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[Continued on next page]

(54) Title: A METHOD OF DISTRIBUTING DATA TRAFFIC

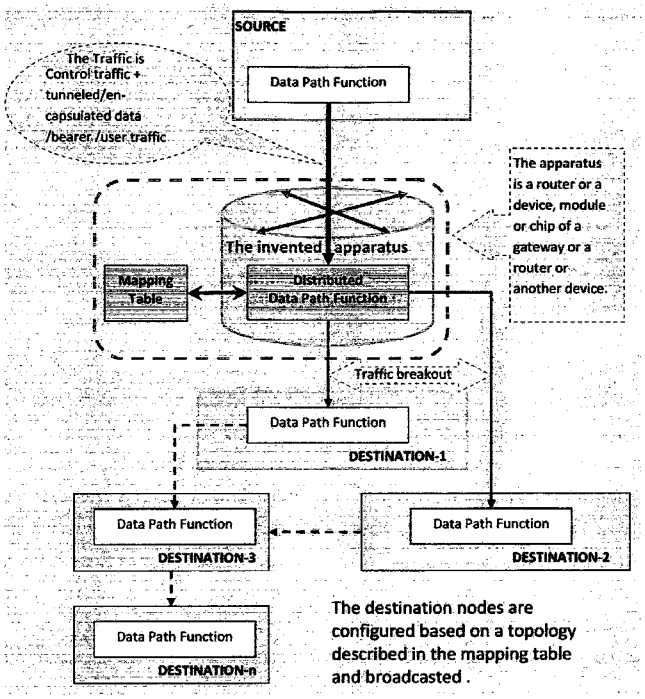


Figure 2

(57) Abstract: A method of distributing data traffic to predetermined destinations in wireless multi hop networks is provided, the method includes the steps of receiving data traffic from a source, breaking out received traffic and redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table.

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Declarations under Rule 4.17:

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

Published:

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

A METHOD FOR DISTRIBUTING DATA TRAFFIC

FIELD OF INVENTION

The present invention relates to a method of distributing data traffic to predetermined destinations in wireless multi hop networks.

BACKGROUND OF INVENTION

Popular designs of wireless networks today are Point-to-Point, Point-to-Multipoint and mesh topologies. In point-to-multipoint (PMP) designs, end nodes can exchange control signals but data or bearer packets cannot traverse from one node to another. The challenge here is making end nodes exchange data packets and control messages without modifying standards.

US 20090073995 A1 describes an apparatus configures to receive traffic of different types such as internet service domain traffic and operators service domain traffic. However, in this solution, the apparatus requires permission from an authentication module to allow a local breakout. Further, breakout rules in this case are only applicable to home agent and not beyond that.

However, as most of the prior art is focussed on internet service domain traffic and mobility, a more comprehensive solution that allows for mapping of data is needed in wireless networks.

SUMMARY OF INVENTION

Accordingly, there is provided a method of distributing data traffic to predetermined destinations in wireless multi hop networks, the method includes the steps of receiving data traffic from a source, breaking out received traffic and redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table.

Further, there is provided a method of distributing data traffic to predetermined destinations in wireless multi hop networks, the method includes the steps of receiving data traffic from a source, instantiating and managing data bearer between a data path function, selecting a payload traversing the data bearer, scanning a chain of headers from data traffic, identifying a plurality of fields to be amended, calling up a mapping table, determining encapsulation of traffic, changing source and destination addresses of the header when there is no encapsulation of traffic and sending data traffic to the predetermined destination.

The present invention consists of several novel features and a combination of parts hereinafter fully described and illustrated in the accompanying description and drawings, it being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, wherein:

Figure 1 shows an example of a method of distributing data traffic to predetermined destinations in wireless multi hop networks wherein two base stations forward or route data traffic in Worldwide Interoperability for Microwave Access (WiMAX) in the preferred embodiment of the invention;

Figure 2 shows a method of distributing data traffic to predetermined destinations in wireless multi hop networks in a location of distributed data path function and a mapping table in the preferred embodiment of the invention;

Figure 3 shows a flowchart of steps performed by the distributed data path function (DDPF);

Figure 4 shows an example of a chain of headers followed by the user payload in an embodiment of the invention;

Figure 5 shows a chart depicting IP and encapsulation details of fields in both types of headers;

Figure 6 shows an example of a topology with data traffic distribution as recorded in the mapping table;

Figure 7 shows a flow of messages flowing to and from the distributed data path function using WiMAX; and

Figure 8 shows the contributing functions of the distributed data path function and the mapping table.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a method of distributing data traffic to predetermined destinations in wireless multi hop networks. More particularly, the method is a method of incorporating multiple performance metrics into a shortest routing protocol in wireless mesh networks. Hereinafter, this specification will describe the present invention according to the preferred embodiment of the present invention. However, it is to be understood that limiting the description to the preferred embodiment of the invention is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications and equivalents without departing from the scope of the appended claims.

