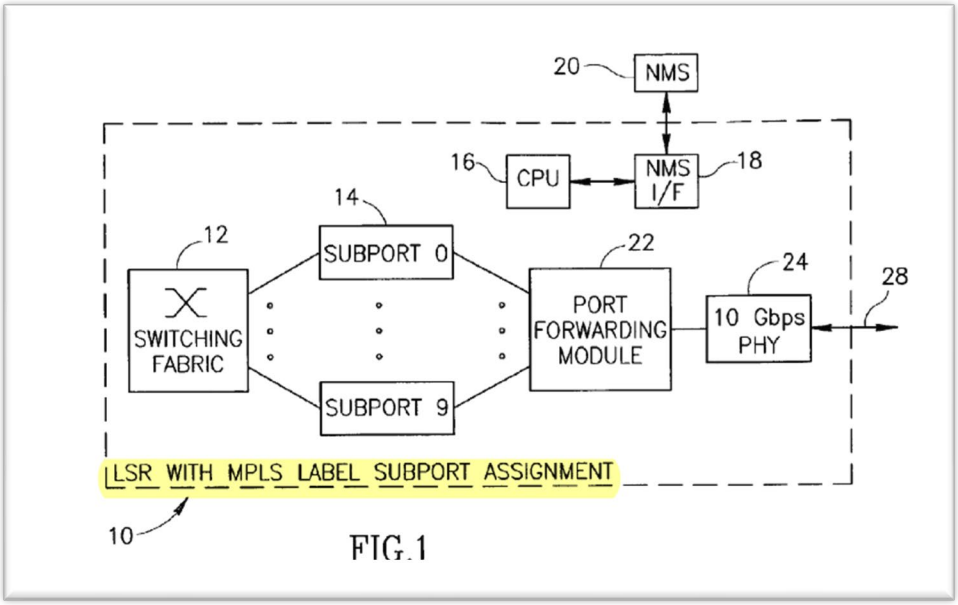


Figure 1 of Raz (Annotated)

Further, Raz discloses the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. Within the LSRs, individual packets from a high speed data stream are assigned to one of a plurality of subports for transportation through the LSR and then re-aggregated into the high speed packet stream before being forwarded to the next node in a network (such as the next LSR), as shown below in Figure 1 of Raz. EX1006, Cols. 2:41-67, 6:34-45, Figure 1.

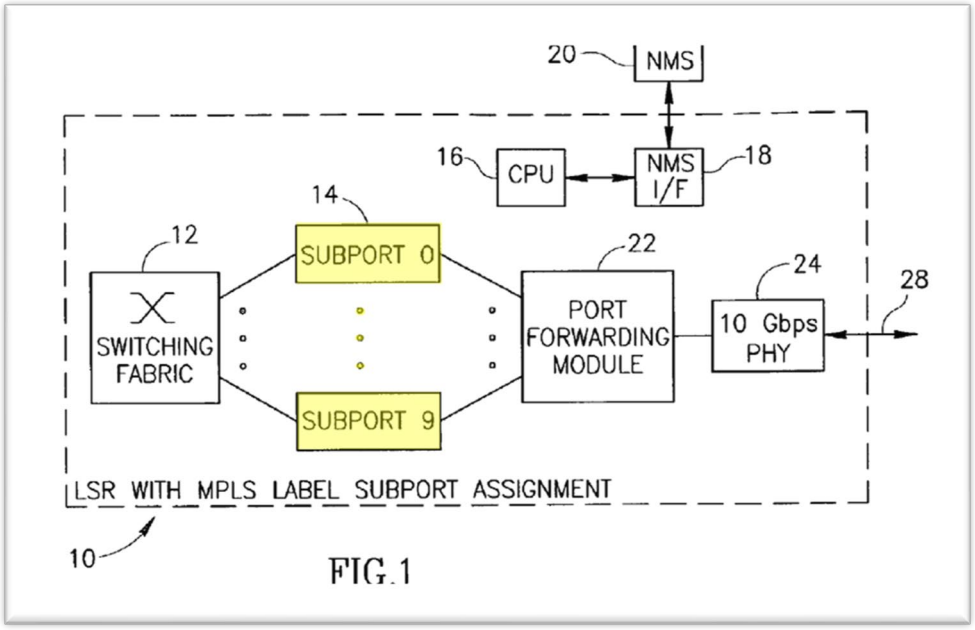


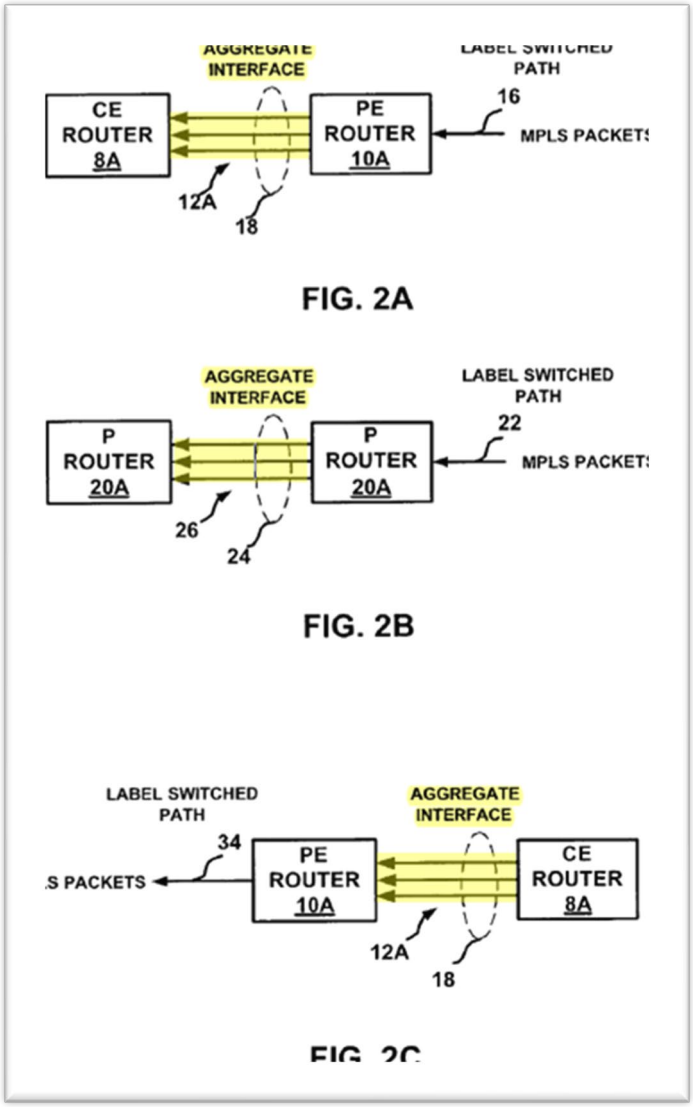
Figure 1 of Raz (Annotated)

The specification of Raz explains that the link aggregation is used to transport a high speed packet stream through a plurality of subports of lesser speed within a LSR. EX1006, Col. 7:7-16; see EX1006, Cols. 9:9-12, 14:19-22, 15:32-35, 16:41-53, 17:62-18:7, 18:39-42, 19:3-7.

243. While Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet streams in an MPLS network, it is my opinion that a POSA similarly would have known to use Ethernet physical data ports of a router or switch in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concept of using aggregation to communicate individual packets of a high speed packet stream through subports in a LSR also applies to communicating individual packets through Ethernet physical data ports of routers or

switches in a MPLS network. In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream. Further, a POSA would have found it obvious to apply the teachings of Raz to an Ethernet LAG because Ethernet was in widespread usage as of the priority date for the ’602 Patent, and a POSA would have known to use Ethernet because it provides the ability to transmit packets at high speeds while maintaining reliable service. Indeed, Raz specifically references using its technology for Ethernet packet streams. EX1006, Cols. 1:16-19, 2:28-31, 13:16-19, 14:42-44, 15:56-58, 17:7-9.

244. In addition, Ferguson discloses the utilization of an Ethernet physical data port in a LAG in an MPLS network for the purpose of communicating high speed packet streams. EX1007, Cols. 1:21-26, 1:43-53, 3:36-4:19, 6:10-31, Figures 2A-2C. As shown below in Figures 2A-2C of Ferguson, MPLS packets are communicated along a physical interconnect that is part of an “aggregate interface” between ports on two routers:



Figures 2A-2C of Ferguson (Annotated)

Further, Ferguson states that the physical interconnects may be Ethernet physical data ports (EX1007, Cols. 1:21-24, 1:43-53, 3:36-4:19, 5:4-24 (Table 1), 7:4-12) and that "the physical interconnects may couple other devices, e.g., **two switches**, a switch and a server, two routers, a switch and an end user station, and the like." EX1007, Cols. 1:24-26 (emphasis added), 8:61-64.

245. Importantly, Ferguson explains to a POSA that techniques used to communicate high speed data streams *within* a router or switch in an MPLS network can also be applied to communicating high speed data streams *between* two routers or *between* two switches in a MPLS network. EX1007, Cols. 5:61-6:6. Ferguson states that "[a]lthough [its] techniques have been described in reference to distribution of MPLS packets across parallel physical interconnects of an aggregated link, the techniques may be applied in a variety of environments." EX1007, Col. 5:63-67. "For example, the techniques may be readily applied to internal parallel data paths within a device." EX1007, Cols. 5:67-6:2. "For example, the techniques may be used by a router [or switch] to distribute packets across internal data paths that begin at the same input interface of the router [or switch] and end at the same output interface of the router [or switch], but traverse through different internal, high-speed switch fabrics." EX1007, Col. 6:2-6. A POSA would have understood from these statements that techniques used to communicate high speed data streams between routers or switches in an MPLS network can also be used to communicate high speed data streams within a router or switch in an MPLS network, and vice versa. This is because packets are communicated the same way within a device as between devices. This knowledge would have motivated a POSA to take the techniques used to communicate packets within the LSR of Raz and use them to communicate packets between LSRs or switches in the same MPLS network.

