

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner

U.S. Patent No. 7,061,859

**DECLARATION OF DR. PAUL MIN,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR
INTER PARTES REVIEW**

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I, Paul Min, do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Cisco Systems, Inc. in the matter of the *Inter Partes* Review of U.S. Patent No. 7,061,859 (“the ’859 patent”) to Barsheshet *et al.*

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

3. I have been asked to provide my opinions regarding whether claims 1-12 (“the Challenged Claims”) of the ’859 patent are unpatentable as they would have been obvious to a person having ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of the Challenged Claims would have been obvious to a POSITA.

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

- a. the ’859 patent, Ex.1001;
- b. the prosecution history of the ’859 patent (“’859 File History”),

Ex.1002; and

c. Japanese Patent Publication No. P2001-53772A to Omichi (“Omichi”), Ex.1005;

5. In forming the opinions expressed below, I have considered:

the documents listed above;

the relevant legal standards, including the standard for obviousness, and any additional authoritative documents as cited in the body of this declaration; and

my own knowledge and experience based upon my work in the field of optical communication as described below, as well as the following materials:

a. The Authoritative Dictionary of IEEE Standards Terms: Seventh Edition, 2001 (Ex.1007);

b. U.S. Patent No. 7,500,016 to Kao (“Kao”), Ex.1007;

c. U.S. Patent No. 5,515,376 to Murthy (“Murthy”), Ex.1008; and

d. U.S. Patent No. 5,768,526 to Fawcett (“Fawcett”), Ex.1009.

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

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. My qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004. The following is

a brief summary of my relevant qualifications and professional experience.

8. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical Engineering in 1987 from the University of Michigan in Ann Arbor. I received several academic honors, including my B.S. degree with honors, a best graduate student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

9. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990. At Bellcore, I was responsible for evolving the public switched telephone network (PSTN) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies, which included the deployment of the Synchronous Optical Network (SONET) as part of the digital backbone networks.

10. In September 1990, I joined the faculty at Washington University in St. Louis. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. I am currently a Senior Professor at Washington University in the Department of Electrical and Systems Engineering. I have also served as the Chair of the Graduate Curriculum (2000-2002) and the Chair of the Undergraduate Curriculum (2011-2014) for the Department of Electrical and Systems Engineering.

11. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. I have received several grants from the U.S. Federal Agencies, including the National Science Foundation and the Defense Advanced Research Project Agency, and numerous contracts from companies and organizations around the world. I have researched a variety of communication, computing, and electronic technologies, including wireless communication, broadband communication, transmission and switching, integrated circuit design, software application and protocol design, and system prototype. I have an extensive background and experience in each of these technologies.

12. As a faculty member at Washington University, I have taught several courses in electronics, communication, and computing at both the undergraduate and graduate levels. For example, I have taught electronic circuits (Washington University ESE 232), communication theory (Washington University ESE 471), transmission and multiplexing (Washington University ESE 571), and signaling and control of communication networks (Washington University ESE 572).

13. I have supervised numerous graduate and undergraduate students, many of whom received a doctoral degree under my guidance. The doctoral theses that I have supervised relate to wireless communication, broadband communication, transmission and switching, integrated circuit design, software application and

protocol design, and system prototype. My students and I have published a number of peer-reviewed articles on transmission and switching, electronic circuit and integrated circuit design, resource allocation, scheduling, modulation, mobility management, switching and transmission, and multiplexing. Several of these articles received accolades in the field. For example, in 2011 we received a best paper award in 3G WCDMA-related mobility and resource management at the prestigious Mobility 2011 international conference.

14. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best-product-of-the-year award in 2004 from a major trade journal for the electronics industry. In these companies, I have designed several circuits and software protocols, including switch fabric, network processor, and high-speed interface devices with transmission media.

15. Outside of my own start-up companies, I have also served in various technology and business advisory roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals

to the Korean Government for CDMA wireless service licenses (1996). I was responsible for designing a commercial scale IS-95 CDMA cellular network, which I understand to be one of the earliest such networks deployed in the world. I worked with numerous engineers and scientists around the world to implement this commercial-scale cellular network before IS-95 CDMA was widely accepted. This provided me with extensive insight into various components of CDMA technology, which extensively use various transmission technologies incorporating packet-framing techniques. I have also been involved with a semiconductor company that specializes in semiconductor memories such as flash EEPROMs as a board member and as a technical advisor (2007-2011).

16. I am a member of and have been actively involved in several professional organizations. For example, in 2014 I served as the Chair of the Saint Louis Section of the IEEE with more than 3,000 members and was a member of the Eta Kappa Nu Honor Society for electrical engineers. I have also been an Ambassador of the McDonnell International Scholars Academy (2007-2013).

17. In my 40+ years of experience with telecommunications technology, I have acquired significant knowledge about telecommunications systems industry standards, standard setting organizations such as Bellcore, IEEE, ATM Forum, IETF, ITU, 3GPP, JEDEC, and the rules and document policies that those organizations have in place to develop industry standards.

18. I am a named inventor on eleven U.S. patents, many of which focus on algorithm and device designs. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. I have organized several international conferences and served as an international journal editor.

19. My work on this case is being billed at a rate of \$500 per hour, with reimbursement for actual expenses. I have no direct financial interest in the dispute between any of the parties, and my compensation is not contingent upon the outcome of this litigation.

III. RELEVANT LEGAL STANDARDS

20. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '859 patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

21. I understand that prior art to the '859 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '859 patent. For purposes of this Declaration, I am applying August 30, 2001 as the earliest possible priority date of the '859 patent.

22. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such

that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

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

IV. FOCUSED ANALYSIS**A. Level of Ordinary Skill in the Art**

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

25. A person of ordinary skill in the art (“POSITA”) in the field of the ’859 patent, as of its earliest possible filing date of August 30, 2001, would have been someone knowledgeable and familiar with networking technologies including ring networks and fault protection. That person would have a bachelor’s degree in electrical engineering, computer science, or equivalent training, and approximately two years of experience working in the field of networking systems. Lack of work experience can be remedied by additional education, and vice versa.

26. For purposes of this Declaration in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of the priority date of the ’859 patent. Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA prior to the priority

date of the '859 patent.

B. Background

1. Ring Networks

27. A ring network is a type of computer network topology where each device (node) is connected to two other nodes in the same ring, forming a circular pathway for data transmission. Ring topologies allow the data to travel in one or both directions (i.e., clockwise or counterclockwise) around the ring until it reaches its destination. Typically, the rings allowing bidirectional data transmission employ a separate connection (e.g., electrical wire, optical fiber) for each of the two directions.

28. Personally, I have spent a great deal of time while I was at Bellcore (during 1987-1990) working on various deployment strategies for the Synchronous Optical Network, which were more commonly referred to as the SONET. During this period at Bellcore, the telephone networks in the United States (and around the world in many developed countries) were experiencing rapid growth in the data traffic. To accommodate this growth, telephone companies were deploying the SONET around various metropolitan areas. One of the tasks that I was focused on was developing the strategies for the multi-teered ring networks, using the Add Drop Multiplex (or the ADM in short).

2. Fault Protection

29. Fault protection in networks involves strategies and technologies to prevent, detect, and recover from failures. Fault protection thus ensures reliable communication and minimal downtime. These protections are essential for maintaining stable and efficient network operations.

30. As the transmission technology evolved, the data rates along the transmission paths were rapidly increasing. Around the time of the alleged invention in the '859 patent, this data rate increase was particularly noted in the optical networks such as the SONET, wherein the data rates were reaching hundreds of megabits per second. Losing the integrity of any of the segments along the transmission path, even for a brief period of time, the amount of data loss could be very substantial.

31. Personally, as part of my effort with regard to the SONET deployment, I researched various options for providing protections, such as the line-level protection, segment-level protection, and path-level protection, utilizing different techniques stemming from switching, re-routing, working/standby redundancy, etc.

3. Boolean Logic

32. Boolean logic is widely used in digital circuits and computer programming. Bitwise Boolean logic operates at the binary level, manipulating

individual bits within numbers. When Boolean logic is represented by binary numbers, often a value of “true” is represented by a ‘1’ and a value of “false” is represented by a ‘0.’

33. Boolean logic involves logical operations such as AND, OR, and NOT to manipulate and evaluate binary numbers. For example, when two bits are ANDed, the result is true (‘1’) only if both bits are also true (‘1’), as shown in the following truth table.

P	Q	$P \wedge Q$
0	0	0
0	1	0
1	0	0
1	1	1

AND Truth Table

IEEE Dictionary, 37.

34. As can be seen, the only case when the result of P AND Q is true (a ‘1’) is where both P and Q are also true.

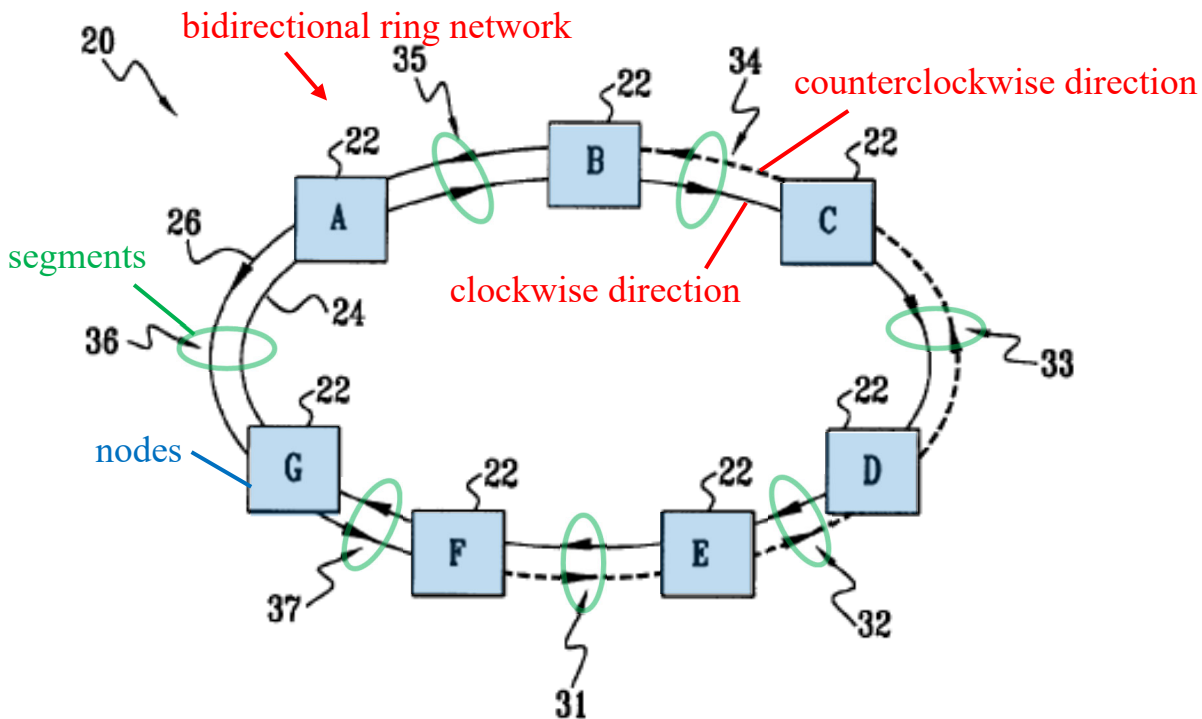
35. Boolean logic would have been within the background knowledge of a POSITA. The ’859 patent refers to Boolean logic operations, but does not explain those operations—thus confirming they would have been understood by a POSITA. *See also* Murthy, 8:49-50 (information can be “combined according to the well-known rules of Boolean logic”); Fawcett, 7:37 (“boolean logic, well

known to those skilled in the art”).

