

(51) International Patent Classification:
G06N 3/12 (2006.01) *H04L 12/24* (2006.01)(21) International Application Number:
PCT/GB2010/051621(22) International Filing Date:
28 September 2010 (28.09.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/246,424 28 September 2009 (28.09.2009) US(71) Applicant (for all designated States except US): **ARIA NETWORKS LIMITED** [GB/GB]; Avonbridge House, Bath Road, Chippenham, Wiltshire SN15 2BB (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **PERRETT, Jay** [GB/GB]; c/o Aria Networks, Avonbridge House, Bath Road, Chippenham, Wiltshire SN15 2BB (GB).(74) Agent: **POWELL, Williams**; Staple Court, 11 Staple Inn Buildings, London, Greater London WC1V 7QH (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

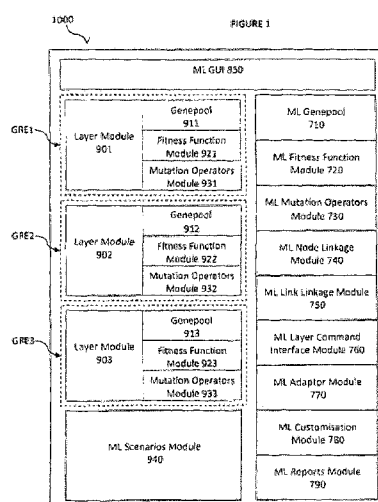
Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report:
26 May 2011

(54) Title: APPARATUS AND METHOD FOR DETERMINING OPTIMUM PATHS IN A MULTI-LAYER NETWORK USING A ROUTING ENGINE



(57) Abstract: Network simulation equipment for determining routes across a multi-layer system, the network simulation equipment comprising: an adaptor module configured to convert a multi-layer system into a multi-layer network of nodes and links; a first routing engine configured to determine a plurality of populations of paths, each population of paths corresponding to a route across a layer of the multi-layer network; a second routing engine configured to determine a plurality of multi-layer populations of paths, each multi-layer population of paths corresponding to a route across the multi-layer network and comprising populations of paths for at least two different layers of the multi-layer network selected from the plurality of populations of paths determined by the first routing engine; and an evolving module configured to mate at least two multi-layer populations of paths from the plurality of multi-layer populations of paths to create a third multi-layer population of paths,

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/051621

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06N3/12
ADD. H04L12/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06N H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	M. YANNUZZI, X. MASIP-BRUI, R. SERRAL-GRACIA, E. MARIN-TORDERA, A. SPRINTSON, A. ORDA: "Maximum coverage at minimum cost for multi-domain IP/MPLS networks" PROCEEDINGS OF THE 27TH CONFERENCE ON COMPUTER COMMUNICATIONS (INFOCOM'08), 13 April 2008 (2008-04-13), pages 1831-1839, XP031263996 the whole document	1-174
X	J. RAK: "Algorithms of fast service restoration in survivable multilayer networks" November 2008 (2008-11), , XP007917338 abstract	1-174



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

25 February 2011

Date of mailing of the international search report

01/04/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Douarche, Nicolas

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/051621

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	K.-H. HO, G. PAVLOU, N. WANG, M. HOWARTH: "Joint optimization of intra- and inter-autonomous system traffic engineering" IEEE TRANSACTIONS ON NETWORK AND SERVICE MANAGEMENT, vol. 6, no. 2, June 2009 (2009-06), pages 64-79, XP011287372 the whole document	1-174
X	----- S. BALON: "Contributions to traffic engineering and resilience in computer networks" 7 November 2008 (2008-11-07), , XP007917337 chapters 2, 6; bibliography	1-174
X	----- K. LENARSKI, B. CZAJKA, I. POZNIAK-KOSZALKA, A. KASPRZAK: "Tabu search algorithm for two-layer networks design problem" PROCEEDINGS OF THE 19TH INTERNATIONAL CONFERENCE ON SYSTEMS ENGINEERING (ICSENG'08), 19 August 2008 (2008-08-19), pages 319-324, XP031315109 the whole document	1-174
X	----- W. BIGOS, B. COUSIN, S. GOSSELIN, M. LE FOLL, H. NAKAJIMA: "Survivable MPLS over optical transport networks: cost and resource usage analysis" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, vol. 25, no. 5, 29 May 2007 (2007-05-29), pages 949-962, XP011182164 the whole document	1-174
X	----- N. SENGEZER, B. PUYPE, E. KARASAN, M. PICKAVET: "A comparative study of single-layer and multi-layer traffic engineering approaches on transparent optical networks" PROCEEDINGS OF THE 9TH INTERNATIONAL CONFERENCE ON TRANSPARENT OPTICAL NETWORKS (ICTON'07), 1 July 2007 (2007-07-01), pages 105-108, XP031130691 the whole document ----- -/--	1-174

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/051621

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	R. RUGHINIS, R. DEACONESCU: "Optimization strategies for MPLS traffic engineering" U.P.B. SCIENTIFIC BULLETIN, SERIES C, vol. 71, no. 1, 31 March 2009 (2009-03-31), pages 91-102, XP002624722 ISSN: 1454-234X the whole document	1-174
A	----- D. KING, T. TSURITANI: "Deploying advanced path computation technologies for optical transport networks" : 5-6 JUNE 2008, [Online] 6 June 2008 (2008-06-06), pages 1-14-meeting agenda, XP002624723 4TH INTERNATIONAL CONFERENCE ON IP+OPTICAL NETWORK (IPOP'08) Retrieved from the Internet: URL:http://www.pilab.jp/ipop2008/info/pdf/ipOP2008_3-4.pdf> [retrieved on 2011-02-24] the whole document	1-174
A	----- D. KING: "Network planning and path computation for next generation networks" 6TH UK NETWORK OPERATORS' FORUM MEETING (UKNOF'6), [Online] 19 January 2007 (2007-01-19), pages 1-14-Online proceedings, XP002624724 Retrieved from the Internet: URL:http://www.uknof.org.uk/uknof6/King-NG N.pdf> [retrieved on 2011-02-24] the whole document -----	1-174