246. Further, a POSA would have been motivated to combine the teachings of Raz and Ferguson. As an initial matter, Raz and Ferguson are analogous art references that address the same technology and attempt to resolve the same issues of maximizing the use of bandwidth when trying to communicate high speed packet streams. Both Raz and Ferguson relate to the use of an MPLS network to communicate data packets. EX1006, Cols. 1:65-2:8, 2:26-31, 6:24-33, Figures 1 and 3-4; EX1007, Cols. 1:57-2:3, 2:22-26, 3:36-67, 8:10-12, Figures 2A-8. Both Raz and Ferguson extensively discuss the use of a LAG in an MPLS network to communicate the data packets. EX1006, Cols. 2:41-67, 6:34-45, 7:7-16, 14:19-22, Figure 1; EX1007, Cols. 1:21-26, 1:43-53, 3:36-4:19, 6:10-31, Figures 2A-2C. Ferguson discloses the utilization of an Ethernet physical data port in a LAG to communicate MPLS packets between routers or switches in an MPLS network, which is the same subject matter as Raz. EX1007, Cols. 1:21-26, 1:43-53, 3:36-4:19, 6:10-31, Figures 2A-2C; EX1006, Cols. 1:65-2:8, 2:41-67, 6:34-45, 7:7-16, 14:6-26, 14:50-52, Figure 1.

247. Moreover, both Raz and Ferguson are directed to solving the problem of ensuring enough bandwidth is available to communicate high speed packet streams through an MPLS network. EX1006, Cols. 10:60-11:12, 14:33-41, 15:47-55, 17:1-9, Figure 5; EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. Raz discusses allocating the bandwidth of subports within an LSR in order to handle high speed

packet streams transiting the LSR. Raz explains that its "invention also comprises a mechanism to improve the ability to handle wide connections . . that require a relatively large amount of CIR bandwidth." Raz explains that "a connection of 500 Mbps, 700 Mbps or even a connection of 1 Gbps may need to be supported." EX1006, Col. 10:60-65. Raz discusses "the problem of fragmentation," and it provides an example where "300 Mbps of CIR bandwidth [is] already allocated on each of the ten subports of a 10G port." EX1006, Col. 10:65-67. "In this case, a connection of 800 Mbps cannot be allocated on it even though the 10G port has 5600 M of free bandwidth." EX1006, Col. 11:1-2.

248. Raz explains that its "invention provides a scheme for allocating LSP bandwidth to subports that helps in solving the problem described above in a way that provides a tradeoff between leaving subports empty for wide LSPs and spreading traffic between subports for best utilizing the bandwidth of the link (e.g., for EIR traffic)." EX1006, Col. 11:3-8. "The central idea is to leave one or more subports empty (i.e. no bandwidth used) in the event a wide connection is to be allocated." EX1006, Col. 11:8-10. "The allocated bandwidth, however, is still distributed among the subports in such a way that EIR traffic is supported." EX1006, Col. 11:10-12.

249. Ferguson similarly addresses the need to have bandwidth available for high speed packet streams when implementing LAG to communicate data packets

in an MPLS network. EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. Ferguson explains that load balancing of MPLS packets in conventional systems "may not be able to achieve substantial distribution of the traffic among the paths, which may result in congestion on one data path and unused bandwidth on another." EX1007, Col. 4:55-59. "This may decrease the efficiency of the network and increase packet latency." EX1007, Col. 4:59-60. Ferguson, like Raz, focuses on improving the use of bandwidth when using a LAG in an MPLS network. EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. Further, like Raz, Ferguson explains that it can "use one or more fields directly from one or more of [the] MPLS labels" to select the path for communicating data packets. EX1007, Col. 8:10-12. A POSA thus would consider Raz and Ferguson to be analogous art references that address similar problems.

250. A POSA would have understood from the disclosures in Ferguson that techniques for utilizing an Ethernet physical data port in a LAG to communicate data packets between routers or switches in an MPLS network are also applicable to the use of subports transmitting the data packets within the routers or switches, and vice versa. EX1007, Cols. 5:61-6:6. A POSA would have known that the techniques disclosed in Raz for using subports to transmit data packets within a router or switch would also have been applicable to an Ethernet physical data port in a LAG that communicates data packets between routers or switches in an MPLS network. As

such, the efficient use of bandwidth realized inside the LSR would also have been realized using the same techniques for communications between LSRs.

251. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [1.0].

[1.1] assigning, by a first MPLS/LAG switch, a single physical tunnel port of a LAG to a network tunnel, wherein the single physical tunnel port of the LAG meets a bandwidth requirement of the network tunnel, and wherein said single physical tunnel port of the LAG has a port serial number;

252. It is my opinion that Element [1.1] is obvious in view of the combination of Raz and Ferguson.

253. With respect to Element [1.1], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. For example, Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR to communicate individual packets within a high speed packet stream. EX1006, Col. 3:1-15. Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1," which is reproduced below. EX1006, Col. 6:65-67; see EX1006, Cols. 7:17-19, 7:26-27. Additionally, Raz provides an example of how the assignment process takes place, and that example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch. EX1006, Col. 7:65-8:13; see EX1006, Cols. 7:30-38 (providing example in which the assignment

of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48.

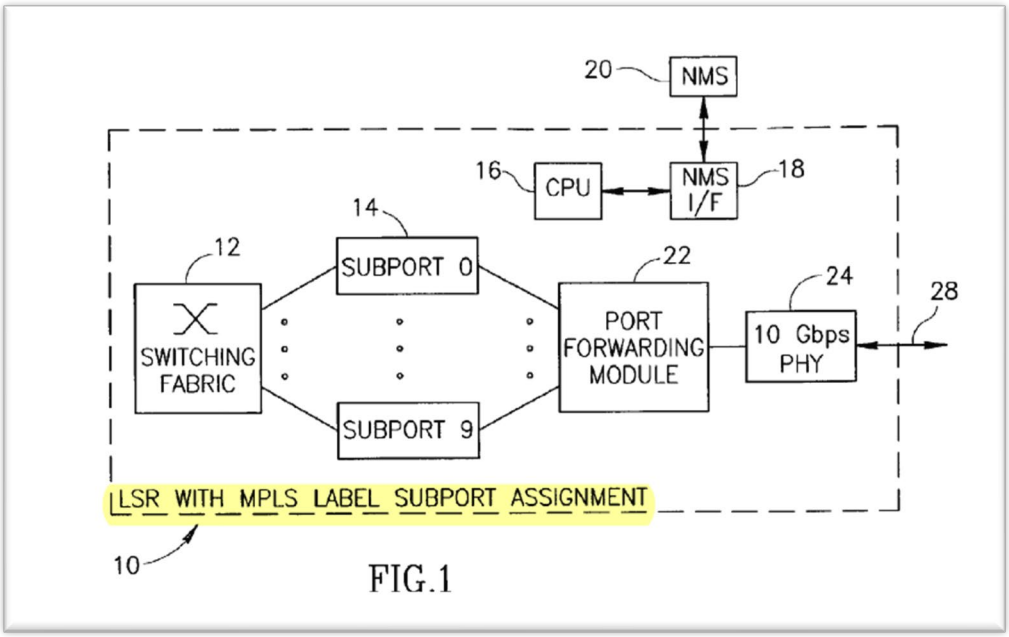


Figure 1 of Raz (Annotated)

254. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. As discussed above for Ground 1, it would have been common knowledge to a POSA as of the priority date that a LSP could be used to implement a network tunnel. See EX1008, Section 3.27.3.

255. Further, a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR. EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-

19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels. Moreover, as discussed above in Ground 1, Raz explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel). EX1006, Cols. 11:3-12:9; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 14:33-41, 15:47-55, 16:65-17:6, Figure 5.

256. In addition, as explained above for Ground 1, Raz discloses that the assigned subport has a serial number that is indicated by assigned bits within the MPLS label. EX1006, Col. 9:41-48, Figures 1, 4. A POSA would have understood that a serial number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number.

257. Further, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also could have been used to assign a physical tunnel port of a MPLS/LAG switch to a network tunnel. Indeed, as discussed above for Ground 1, a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. See EX1009; EX1006, Col 7:7-16. Moreover, Raz discloses that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS (which correlates to a network tunnel) is assigned to communicate packets from a high speed data stream.

The same principles would have applied to forwarding packets between MPLS/LAG switches in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the MPLS/LAG switch to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. A POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve the ability to communicate high speed packet streams that require increased bandwidth.

258. Ferguson teaches a POSA that the method of assigning a subport with appropriate bandwidth *within* the LSR that is disclosed in Raz could also be implemented *between* MPLS/LAG switches in an MPLS network. That is, to the extent that it was not already obvious from Raz, Ferguson discloses that the techniques in Raz for assigning a physical tunnel subport can also be implemented to assign a physical tunnel port to communicate packets along "physical interconnects" between "two switches" in an MPLS network. EX1007, Col. 1:22-27, 1:57-66. In addition, Ferguson discloses that the physical interconnects between the two switches can be used as part of a LAG. EX1007, Cols. 1:28-53, 2:44-47. As

such, a POSA would have understood the two switches implementing the techniques of Ferguson to be MPLS/LAG switches.

259. In addition, and as discussed above for Element [1.0], Ferguson teaches that the techniques used to reserve the bandwidth needed to communicate packets within a network device can also be applied to reserve the bandwidth needed to communicate packets between network devices in an MPLS network. A POSA would have understood this to mean that the techniques disclosed in Raz for forwarding packets within a LSR in an MPLS network could also be applied when communicating packets from one MPLS/LAG switch to another MPLS/LAG switch. Indeed, a POSA would have been motivated to apply the teachings of Ferguson to Raz because this increases the available bandwidth to communicate high speed packet streams.

260. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [1.1].

[1.2] dedicating a sub-set of bits in a data packet label prepared by the first MPLS/LAG switch to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

261. It is my opinion that Element [1.2] is obvious in view of the combination of Raz and Ferguson.

262. With respect to Element [1.2], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As explained

in Ground 1, Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) prepared by the LSR to encode the serial number of a physical subport of the LAG into the label. See EX1006, Col. 9:41-58, Figures 3-4. Raz provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. EX1006, Col. 9:41-58, Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR (which corresponds to the claimed MPLS/LAG switch) constitutes encoding the subport serial number in the label. A serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

263. It would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS

label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

264. Moreover, for the reasons discussed above with respect to Elements [1.0] and [1.1], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

265. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [1.2].

[1.3] sending, by said first MPLS/LAG switch, the data packet label, in which said port serial number of said single physical tunnel port is encoded, to a preceding node;

266. It is my opinion that Element [1.3] is obvious in view of the combination of Raz and Ferguson.

267. With respect to Element [1.3], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. Raz explains that MPLS label 140 (i.e. a data packet label) containing the sub-set of bits that encode the serial number of the physical subport of the LAG is sent from the LSR

in which the label is generated to an "upstream" or preceding node. EX1006, Cols. 7:26-38, 8:4-10, 9:49-58. The LSR that generates the label corresponds to the claimed MPLS/LAG switch. In the example described in Column 7 of Raz, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node. EX1006, Col. 7:26-38.

268. Further, as discussed above for Elements [1.0]-[1.2], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

269. Moreover, as discussed above with respect to Elements [1.0]-[1.2], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding

node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

270. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [1.3].

