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**APPLICATION NUMBER: 15/940,890
FILING DATE: March 29, 2018
PATENT NUMBER: 10681698
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Application Number	application submitted herewith
Filing Date	March 29, 2018
First Named Inventor	Joseph Amalan Arul EMMANUEL
Title	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
Art Unit	not yet assigned
Examiner Name	not yet assigned
Attorney Docket Number	110729-8058.US02

SIGNATURE of Applicant or Patent Practitioner

Signature	/Han-Wei Chen/	Date (Optional)	3/29/2018
Name	Han-Wei Chen	Registration Number	75,350
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

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	Filing Date		2018-03-29
	First Named Inventor	Joseph Amalan Arul Emmanuel	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	110729-8058.US02	

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	4	20100118830	A1	2010-05-13	STEPHENSON, et al.	

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Attorney Docket Number	110729-8058.US02	

5	20110081903	A1	2011-04-07	CAI, et al.	
6	20110286404	A1	2011-11-24	ABRAHAM, et al.	
7	20120020319	A1	2012-01-26	SONG, et al.	
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14	20150264614	A1	2015-09-17	STAGER, et al.	
15	20150334750	A1	2015-11-19	MEHTA	

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Examiner Name		
Attorney Docket Number	110729-8058.US02	

16	20160007273	A1	2016-01-07	PANG, et al.	
17	20160142163	A1	2016-05-19	SIROTKIN	
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26	20170215091	A1	2017-07-27	LING	

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Attorney Docket Number	110729-8058.US02	

27	20170251410	A1	2017-08-31	COMSTOCK
28	20170325243	A1	2017-11-09	YASUKAWA, et al.

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	1	"WLAN High Availability", Technical white paper; Hewlett-Packard Development Company, L.P., Oct. 2014, 8 pages	

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Name/Print	Han-Wei (Harvey) Chen	Registration Number	75350

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WLAN high availability

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Overview

In a large-sized WLAN, ACs are required to provide uninterrupted services when single points of failure occur. Users have different requirements for failure detection speed, switchover time, redundancy ratio, usability, performance, and costs. The HP WLAN high availability technology provides device-level and service-level high availability to meet different network requirements:

- As shown in Table 1, device-level high availability has the following backup features:
 - 1+1 fast backup**—Two ACs back up each other. When the primary AC fails, the backup AC takes place immediately to provide WLAN services.
 - N+1 backup**—One AC backs up multiple ACs.
 - N+N backup**—Each AC acts as the backup AC for the other ACs.
 - VRRP**—The primary AC and the backup AC form a VRRP group and use one virtual IP address to provide services.

Table 1. Backup methods characters

Item	1+1 fast backup	N+1 backup	N+N backup	VRRP backup
Focus	Reliability	Maintainability	Flexibility	Reliability
Feature	AC failure detection and primary and backup AC switchover in subseconds	One backup AC for multiple primary ACs. All APs connect to their respective primary AC as long as the primary AC operates correctly.	Easy and flexible, and can meet the requirements of most scenarios.	Two ACs form one VRRP group to provide one virtual IP address.
Availability	High	Middle	Middle	High
Maintainability	High	High	Middle	High
Flexibility	Middle	Low	High	Middle
Load balancing	Supported	Not supported	Supported	Supported
Heartbeat detection	Supported	Not supported	Not supported	Not supported
Cost	High	Low	Low	High
Performance	High	Middle	Low	Middle

- Service-level high availability has the following failover features:
 - 802.1X stateful failover.
 - Portal stateful failover.
 - DHCP stateful failover.

WLAN high availability implementation

Fundamental high availability technologies

This section describes fundamental high availability technologies.

AP connection priority

You can configure the AP connection priority for an AC. The priority value is in the range of 0 to 7. A larger value represents a higher priority. An AP prefers to connect to an AC with higher priority.

AC selection

AC selection is performed in the following descending order:

1. An AC that has APs with manually configured serial IDs.
2. An AC with higher AP connection priority
3. An AC with a lower load.
The load of an AC is determined by the numbers of supported and online APs and clients.
4. The first discovered AC.

Dual-link

Dual-link enables an AP to establish LWAPP tunnels with a primary and a backup AC. The primary AC provides services for the AP. When the primary AC fails, the backup AC becomes the new primary AC to provide services.