C. Overview of the '859 Patent

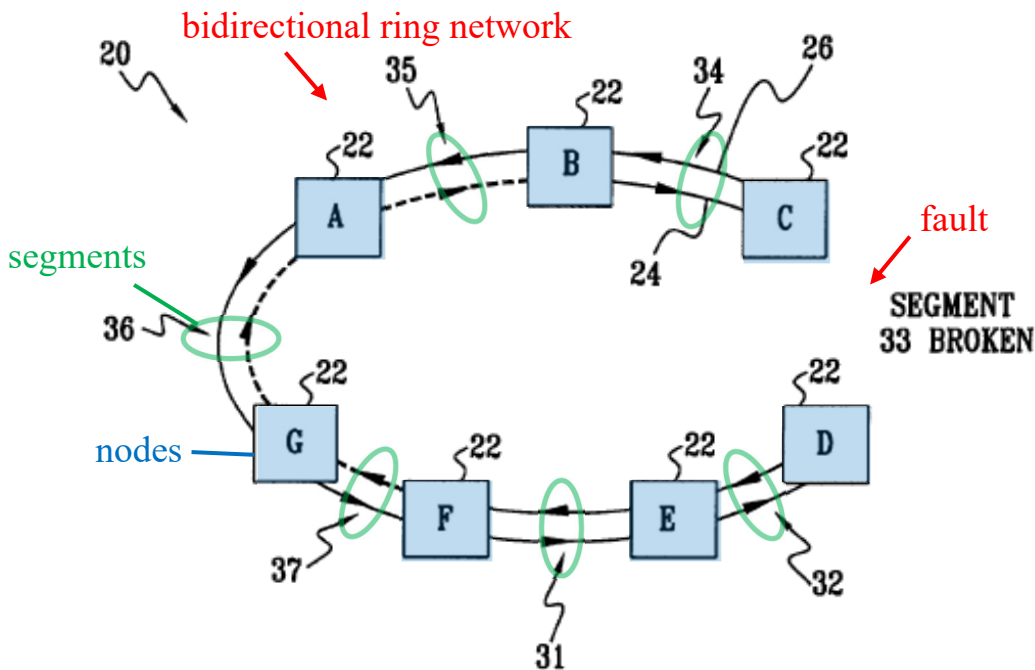
1. Summary of the '859 patent

36. The '859 patent “relates generally to communication networks, and specifically to high-speed packet rings.” '859 patent, 1:5-6. The '859 patent describes a “bidirectional ring network 20” that “comprises a plurality of nodes 22, labeled A through C, which are mutually connected by network segments 31, 32, 33, 34, 35, 36, and 37.” '859 patent, 3:52-55. “The network segments comprise a bidirectional communication medium, such as optical fibers or conductive wires.” '859 patent, 3:57-59. “The communication medium is configured to define an inner ring 24, over which packets are conveyed between the nodes in a clockwise direction, and an outer ring 26, over which the packets are conveyed in a counterclockwise direction.” '859 patent, 3:59-63. The bidirectional ring network is shown in Fig. 1 below.



'859 patent, Fig. 1 (annotated).

37. The '859 patent describes a “mechanism for rapid fault protection in a ring network.” '859 patent, 2:16-18. For example, if there is a fault in the network, data that was using the clockwise ring may need to switch to using the counterclockwise ring. “FIG. 3 is a block diagram showing an alternative route taken by the data flow from node F to node B ... following occurrence of a fault in segment 33.” '859 patent, 4:24-27.



'859 patent, Fig. 3 (annotated).

38. The purported novelty of the '859 patent is to use a first set of bits to represent the state of each of the segments in the network. This first set of bits is referred to in the '859 patent as a "*general mask*." '859 patent, 2:19-30 ("constructing the general mask includes assigning a respective general mask bit to each of the segments, indicating whether the segment can be reached following occurrence of the fault"). For example, a "general mask in the absence of any fault in network 20 has the form 0000000." '859 patent, 4:54-55. However, "[i]n the situation shown in FIG. 3, the general mask ... would have the form 0000100, wherein the bits run in a counterclockwise direction from segment 31 (least significant bit) to segment 37 (most significant bit). The third bit is set to '1' to indicate that segment 33 is broken." '859 patent, 4:48-52.

39. In addition to the general mask, the nodes use a second set of bits “to represent each of its data flows.” ’859 patent, 4:56-57. This second set of bits is referred to as a “*specific mask*.” ’859 patent, 2:19-30 (“the specific mask includes assigning a respective specific mask bit to each of the segments, indicating whether the flow was to be conveyed over the segment had the fault not occurred”). As an example, the “specific mask” for a data flow between node F and Node B “has the form 0001111, to indicate that the flow passes through segments 31, 32, 33 and 34.” ’859 patent, 4:61-63.

40. Both the general mask and the specific mask are used together to determine if a data flow should be rerouted. “In order to determine how to handle the data flow following the fault, node F mathematically superimposes the applicable general and specific masks, preferably by taking the Boolean conjunction (AND) of the masks.” ’859 patent, 4:64-67. “If the conjunction is 0000000, the node can conclude that there is no overlap between this data flow and the failed segments in network 20, and therefore determines that no steering of this flow is required.” ’859 patent, 5:1-4. “In the situation shown in FIG. 3, however, the conjunction of the masks is 0000100 ... In this case, the node concludes that the current data flow overlaps all of the unreachable segments, and therefore steers the data flow around the ring in the opposite direction.” ’859 patent, 8-13.

41. However, as will be explained in detail below, it was already known

to compare a first set of bits representing working segments with a second set of bits representing data flows, as taught by Omichi.

2. Prosecution History of the '859 patent.

42. The '859 patent was filed on August 30, 2001. In a first Office Action, all claims were rejected as being anticipated by U.S. Patent No. 6,366,556 to Ballintine et al. '859 File History, 88. In response, the Applicant amended the claims to recite additional details about the “general mask” and “specific mask” concepts.

1. (Currently amended) In a bidirectional ring network, in which nodes are mutually connected by network segments, a method of fault protection, comprising:

constructing a general mask indicating which of the segments can be reached in the event of a fault in the network by assigning a respective general mask bit to each segment, indicating whether the segment can be reached following occurrence of the fault;

for a given data flow to be conveyed through the network from a source node to a destination node, constructing a specific mask indicating the segments on a desired path of the flow by assigning a respective specific mask bit to each of the segments, indicating whether the flow was to be conveyed over the segment had the fault not occurred; and

superimposing the general and specific masks in order to determine a disposition of the flow.

43. The Office then issued an additional rejection under 35 U.S.C. 112 (enablement) and maintained the anticipation rejection of Ballantine. '859 File

History, 110. The Applicant then made some minor amendments to “clarify the meaning of the claim.” ’859 File History, 42-47.

44. The Office then issued a notice of allowance. However, again, it was already known to compare a first set of bits representing working segments with a second set of bits representing data flows, as taught by Omichi.

D. Claim Construction

45. It is my understanding that in order to properly evaluate the ’859 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard, under which claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. I do not believe any of the terms require express construction, and that the plain and ordinary meaning should be applied. Below are my opinions on how a POSITA would have understood certain claim terms as of the priority date of the ’859 patent.

1. “*mask*”

46. In the context of computers, a mask includes “a pattern of characters that is used to control the retention or elimination of portions of another pattern of characters.” IEEE Dictionary, 668. In other words, a mask may be “a pattern of

bits” that is logically combined with another item to “retain or suppress” portions of that data item. IEEE Dictionary, 668. For example, consider the following eight-bit mask: 00000011. If one were to combine (e.g., logically AND) this mask with another data item, the result of that combination (e.g., AND operation) would retain only the last two bits. The first six bits would be eliminated. In particular, if the mask 00000011 is combined with the value 10101010, the result would be 00000010.

2. “*null*”

47. A null value includes the value zero. For example, an eight-bit value that is null would be comprised of eight ‘0’s: 00000000. *See* IEEE, 748.

E. Key Prior Art Teachings

48. Omichi describes a system that compares the bits of the ring link failure table with the bits of the used ring link table. What Omichi describes is known as an AND operation. “[T]he used ring link table ... is compared against the ring link failure table, and a determination is made as to whether or not there are bits having the same bit number and whose contents are both “1” (S4).” Omichi, [0040]. This is exactly what the truth table from IEEE Dictionary at 37 (reproduced above) shows. The only outcome of “true” from the AND operation is when the two inputs P and Q are both true (i.e., both logic “1”), just like how Omichi is trying to identify whether or not there is a ring link failure (condition

“P”) AND whether or not the failed rink is part of the path of data flow (condition “Q”).

49. The graphic below shows a comparison result of Omichi’s ring link failure table of Fig. 6a with Omichi’s used ring link table of Fig. 6b.

ring link failure table

(a)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

used ring link table

(b)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

comparison result (i.e., result of AND operation)

0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Bits whose same bit number (b5) are both 1

Omichi, Figs. 6a, 6b (partial, annotated).

50. By comparing bits to see if they are both a ‘1,’ Omichi’s system is performing an AND operation. *See also, IEEE Dictionary, 37 (“AND (mathematics of computing) A Boolean operator having the property that if P is a statement, Q is a statement, R is a statement, ... , then the AND of P,Q,R, . . . is true if and only if all statements are true.”).*

V. DETAILED IDENTIFICATION OF HOW THE CLAIMS ARE

UNPATENTABLE

51. I have been asked to provide my opinion as to whether the Challenged Claims of the '859 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the '859 patent.

52. As part of my analysis, I have considered the scope and content of the prior art and any differences between the alleged invention and the prior art. I describe in detail below the scope and content of the prior art, as well as any differences between the alleged invention and the prior art, on an element-by-element basis for each Challenged Claims of the '859 patent.

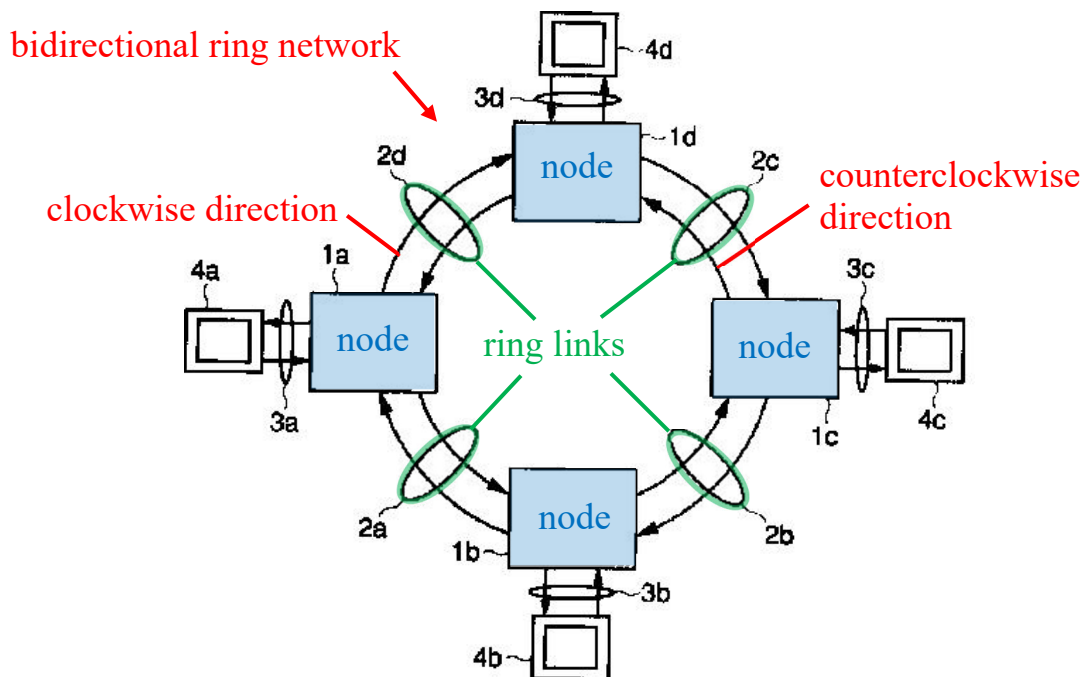
53. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA.