[1.4] receiving from the preceding node, by said first MPLS/LAG switch, a data packet comprising said data packet label, in which said port serial number of said single physical tunnel port is encoded; and

271. It is my opinion that Element [1.4] is obvious in view of the combination of Raz and Ferguson.

272. With respect to Element [1.4], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. Raz explains that a LSR receives a packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 8:7-10, 9:29-58, 14:23-26, Figures 3-4. As discussed above for Element [1.2], the serial number for the physical tunnel subport is encoded within the data packet label.

273. As discussed above for Elements [1.0]-[1.3], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-

16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz.

274. Moreover, for the reasons discussed above with respect to Elements [1.0]-[1.3], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz.

275. Accordingly, it is my opinion that the combination of Raz and Ferguson, discloses and renders obvious Element [1.4].

[1.5] sending said data packet from said first MPLS/LAG switch to a second MPLS/LAG switch via said single physical tunnel port having the port serial number encoded in the data packet label.

276. It is my opinion that Element [1.5] is obvious in view of the combination of Raz and Ferguson.

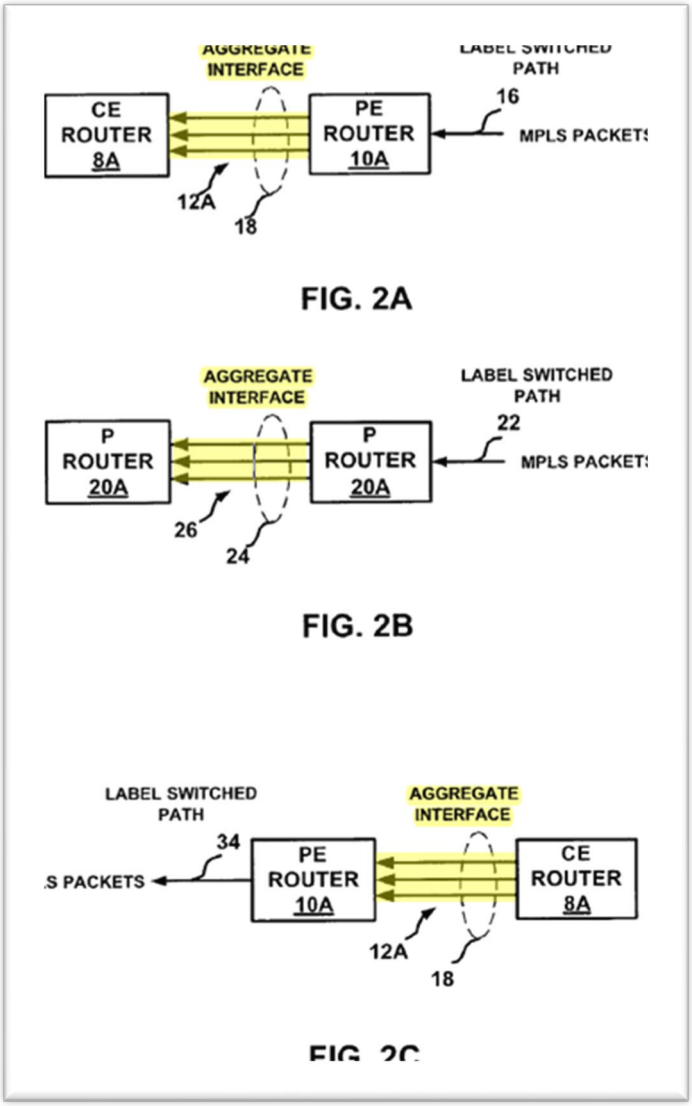
277. With respect to Element [1.5], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As I explained in Ground 1, it is my opinion that a POSA would have found it obvious from Raz to send a data packet from a first MPLS/LAG switch to a second MSPLS/LAG switch via a single physical tunnel port having the port serial number encoded in the data

packet label. For example, LSR B in the example described in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. A POSA would have understood that a data packet in LSR B could be sent to another LSR (which corresponds to the claimed second MPLS/LAG switch) via a physical tunnel subport (subport 3) having the port serial number encoded in the data packet label. EX1006, Col. 7:39-45; see EX1006, Cols. 7:17-29, 9:29-58, 14:23-26, Figures 3-4.

278. As discussed above for Elements [1.0]-[1.4], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

279. Moreover, for the reasons discussed above with respect to Elements [1.0]-[1.4], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices

in an MPLS network, as shown below in Figures 2A-2C of Ferguson. Thus, Ferguson would have motivated a POSA to treat packets communicated between MPLS/LAG switches in a MPLS network in the same way as packets communicated between LSRs in Raz.



Figures 2A-2C of Ferguson (Annotated)

280. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [1.5].

b. Claim 2

[2] The method of claim 1, further comprising the step of receiving from a preceding node located upstream from said first MPLS/LAG switch, by said first MPLS/LAG switch, a request message requesting configuration of said network tunnel, the message further requesting said data packet label associated with said network tunnel.

281. It is my opinion that the element of Claim 2 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

c. Claim 3

[3] The method of claim 2, wherein said request message comprises an RSVP-TE PATH message augmented with a LABEL_REQUEST object.

282. It is my opinion that the element of Claim 3 is obvious in view of Raz and the knowledge of a POSA for the same reasons as those explained above in Ground 1.

d. Claim 4

[4] The method according to claim 3, wherein said request comprises an indication of a service property, and wherein said selecting comprises identifying a physical port in compliance with said service property.

283. It is my opinion that the element of Claim 4 is obvious in view of Raz and the knowledge of a POSA for the same reasons as those explained above in Ground 1.

e. Claim 5

[5] The method according to claim 4, wherein said service property comprises at least one of: a guaranteed bandwidth; a peak bandwidth; and a class of service.

284. It is my opinion that the element of Claim 5 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

f. Claim 6

[6] The method according to claim 1, wherein said selecting comprises selecting a single physical tunnel port having a maximum available bandwidth of said plurality of physical data ports.

285. It is my opinion that the element of Claim 6 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

g. Claim 7

[7] The method according to claim 1, wherein said selecting comprises selecting a port having a minimum available bandwidth of said plurality of physical data ports which is not less than said bandwidth requirement of the network tunnel.

286. It is my opinion that the element of Claim 7 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

h. Claim 8

[8] The method according to claim 1, wherein said switching said data packet is according to a mapping function.

287. It is my opinion that the element of Claim 8 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

i. Claim 9

[9] The method according to claim 1, wherein said preparing comprises inserting into said data packet label a set of bits that identify said single physical tunnel port; and wherein said switching said data packet comprises extracting said set of bits to determine an identity of said single physical tunnel port.

288. It is my opinion that the element of Claim 9 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

j. Claim 10

[10] The method according to claim 1, wherein said preparing comprises storing said data packet label along with an identifier of said single physical tunnel port in a memory, and wherein said switching said data packet comprises retrieving said identifier from said memory responsively to said data packet label.

289. It is my opinion that the element of Claim 10 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

k. Claim 11

[11] The method according to claim 1, further comprising the steps of: selecting a backup port from among the plurality of physical data ports, different from said single physical tunnel port; and responsively to a service interruption of said single physical tunnel port, switching said data packet to said backup port and sending said data packet to said second MPLS/LAG switch via said backup port.

290. It is my opinion that the element of Claim 11 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

l. Claim 12

[12] The method according to claim 11, further comprising the step of responsive to a restoral of said service interruption of said single physical tunnel port, reverting switching of said data packet from said backup port and sending said data packet to said second MPLS/LAG switch via said single physical tunnel port.

291. It is my opinion that the element of Claim 12 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

m. Claim 13

[13] The method according to claim 1, wherein said first MPLS/LAG switch comprises a Label Switched Router (LSR).

292. It is my opinion that the element of Claim 13 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

n. Claim 14

[14] The method of claim 1, further comprising the step of designating by said first MPLS/LAG switch, the plurality of physical data ports in said first MPLS/LAG switch as a single logical port.

293. It is my opinion that the element of Claim 14 is obvious in view of Ferguson. EX1001, Col. 10:35-38. Ferguson explains that "[t]he term 'link aggregation' refers to a technique by which the multiple physical interconnects are **logically associated and treated as a single, aggregated link**." EX1007, Col. 1:28-30 (emphasis added); see EX1007, Cols. 1:60-63, 2:44-47, 3:42-44, 4:1-7. It is my

opinion that a POSA would have understood from these disclosures in Ferguson that the plurality of physical data ports of a MPLS/LAG switch that are used to implement a LAG would be considered a single logical port. A POSA would have understood that a LAG is created by bonding multiple physical links to act as a single logical port.

294. Accordingly, it is my opinion that Ferguson discloses and renders obvious the element of Claim 14.

o. Claim 15

[15.0] An apparatus for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) located downstream from a preceding node in a MultiProtocol Label Switching (MPLS) network tunnel employing Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning, the LAG having a first MPLS/LAG switch and a second MPLS/LAG switch, the apparatus comprising:

295. It is my opinion that Element [15.0] is obvious in view of the combination of Raz and Ferguson.

296. With respect to Element [15.0], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed in Ground 1, Raz discloses the use of an apparatus (such as a processor, FPGA, an ASIC or a combination thereof) for implementing its system for communicating packets within a high speed packet stream. EX1006, Cols. 2:33-40, 7:54-8:13, 12:25-30, 12:57-31:1, 13:56-61. Further, Raz explains that its apparatus can be used to communicate packets within an MPLS network tunnel, as shown

below in Figure 1 of Raz. EX1006, Abstract, Cols. 1:40-55, 7:7-29; 9:9-48, 11:3-12, 14:30-32, 14:50-52, 16:63-65, 17:14-16, Figure 1.