Together with the heartbeat detection function, the backup AC can immediately detect primary AC failure and become the primary AC to provide services. The heartbeat detection function requires the two ACs to be in the same Layer 2 network.

VRRP

VRRP is an error-tolerant protocol. It enables hosts on a LAN to communicate with the external network when the gateway fails.

VRRP has the following benefits:

- Simplified network management.
VRRP avoids single points of failure and simplifies the configuration on hosts. When the master in the VRRP group on a multicast or broadcast LAN fails, another router in the VRRP group takes over. The switchover is complete without causing dynamic route recalculation, route re-discovery, gateway reconfiguration on the hosts, or traffic interruption.
- Strong adaptability.
VRRP packets are encapsulated in IP packets and support all kinds of upper-layer protocols.
- Low cost.
Only masters send periodic VRRP advertisements.

VRRP can be used to realize portal stateful failover, 802.1X stateful failover, and AC virtualization backup in WLAN high availability.

1+1 fast backup

An AP establishes LWAPP tunnels with a primary AC and a backup AC. The primary AC provides services for the AP. When the primary AC fails, the backup AC can detect the failure in subseconds, and it becomes the new primary to provide services without service interruption.

1+1 fast backup uses the heartbeat detection mechanism. It has a higher redundancy ratio (1:1) but occupies more system resources.

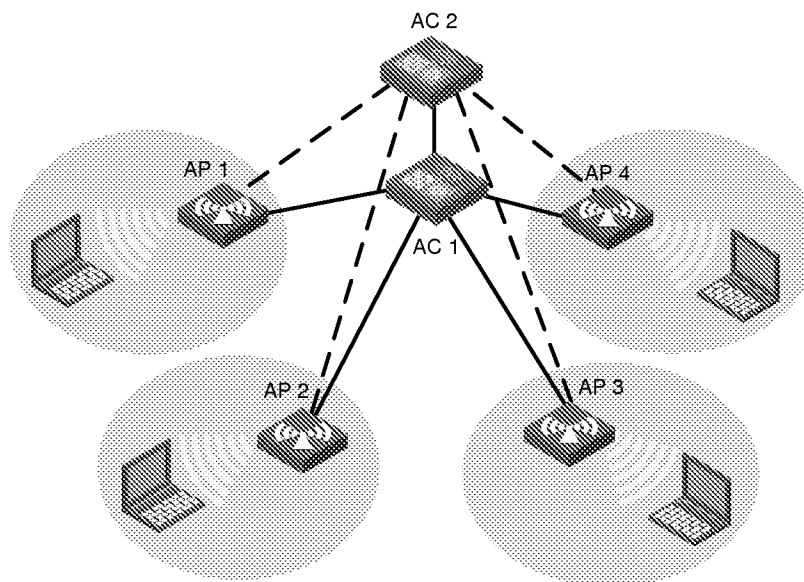
HP recommends using one AC as the backup AC to simplify maintenance. You can also configure the two ACs to balance load for each other to meet specific requirements.

As shown in Figure 1, AC 1 is the primary AC for all APs. 1+1 fast backup operates as follows:

1. The APs select AC 1 as the primary AC because AC 1 has higher AP connection priority.
2. When the primary AC fails, the APs connect to the backup AC.