A. Ground 1: Claims 1-12 are rendered obvious by Omichi.

1. Summary of Omichi

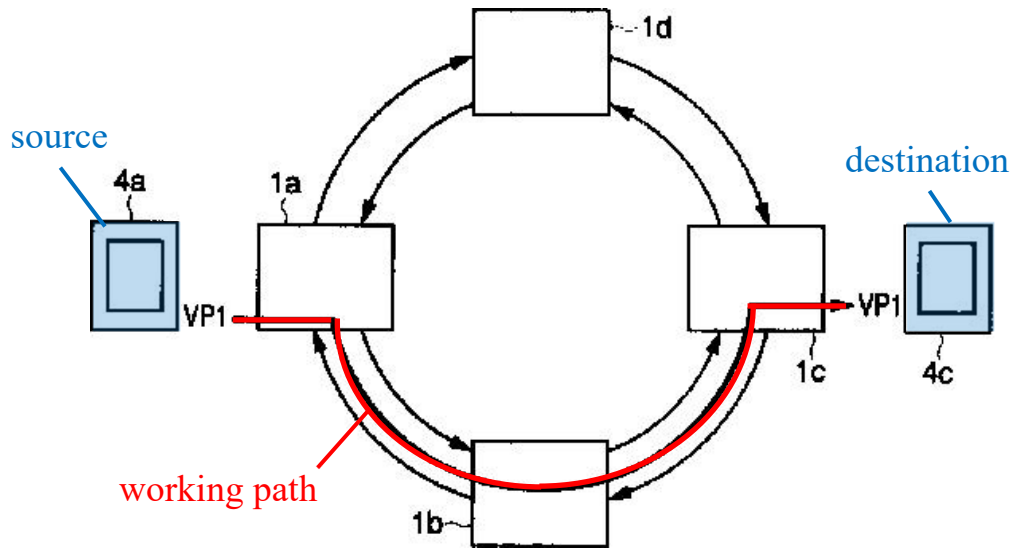
54. Like the '859 patent, Omichi relates to a “ring network comprising a plurality of branch insertion nodes and method of failure recovery of ring network.” Omichi, title. Omichi describes a bidirectional “ring network [that] comprises a plurality of branch insertion nodes 1a through 1d that are arranged in a ring shape.” Omichi, [0024]. The nodes are connected to each other through

segments referred to as ring links: “Ring links 2a through 2d that respectively connect adjacent branch insertion nodes 1a through 1d as shown in FIG. 1 are bidirectional physical transmission paths and constitute clockwise ring transmission paths and counterclockwise ring transmission paths.” Omichi, [0025]. The bidirectional ring network is shown in Fig. 1 below.



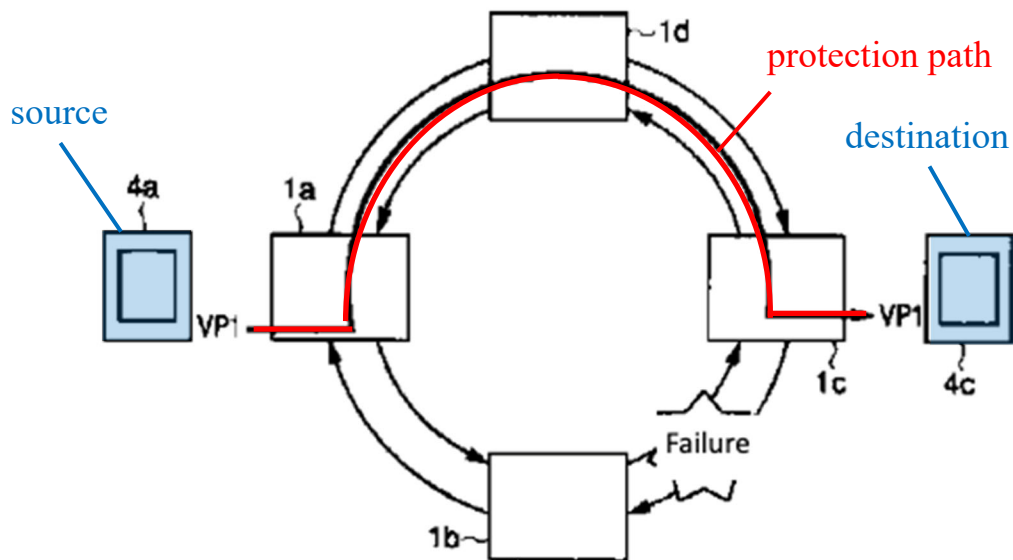
Omichi, Fig. 1 (annotated).

55. Omichi, describes an example in which data is routed along a “working path,” as shown in Fig. 3 below. “FIG. 3 describes the working path of a virtual path. A working path is a virtual path that is normally used.” Omichi, [0030].



Omichi, Fig. 3 (annotated).

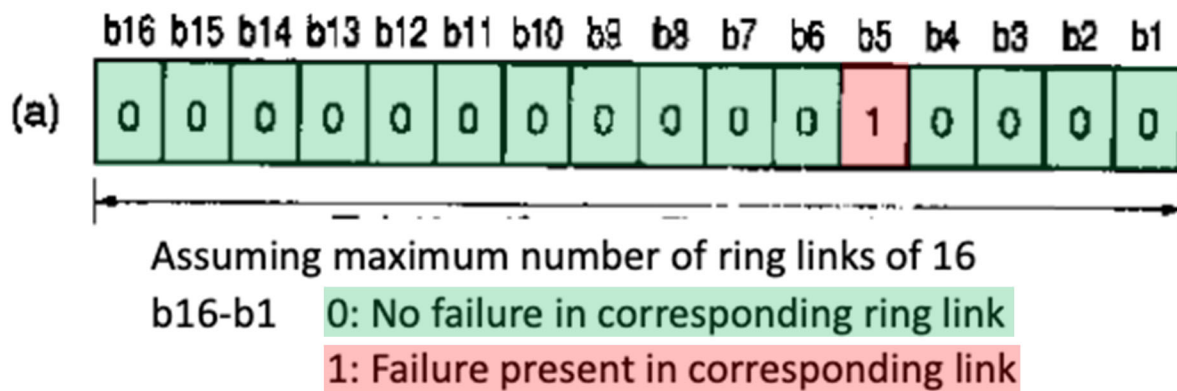
56. However, when there is a fault in the working path, Omichi's system reroutes the data flow to a "protection path." "FIG. 4 is used to describe a protection path for a virtual path. A protection path is a virtual path that is used to circumvent a failure when a failure occurs on a ring network." Omichi, [0031].



Omichi, Fig. 4 (annotated).

57. To make the decision to reroute a data flow, Omichi uses the same technique described in the '859 patent—comparing a first set of bits representing the available ring links with a second set of bits representing the desired path.

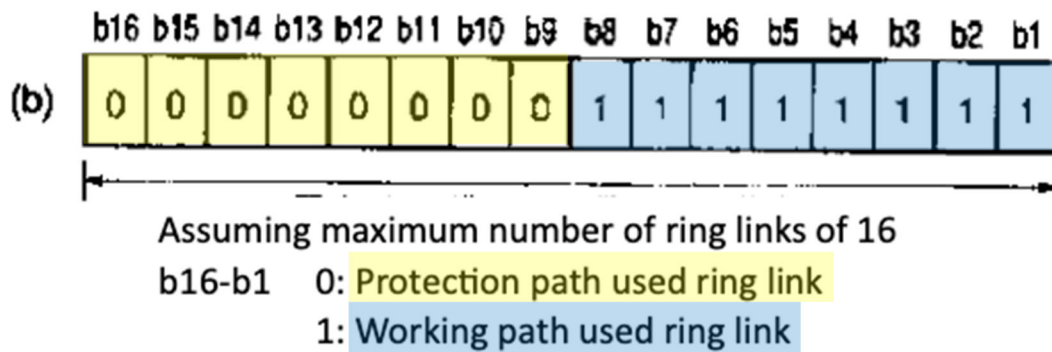
58. Omichi describes using a first set of bits in the form of a ring link failure table, as illustrated in Fig. 6a below. “The ring link failure table shown in FIG. 6(a) is used to hold information that indicates whether or not a failure has occurred in a ring link.” “The ring link failure table has a bit width equal to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. A particular bit with a value of “0” indicates that there is no failure in the corresponding ring link. A value of “1” indicates a failure in the corresponding ring link.” Omichi, [0036].



Omichi, Fig. 6a (annotated).

59. Omichi further describes using a second set of bits in the form of a used ring table as shown in Fig. 6b below. “The used ring link table shown in FIG.

6(b) is provided for each virtual path and identifies the ring link that is used as a working path. The used ring link table has a bit width that corresponds to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. A value of “0” for a bit shows that the corresponding ring link is used as a protection path. A value of “1” shows that the corresponding ring link is used as a working path.” Omichi, [0037].



Omichi, Fig. 6A (annotated).

60. Omichi then describes comparing the ring link table with the used ring link table. For a given ring link, if the bits from both tables are “1,” this means that the working path flows over a fault, and traffic should be re-routed on the opposite ring (i.e., the protection path). “If there are bits having the same bit number and whose contents are both “1” (S4, Yes), because this means that the working path includes a ring link where a failure has occurred.” Omichi, [0041]. Accordingly, “frame 5 or ATM-cell 6 is transmitted using the protection path (S6).” Omichi, [0041].

61. If, however, there are no ring links for which the bits in both table are a “1,” then no re-route need be taken. “If there are no bits having the same bit number and whose contents are both “1” (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred.” Omichi, [0040].

62. Thus, Omichi provides evidence that it was known to make decisions on how to route data flows by comparing a set of bits representing faults with a set of bits representing the data flow path.

2. Claim 1

[1.0] In a bidirectional ring network, in which nodes are mutually connected by network segments, a method of fault protection, comprising:

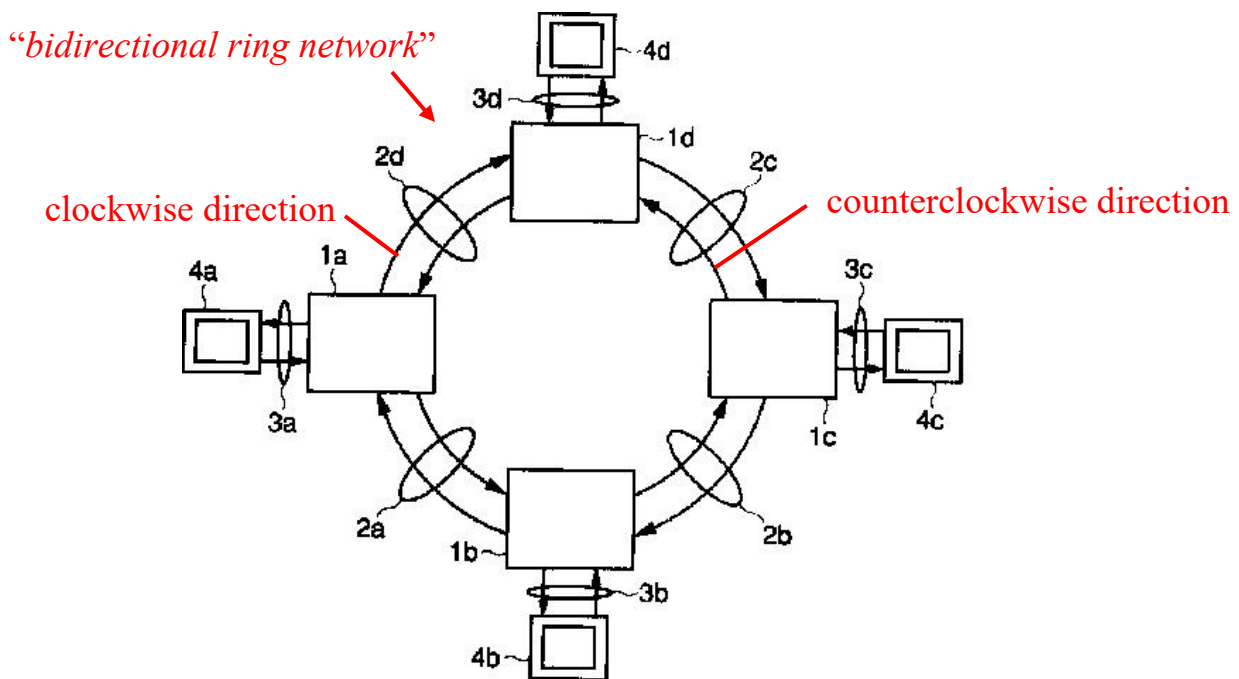
63. **First**, Omichi describes a ring network with bidirectional transmission paths (“a *bidirectional ring network*”).