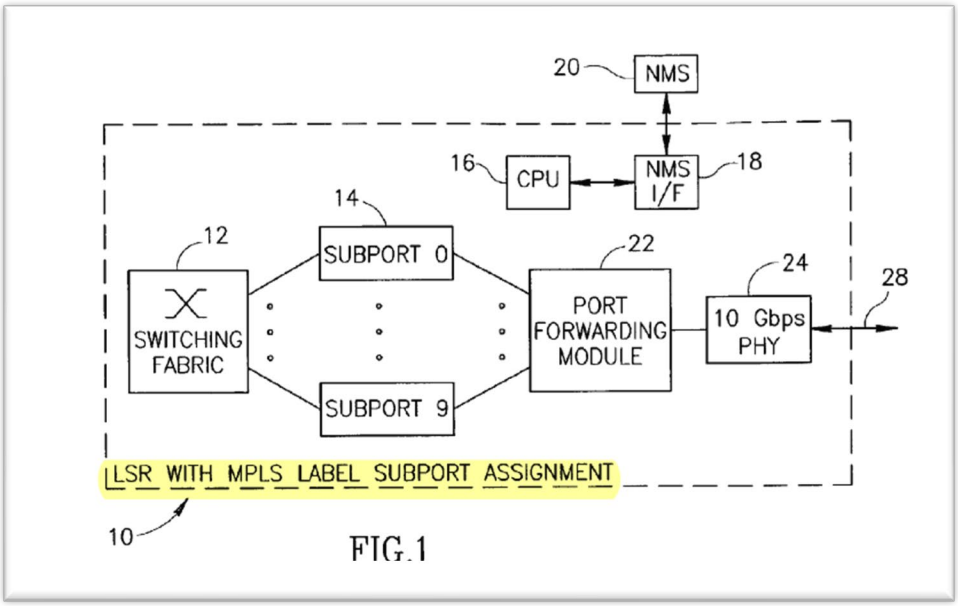


Figure 1 of Raz (Annotated)

Raz also discloses that its MPLS tunnel employs Resource Reservation Protocol Traffic Engineering (RSVP-TE) tunnel provisioning. EX1006, Col. 6:46-50; see EX1006, Cols. 1:36-39, 5:10.

297. In addition, Raz teaches the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. EX1006, Cols. 2:41-67, 6:34-45. Figure 1 of Raz (shown below) provides an example of ten subports (Subport 0-Subport 9) used to implement link aggregation within an LSR in an MPLS environment:

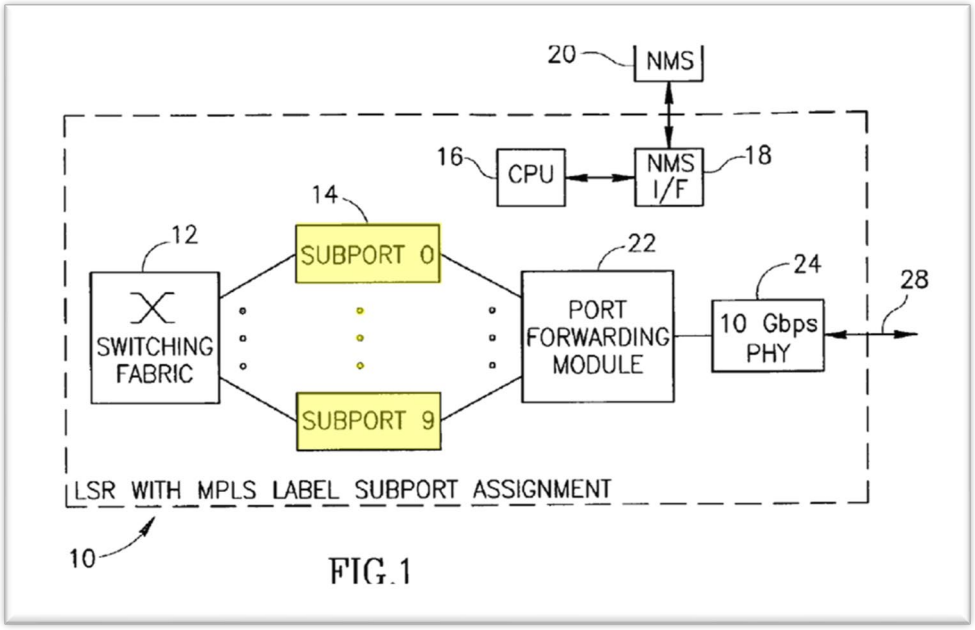


Figure 1 of Raz (Annotated)

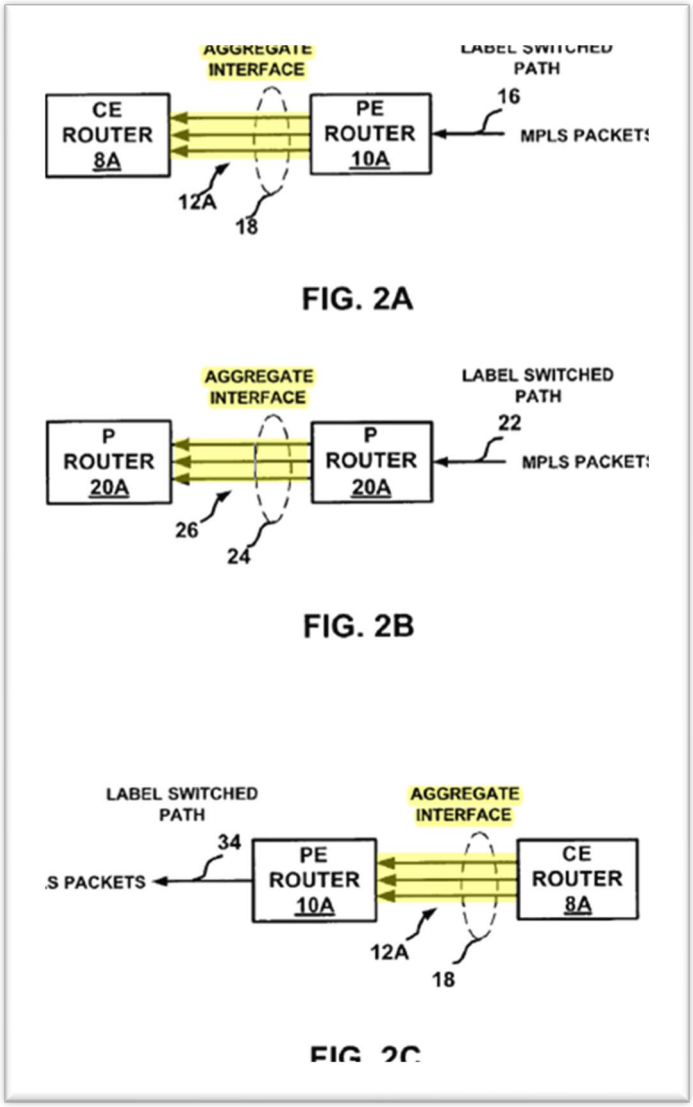
The specification of Raz explains that the link aggregation is used to transport a high speed packet stream through a plurality of subports of lesser speed within a LSR.[4] EX1006, Cols. 7:7-16, 9:9-12, 14:19-22, 15:32-35, 16:41-53, 17:62-18:7, 18:39-42, 19:3-7.

298. As discussed above for Element [1.0], while Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet streams in an MPLS network, it is my opinion that a POSA similarly would have

[4] As discussed above in Ground 1, a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. See EX1009; EX1006, Col. 7:7-16.

known to use Ethernet physical data ports of a router or switch that are downstream of a preceding node in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concept of using aggregation to communicate individual packets of a high speed packet stream through subports in a LSR also applies to communicating individual packets through Ethernet physical data ports of routers or switches in a MPLS network. In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream.

299. Further, as discussed above for Element [1.0], Ferguson discloses the utilization of an Ethernet physical data port in a LAG in an MPLS network for the purpose of communicating high speed packet streams. EX1007, Cols. 1:21-26, 1:43-53, 3:36-4:19, 6:10-31, Figures 2A-2C. As shown below in Figures 2A-2C of Ferguson, MPLS packets are communicated along a physical interconnect that is part of an aggregate interface between ports on two routers:



Figures 2A-2C of Ferguson (Annotated)

Ferguson also discloses that the physical interconnects may be Ethernet physical data ports (EX1007, Cols. 1:21-24, 1:43-53, 3:36-4:19, 5:4-24 (Table 1), 7:4-12) and that "the physical interconnects may couple other devices, e.g., **two switches**, a switch and a server, two routers, a switch and an end user station, and the like." EX1007, Cols. 1:24-26 (emphasis added), 8:61-64.

300. In addition, Ferguson explains to a POSA that techniques used to communicate high speed data streams *within* a router or switch in an MPLS network can also be applied to communicating high speed data streams *between* two routers or *between* two switches in a MPLS network. EX1007, Cols. 5:61-6:6. Ferguson states that "[a]lthough [its] techniques have been described in reference to distribution of MPLS packets across parallel physical interconnects of an aggregated link, the techniques may be applied in a variety of environments." EX1007, Col. 5:63-67. "For example, the techniques may be readily applied to internal parallel data paths within a device." EX1007, Cols. 5:67-6:2. "For example, the techniques may be used by a router [or switch] to distribute packets across internal data paths that begin at the same input interface of the router [or switch] and end at the same output interface of the router [or switch], but traverse through different internal, high-speed switch fabrics." EX1007, Col. 6:2-6. A POSA would have understood from these statements that techniques used to communicate high speed data streams between routers or switches in an MPLS network can also be used to communicate high speed data streams within a router or switch in an MPLS network, and vice versa. This knowledge would have motivated a POSA to take the techniques used to communicate packets within the LSR of Raz and use them to communicate packets between LSRs or switches in the same MPLS network.

301. Moreover, a POSA would have been motivated to combine the teachings of Raz and Ferguson because they are analogous art references for the reasons explained above in connection with Element [1.0]. EX1006, Cols. 10:60-11:12, 14:33-41, 15:47-55, 17:1-9, Figure 5; EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. Moreover, a POSA would have been motivated to combine the teachings of Raz and Ferguson because they are both directed to solving the problem of ensuring enough bandwidth is available to communicate high speed packet streams through an MPLS network, as explained above in connection with Element [1.0]. EX1006, Cols. 10:60-11:12, 14:33-41, 15:47-55, 17:1-9, Figure 5; EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. As such, a POSA would have understood from the disclosures in Ferguson that techniques for utilizing an Ethernet physical data port in a LAG to communicate data packets between routers or switches in an MPLS network are also applicable to the use of subports transmitting the data packets within the routers or switches, and vice versa. EX1007, Cols. 5:61-6:6. Thus, a POSA would have known that the techniques disclosed in Raz for using subports to transmit data packets within a router or switch would also have been applicable to an Ethernet physical data port in a LAG that communicates data packets between routers or switches in an MPLS network and readily implementable and compatible with Raz's disclosures.

302. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [15.0].

[15.1] a processor, which is configured to:

303. It is my opinion that Element [15.1] is taught by Raz. EX1001, Col. 10:49.

304. With respect to Element [15.1], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. Specifically, Raz discloses that its invention "is suited for implementation in hardware such as a network **processor** adapted to implement the mechanism of the present invention, software or a combination of hardware and software." EX1006, Col. 2:33-36 (emphasis added); see EX1006, Cols. 2:36-40, 3:39, 7:54-8:13, 12:25-30, 12:57-31:1, 13:56-61.

305. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.1].