The following detailed description of the preferred embodiment will now be described in accordance with the attached drawings, either individually or in combination.

Figure 2 illustrates a method of distributing data traffic to predetermined destinations in wireless multi hop networks. The method includes the steps of receiving data traffic from a source, breaking out received traffic and redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table. For example, a distributed data path function (DDPF) refers to a mapping table in order to guide or breakout traffic. The mapping table describes a configuration of a network where the source, destination and data path identifications are recorded in the mapping table. The mapping table allows for single or multi-hop configurations. The mapping table can be configured for fixed topology or the

mapping table may be adapted by an operator as part of Operation and Maintenance. Figure 1 shows an example of this embodiment wherein two base stations cannot forward or route data traffic in Worldwide Interoperability for Microwave Access (WiMAX).

A data path function at the source, such as in Access Service Network Gateway (ASN GW) in WiMAX, forwards or routes data traffic to the distributed data path function (DDPF) in the method. The DDPF performs breakout of traffic and redistributes the traffic to destinations as configured in the mapping table. The destinations can be configured in single hop, multi hop, random, mesh or any topology as seen fit for application by one skilled in the art.

A preferred embodiment of the method of distributing data traffic to predetermined destinations in wireless multi hop networks is described herein. The method includes the steps of receiving data traffic from a source, instantiating and managing data bearer between a data path function, selecting a payload traversing the data bearer, scanning a chain of headers from data traffic, identifying a plurality of fields to be amended, calling up a mapping table, determining encapsulation of traffic, changing source and destination addresses of the header when there is no encapsulation of traffic and sending data traffic to the predetermined destination as seen in Figure 3. When there is encapsulation, data path identification field is changed.

The DDPF may be located in a router, device, module or chip of a gateway or a router or another device. The DDPF receives traffic from the source wherein the traffic includes user payload with a chain of headers preceding the user payload. Examples of the headers include transport Internet Protocol (IP) header, encapsulation header and other headers that may be used in the traffic.

Figure 4 shows an example of a chain of headers followed by the user payload. The DDPF scans the headers to identify their types and amendable fields in each type. If the traffic is simple IP traffic, this means that the IP header exists with relevant fields. If the traffic is tunneled traffic, then the encapsulation header is found following IP header. Details of fields in both types of headers are depicted in Figure 5. It is to be understood that headers of other types may also be used depending on application of the method.

In order to breakout traffic to an intended destination within a configure topology, the DDPF changes two fields in the IP header (501 and 502 in Figure 5) if the traffic is not capsulated. For encapsulated traffic, three fields (501, 502 and 503 in Figure 5) are changed by DDPF. Source address (501 in Figure 5) of the IP header refers to the source IP address of the traffic. Destination IP addresses (502 in Figure 5) of the IP header refers to a destination of the traffic. A traffic path for the traffic to follow is represented by data path identification (503 in Figure 5). In order for the DDPF to get correct values of the fields to amend, a mapping table (MMT) is created. The MMT explains topology configuration and can handle single or multihop scenarios as well as be part of Operation and Maintenance. The MMT may include setup of any tunnels and additional functionality that may be required. As described earlier, the mapping table guides traffic to destinations such as mesh topology.

Figure 6 shows a topology, where source data traffic is distributed amongst network elements configured in any fashion. Topology map for this example is illustrated in Table 1.

DDPF	Action	Destination		Path/Tunnel Number	End User (Connection Identification)
		Network Element	Apparatus		
1	Forward to	1		1	1 2 3
	Route to		2	2	4 5 6 7 8
2	Forward to	2		4	4 5 6
	Route to		3	3	7 8
3	Forward to	3	NONE	5	7 8

Table 1: Example of mapping table for a topology

Referring to Figure 6 and Table 1, for example DDPF1 receives source traffic (either tunneled or not), which follows the steps of the method as seen in Figure 3 for mapping or disseminating traffic to two paths. As seen in Figure 6, path 1 is mapped towards network element 1 followed by end users 1, 2 and 3 as well as path 2 towards DDPF2. Similarly, DDPF2 maps or disseminates traffic to path 3 and path 4 then to network elements and DDPF towards end users.

Traffic mapping or distribution is done by referring to the MMT which is broadcast to all neighboring nodes. The MMT should be updated in case of mobility, handover, configuration change, classification rule change or any other reason that causes topology change that allows for single hop or multi hop topology. Values of the source, destination and key, tag or connection identification values in Table 1 are obtained by the DDPF from the IP headers and encapsulation headers after de-capsulation. The values are recorded in the MMT for further reference in routing. A set of messages are present for each wireless standard to set up, modify or remove the data path. A flow of messages for standards such as WiMAX are changed to cater to required processes of DDPF. This flow of messages is shown in Figure 7.