FIG. 1 shows a schematic view of the configuration of Embodiment 1 of **a ring network** according to the present invention. This ring network comprises a plurality of branch insertion nodes 1a through 1d that are arranged in a ring shape, ring links 2a through 2d that respectively connect adjacent branch insertion nodes 1a through 1d, branch line links 3a through 3d that are respectively connected to branch insertion nodes 1a through 1d, and branch line nodes 4a through 4d that are respectively connected to branch insertion nodes 1a through 1d via branch line links 3a through 3d.

Ring links 2a through 2d that respectively connect adjacent branch insertion nodes 1a through 1d as shown in FIG. 1 are **bidirectional physical transmission paths and constitute clockwise ring transmission paths and counterclockwise ring transmission paths.**

These ring links 2a through 2d are used as information transmission paths between branch insertion nodes 1a through 1d.

Omichi, [0024]-[0025].



Omichi, Fig. 1 (annotated).

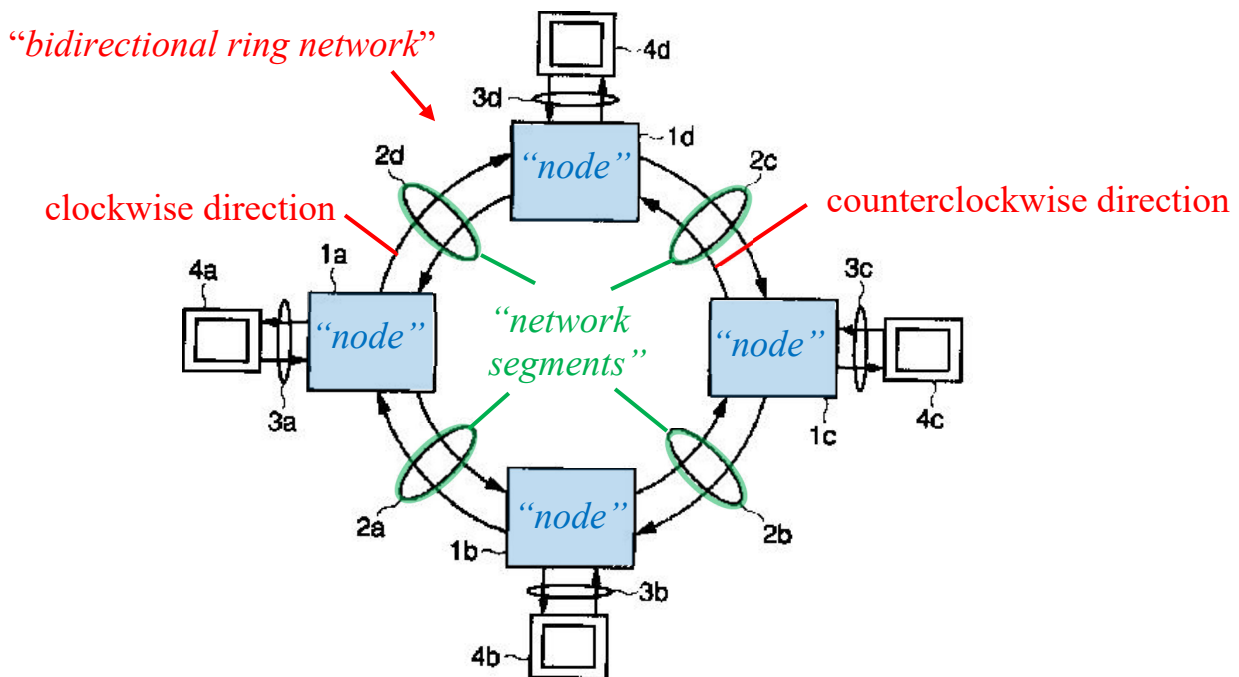
64. Second, Omichi's ring network includes several branch insertion nodes 1a-1d ("*nodes*") that are connected to each other using ring links 2a-2d ("*network segments*").

Ring links 2a through 2d that respectively connect adjacent branch insertion nodes 1a through 1d as shown in FIG. 1 are bidirectional physical transmission paths and constitute clockwise ring transmission

paths and counterclockwise ring transmission paths. These ring links 2a through 2d are used as information transmission paths between branch insertion nodes 1a through 1d.

Branch insertion nodes 1a through 1d determine the transmission destination of the information received via connected ring links 2a through 2d or the information received via connected branch line links 3a through 3d based on information held in branch insertion nodes 1a through 1d and transmit the information to ring links 2a through 2d or branch line links 3a through 3d.

Omichi, [0025]-[0026].



Omichi, Fig. 1 (annotated).

65. Accordingly, because each ring link ("network segment") connects two adjacent nodes together with both a clockwise link and a counterclockwise link, the nodes are "*mutually connected*" as claimed.

66. Third, Omichi states that “a first object of the present invention is to provide a branch insertion node that is capable of quickly recovering from failures that occur in a ring network” (Omichi, [0008]), which teaches “*a method of fault protection*” as claimed.

[Problem] To provide a branch insertion node that **can quickly perform failure recovery when a failure occurs in a ring network.**

[Means of Solution] A branch insertion node comprises: branch line link transmission part 12 and branch line link reception part 13 for communicating information via a branch line link; ring link transmission part 10 and ring link reception part 11 for communicating information via a ring link; and route selection processing part 8 for receiving, via a ring link reception part 11, notification of occurrence of failure in a ring link and for causing ring link transmission part 10 to transmit information in an opposite direction to virtual paths that are affected by the failure in a ring link. **Because route selection processing part 8 causes ring link transmission part 10 to transmit information in the opposite direction to the virtual paths that are affected by the failure in a ring link, a rapid recovery from failure becomes possible.**

Omichi, abstract.

The present invention was made to solve the afore-described problems, and a first object of the present invention is to provide a branch insertion node **that is capable of quickly recovering from failures that occur in a ring network.**

Omichi, [0008].

Because the route selection means receives, via the ring link communication means, **notifications of occurrence of failures in a ring link and causes the ring link communication means to transmit information in an opposite direction to the virtual paths that are affected by the failure in a ring link, quick recovery becomes possible from a failure.**

Omichi, [0013].

FIG. 4 is used to describe a protection path for a virtual path. A protection path is a virtual path that is **used to circumvent a failure when a failure occurs on a ring network.** In FIG. 4, because a failure has occurred on ring link 2b between branch insertion node 1b and branch insertion node 1c, virtual path VP1, which is a protection path that is not routed over ring link 2b, is used.

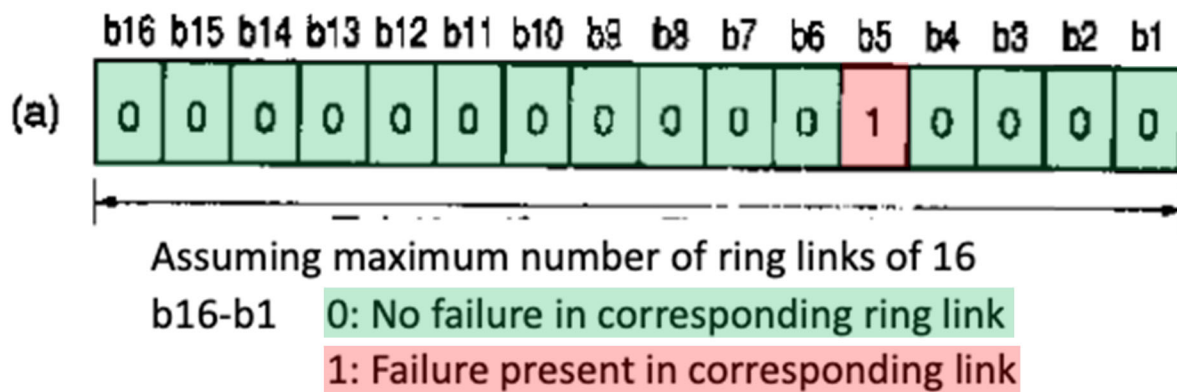
[0032] **The failure that occurred in ring link 2b is detected by branch insertion node 1b or 1c.** Other branch insertion nodes are notified of the failure. Branch insertion node 1a, which receives the failure notification, determines which of the virtual paths connected to it from branch line node 4a are affected by the failure and sends either frame 5 or ATM cell 6 to ring link 2d in the opposite direction for the virtual paths that are affected by the failure, **thus circumventing the failure.** To explain, branch insertion node 1a circumvents the failure by switching the route of virtual path VP1 from the counterclockwise direction (working path) shown in FIG. 3 to the clockwise direction (protection path) shown in FIG. 4. The details of the switching of the protection path are described below.

Omichi, [0031]-[0032].

67. Thus, because Omichi describes circumventing failures in a ring network having a plurality of nodes interconnected through ring links, Omichi renders obvious “[i]n a bidirectional ring network, in which nodes are mutually connected by network segments, a method of fault protection.”

[1.1] constructing a general mask indicating which of the segments are reachable in the event of a fault in the network by assigning a respective general mask bit to each segment, indicating whether the segment is reachable following occurrence of the fault;

68. First, Omichi describes a ring link failure table (“general mask”) that indicates whether or not failure has occurred in a ring link (“indicating which of the segments are reachable in the event of a fault in the network”).



Omichi, Fig. 6A (annotated).

FIGS. 6(a) through FIG. 6(c) show the tables that are stored in route information part 9. **The ring link failure table shown in FIG. 6(a) is used to hold information that indicates whether or not a failure has occurred in a ring link.** The ring link failure table has a bit width equal

to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. A particular bit with a value of “0” indicates that there is no failure in the corresponding ring link. A value of “1” indicates a failure in the corresponding ring link. Thus, there is no failure anywhere, and all bits in the ring link failure table are “0.” However, if a failure occurs in a ring link, a branch insertion node 1a through 1d that receives the failure notification sets the value to “1” for the bit number corresponding to the ring link number where a failure has occurred.

Omichi, [0036].

69. Second, the ring link table assigns one bit to each ring link (“*by assigning a respective general mask bit to each segment*”).

FIGS. 6(a) through FIG. 6(c) show the tables that are stored in route information part 9. The ring link failure table shown in FIG. 6(a) is used to hold information that indicates whether or not a failure has occurred in a ring link. **The ring link failure table has a bit width equal to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number.** A particular bit with a value of “0” indicates that there is no failure in the corresponding ring link. A value of “1” indicates a failure in the corresponding ring link. Thus, there is no failure anywhere, and all bits in the ring link failure table are “0.” However, if a failure occurs in a ring link, a branch insertion node 1a through 1d that receives the failure notification sets the value to “1” for the bit number corresponding to the ring link number where a failure has occurred.

Omichi, [0036].

70. Third, each bit indicates whether or not the corresponding ring link (“segment”) has failed (“*indicating whether the segment is reachable following occurrence of the fault*”).

FIGS. 6(a) through FIG. 6(c) show the tables that are stored in route information part 9. The ring link failure table shown in FIG. 6(a) is used to hold information that indicates whether or not a failure has occurred in a ring link. The ring link failure table has a bit width equal to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. **A particular bit with a value of “0” indicates that there is no failure in the corresponding ring link. A value of “1” indicates a failure in the corresponding ring link. Thus, there is no failure anywhere, and all bits in the ring link failure table are “0.” However, if a failure occurs in a ring link, a branch insertion node 1a through 1d that receives the failure notification sets the value to “1” for the bit number corresponding to the ring link number where a failure has occurred.**

Omichi, [0036].

71. Omichi’s ring link failure table is similar to the general mask as described in the ’859 patent: “The general mask in the absence of any fault in network 20 has the form 0000000.” ’859 patent, 4:54-55. “At a general mask building step 50, the node builds a general mask indicating which of the segments cannot be reached as a result of the fault. In the situation shown in FIG. 3, the

general mask constructed by node F would have the form 0000100.” ’859 patent, 4:45-49.