[15.2] assign a single physical tunnel port of a LAG to a network tunnel, wherein said single physical tunnel port meets a bandwidth requirement of the network tunnel, and wherein said single physical tunnel port has a port serial number.

306. It is my opinion that Element [15.2] is obvious in view of the combination of Raz and Ferguson.

307. With respect to Element [15.2], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. For

example, Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR. EX1006, Col. 3:1-15 (discussing the assignment of "outbound packets to one of a plurality of subports in accordance with the label associated with each outbound packet."). Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1," which is reproduced below. EX1006, Col. 6:65-67; see EX1006, Cols. 7:17-19, 7:26-27.

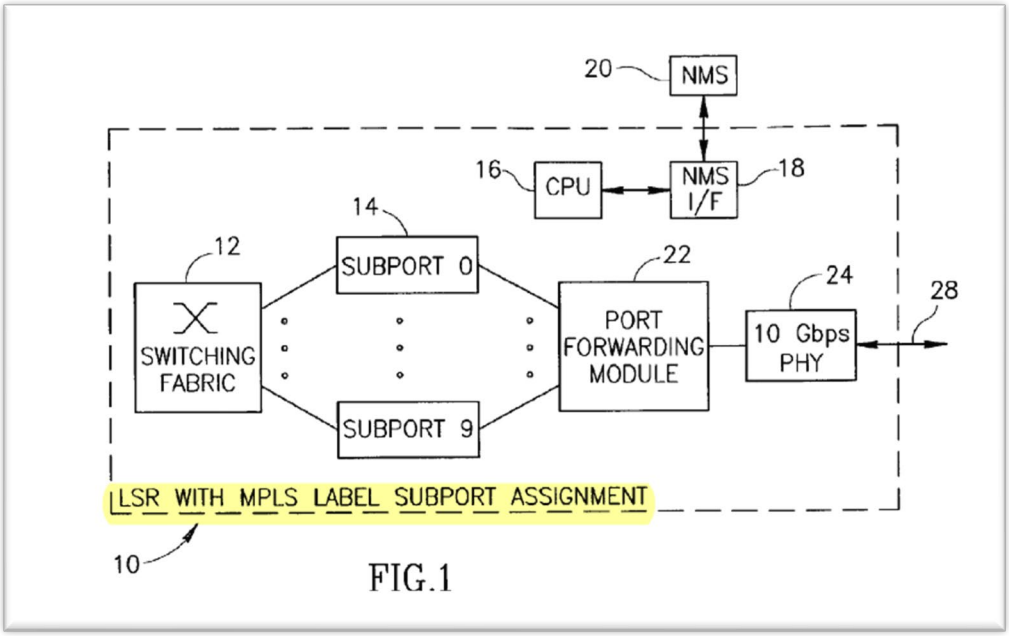


Figure 1 of Raz (Annotated)

Additionally, Raz provides an example of how the assignment process takes place, and that example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch. EX1006, Col. 7:65-8:13; see EX1006, Cols. 7:30-38 (providing example in

which the assignment of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. It would have been common knowledge to a POSA as of the priority date that a LSP could be used to implement a network tunnel. See EX1008, Section 3.27.3.

308. Further, as discussed above in Ground 1, a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR. EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels.

309. Also, as discussed above in Ground 1, Raz explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel). EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:22-26, 7:7-16, 11:13-12:9, 14:33-41, 15:47-55, 16:65-17:6, Figure 5.

310. Moreover, as discussed above in Ground 1, Raz discloses that the assigned subport has a serial number. In discussing Figure 4, Raz explains that the MPLS label contains bits that "indicate the subport," which a POSA would have

understood to mean that the subport has a serial number that is indicated by the bits. EX1006, Col. 9:41-48, Figures 1, 4. A POSA would have understood that a serial number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number.

311. Further, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also could have been used to assign a physical tunnel port of a network device. Raz teaches that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS is assigned to communicate packets from a high speed data stream. The same principles would have applied to forwarding packets between network devices (such as MPLS/LAG switches) in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the network device to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. A POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve the ability to communicate high speed packet streams that require increased bandwidth.

312. Moreover, as discussed above with respect to Elements [1.0] and [15.0], Ferguson teaches a POSA that the method of assigning a subport with appropriate bandwidth within the LSR of Raz could also be implemented between network devices (such as MPLS/LAG switches) in an MPLS network. Ferguson discloses that its techniques can be implemented to communicate packets along "physical interconnects" between "two switches" in an MPLS network. EX1007, Col. 1:22-27, 1:57-66. In addition, Ferguson discloses that the physical interconnects between network devices (such as switches or routers) can be used as part of a LAG. EX1007, Cols. 1:28-53, 2:44-47.

313. In addition, and as discussed above for Elements [1.0] and [15.0], Ferguson teaches that the techniques used to reserve the bandwidth needed to communicate packets within a network device can also be applied to reserve the bandwidth needed to communicate packets between network devices in an MPLS network. A POSA would have understood this to mean that the techniques disclosed in Raz for forwarding packets within a LSR in an MPLS network could also be applied when communicating packets from one MPLS/LAG switch to another MPLS/LAG switch. Indeed, a POSA would have been motivated to apply the teachings of Ferguson to Raz because this increases the available bandwidth to communicate high speed packet streams.

314. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [15.2].

[15.3] dedicate a sub-set of bits in a data packet label to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

315. It is my opinion that Element [15.3] is obvious in view of the combination of Raz and Ferguson.

316. With respect to Element [15.3], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed in Ground 1, Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. EX1006, Col. 9:41-58, Figures 3-4. Raz provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. EX1006, Col. 9:41-58, Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR (which corresponds to the claimed MPLS/LAG switch) constitutes encoding the subport serial number in the label. A serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

317. As discussed above for Element [1.2] and [1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in physical tunnel ports of a network device in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

318. Moreover, for the reasons discussed above with respect to Elements [1.0] and [15.0], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of a network device (such as a MPLS/LAG switch) to be used to forward packets through a network tunnel formed by a LSP.

319. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [15.3].

[15.4] publish said packet label upstream;

320. It is my opinion that Element [15.4] is taught by Raz. EX1001, Col. 10:58.

321. With respect to Element [15.4], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As I discussed in Ground 1 and Element [15.3], Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. Raz explains that the label encoding the serial number of the subport is communicated from the LSR that generates the label "to the **upstream (i.e. sending) node via the label that is assigned to the LSP**." EX1006, Col. 7:26-38 (emphasis added); see EX1006, Cols. 8:4-10, 9:49-58. The LSR that generates the label corresponds to the claimed MPLS/LAG switch, and it sends the label to the preceding node. In the example described in Column 7 of Raz, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node. EX1006, Col. 7:26-38.

322. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.4].

[15.5] and a mapper, which is configured to:

323. It is my opinion that Element [15.5] is disclosed or obvious in view of Raz. EX1001, Col. 10:59.

324. With respect to Element [15.5], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed above in Ground 1, Raz discloses that its apparatus can be implemented using a network processor, a FPGA, an ASIC or a combination of these. EX1006, Cols. 2:3-8, 2:33-40, 3:39, 6:27-29, 7:54-8:13, 12:25-30, 12:57-31, 13:56-61. A POSA would have understood from this disclosure that the apparatus of Raz includes a mapper which performs the functions recited below in Elements [15.6]-[15.8]. A POSA would have understood from Elements [15.6]-[15.8] that the purpose of the mapper is to receive a data packet, detect a data packet label within the data packet, and determine how to forward the data packet in accordance with the label. Raz discloses a forwarding module that performs these functions and thus corresponds to the mapper recited in Element [15.5]. EX1006, Col. 7:30-58; see EX1006, Col. 9:29-58, Figures 3-4.

325. In view of the above, it is my opinion that Raz discloses or renders obvious Element [15.5].

[15.6] receive a data packet from an upstream node;

326. It is my opinion that Element [15.6] is taught by Raz. EX1001, Col. 10:60.

327. With respect to Element [15.6], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. It is my opinion that Raz discloses receiving a data packet comprising the data packet label in which the port serial number of physical subport is encoded from an upstream node. Raz explains that a LSR receives a packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, 14:23-26, Figures 3-4.

328. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.6].

[15.7] detect said data packet label in said data packet; and

329. It is my opinion that Element [15.7] is disclosed by Raz. EX1001, Col. 10:61.

330. With respect to Element [15.7], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. Raz teaches that, when a LSR receives a data packet from an upstream node, the LSR detects the data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Col. 7:39-45; see EX1006, Col. 9:29-58, 14:23-26, Figures 3-4.

331. In view of the above, it is my opinion that Raz discloses and renders obvious Element [15.7].

[15.8] if said data packet contains said data packet label, send said data packet to the second MPLS/LAG switch via said single physical tunnel port.

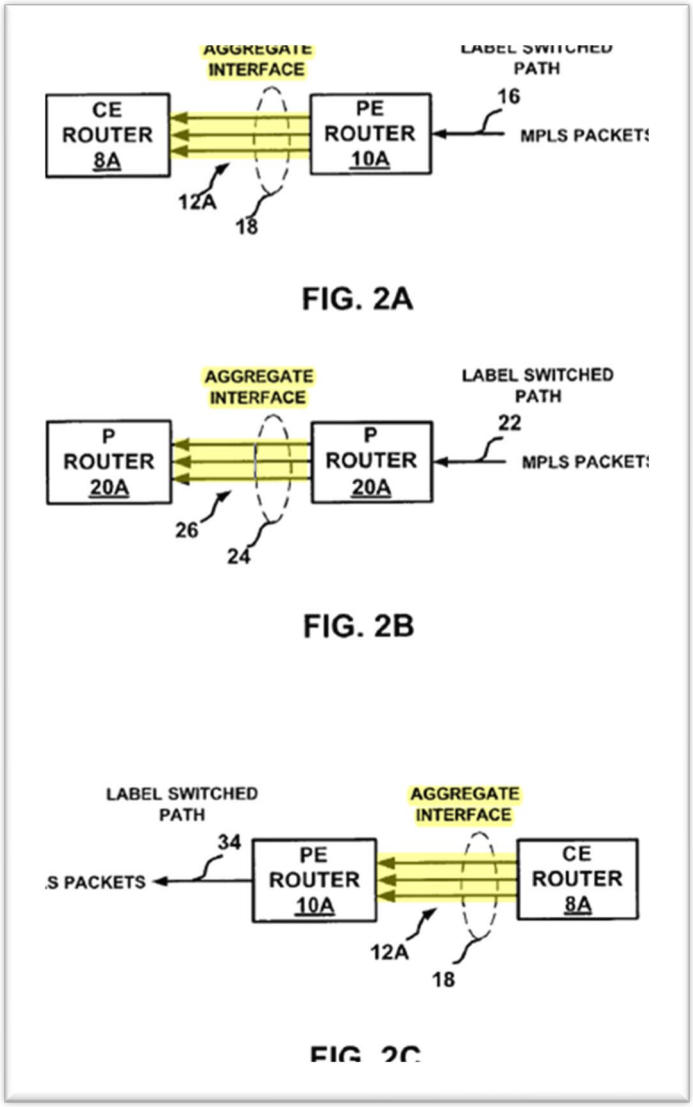
332. It is my opinion that Element [15.8] is obvious in view of the combination of Raz and Ferguson.