The data path function (DPF) is used to set up a bearer plane between base stations or between other entities such as gateways or between gateways and base stations. Each data path function is responsible for instantiating and managing data bearer between the data path function and another data path function as well as selecting the user payload traversing an established data bearer. User Datagram Protocol Internet Protocol (UDP/IP) is an example of a transport protocol for communication between peer DPFs. Other types of traffic may be used as well. A peer DPF at each end is addressed by the ID of network component which hosts the data path such as base station ID (BSID). Many technologies are used for tunneling or setting up path such as Generic Route Encapsulation (GRE), Multiprotocol Label Switching (MPLS) and 802.1Q Virtual LANS (VLANs). Granularity of tunnels are defined and handled by the DPF.

Figure 8 illustrates a contributed function DDPF and the mapping table. The traffic breakout step further includes the steps of building a DDPF to negotiate with DPF at different peer or

network element of classification rules, building a MMT to save a source and destination addresses captured from IP headers or forwarded traffic, saving the data path identifications of different service flow captured from encapsulation headers for tunneled traffic after de-capsulating traffic, identifying the source and destination addresses for the IP header and deciding on a correct route accordingly, identifying a key, tag values or data path identification for the service flow to be routed and the MMT may be broadcasted to all neighboring devices wherein each neighboring device selects relevant traffic.

A router includes at least one switch configured to switch incoming traffic to at least one traffic paths, a data path function and a network address translation function or network address port translation function. The switch is selected from at least one of a layer 3 switch and a public or private switch. The switch is provided between the data path function or a gateway output, and other traffic tunnel end point.

This invention is adapted for use with single hop and multi hop wireless networks of various topologies. The disclosed invention is suitable, but not restricted to, for use in performance forwarding data traffic to destinations in any wireless networks such as WiMAX.

CLAIMS

1. A method of distributing data traffic to predetermined destinations in wireless multi hop networks, the method includes the steps of:

   i. receiving data traffic from a source;

   ii. breaking out received traffic; and

   iii. redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table.

2. The method as claimed in claim 1, wherein a distributed data path function (DDPF) refers to the mapping table in order to guide or breakout traffic.

3. The method as claimed in claim 1, wherein the mapping table allows for single configurations.

4. The method as claimed in claim 1, wherein the mapping table allows for multi-hop configurations.

5. The method as claimed in claim 1, wherein the mapping table is configured for fixed topology.

6. The method as claimed in claim 1, wherein the mapping table is adapted by an operator as part of Operation and Maintenance.

7. A method of distributing data traffic to predetermined destinations in wireless multi hop networks, the method includes the steps of:

   i. receiving data traffic from a source;

   ii. instantiating and managing data bearer between data path functions;

   iii. selecting a payload traversing the data bearer;

   iv. scanning a chain of headers from data traffic;

   v. identifying a plurality of fields to be amended;

   vi. calling up a mapping table;

   vii. determining encapsulation of traffic;

   viii. changing source and destination addresses of the header when there is no encapsulation of traffic; and

   ix. sending data traffic to the predetermined destination.

8. The method as claimed in claim 7, wherein if traffic is encapsulated, data path identification of header is changed before sending data traffic to the predetermined destination.

9. The method as claimed in claim 7, wherein a distributed data path function (DDPF) is located in a router, device, module or chip of a gateway or a router or another device.

10. The method as claimed in claim 9, wherein the DDPF receives traffic from the source wherein the traffic includes user payload with a chain of headers preceding the user payload.

11. The method as claimed in claim 9, wherein the DDPF scans the headers to identify their types and amendable fields in each type.

12. The method as claimed in claim 7, wherein the mapping table (MMT) is updated in case of mobility, handover, configuration change, classification rule change or any other reason that causes topology change that allows for single hop or multi hop topology.

13. The method as claimed in claim 7, wherein the data path function (DPF) is used to set up a bearer plane between base stations or between other entities.

14. The method as claimed in claim 7, wherein the method further includes the steps of:

i. building a DDPF to negotiate with DPF at different peer or network element of classification rules;

ii. building a MMT to save a source and destination addresses captured from IP headers or forwarded traffic;

iii. saving the data path identifications of different service flow captured from encapsulation headers for tunneled traffic after de-capsulating traffic;

iv. identifying the source and destination addresses for the IP header and deciding on a correct route accordingly;

v. identifying a key, tag values or data path identification for the service flow to be routed; and

vi. broadcasting the MMT to all neighboring devices wherein each neighboring device selects relevant traffic.