72. Thus, because Omichi constructs a ring link failure table in which each bit corresponds to a ring link and indicate whether there is a fault in that ring link, Omichi renders obvious “*constructing a general mask indicating which of the segments are reachable in the event of a fault in the network by assigning a respective general mask bit to each segment, indicating whether the segment is reachable following occurrence of the fault.*”

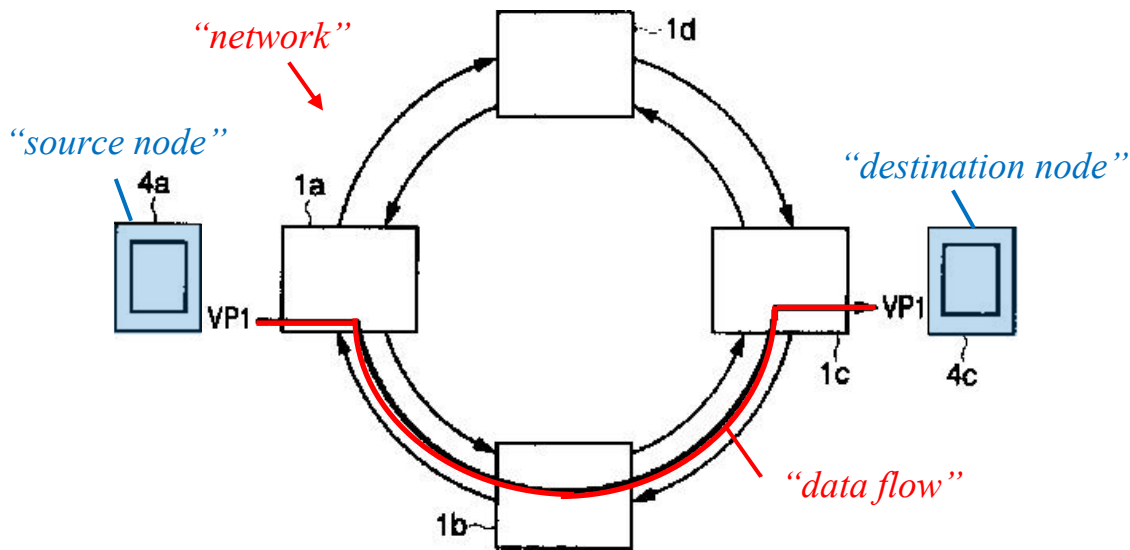
[1.2] for a given data flow to be conveyed through the network from a source node to a destination node, constructing a specific mask indicating the segments on a desired path of the flow by assigning a respective specific mask bit to each of the segments, indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault; and;

73. First, Omichi describes a virtual path (“a given data flow”) through the ring network (“to be conveyed through the network from a source node to a destination node”).

Virtual paths are established between branch line nodes 4a through 4d via a ring network and serve as communication paths for variable-length-size frames and fixed-length-size ATM cells which contain information.

FIG. 3 describes the working path of a virtual path. A working path is a virtual path that is normally used. In FIG. 3, virtual path VP1, a route that extends from branch line node 4a to branch line node 4c, is shown as an example of a working path.

Omichi, [0029]-[0030].

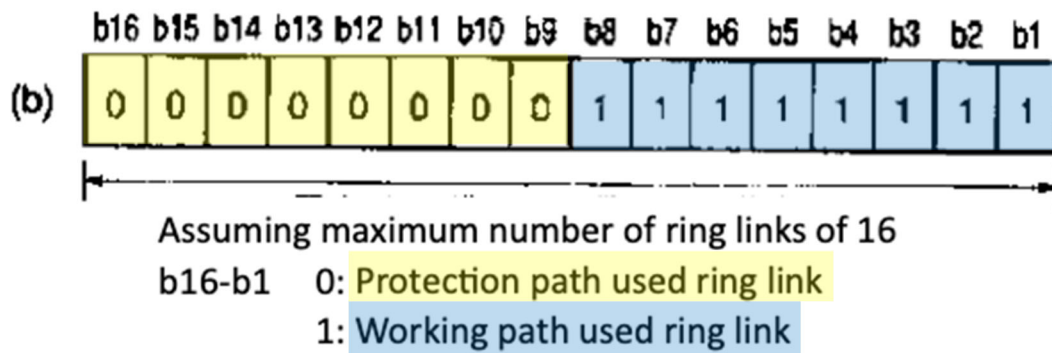


Omichi, Fig. 3 (annotated).

74. **Second**, for each virtual path (“given data flow”), Omichi’s system creates a used ring link table (“specific mask”).

The used ring link table shown in FIG. 6(b) is provided for each virtual path and identifies the ring link that is used as a working path. The used ring link table has a bit width that corresponds to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. A value of “0” for a bit shows that the corresponding ring link is used as a protection path. A value of “1” shows that the corresponding ring link is used as a working path.

Omichi, [0037]; I note that the table in Fig. 6b applies to a larger exemplary ring network (with 16 segments) rather than the example ring of Fig. 3.



Omichi, Fig. 6A (annotated).

75. **Third**, Omichi's used ring link table distinguishes a working path (*"segments on a desired path"*) from a protection path (e.g., a backup path). The used ring link table makes this distinction using the bits assigned to each segment, as described below.

The used ring link table shown in FIG. 6(b) is provided for each virtual path and identifies the ring link that is used as a working path. **The used ring link table has a bit width that corresponds to the maximum number of ring links in the ring network**, and the bit number corresponds to the ring link number. A value of "0" for a bit shows that the corresponding ring link is used as a protection path. A value of "1" shows that the corresponding ring link is used as a working path.

Omichi, [0037].

76. Accordingly, by assigning a bit to each ring link (*"segment"*), Omichi teaches *"constructing a specific mask indicating the segments on a desired path of the flow by assigning a respective specific mask bit to each of the segments."*

77. **Fourth**, the used ring table uses a '1' to indicate the working path

assuming there is no fault (*“indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault”*).

The used ring link table shown in FIG. 6(b) is provided for each virtual path and identifies the ring link that is used as a working path. The used ring link table has a bit width that corresponds to the maximum number of ring links in the ring network, and the bit number corresponds to the ring link number. **A value of “0” for a bit shows that the corresponding ring link is used as a protection path. A value of “1” shows that the corresponding ring link is used as a working path.**

Omichi, [0037].

78. Omichi’s used ring link table is similar to the *“specific mask”* as it is described in the ’859 patent. “For the flow shown in FIG. 1, the specific mask at node F has the form 0001111, to indicate that the flow passes through segments 31, 32, 33 and 34.” ’859 patent, 4:61-63.

79. Thus, for each virtual path, Omichi’s system uses a used ring link table in which each ring link corresponds to one bit and a ‘1’ is used to indicate the links on the desired working path, which anticipates, or in the minimum renders obvious *“for a given data flow to be conveyed through the network from a source node to a destination node, constructing a specific mask indicating the segments on a desired path of the flow by assigning a respective specific mask bit to each of the segments, indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault.”* To be specific,

Omichi's used ring link table indicates that the path of a specific data flow would utilize the links identified in the used ring link table if each of these links were operation, thus satisfying the claimed "*indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault.*"

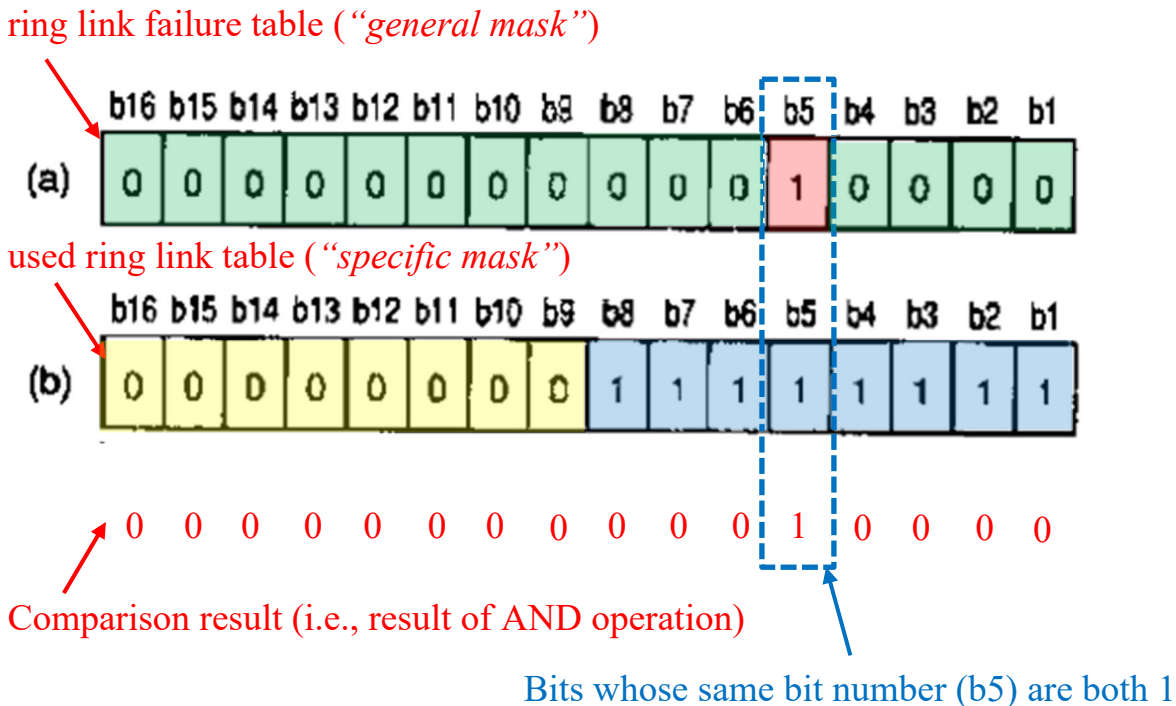
[1.3] *superimposing the general and specific masks in order to determine a disposition of the flow.*

80. First, Omichi's system compares ("*superimpose[es]*") the bits of the ring link failure table ("*general mask*") with the bits of the used ring link table ("*specific mask*").

Next, route selection processing part 8 determines whether or not the route switching flag that corresponds to the virtual path number that was specified in step S2 is "0" (S3). **If the route switching flag is "0" (S3, 0), the used ring link table that corresponds to the virtual path number that was specified in step S2 is compared against the ring link failure table, and a determination is made as to whether or not there are bits having the same bit number and whose contents are both "1" (S4).** If there are no bits having the same bit number and whose contents are both "1" (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 to transmit frame 5 or ATM cell 6 in the clockwise [direction] (S5).

Omichi, [0040].

81. The graphic below shows a comparison result of Omichi's ring link failure table of Fig. 6a ("general mask") with Omichi's used ring link table of Fig. 6b ("specific mask").



Omichi, Fig. 6a, 6b (partial, annotated).

82. By comparing bits to see if they are both a '1', Omichi's system is performing an AND operation. IEEE Dictionary, 37 ("AND (mathematics of computing) A Boolean operator having the property that if P is a statement, Q is a statement, R is a statement, ... , then the AND of P,Q,R, ... is true if and only if all statements are true." Omichi's comparing of both the ring link failure table and the used ring link table is within the scope of "*superimposing*" as recited in claim 1.

Indeed, claim 2 (described in more detail below) recites that “*superimposing*” comprises “*combining the masks by means of a Boolean operation.*”

83. Second, the two tables are compared to determine whether to reroute data (“*in order to determine a disposition of the flow*”). For a given ring link, if the bits from both tables are “1,” this means that the working path flows over a faulty link, and traffic should be re-routed on the opposite ring (i.e., the protection path).

If there are bits having the same bit number and whose contents are both “1” (S4, Yes), because this means that the working path includes a ring link where a failure has occurred, ring link transmitting unit 10 is made to transmit frame 5 or ATM-cell 6 in the counterclockwise direction. That is, frame 5 or ATM-cell 6 is transmitted using the protection path (S6).

