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(71) **Applicant**: **PARALLEL WIRELESS INC.** [US/US]; One Tara Boulevard, Suite 404, Nashua, NH 03062 (US).

(72) **Inventors**: **MISHRA, Rajesh, Kumar**; 243 Groton Road, Westford, MA 01886 (US). **AGARWAL, Kaitki**; 243 Groton Road, Westford, MA 01886 (US). **DONEPUDI, Sridhar**; 22 Sky County Drive, Nashua, NH 03062 (US). **PAPA, Steven, Paul**; 15 Floral Street, Wyndham, NH 03087 (US).

(74) **Agent**: **SAJI, Michael**; Parallel Wireless Inc., One Tara Boulevard, Suite 404, Nashua, NH 03062 (US).

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[Continued on next page]

(54) **Title**: HETEROGENEOUS MESH NETWORK AND A MULTI-RAT NODE USED THEREIN

(57) **Abstract**: This invention discloses a heterogeneous mesh network comprised of multiple radio access technology nodes, wherein nodes can function dynamically, switching roles between client and server. Moreover, these nodes can operate in a heterogeneous fashion with respect to one another. In an alternate embodiment, the invention describes a mesh network comprised of nodes operating over TV white-space. This invention additionally discloses self-organizing network embodiments and embodiments that include novel methods of monitoring operational parameters within a mesh network, adjusting those operational parameters, and creating and implementing routing tables.

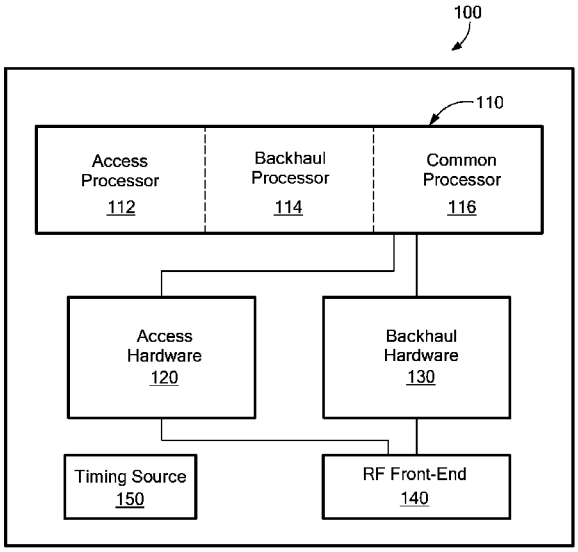

FIG. 1

WO 2014/052452 A3

WO 2014/052452 A3

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

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

(88) Date of publication of the international search report:
25 June 2015

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/061677

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04W 88/06 (2014.01)
USPC - 370/254
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) - H04B 7/00; H04W 36/14, 36/16, 72/00, 88/00, 88/06 (2014.01)
USPC - 370/252, 252, 254, 331, 406; 455/509

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - H04W 36/165, 72/12, 72/1215, 84/18 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	WO 2011/034941 A1 (CHANDRAMOULI et al) 24 March 2011 (24.03.2011) entire document	1-3 ---- 4-26
Y	US 2012/0113839 A1 (ETEMAD) 10 May 2012 (10.05.2012) entire document	4, 13-15
Y	US 2012/0236726 A1 (SHIHADA et al) 20 September 2012 (20.09.2012) entire document	8, 16-22
Y	US 6,717,920 B1 (CHENG) 06 April 2004 (06.04.2004) entire document	9, 12
Y	US 2012/0120821 A1 (KAZMI et al) 17 May 2012 (17.05.2012) entire document	10-12, 18-21
Y	US 2012/0064908 A1 (FOX et al) 15 March 2012 (15.03.2012) entire document	23-26
Y	US 2011/0044218 A1 (KAUR et al) 24 February 2011 (24.02.2011) entire document	24-26

☐ 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	Date of mailing of the international search report
28 February 2014	18 MAR 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/061677

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.:
1-26

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.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/061677

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 1-26; drawn to a mesh network comprising at least two dynamic mesh nodes wherein the two dynamic mesh nodes further comprise multiple radio access technology architecture.
Group II, claims 27-32, drawn to a computer program product and method of routing data within a heterogeneous mesh network by a. a first radio receiving a data stream having a certain protocol wherein the data stream contains priority information for the packets contained therein; b. the first radio processing the data stream through its internal architecture; and c. an abstraction layer abstracting the certain protocol from the data stream thereby creating an agnostic data stream.

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 mesh network comprising at least two dynamic mesh nodes wherein the two dynamic mesh nodes further comprise multiple radio access technology architecture as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: a computer program product and method of routing data within a heterogeneous mesh network by a. a first radio receiving a data stream having a certain protocol wherein the data stream contains priority information for the packets contained therein; b. the first radio processing the data stream through its internal architecture; and c. an abstraction layer abstracting the certain protocol from the data stream thereby creating an agnostic data stream 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 a mesh network, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of WO 2011/034941 A1 (CHANDRAMOULI et al) 24 March 2011 (24.03.2011) abstract, page 12, lines 7-14, page 20, line 19 through page 21, line 20, page 45, lines 1-20, figure 21.

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.