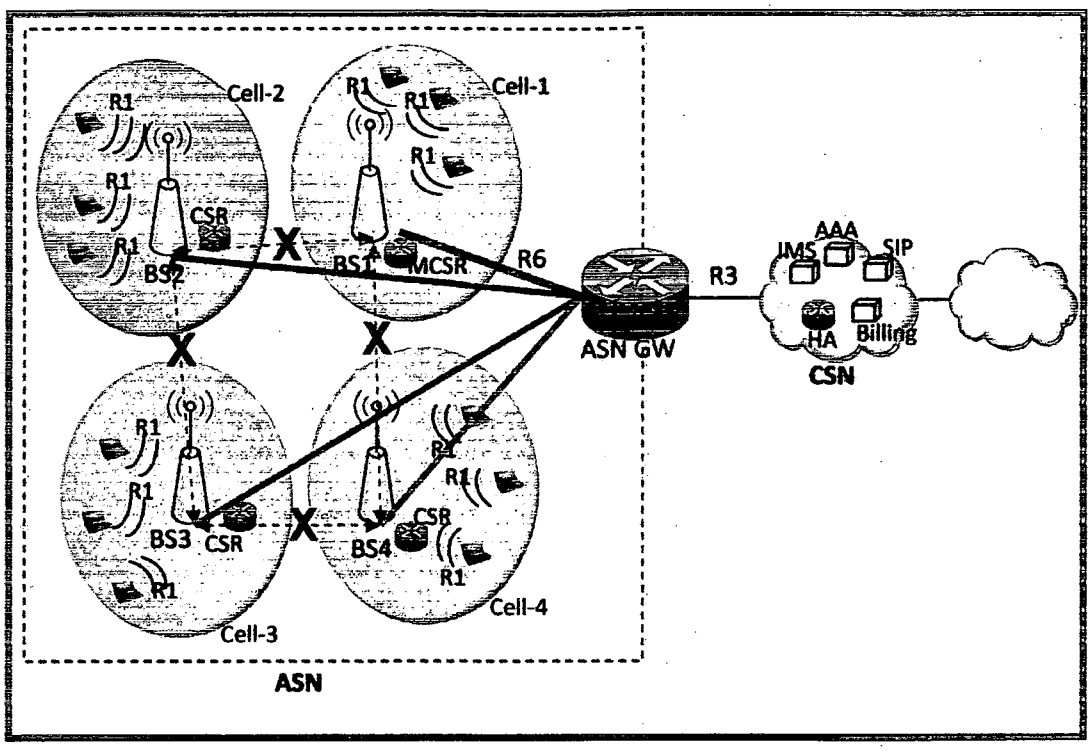

Cell-2
Cell-1
Cell-3
Cell-4
R1
CSR
BS2
BS1
MCSR
BS3
BS4
R6
R3
ASN GW
AAA
IMS
SIP
HA
Billing
CSN
ASN