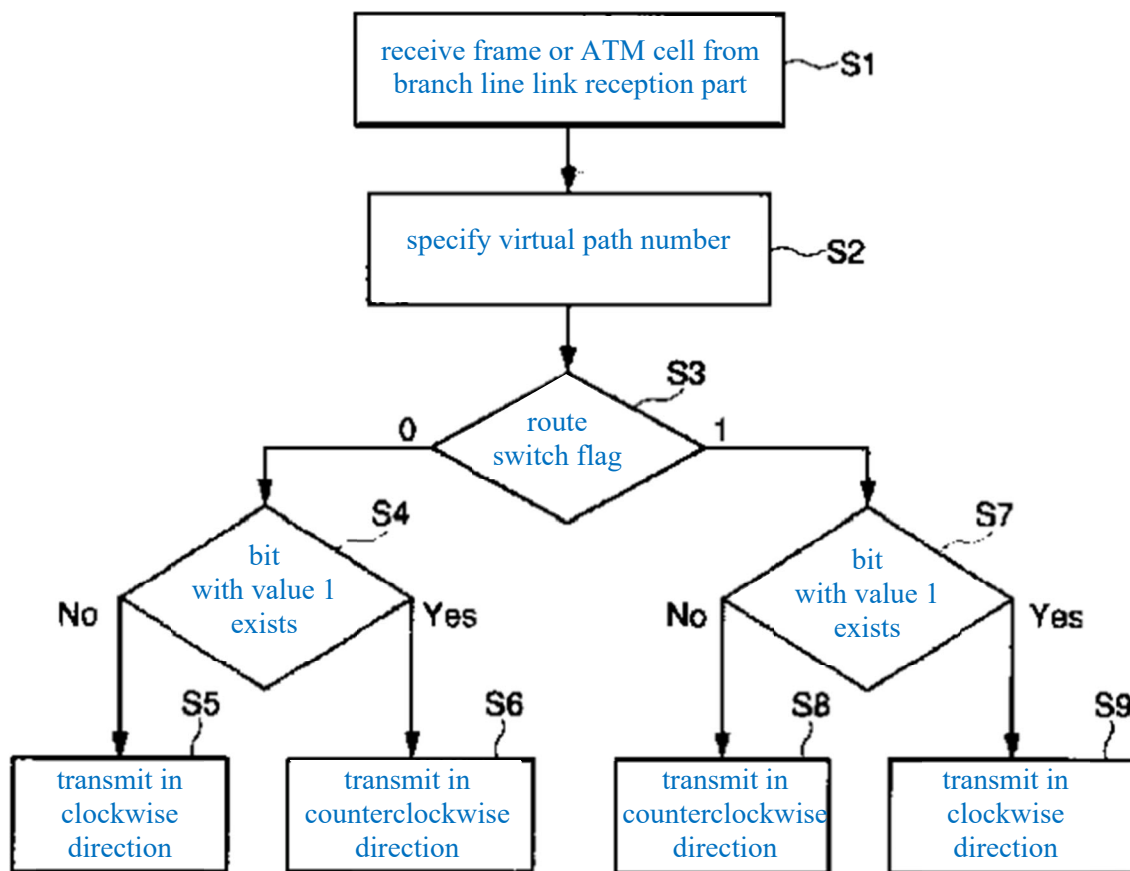
Omichi, [0041].

84. If, however, there are no ring links for which the bits in both tables are a “1,” then no re-route need be taken.

If there are no bits having the same bit number and whose contents are both “1” (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 to transmit frame 5 or ATM cell 6 in the clockwise [direction] (S5).

Omichi, [0040].

85. The example described above is for the case where the working path is in the clockwise direction, and the protection path is in the counter-clockwise direction, as indicated by the route switching flag. “A route switching flag of “0” shows that the working path is clockwise.” Omichi, [0038]. The overall process of selecting either a clockwise or counter-clockwise direction for a transmission is illustrated in Omichi’s Figure 7, below.



Omichi, Fig. 7 (annotated with translation).

S1. Receive frame or ATM cell from branch line link reception part

S2. Specify virtual path number

- S3. Route switch flag
- S4. Bit with value of “1” exists
- S5. Transmit in clockwise direction
- S6. Transmit in counterclockwise direction (circumvent the failure)
- S7. Bit with value of “1” exists
- S8. Transmit in counterclockwise direction
- S9. Transmit in clockwise direction (circumvent the failure)

Omichi, Fig. 7 translation.

86. Omichi also illustrates the case where the working path is in the counter-clockwise direction and the protection path is in the clockwise direction: “A value of ‘1’ shows that the working path is counterclockwise.” Omichi, [0038]. In this case, if the working path includes a fault, traffic is rerouted from the (counterclockwise) working path to the (clockwise) protection path.

Furthermore, if there are bits having the same bit number and whose contents are both “1” (S7, Yes), the working path includes a ring link where a failure has occurred. The ring link transmission part 10 is then made **to transmit frame 5 or ATM cell 6 in the clockwise direction.**

In other words, frame 5 or ATM cell 6 is sent using the protection path.

Omichi, [0043].

87. However, if no bits are both a ‘1,’ then no re-route is needed. The system can keep using the counterclockwise working path.

If no bits have the same bit number and content of “1” (S7, No), this means either that no failure has occurred in the ring network or that

even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 **to transmit frame 5 or ATM cell 6 in the counterclockwise [direction]** (S8).

Omichi, [0042].

88. By selecting a transmission direction, Omichi's process "*determine[s] a disposition of the flow.*" Thus, because Omichi compares the bits in the ring link failure table with the bits in the used ring link table to determine whether to reroute data, Omichi renders obvious "*superimposing the general and specific masks in order to determine a disposition of the flow.*"

3. Claim 2

[2.1] A method according to claim 1, wherein superimposing the masks comprises combining the masks by means of a Boolean operation.

89. First, as explained above at [1.3], Omichi describes comparing the masks to see where there is a '1' in both fields.

Next, route selection processing part 8 determines whether or not the route switching flag that corresponds to the virtual path number that was specified in step S2 is "0" (S3). **If the route switching flag is "0" (S3, 0), the used ring link table that corresponds to the virtual path number that was specified in step S2 is compared against the ring link failure table, and a determination is made as to whether or not there are bits having the same bit number and whose contents are both "1" (S4).** If there are no bits having the same bit number and

whose contents are both “1” (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 to transmit frame 5 or ATM cell 6 in the clockwise [direction] (S5).

Omichi, [0040].

90. The graphic below shows a comparison result of Omichi’s ring link failure table of Fig. 6a (“*general mask*”) with Omichi’s used ring link table of Fig. 6b (“*specific mask*”).

ring link failure table (“*general mask*”)

(a)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

used ring link table (“*specific mask*”)

(b)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0

Comparison result (i.e., result of AND operation)

Bits whose same bit number (b5) are both 1

Omichi, Fig. 6a, 6b (partial, annotated).

91. **Second**, a POSITA would have understood that comparing bits in the

manner described by Omichi is effectively performing a Boolean AND operation.

A Boolean AND operations compares two bits to determine if both bits are ‘1’:

“AND (mathematics of computing) A Boolean operator having the property that

if P is a statement, Q is a statement, R is a statement, ... , then the AND of P,Q,R,

... is true if and only if all statements are true.” IEEE Dictionary, 37. The IEEE

Dictionary gives an example, as illustrated below. Omichi performs the Boolean

operation of “AND.” The only outcome of “true” from the AND operation is when

the two inputs P and Q are both true (i.e., both logic “1”), just like how Omichi is

trying to identify whether or not there is a ring link failure (condition “P”) AND

whether or not the failed rink is part of the path of data flow (condition “Q”).

92. Omichi’s comparing of both the ring link failure table (Fig. 6a) and the used ring link table (Fig. 6b) (“*superimposing*”) is thus “*combining the masks by means of a Boolean operation.*”

93. Thus, Omichi describes what is known as a Boolean AND operations by comparing the two tables to see where there is a ‘1’ in both corresponding bit numbers, which renders obvious “*wherein superimposing the masks comprises combining the masks by means of a Boolean operation.*”

4. Claim 3

[3.1] *A method according to claim 1, wherein superimposing the masks comprises determining whether to convey the data flow over the desired path, to steer the data flow over an alternative path, or to stop conveying the data flow.*

94. First, for the reasons explained above at [1.3], Omichi describes the situation in which the system decides to maintain the data flow over the working path (“*desired path*”). If the result of the comparison (i.e., Boolean AND operation) between the ring link failure table (“*general mask*”) and the used ring link table (“*specific mask*”) is all zeros, then there are no failures along the working path.

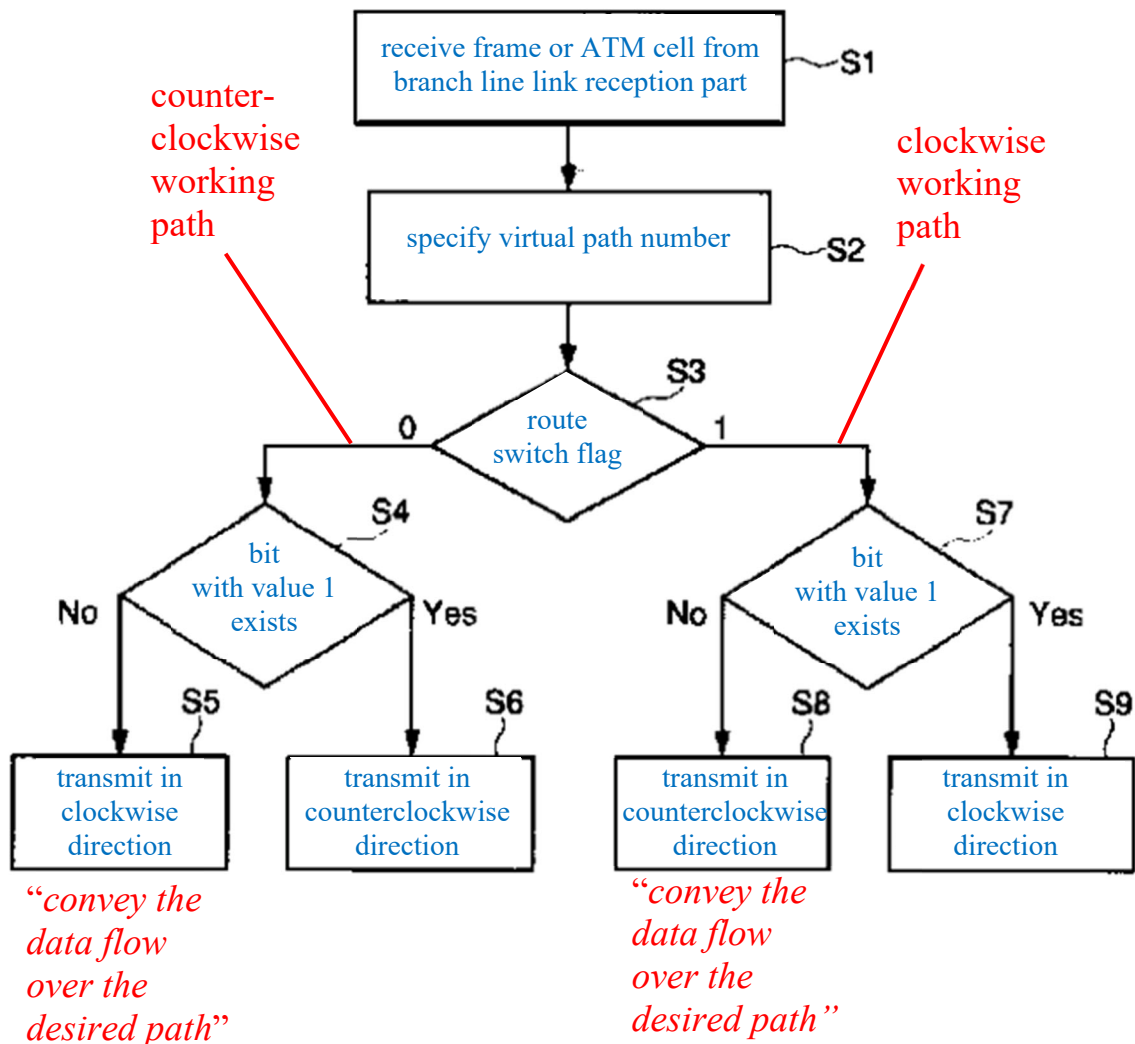
If there are no bits having the same bit number and whose contents are both “1” (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 to transmit frame 5 or ATM cell 6 in the clockwise [direction] (S5).