333. With respect to Element [15.8], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed above in Element [15.7], Raz discloses, when a data packet is received from an upstream node, the LSR detects the data packet label. Further, Raz explains that a packet received at a first LSR is forwarded to a second LSR, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be forwarded. For example, LSR B in the example described in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. EX1006, Col. 7:26-45. A POSA would have understood that the data packet in LSR B could be sent to another LSR (which corresponds to the claimed second MPLS/LAG switch) via a physical tunnel subport (subport 3). EX1006, Col. 7:39-45; see EX1006, Cols. 7:17-29, 9:29-58, 14:23-26, Figures 3-4.

334. As discussed above for Elements [15.0] and [15.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in

MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

335. Moreover, for the reasons discussed above with respect to Elements [1.0]-[1.4], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network, as shown below in Figures 2A-2C of Ferguson. Thus, Ferguson would have motivated a POSA to treat packets communicated between MPLS/LAG switches in a MPLS network in the same way as packets communicated between LSRs in Raz.



Figures 2A-2C of Ferguson (Annotated)

336. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [15.8].

p. Claim 16

[16] The apparatus according to claim 15, wherein the processor is configured to make said selection in compliance with a service property.

337. It is my opinion that the element of Claim 16 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

q. Claim 17

[17] The apparatus according to claim 16, wherein said service property comprises at least one of the group consisting of a guaranteed bandwidth, a peak bandwidth, and a class of service.

338. It is my opinion that the element of Claim 17 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

r. Claim 18

[18] The apparatus according to claim 17, wherein said processor is configured to make said selection of a port having a maximum available bandwidth of the plurality of ports.

339. It is my opinion that the element of Claim 18 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

s. Claim 19

[19] The apparatus according to claim 17, wherein said processor is configured to make said selection of a port having a minimum available bandwidth of the plurality of ports which is not less than said bandwidth requirement of the network tunnel.

340. It is my opinion that the element of Claim 19 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

t. Claim 20

[20] The apparatus according to claim 15, wherein said processor is configured to insert into said data packet label a set of bits which identify said single physical tunnel port; and wherein said mapper is configured to extract said set of bits to determine an identity of said single physical tunnel port.

341. It is my opinion that the element of Claim 20 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

u. Claim 21

[21] The apparatus according to claim 15, further comprising a memory, and wherein said processor is configured to store said data packet label along with an identifier of said single physical tunnel port in said memory, and wherein said mapper is configured to retrieve said identifier from said memory responsively to said data packet label.

342. It is my opinion that the element of Claim 21 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

v. Claim 22

[22] The apparatus according to claim 15, wherein said processor is further configured to select a backup port from among the plurality of physical data ports, different from said single physical tunnel port, and wherein said mapper is further configured, responsively to a service interruption of said single physical tunnel port, to direct the first MPLS/LAG switch to switch said data packet to said backup port, and send said data packet to the second MPLS/LAG switch via said backup port.

343. It is my opinion that the element of Claim 22 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

w. Claim 23

[23] The apparatus according to claim 15, wherein said first MPLS/LAG switch comprises a Label Switched Router (LSR).

344. It is my opinion that the element of Claim 23 is obvious over Raz in view of the knowledge of a POSA for the same reasons as those explained above in Ground 1.

x. Claim 24

[24] The apparatus according to claim 15, wherein said processor comprises a network processor.

345. It is my opinion that the element of Claim 24 is obvious in view of Raz for the same reasons as those explained above in Ground 1.

y. Claim 25

[25] The apparatus according to claim 15, wherein said plurality of physical data ports are selected from a single logical port.

346. It is my opinion that the element of Claim 25 is obvious over Ferguson. EX1001, Col. 12:1-3. As discussed above for Claim 14, Ferguson explains that "[t]he term 'link aggregation' refers to a technique by which the multiple physical interconnects are **logically associated and treated as a single, aggregated link**." EX1007, Col. 1:28-30 (emphasis added); see EX1007, Cols. 1:60-63, 2:44-47, 3:42-

44, 4:1-7. It is my opinion that a POSA would have understood from these disclosures in Ferguson that the plurality of physical data ports of a MPLS/LAG switch that are used to implement a LAG would be designated and treated as a single logical port. A POSA would have understood that a LAG is created by bonding multiple physical links to act as a single logical port.

347. Accordingly, it is my opinion that Ferguson discloses and renders obvious Claim 25.

z. Claim 26

[26.0] A method for assigning and utilizing an Ethernet physical data port in an Ethernet Link Aggregation Group (LAG) in a Multi-Protocol Label Switching (MPLS) network, the method comprising the steps of:

348. It is my opinion that Element [26.0] is obvious in view of the combination of Raz and Ferguson.

349. With respect to Element [26.0], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed in Ground 1, Raz discloses the communication of packets within a MPLS network, as shown below in Figure 1 of Raz. EX1006, Abstract, Cols. 1:40-55, 7:7-29, 9:9-48, 11:3-12, 14:30-32, 14:50-52, 16:63-65, 17:14-16, Figure 1.

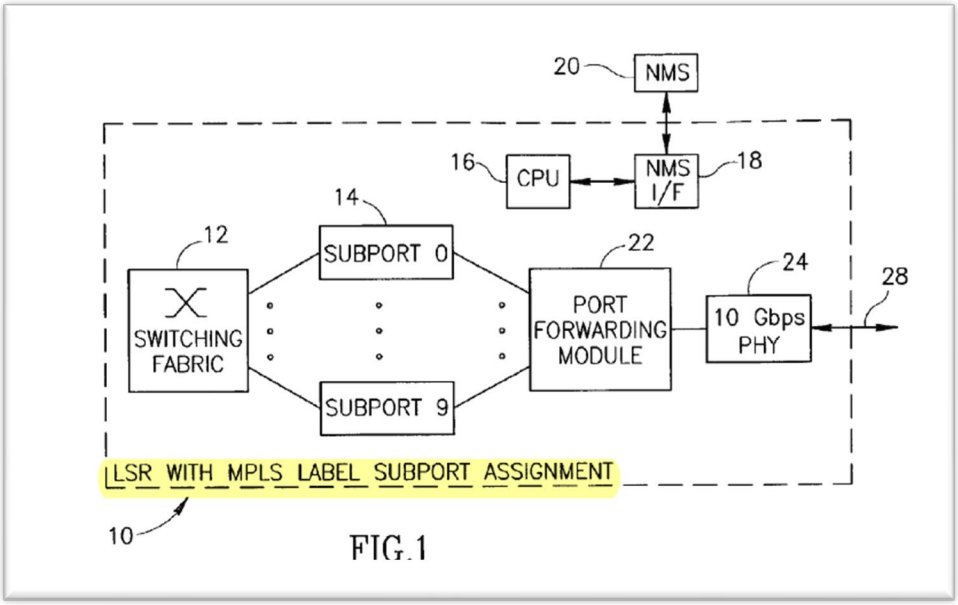


Figure 1 of Raz (Annotated)

350. Further, Raz discloses the use of link aggregation to transport high speed network traffic within the LSRs in an MPLS network. EX1006, Cols. 2:41-67, 6:34-45. Figure 1 of Raz (shown below) provides an example of ten subports (Subport 0-Subport 9) used to implement link aggregation to transport a high speed packet stream within an LSR in an MPLS environment. EX1006, Cols. 7:7-16, 9:9-12, 14:19-22, 15:32-35, 16:41-53, 17:62-18:7, 18:39-42, 19:3-7, Figure 1.

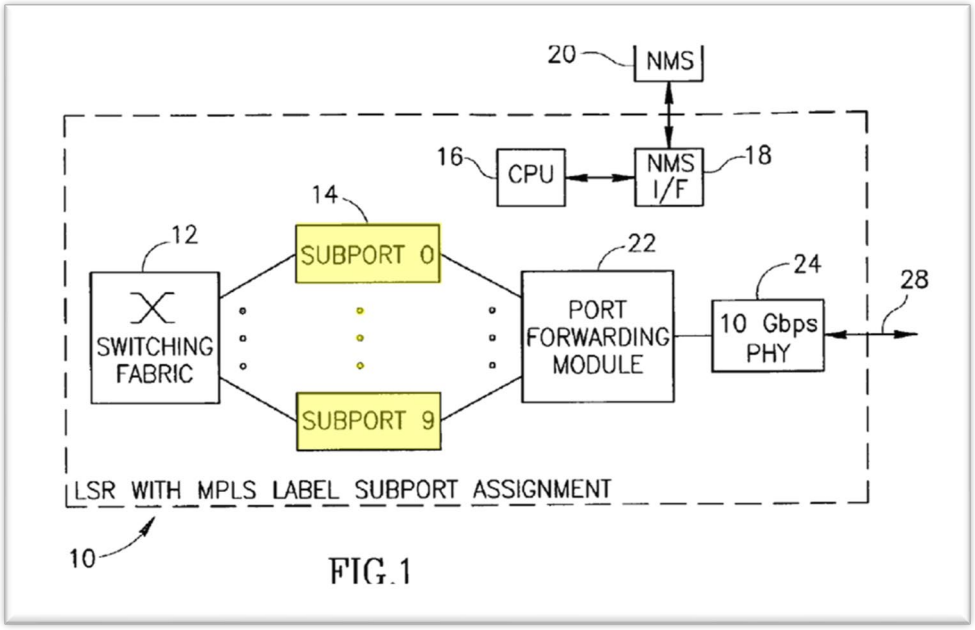


Figure 1 of Raz (Annotated)

351. As discussed above in Ground 1, while Raz discusses the utilization of subports in a LAG within a LSR to communicate high speed packet streams in an MPLS network, it is my opinion that a POSA similarly would have known to use Ethernet physical data ports of a router or switch in an Ethernet LAG to communicate high speed packet streams in a MPLS network. The concept of using aggregation to communicate individual packets of a high speed packet stream through subports in a LSR also applies to communicating individual packets through Ethernet physical data ports of routers or switches in a MPLS network. In either case, there is a desire to identify and assign a path that will have sufficient bandwidth to accommodate packets within a high speed stream.