Figure 1

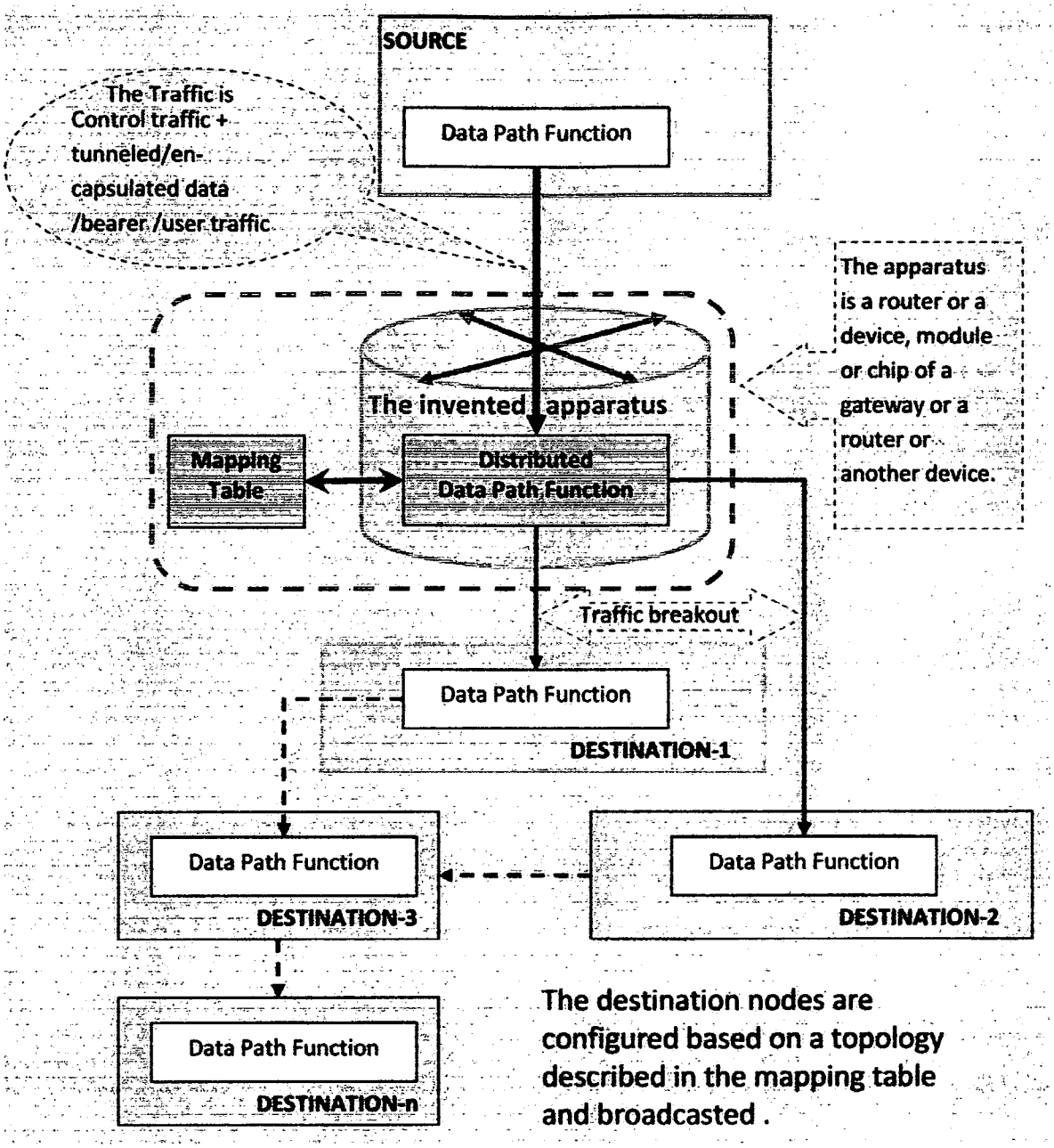

SOURCE
Data Path Function
The Traffic is Control traffic + tunneled/en-capsulated data /bearer /user traffic
The apparatus is a router or a device, module or chip of a gateway or a router or another device.
The invented apparatus
Mapping Table
Distributed Data Path Function
Traffic breakout
Data Path Function
DESTINATION-1
Data Path Function
DESTINATION-3
Data Path Function
DESTINATION-2
Data Path Function
DESTINATION-n
The destination nodes are configured based on a topology described in the mapping table and broadcasted .