Omichi, [0040].

95. Accordingly, traffic is maintained along the clockwise working path. Omichi also describes the same example in the case where the working path is the counterclockwise path.

If no bits have the same bit number and content of “1” (S7, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] then causes ring link transmission part 10 to transmit frame 5 or ATM cell 6 in the counterclockwise [direction] (S8).

Omichi, [0042].



Omichi, Fig. 7 (annotated).

96. **Second**, for the reasons explained above at [1.3], Omichi describes the situation where the system decides to switch from the working path to the protection path (“to steer the data flow over an alternative path”). For a given ring link, if the bits from both tables are “1,” this means that the working path flows over a fault, and traffic should be re-routed on the opposite ring (i.e., the protection

path).

If there are bits having the same bit number and whose contents are both “1” (S4, Yes), because this means that the working path includes a ring link where a failure has occurred, ring link transmitting unit 10 is made to transmit frame 5 or ATM-cell 6 in the counterclockwise direction. That is, frame 5 or ATM-cell 6 is transmitted using the protection path (S6).

Omichi, [0041].

97. Accordingly, traffic is maintained along the clockwise working path.

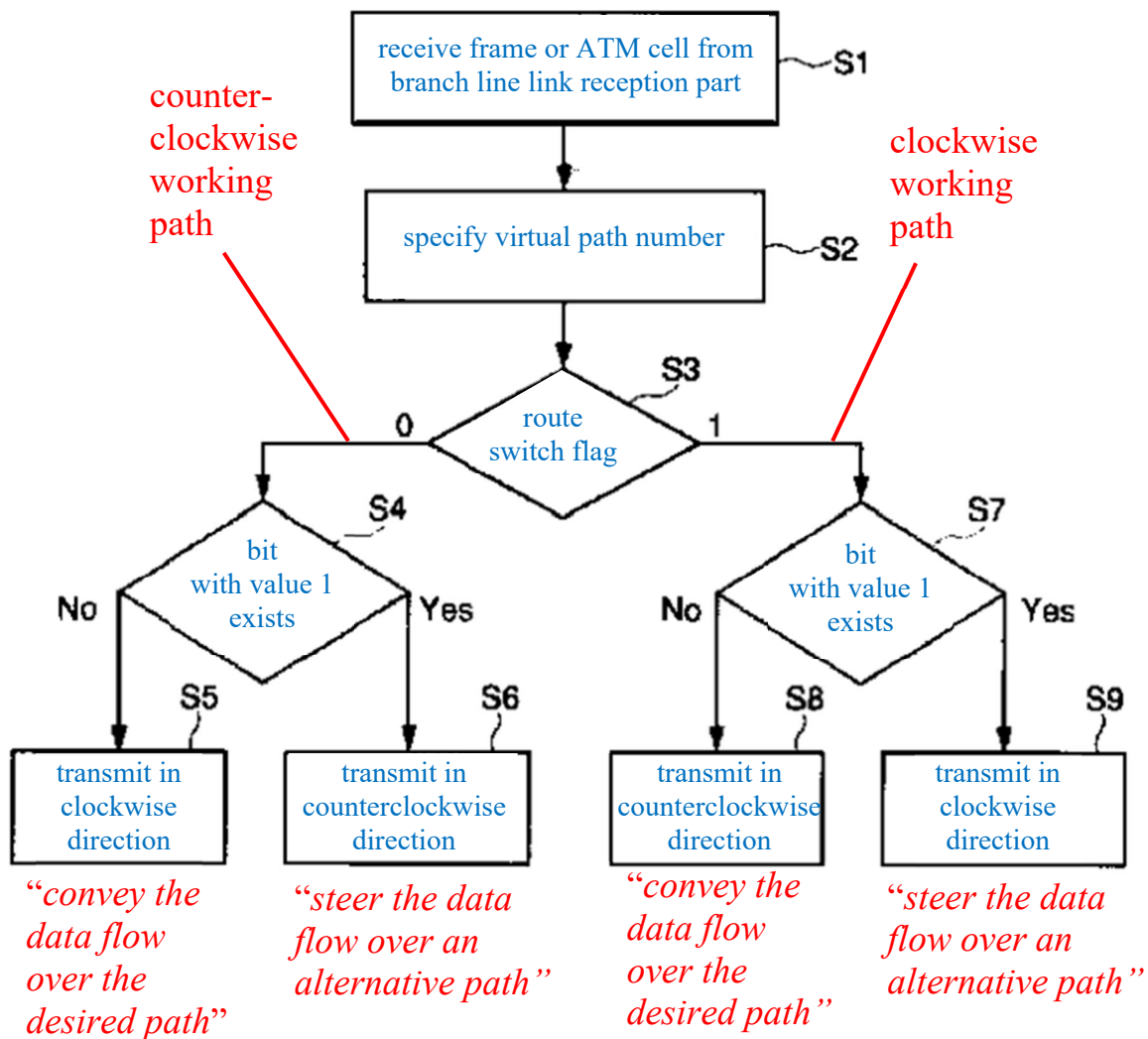
Omichi also describes the same example in the case where the working path is the counterclockwise path.

98. Omichi also illustrates the case where the working path is in the counter-clockwise direction and the protection path is in the clockwise direction: “A value of ‘1’ shows that the working path is counterclockwise.” Omichi, [0038]. In this case, if the working path includes a fault, traffic is rerouted from the (counterclockwise) working path to the (clockwise) protection path.

Furthermore, if there are bits having the same bit number and whose contents are both “1” (S7, Yes), the working path includes a ring link where a failure has occurred. The ring link transmission part 10 is then made **to transmit frame 5 or ATM cell 6 in the clockwise direction**.

In other words, frame 5 or ATM cell 6 is sent using the protection path.

Omichi, [0043].



Omichi, Fig. 7 (annotated).

99. **Third**, it would have been obvious that if both rings have a fault, there would be no reason to transmit data along either path. Omichi’s system first determines that the working path has a fault. Then, as described above, the flow is switched to the protection path. When this switch happens, the protection path become the working path, which changes the bit patterns in the used ring link table to identify the ring links belonging to the protection paths now set to have the

value of 1. At this point, the same technique described above can be applied to determine whether or not this new working path has any fault, by comparing the bits in the used ring link table of the new working path with the ring link failure table. If the comparison results in the logic “1” at any bit positions, then the new working path too has fault, at which point no data transmission to the destination node would be possible. It would thus be inconsistent with Omichi’s goal of using “link bands efficiently” to attempt to transmit data when both paths to the destination node have failed. *See* Omichi, [0009], [0048].

100. In other words, if both the working path and the protection path both fail, there is no reason to transmit data along either path. Such a decision is merely obvious to try, and in fact well within the disclosure of Omichi, noting that when switching to the protection path occurs due to a fault in the working path, the protection path becomes a new working path, a fact well known to a POSITA. When faced with a situation in which all paths have failed, there are two options: transmit the data or not transmit the data. In fact, when both paths fail, it is not possible to transmit, and it would have at least been obvious to not transmit data when both paths have failed. A POSITA would have thus found it obvious “*to stop conveying the data flow*” when both the working path and the protection path fail.

101. Accordingly, Omichi explicitly teaches two of the three alternative recitations of this claim, and a POSITA would have found the third alternative

recitation obvious based on POSITA's knowledge of the relation between the working path and the protection path.

102. Thus, Omichi's system compares the ring link failure table with the used ring link table to decide whether to stay with the working path or switch to the protection path, which renders obvious "*wherein superimposing the masks comprises determining whether to convey the data flow over the desired path, to steer the data flow over an alternative path, or to stop conveying the data flow*" as claimed.

5. Claim 4

[4.1] *A method according to claim 3, wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should be conveyed over the desired path when the combined mask is null.*

103. First, as described above at [1.3], Omichi describes comparing the ring link failure table with the used ring link table through a Boolean AND operation. The result of this comparison operation teaches a "*combined mask*" as claimed.

104. Both the ring link failure table of Fig. 6a and the used ring link table of Fig. 6b are represented using bits. *See* Omichi, [0036]-[0037]. Accordingly, it would have been obvious that the comparison operations described by Omichi similarly results in a set of bits. The resulting set of bits is thus achieved by combining (through an AND operation) the ring link failure table and the used ring

link table. The resulting set of bits is thus a “*combined mask*” as claimed.

105. Second, for the reasons described at [3.1], Omichi teaches “*determining that the data flow should be conveyed over the desired path.*”

106. Third, Omichi’s system decides to stay with the working path when the result of the comparison is that no bits are “1” (“*when the combined mask is null*”).

If there are no bits having the same bit number and whose contents are both “1” (S4, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing part 8] **then causes ring link transmission** part 10 to transmit frame 5 or ATM cell 6 **in the clockwise [direction]** (S5).

Omichi, [0040].

107. In binary, values can be either a zero or a one. Thus, when Omichi describes a result in which there are no ‘1’s, it means that all values are ‘0.’

108. Omichi also describes the same example in the case where the working path is the counterclockwise path.

If no bits have the same bit number and content of “1” (S7, No), this means either that no failure has occurred in the ring network or that even if a failure has occurred, the working path does not include a ring link where a failure has occurred. [Route selection processing

part 8] then causes ring link transmission part 10 **to transmit frame 5 or ATM cell 6 in the counterclockwise [direction]** (S8).

Omichi, [0042].

109. In the figure below, I have modified the ring link failure table to match the scenario described above, in which “no failure has occurred in the ring network.” Omichi, [0040], [0042].

ring link failure table (“general mask”)

(a)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

used ring link table (“specific mask”)

(b)

b16	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Comparison result (“combined mask”)

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Bits with same bit number (b5)

Omichi, Figs. 6a, 6b (partial, annotated).

110. A POSITA would have understood that the term “null” refers to a set of ‘0’s. IEEE Dictionary, 748. Accordingly, when “there are no bits having the same bit number and whose contents are both ‘1,’” the combined result of the Boolean AND operation is a set of ‘0’s (“the combined mask is null”). Omichi,

[0040].

111. Thus, because Omichi's system determines to stay with the working path when the comparison result between the ring link failure table and used ring link table has no bits with both a 1, thus resulting in only zeros, Omichi renders obvious "*wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should be conveyed over the desired path when the combined mask is null.*"

6. Claim 5

[5.1] *A method according to claim 3, wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should be steered over the alternative path when the combined mask corresponds to the general mask.*

112. First, as described above at [1.3], Omichi describes comparing the ring link failure table with the used ring link table through a Boolean AND operation. The result of this comparison operation teaches a "*combined mask*" as claimed.

113. Second, for the reasons described at [3.1], Omichi teaches "*determining that the data flow should be steered over the alternative path.*"

114. Third, Omichi's system decides to switch from the working path to the protection path when there are bits having the same bit number and whose contents are both '1.'