3. When the primary AC recovers, the APs connect to the primary AC.

Figure 1. Network diagram



N+1 backup

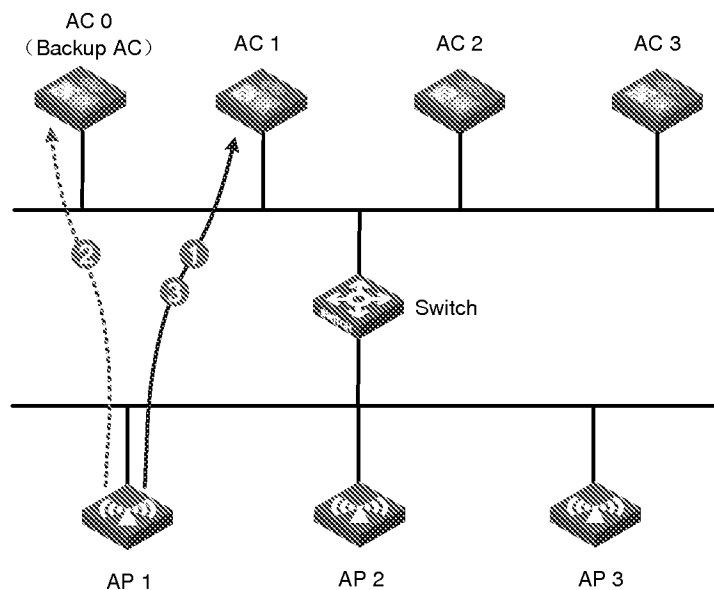
A backup AC can back up a maximum of four primary ACs. The backup AC provides services only when a primary AC fails. When the primary AC recovers, all APs switch back to the primary AC automatically.

1+1 backup is the same as 1+1 fast backup except that 1+1 backup does not support heartbeat detection.

As shown in Figure 2, AC 1, AC 2, and AC 3 are the primary AC for AP 1, AP 2, and AP 3, respectively. AC 0 is the backup AC for the other three ACs. N+1 backup operates as follows:

1. AP 1, AP 2, and AP 3 use AC 1, AC 2, and AC 3 as their primary AC, respectively because the ACs are configured with different AP connection priorities.
2. When AC 1 fails, AP 1 switches to AC 0.
3. When AC 1 recovers, AP 1 switches back to AC 1.

Figure 2. Network diagram



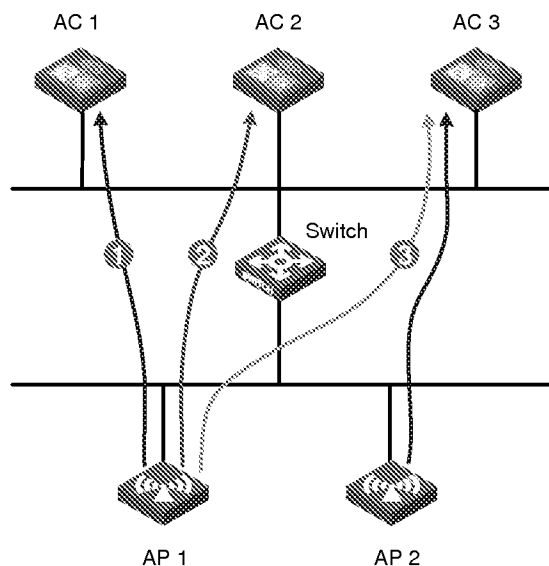
N+N backup

Each AC acts as the backup AC for the other ACs. APs select an optimum AC as the primary AC. When the primary AC fails, the APs select another AC to connect to. When the primary AC recovers, the APs do not switch back to the primary AC.

As shown in Figure 3, AC 1, AC 2, and AC 3 provide services for all APs. N+N backup operates as follows:

1. All ACs have the same priority, so AP 1 can select an AC to connect to. Assume AP 1 selects AC 1.
2. When AC 1 fails, AP 1 selects AC 2.
3. When both AC 1 and AC 2 fail, AP 1 connects to AC 3.
4. When AC 1 recovers, AP 1 does not switch back to AC 1.

Figure 3. Network diagram



Portal stateful failover

Stateful failover supports hot backup of services on two devices. Stateful failover can be configured on key devices to avoid service interruptions caused by single point failures. When operating correctly, the two devices synchronize service information. If one device fails, the other device takes over the services.