Figure 2

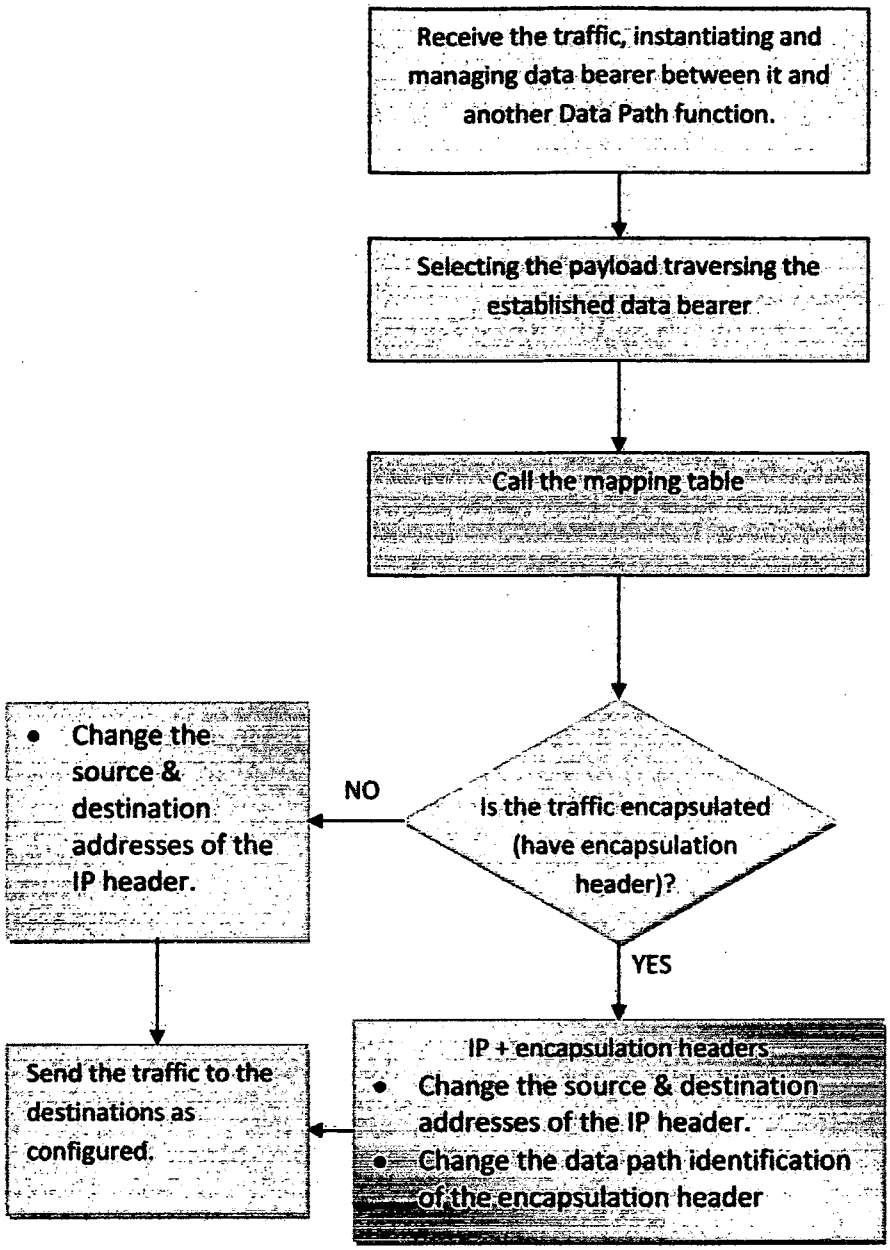

Receive the traffic, instantiating and managing data bearer between it and another Data Path function.
Selecting the payload traversing the established data bearer
Call the mapping table
Is the traffic encapsulated (have encapsulation header)?
NO
YES
• Change the source & destination addresses of the IP header.
Send the traffic to the destinations as configured.
IP + encapsulation headers
• Change the source & destination addresses of the IP header.
• Change the data path identification of the encapsulation header