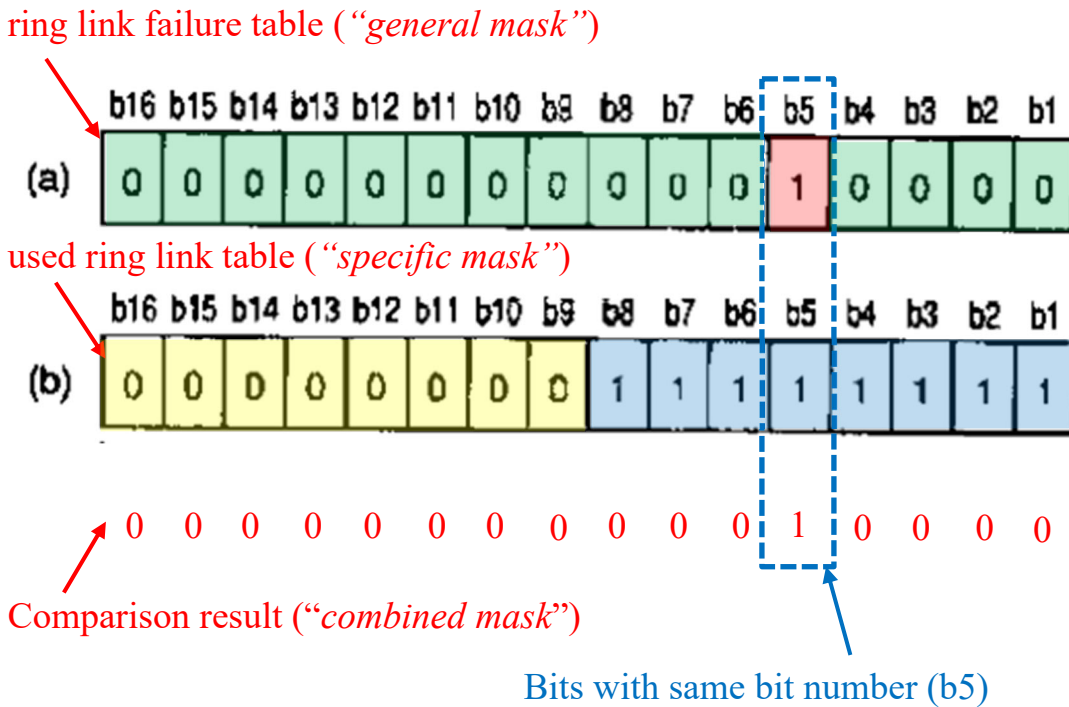
If there are bits having the same bit number and whose contents are both “1” (S4, Yes), because this means that the working path includes a ring link where a failure has occurred, ring link transmitting unit 10 is made **to transmit frame 5** or ATM-cell 6 in the **counterclockwise direction**. That is, frame 5 or ATM-cell 6 **is transmitted using the protection path (S6)**.

Omichi, [0041].

Furthermore, if there are bits having the same bit number and whose contents are both “1” (S7, Yes), the working path includes a ring link where a failure has occurred. The ring link transmission part 10 is then made **to transmit frame 5 or ATM cell 6 in the clockwise direction**. In other words, frame 5 or ATM cell 6 is sent using the protection path.

Omichi, [0043].

115. The combined figure below illustrates the case where “there are bits having the same bit number and whose contents are both ‘1.’” Omichi, [0041], [0043].



Omichi, Figs. 6a, 6b (partial, annotated).

116. As can be seen, the comparison result (“combined mask”) is identical to the ring link failure table (“general mask”). Accordingly, “the combined mask corresponds to the general mask” as claimed.

117. Thus, Omichi’s system determines to switch to the protection path when the comparison result between the ring link failure table and used ring link table matches the ring link failure table, which renders obvious “wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should be steered over the alternative path when the combined mask corresponds to the general mask.”

7. Claim 6

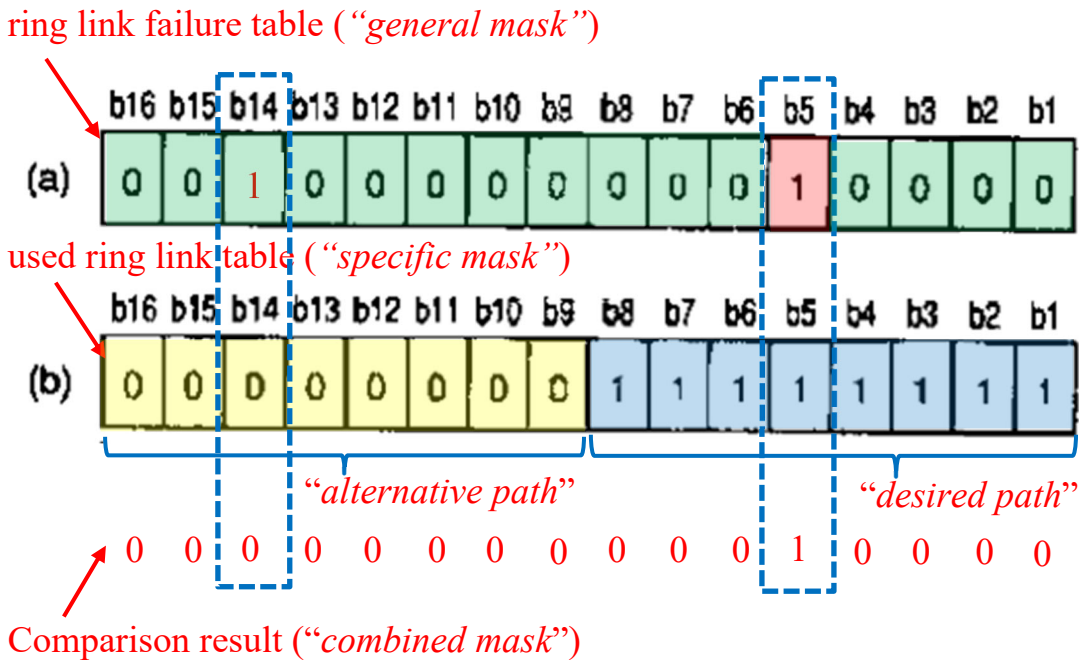
[6.1] *A method according to claim 3, wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should not be conveyed when the combined mask is neither null, nor does it correspond to the general mask.*

118. First, as described above at [1.3], Omichi describes comparing the ring link failure table with the used ring link table through a Boolean AND operation. The result of this comparison operation teaches a “*combined mask*” as claimed.

119. Second, for the reasons described at [3.1], it would have been obvious that where both the working path and the protection path fail, “*the data flow should not be conveyed.*”

120. Third, Omichi contemplates that either the clockwise path or the counterclockwise path may fail. *See* Omichi, [0041] (the clockwise path is the working path and “the working path includes a ring link where a failure has occurred.”), [0043] (the counterclockwise path is the working path and “the working path includes a ring link where a failure has occurred.”). Because either path may fail, it may be the case that both paths fail at the same time.

121. I have modified the figure below to show the case where there are at least two ring link failures (one on the working path and one on the protection path). Omichi, [0041], [0043].



Omichi, Figs. 6a, 6b (partial, annotated).

122. As can be seen, the comparison result ("combined mask") includes a '1' (is not null) and is different than (does not correspond to) the ring link failure table ("general mask"). Accordingly, *"the combined mask is neither null, nor does it correspond to the general mask"* as claimed.

123. Thus, in Omichi's system when there is a fault in both the working path and the protection path, and there is thus no reason to transmit data, this will be indicated by a non-null comparison result that is different than the used ring link failure table, which renders obvious *"wherein superimposing the masks comprises generating a combined mask, and determining that the data flow should not be conveyed when the combined mask is neither null, nor does it correspond to the"*

general mask.”

8. Claim 7

[7.0] *A communication device for use in a bidirectional ring network, in which nodes are mutually connected by network segments,*

124. First, for the reasons described above at [1.0], Omichi teaches a bidirectional ring network having a plurality of branch insertion nodes (“*a bidirectional ring network, in which nodes are mutually connected by network segments.*”)

125. Second, each of Omichi’s branch insertion nodes is a “*communication device for use in*” the bidirectional network because each node communicates with the other nodes as described above at [1.0].

[7.1] *the device comprising a network processor,*

126. First, Omichi’s branch insertion nodes (“*device[s]*”) include a processing means (“*network processor*”).

The branch insertion node according to claim 2 is a branch insertion node according to claim 1 wherein the route selection means comprises: a first table for holding the location of a ring link where a failure occurred; a second table that is provided for each virtual path and identifies the ring links that are used as a working path; and a route switching flag that is provided for each virtual path and switches the direction for a route that is used as a working path; and **a processing means that uses the information regarding the location of the ring link where a failure has occurred that is held in the first table, the**

information regarding the ring link to be used as a working path that is set in the second table and the route direction that is set by the route switching flag to determine whether or not a virtual path is affected by a failure in the ring link, and, if a virtual path is affected, causes the ring link communication means to transmit information in an opposite direction.

Because **the processing means uses the values set in the first table, the second table and the route switching flag to determine whether or not a virtual path is affected by the failure of a ring link**, whether or not a virtual path is affected by a failure of a ring link can be determined quickly, thus enabling a quick recovery from a failure.

Omichi, [0014]-[0015].

127. A POSITA would have recognized Omichi's processing means to be a network processor, as network processor's were commonly used in the branch nodes described my Omichi. *See e.g.*, Kao, 6:42-43 ("Branch nodes 231-235 may each be associated with a host (such as a network processor)").

128. The processing means performs the steps in Fig. 7: "FIG. 7 is a flowchart showing the **processing sequence** of a branch insertion node according to the present embodiment." Omichi, [0039].

129. Thus, Omichi's branch insertion nodes include a processing means to perform the processes described within its disclosure, which renders obvious "*the device comprising a network processor.*"

[7.2] which is adapted to construct a general mask indicating which of the

segments are reachable in the event of a fault in the network, the general mask comprising a respective general mask bit for each segment, indicating whether the segment is reachable following occurrence of the fault, and

130. First, as explained above at [7.1], Omichi describes “a processing means that uses the information regarding the location of the ring link where a failure has occurred that is held in the first table.” Omichi, [0014]. As described above, at [1.1], Omichi’s ring link failure table teaches a “*general mask*” as claimed.

131. Second, for the reasons explained above at [1.1], Omichi renders obvious “*which is adapted to construct a general mask indicating which of the segments are reachable in the event of a fault in the network, the general mask comprising a respective general mask bit for each segment, indicating whether the segment is reachable following occurrence of the fault.*”

[7.3] to construct a specific mask for a given data flow to be conveyed through the network from a source node to a destination node, the specific mask indicating the segments on a desired path of the flow by comprising a respective specific mask bit for each segment, indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault, and

132. First, as explained above at [7.1], Omichi describes “a processing means that uses ... the information regarding the ring link to be used as a working path that is set in the second table.” Omichi, [0014]. As described above, at [1.2], Omichi’s used ring link table teaches a “*specific mask*” as claimed.

133. For the reasons explained above at [1.2], Omichi renders obvious “*to*

construct a specific mask for a given data flow to be conveyed through the network from a source node to a destination node, the specific mask indicating the segments on a desired path of the flow by comprising a respective specific mask bit for each segment, indicating whether the flow was to be conveyed over the segment had occurrence of the segment been operational before the fault.”

[7.4] to superimpose the general and specific masks in order to determine a disposition of the flow.

134. First, as described above at [7.1], Omichi describes a series of steps performed by a processing means (“*network processor*”) as illustrated in Fig. 7. “FIG. 7 is a flowchart showing the **processing sequence** of a branch insertion node according to the present embodiment.” Omichi, [0039].

135. For the reasons explained above at [1.3], the steps described in connection with Omichi’s Fig. 7 render obvious “*to superimpose the general and specific masks in order to determine a disposition of the flow.*”

9. Claim 8

[8.1] A device according to claim 7, wherein the processor is adapted to superimpose the masks by performing a Boolean operation on the masks.

136. See [2.1] and [7.1].

10. Claim 9

[9.1] A device according to claim 7, wherein the processor is adapted to determine whether to convey the data flow over the desired path, to steer the data flow over an alternative path, or to stop conveying the data flow based on the superimposed masks.

137. See [3.1] and [7.1].

11. Claim 10

[10.1] *A device according to claim 9, wherein the processor is adapted to superimpose the masks so as to generate a combined mask, and to determine that the data flow should be conveyed over the desired path when the combined mask is null.*

138. See [4.1] and [7.1].

12. Claim 11

[11.1] *A device according to claim 9, wherein the processor is adapted to superimpose the masks so as to generate a combined mask, and to determine that the data flow should be steered over the alternative path when the combined mask corresponds to the general mask.*

139. See [5.1] and [7.1].

13. Claim 12

[12.1] *A device according to claim 9, wherein the processor is adapted to superimpose the masks so as to generate a combined mask, and to determine that the data flow should not be conveyed when the combined mask is neither null, nor does it correspond to the general mask.*

140. See [6.1] and [7.1].

VI. CONCLUSION

141. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on 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 or Title 18 of the United States Code.

Date: May 31, 2025

Paul Min