352. Further, as discussed above for Element [1.0], Ferguson discloses the utilization of an Ethernet physical data port in a LAG in an MPLS network for the purpose of communicating high speed packet streams. EX1007, Cols. 1:21-26, 1:43-53, 3:36-4:19, 6:10-31, Figures 2A-2C. Figures 2A-2C of Ferguson demonstrate that MPLS packets are communicated in that system along a physical interconnect that is part of an aggregate interface between ports on two routers. EX1007, Figures 2A-2C. Further, Ferguson discloses that the physical interconnects may be Ethernet physical data ports (EX1007, Cols. 1:21-24, 1:43-53, 3:36-4:19, 5:4-24 (Table 1), 7:4-12) and that "the physical interconnects may couple other devices, e.g., **two switches**, a switch and a server, two routers, a switch and an end user station, and the like." EX1007, Cols. 1:24-26 (emphasis added), 8:61-64.

353. Importantly, Ferguson explains to a POSA that techniques used to communicate high speed data streams *within* a router or switch in an MPLS network can also be applied to communicating high speed data streams *between* two routers or *between* two switches in a MPLS network. EX1007, Cols. 5:61-6:6. Ferguson states that "[a]lthough [its] techniques have been described in reference to distribution of MPLS packets across parallel physical interconnects of an aggregated link, the techniques may be applied in a variety of environments." EX1007, Col. 5:63-67. "For example, the techniques may be readily applied to internal parallel data paths within a device." EX1007, Cols. 5:67-6:2. "For example, the techniques

may be used by a router [or switch] to distribute packets across internal data paths that begin at the same input interface of the router [or switch] and end at the same output interface of the router [or switch], but traverse through different internal, high-speed switch fabrics." EX1007, Col. 6:2-6. A POSA would have understood from these statements that techniques used to communicate high speed data streams between routers or switches in an MPLS network can also be used to communicate high speed data streams within a router or switch in an MPLS network, and vice versa. This knowledge would have motivated a POSA to take the techniques used to communicate packets within the LSR of Raz and use them to communicate packets between LSRs or switches in the same MPLS network.

354. Moreover, a POSA would have been motivated to combine the teachings of Raz and Ferguson because they are analogous art references for the reasons explained above in connection with Element [1.0]. EX1006, Cols. 10:60-11:12, 14:33-41, 15:47-55, 17:1-9, Figure 5; EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. Moreover, a POSA would have been motivated to combine the teachings of Raz and Ferguson because they are both directed to solving the problem of ensuring enough bandwidth is available to communicate high speed packet streams through an MPLS network, as explained above in connection with Element [1.0]. EX1006, Cols. 10:60-11:12, 14:33-41, 15:47-55, 17:1-9, Figure 5; EX1007, Cols. 1:28-42, 2:54-57, 4:55-60. As such, a POSA would have understood from the disclosures in

Ferguson that techniques for utilizing an Ethernet physical data port in a LAG to communicate data packets between routers or switches in an MPLS network are also applicable to the use of subports transmitting the data packets within the routers or switches, and vice versa. EX1007, Cols. 5:61-6:6. Thus, a POSA would have known that the techniques disclosed in Raz for using subports to transmit data packets within a router or switch would also have been applicable to an Ethernet physical data port in a LAG that communicates data packets between routers or switches in an MPLS network.

355. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.0].

[26.1] receiving from a preceding node located upstream from a first MPLS/LAG switch, at said first MPLS/LAG switch, a request message requesting configuration of a network tunnel, the message further requesting a data packet label associated with said network tunnel, said request message specifying a bandwidth requirement;

356. It is my opinion that Element [26.1] is obvious in view of the combination of Raz and Ferguson.

357. With respect to Element [26.1], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As I discussed above for Ground 1, Raz discloses that a preceding node located upstream of an LSR will send a request message seeking a label that will provide the

configuration of the subports that form the network tunnel.[5] EX1006, Col. 7:65-8:13. Further, it is my opinion that Raz's focus on ensuring that the subports have sufficient bandwidth for communicating the packet in a high speed packet stream demonstrates that it would have been obvious that the request message would specify a bandwidth requirement. EX1006, Cols. 2:23-25, 7:7-26, 11:3-12:9, 14:33-41, 15:47-55, 16:65-17:6, Figure 5.

358. Further, as discussed above for Elements [1.0]-[1.1], it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

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[5] As discussed above for Element [1.1], a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch. See EX1008; EX1006, Col. 7:7-16.

359. Moreover, for the reasons discussed above with respect to Element [1.0], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

360. In view of the above, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.1].

[26.2] assigning, at the first MPLS/LAG switch, a single physical tunnel port of a LAG to the network tunnel wherein the single physical tunnel port of the LAG, which meets the specified bandwidth requirement, wherein said single physical tunnel port of said LAG has a port serial number;

361. It is my opinion that Element [26.2] is obvious in view of the combination of Raz and Ferguson.

362. With respect to Element [26.2], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed above for Ground 1, Raz discloses the assignment of one subport of a LAG to a network tunnel within a LSR to communicate individual packets within a high speed packet stream. EX1006, Col. 3:1-15. Further, Raz states that "[a] diagram illustrating an example LSR with label based **subport assignment** constructed in accordance with a first embodiment of the present invention is shown in [Figure] 1,"

which is reproduced below. EX1006, Col. 6:65-67 (emphasis added); see EX1006, Col. 7:17-19, 7:26-27.

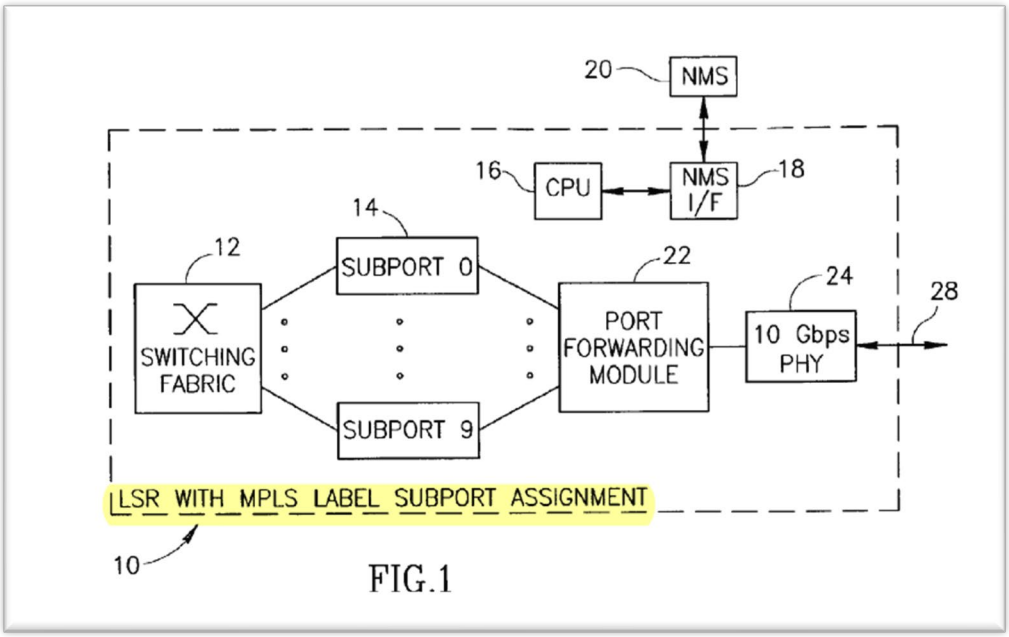


Figure 1 of Raz (Annotated)

Additionally, Raz provides an example of how the assignment process takes place, and that example states that the assignment of the subport of the LAG to a network tunnel is performed by a LSR that corresponds to the claimed first MPLS/LAG switch. EX1006, Col. 7:65-8:13; see EX1006, Cols. 7:30-38 (providing example in which the assignment of subport 3 of a LAG to a network tunnel is performed by LSR B, which corresponds to the claimed MPLS/LAG switch), 7:11-14, 9:41-48. Moreover, a POSA would have understood that the assignment of the subport would be to a network tunnel formed by the LSP used to transmit the individual packets of the high speed packet stream. EX1006, Cols. 3:1-15, 7:11-19, 7:65-8:13. It would

have been common knowledge to a POSA as of the priority date that a LSP could be used to implement a network tunnel. See EX1008, Section 3.27.3.

363. Further, as discussed above in Ground 1, a POSA would have understood that the subport within the LSR is a physical subport. Raz describes a series of 10 1G subports that collectively comprise a 10G interface of the LSR. EX1006, Cols. 7:7-29, 8:40-55, 9:29-40; 13:1-19. A POSA would have understood that each of the 1G subports is implemented as a physical subport on the LSR through which a 1G packet stream travels.

364. Moreover, as discussed above in Ground 1, Raz explains that the assigned subport meets a bandwidth requirement of the LSP (i.e., the claimed network tunnel). EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-26, 11:13-12:9, 14:33-41, 15:47-55, 16:65-17:6, Figure 5.

365. In addition, as discussed in Ground 1, Raz discloses that the assigned subport has a serial number. EX1006, Col. 9:41-48, Figures 1, 4. A POSA would have understood that a serial number is just a numerical identifier for the subport, and thus the series of bits disclosed in Raz is a serial number

366. Moreover, while Raz discloses a method of forwarding individual packets of a high speed packet stream by assigning a subport within a LSR, a POSA would have understood that the method also could have been used to assign a physical tunnel port of a MPLS/LAG switch to a network tunnel. As discussed above

in Ground 1 a POSA would have considered the LSR in Raz to be a type of MPLS/LAG switch.

367. Moreover, as discussed above in Ground 1, Raz teaches that a switching fabric within the LSR has subports and one of the subports with sufficient bandwidth to meet the requirements of a LPS (which correlates to a network tunnel) is assigned to communicate packets from a high speed data stream. The same principles would have applied to forwarding packets between MPLS/LAG switches in an MPLS network. A POSA would have understood from Raz, and would have been motivated, to assign a physical tunnel port of the MPLS/LAG switch to a network tunnel in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding packets in a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. A POSA would have been motivated to employ this same concept between nodes in an MPLS network in order to improve the ability to communicate high speed packet streams that require increased bandwidth.

368. Further, as discussed above with respect to Elements [1.0]-[1.1], Ferguson teaches a POSA that the method of assigning a subport with appropriate bandwidth within the LSR of Raz could also be implemented between MPLS/LAG switches in an MPLS network. Ferguson discloses that its techniques can be

implemented to communicate packets along "physical interconnects" between "two switches" in an MPLS network. EX1007, Col. 1:22-27, 1:57-66. In addition, Ferguson discloses that the physical interconnects between the two switches can be used as part of a LAG. EX1007, Cols. 1:28-53, 2:44-47. As such, a POSA would have understood the two switches implementing the techniques of Ferguson to be MPLS/LAG switches.