Figure 3

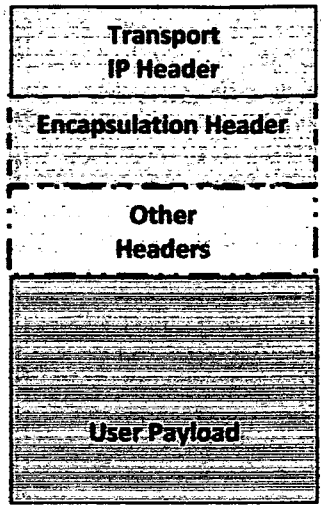


Figure 4

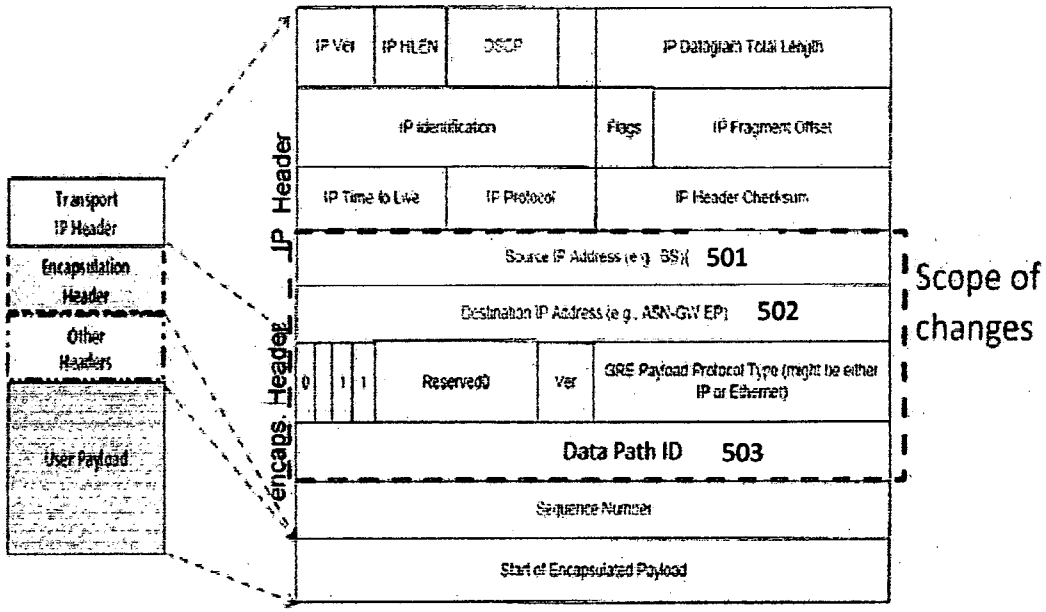


Figure 5

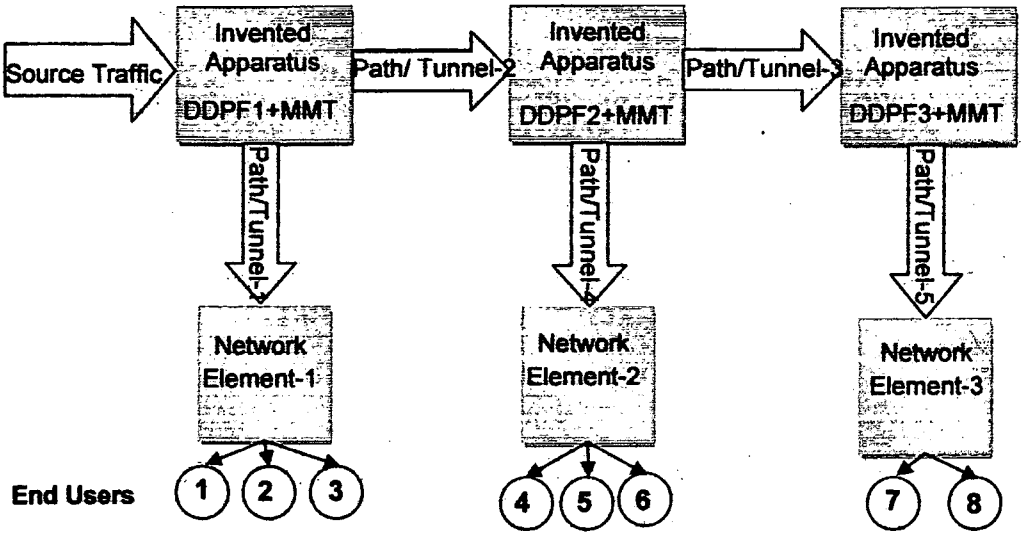

Source Traffic
Invented Apparatus DDPF1+MMT
Path/ Tunnel-2
Invented Apparatus DDPF2+MMT
Path/Tunnel-3
Invented Apparatus DDPF3+MMT
Path/Tunnel-1
Path/Tunnel-4
Path/Tunnel-5
Network Element-1
Network Element-2
Network Element-3
End Users
1
2
3
4
5
6
7
8

Figure 6

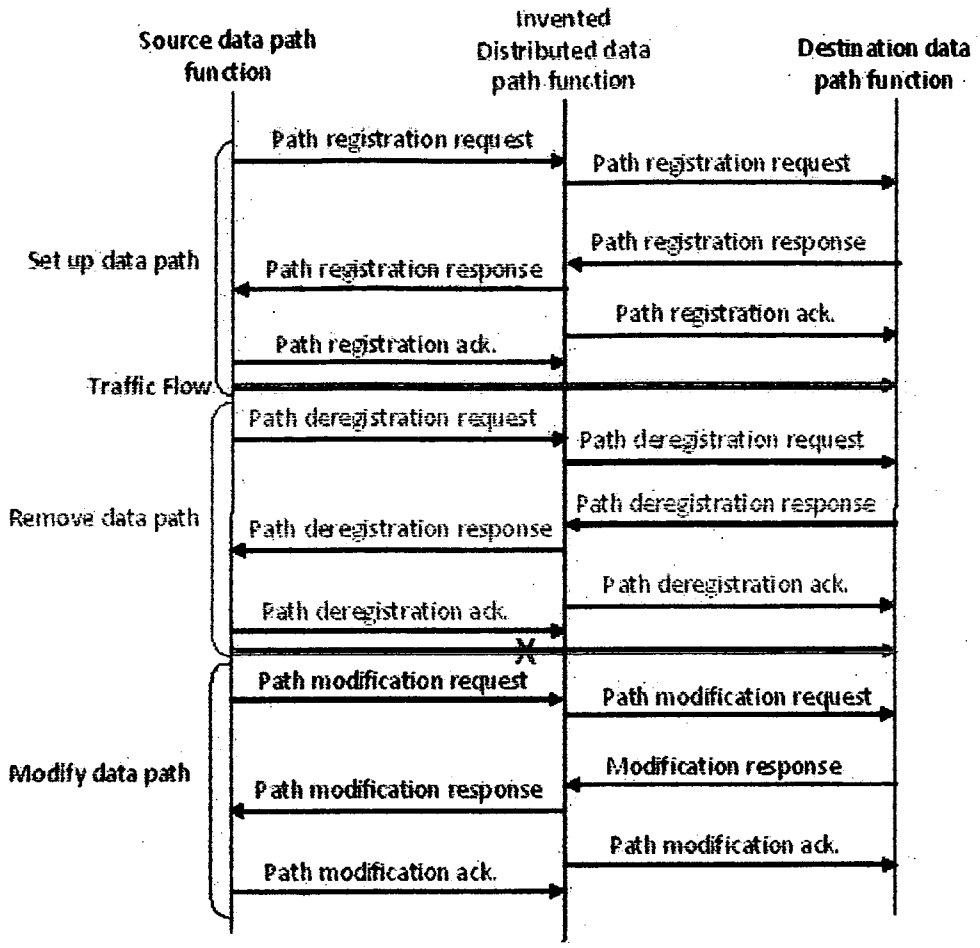

Source data path function
Invented Distributed data path function
Destination data path function
Path registration request
Path registration request
Path registration response
Path registration response
Set up data path
Path registration ack.
Path registration ack.
Traffic Flow
Path deregistration request
Path deregistration request
Path deregistration response
Remove data path
Path deregistration response
Path deregistration ack.
Path deregistration ack.
Path modification request
Path modification request
Modification response
Modify data path
Path modification response
Path modification ack.
Path modification ack.