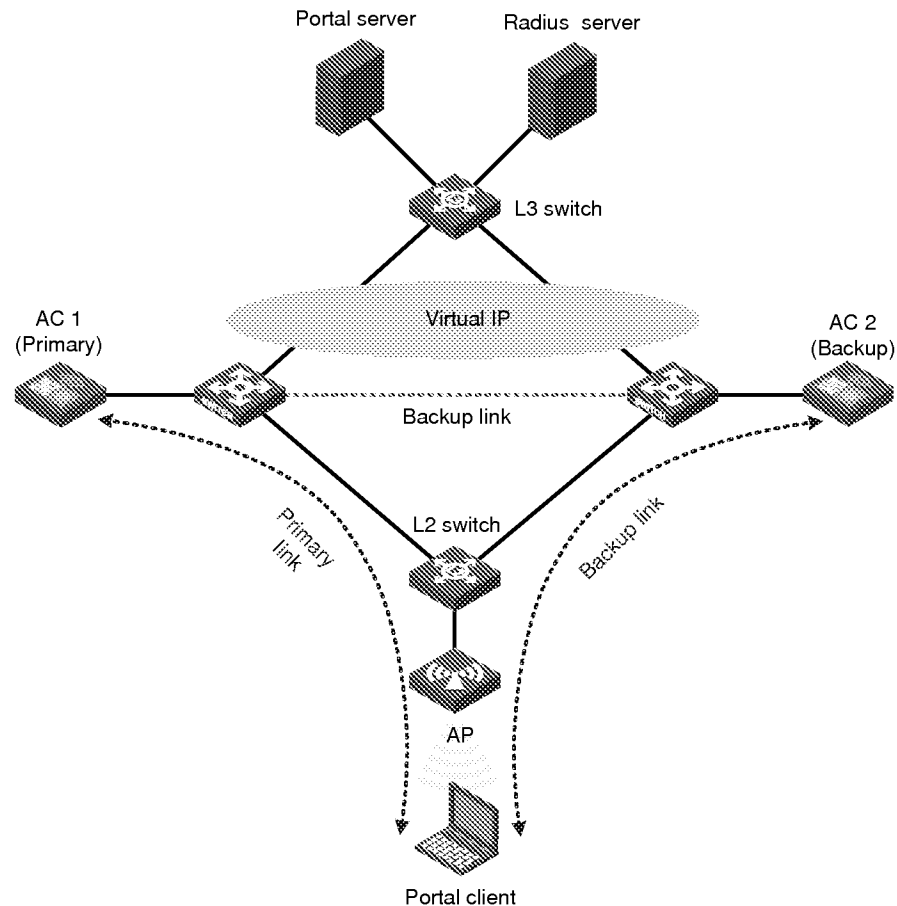
Portal stateful failover supports local and remote portal server, and local user and remote AAA server.

To implement stateful failover for portal, configure VRRP for traffic switchover. You can also configure 1+1 fast backup between the two ACs.

For a remote portal server, HP recommends that you use portal stateful failover with 1+1 fast backup, and enable VRRP on the Layer 3 interfaces that connect the ACs to the switches.

As shown in Figure 4, when portal stateful failover is enabled, the ACs back up their portal online user information through the failover link. If either AC fails, the other can guarantee data communication of the online portal users and perform portal authentication for new portal users.