369. In addition, and as discussed above for Element [1.1], Ferguson teaches that the techniques used to reserve the bandwidth needed to communicate packets within a network device can also be applied to reserve the bandwidth needed to communicate packets between network devices in an MPLS network. A POSA would have understood this to mean that the techniques disclosed in Raz for forwarding packets within a LSR in an MPLS network could also be applied when communicating packets from one MPLS/LAG switch to another MPLS/LAG switch. Indeed, a POSA would have been motivated to apply the teachings of Ferguson to Raz because this increases the available bandwidth to communicate high speed packet streams.

370. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.2].

[26.3] dedicating a sub-set of bits in a data packet label prepared by said first MPLS/LAG switch to encode said port serial number of said single physical tunnel port of the LAG into the data packet label;

371. It is my opinion that Element [26.3] is obvious in view of the combination of Raz and Ferguson.

372. With respect to Element [26.3], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed above in Ground 1, Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) prepared by the LSR to encode the serial number of a physical subport of the LAG into the label. EX1006, Col. 9:41-58, Figures 3-4. Raz provides two examples of a sub-set of bits in a data packet label being dedicated to the identification of the subport of a LAG through which a packet should be sent. EX1006, Col. 9:41-58, Figures 3-4. A POSA would have understood that the inclusion of the bits in a data packet label by the LSR (which corresponds to the claimed MPLS/LAG switch) constitutes encoding the subport serial number in the label. A serial number is a numerical identifier for the subport, and the series of bits in the label is a serial number that is encoded because it has been put into the label in a format in which it can be used to identify the subport.

373. Further, as discussed above in Ground 1, it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches of an MPLS network in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols.

2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

374. Moreover, for the reasons discussed above with respect to Element [1.0], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz of dedicating a sub-set of bits in MPLS label 140 to encode the serial number of a physical subport, and extend that to dedicating a sub-set of bits in an MPLS label to encode the serial number of the physical port of the MPLS/LAG switch to be used to forward packets through a network tunnel formed by the LSP.

375. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.3].

[26.4] sending, by said first MPLS/LAG switch, said data packet label, in which said port serial number of said single physical tunnel port is encoded, to the preceding node;

376. It is my opinion that Element [26.4] is obvious in view of the combination of Raz and Ferguson.

377. With respect to Element [26.4], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed in Ground 1, Raz discloses dedicating a sub-set of bits in MPLS label 140 (i.e. a data packet label) to encode the serial number of a physical subport of the LAG into the label. Raz also explains that the label encoding the serial number of the subport is sent from the LSR that generated the label to an "upstream" or preceding node. EX1006, Cols. 7:26-38, 8:4-10, 9:49-58. The LSR that generates the label corresponds to the claimed MPLS/LAG switch, and it sends the label to the preceding node. In the example described in Column 7 of Raz, LSR B (which corresponds to the claimed MPLS/LAG switch) generates the label, and the label is sent to LSR A, which is the preceding node. EX1006, Col. 7:26-38.

378. Further, as discussed above for Ground 1, it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial

number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

379. Moreover, for the reasons discussed above with respect to Element [1.0], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to take the teaching of Raz that the label encoding the serial number of the subport is sent to a preceding node, and extend that to sending a label that encodes the serial number of a physical port of an MPLS/LAG switch to a preceding node in an MPLS network.

380. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.4].

[26.5] receiving from the preceding node, at said first MPLS/LAG switch, a data packet that includes said data packet label, in which said port serial number of said single physical tunnel port is encoded; and

381. It is my opinion that Element [26.5] is obvious in view of the combination of Raz and Ferguson.

382. With respect to Element [26.5], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed above for Ground 1, it is my opinion that Raz discloses receiving, from a preceding node, a data packet comprising the data packet label in which the port serial number of physical subport is encoded. Raz explains that a LSR receives a

packet from a previous node in the LSP, wherein the packet has a data packet label indicating the physical tunnel subport over which the packet should be communicated. EX1006, Cols. 7:39-45, 9:29-58, Figures 3-4. As discussed above for Element [1.2], the serial number for the physical tunnel subport is encoded within the data packet label. Raz further states that data packet label is sent to the "upstream node" in its LSP "in order for the upstream node to know how to label packets belonging to this LSP." EX1006, Col. 8:7-10. In addition, Claim 1 of Raz recites "forwarding inbound packets transmitted by said upstream node and **received over said communications link by said downstream node to a subport in accordance with the label associated with said inbound packet**." Exhibit 1006, Col. 14:23-26 (emphasis added).

383. As discussed above in Ground 1, it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz.

384. Moreover, for the reasons discussed above with respect to Elements [1.0]-[1.1], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network. Thus, Ferguson would have motivated a POSA to treat packets received at a MPLS/LAG switch from a previous node in a MPLS network in the same way as packets received at the LSR in Raz.

385. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.5].

[26.6] sending said data packet from said first MPLS/LAG switch to a second MSPLS/LAG switch via said single physical tunnel port having the port serial number encoded in the data packet label.

386. It is my opinion that Element [26.6] is obvious in view of the combination of Raz and Ferguson.

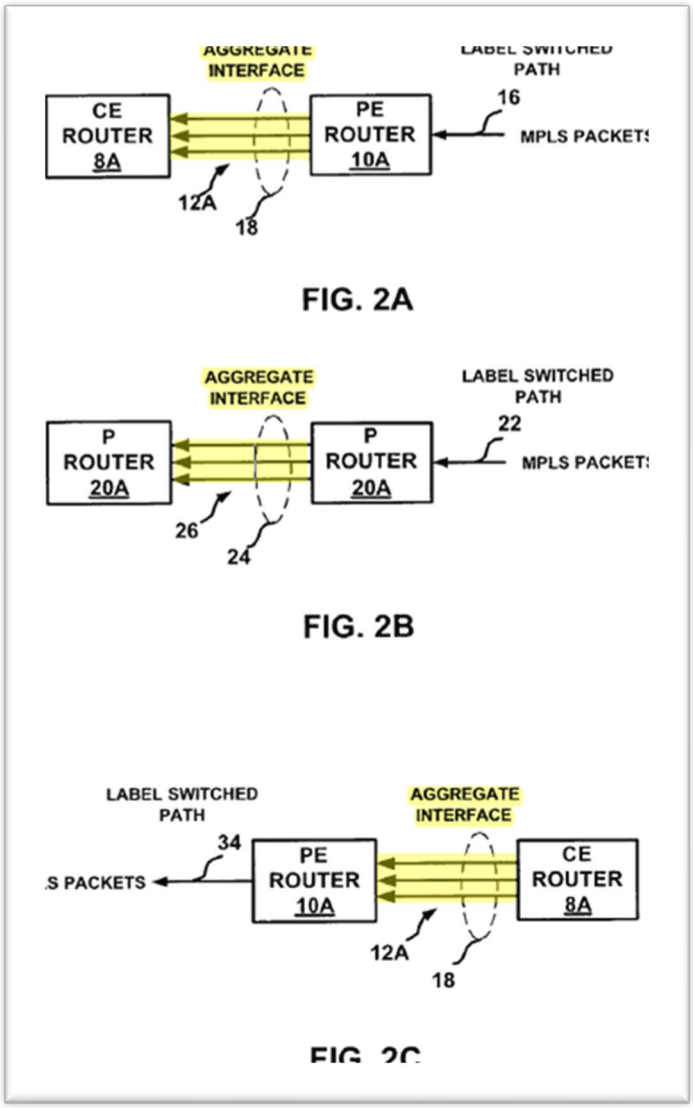
387. With respect to Element [26.6], I provided my opinions about Raz above as part of Ground 1, and I incorporate that analysis here by reference. As discussed in Ground 1, it is my opinion that Raz discloses sending a data packet from a first MPLS/LAG switch to a second MSPLS/LAG switch via a single physical tunnel port having the port serial number encoded in the data packet label. For example, LSR B in the example described in Column 7 of Raz is the LSR that generates the data packet label in which the port serial number (e.g., subport 3) is encoded, and it corresponds to the claimed first MPLS/LAG switch. EX1006, Col.

7:26-38. A POSA would have understood that a data packet in LSR B could be sent to another LSR (which corresponds to the claimed second MPLS/LAG switch) via a physical tunnel subport (subport 3) having the port serial number encoded in the data packet label. EX1006, Cols. 7:17-45, 9:29-58, 14:23-26, Figures 3-4. As discussed above for Element [1.2], the serial number for the physical tunnel subport is encoded within the data packet label.

388. As discussed above in Ground 1, it would have been within the knowledge of a POSA to implement the method disclosed by Raz in MPLS/LAG switches in order to provide a tunnel pathway that can meet the bandwidth requirements "in the event a wide connection is to be allocated" for forwarding a high speed packet stream. EX1006, Col. 11:3-12; see EX1006, Cols. 2:23-25, 7:7-16, 7:22-26, 11:13-12:9, Figure 5. As such, a POSA also would have been motivated to communicate packets from a first MPLS/LAG switch to a second MPLS/LAG switch in a MPLS network in the same way as packets communicated from one LSR to another in Raz.

389. Moreover, for the reasons discussed above with respect to Elements [1.0]-[1.1], Ferguson discloses that the techniques used to forward packets within a network device could also be applied to forward packets between network devices in an MPLS network, as shown below in Figures 2A-2C of Ferguson. Thus, Ferguson would have motivated a POSA to treat packets communicated between

MPLS/LAG switches in a MPLS network in the same way as packets communicated between LSRs in Raz.



Figures 2A-2C of Ferguson (Annotated)

390. Accordingly, it is my opinion that the combination of Raz and Ferguson discloses and renders obvious Element [26.6].

VIII. OBJECTIVE INDICIA OF NON-OBVIOUSNESS

391. I am not aware of any objective indicia of non-obviousness that would make Claim 1 of the ’602 Patent non-obvious over the prior art considered herein. In my opinion, any possible objective indicia of non-obviousness would not overcome the prior art that clearly demonstrates that the subject matter of Claim 1 of the ’602 Patent would have been obvious to a POSA as of May 6, 2005.

392. I reserve the right to supplement my opinions as appropriate if Corrigent alleges or offers any purported evidence of any such objective indicia of non-obviousness.

I hereby 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 further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed this 9th day of January, 2023.

Respectfully submitted,

Samrat Bhattacharjee, Ph.D.