Figure 7

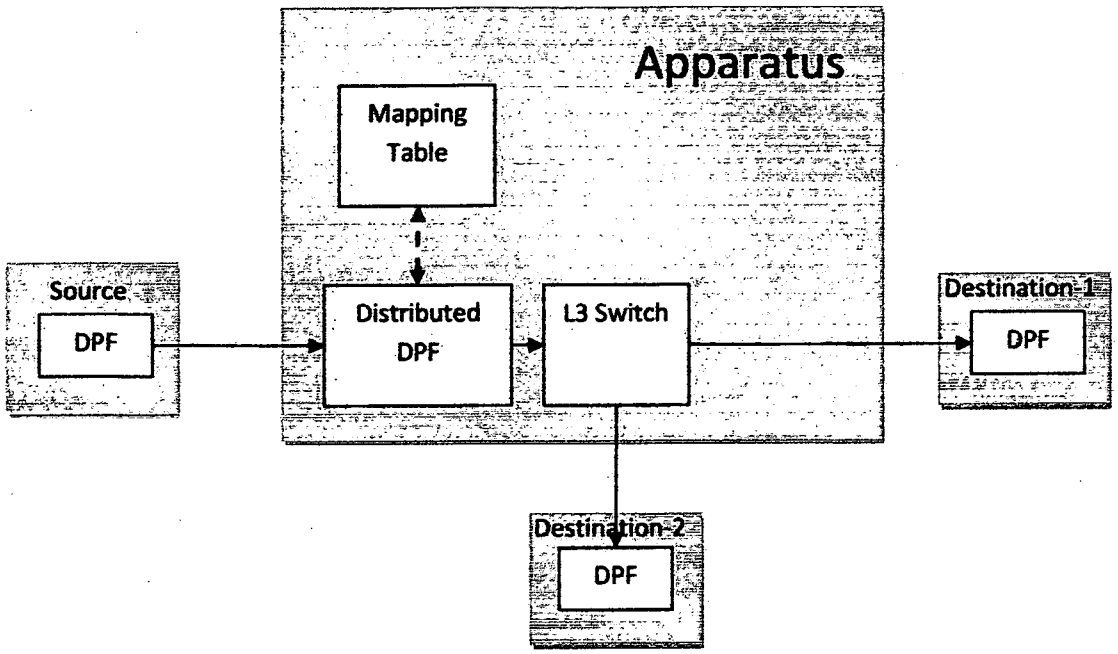

Apparatus
Mapping Table
Source
DPF
Distributed DPF
L3 Switch
Destination-1
DPF
Destination-2
DPF

Figure 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2011/000085

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H04L 12/56 (2006.01) ***H04W 40/22*** (2009.01)

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)

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)
EPODOC, WPI, Google Patents: Keywords (wireless, multi-hop, data, traffic, route, distribute, map) and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0072604 A1 (WANG) 29 March 2007 (Paragraphs [0007], [0015], [0062-0065], [0107])	1-6

☐ 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 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
26 September 2011	28/09/2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **PRADNYA SATARKAR** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2751

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2011/000085

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 Supplemental Box 1

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.: **1-6**

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.

Supplemental Box 1
(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are **2** different inventions as follows:

- Claims **1-6** are directed towards distributing data traffic towards predetermined destinations in wireless multi hop networks, including the steps of receiving data traffic from a source, breaking out received traffic and redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table. It is considered that ***receiving data traffic from a source, breaking out received traffic and redistributing traffic to predetermined destinations which are configurable as recorded in a mapping table*** comprises a **first** distinguishing feature.

- Claims **7-14** are directed towards distributing data traffic towards predetermined destinations in wireless multi hop networks, including the steps of receiving data traffic from a source, instantiating and managing data bearer between data path functions, selecting a payload traversing the data bearer, scanning a chain of headers from data traffic, identifying a plurality of fields to be amended, calling up a mapping table, determining encapsulation of traffic, changing source and destination addresses of the header when there is no encapsulation of traffic and sending data traffic to the predetermined destination. It is considered that ***receiving data traffic from a source, instantiating and managing data bearer between data path functions, selecting a payload traversing the data bearer, scanning a chain of headers from data traffic, identifying a plurality of fields to be amended, calling up a mapping table, determining encapsulation of traffic, changing source and destination addresses of the header when there is no encapsulation of traffic and sending data traffic to the predetermined destination*** comprises a **second** distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art. When there is no special technical feature there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claims and therefore cannot provide the required technical relationship. The only feature common to all of the claims and which provides a technical relationship among them is *'receiving data traffic from a source to distribute it to predetermined destinations in wireless multi hop networks'*. However it is considered that this feature is generic in this particular art.

Therefore in this light this common feature cannot be a special technical feature. Therefore there is no special technical feature present in the claims and the requirements for unity of invention are consequently not satisfied **a posteriori.**

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/MY2011/000085**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	2007072604	EP	1932286	WO	2007019672

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX