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(54) Title: METHODS AND APPARATUS FOR TRAFFIC MANAGEMENT IN MULTI-MODE SWITCHING DWDM NETWORKS

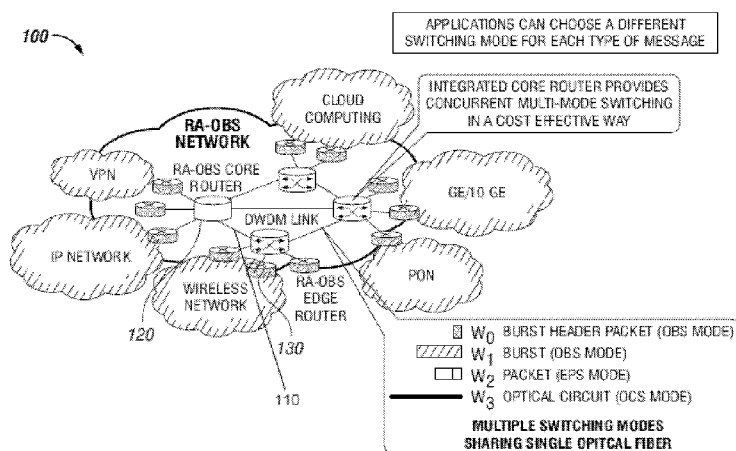


FIG. 1

(57) Abstract: A Wavelength Division Multiplexing (WDM) multi-mode switching system and method and method provides concurrent switching in various switching modes including, but not limited to, an electronic packet switching (EPS) mode, optical circuit switching (OCS) mode, and optical burst switching (OBS) mode. Edge routers in the WDM multi-mode switching systems may provide a traffic management module that processes incoming data and routes the data for transmission in an electronic packet switching (EPS), optical burst switching (OBS), or optical circuit switching (OCS) modes via a WDM link.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/031251

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H04J14/04 (2012.01)

USPC - 398/48

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)

IPC(8) - H04J14/00, 14/02, 14/04; H04B10/13 (2012.01)

USPC - 398/47, 48, 68, 143

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 practicable, search terms used)

PatBase, Orbit.com, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 6,925,257 B2 (YOO) 2 August 2005 (02.08.2005) entire document	1-3, 5-7, 9-16, 20, 22-23, 25-28, 30-31, 33-40, 44, 46-47, 49 ----- 4, 8, 17-19, 21, 24, 29, 32, 41-43, 45, 48
Y	A Transport Layer Architectural Framework for Optical Burst Switched (OBS) Networks, Bragg et al. Opticomm '03 (WOBS), Proceedings of SPIE. 2003. [retrieved on 2012-08-17]. Retrived from the Internet: <URL: http://www.cse.buffalo.edu/~qiao/wobs/wobs2003/files/WOBS105Bragg.pdf > entire document	4, 8, 29, 32
Y	US 2008/0225894 A1 (POWELL) 18 September 2008 (18.09.2008) entire document	17-19, 41-43
Y	US 2003/0035411 A1 (MOY et al.) 20 February 2003 (20.02.2003) entire document	21, 24, 45, 48
A	US 2009/0148162 A1 (TANG et al) 11 June 2009 (11.06.2009) figures 16-18, paragraphs 65-68, 82, 93, 98, 110-114	1-49

☐ Further documents are listed in the continuation of Box C.


* 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 application or patent 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

17 August 2012

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/031251

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-49

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continuation of Box III.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-49, drawn to an edge router system for multi-mode switching and a method for multi-mode edge routing comprising: a traffic management module receiving data from one or more sources; a multi-mode packet processor receiving the data, and routing the data for transmission in an electronic packet switching mode, optical burst switching mode or optical circuit switching mode; an EPS mode processor, an OBS mode processor, and an OCS mode processor coupled to the multi-mode packet processor, and a multiplexer coupled to the EPS, OBS, or OCS mode processor.

Group II, claims 50-56, drawn to an edge router system for optical burst switching comprising: an OBS processor module comprising a burst assembler receiving the data of the burst reservation packets, forming bursts and initiating burst connection setup requests to establish a burst connection, a packet pool temporarily queueing the data, and an OBS packet scheduler selecting packets from the packet pool to transmit the packets under the burst connection.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: a traffic management module receiving data from one or more sources; a multi-mode packet processor receiving the data, and routing the data for transmission in an electronic packet switching mode, optical burst switching mode or optical circuit switching mode; an EPS mode processor, an OBS mode processor, and an OCS mode processor coupled to the multi-mode packet processor, and a multiplexer coupled to the EPS, OBS, or OCS mode processor as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: an OBS processor module comprising a burst assembler receiving the data of the burst reservation packets, forming bursts and initiating burst connection setup requests to establish a burst connection, a packet pool temporarily queueing the data, and an OBS packet scheduler selecting packets from the packet pool to transmit the packets under the burst connection as claimed therein is not present in the invention of Groups I.

Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of an OBS processor; a WDM output link outputting the data, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 2009/0148162 A1 (TANG et al) 11 June 2009 (11.06.2009) figures 16-18, paragraphs 65-68, 82, 93, 98, 110-114.

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.