Figure 4. Network diagram

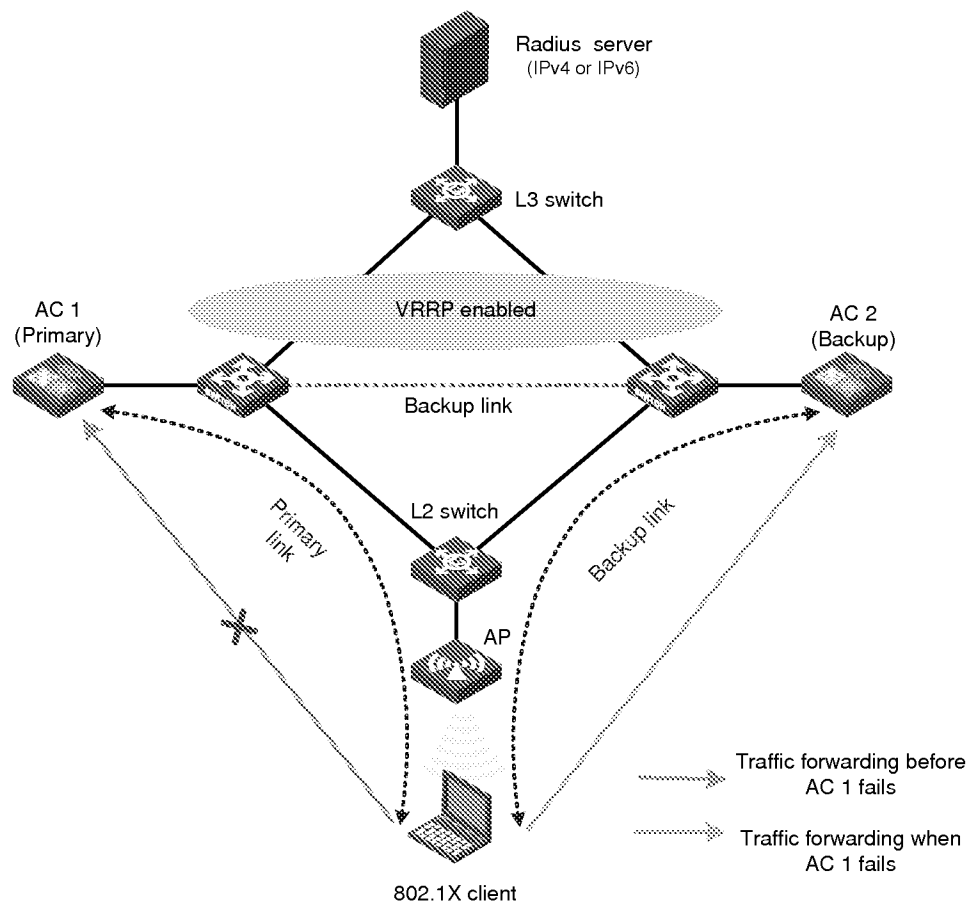


802.1X stateful failover

802.1X stateful failover backs up client information, client status information, and client authentication information between two ACs. This ensures that the backup AC can immediately use backup information to provide WLAN services without service interruption.

Use 802.1X stateful failover together with the VRRP for communication with the RADIUS server with one virtual IP address, and 1+1 fast backup for fast failure detection in subseconds.

Figure 5. Network diagram

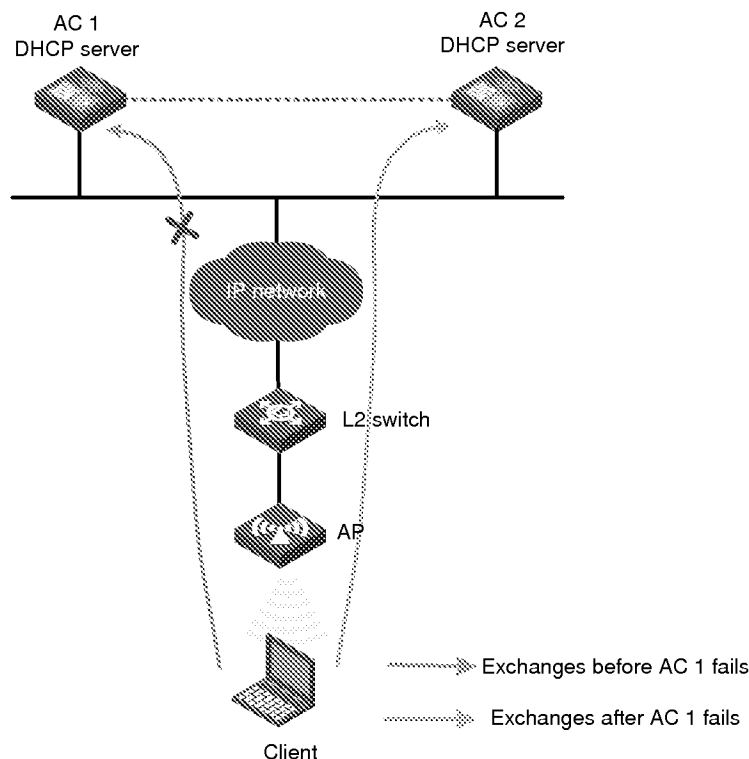


DHCP stateful failover

DHCP stateful failover enables real-time synchronization of address allocation and lease extension information between two ACs that operate as DHCP servers. When one AC fails, the other AC takes over to provide address allocation and lease extension services for clients.

If the ACs and clients are not on the same subnet, a DHCP relay agent is required, and you must specify both ACs on the relay agent. When the interface receives request messages from clients, the relay agent forwards them to both ACs.

Figure 6. Network diagram



VRRP for WLAN

VRRP for WLAN enables two ACs to form one VRRP group to provide one virtual IP address for APs and clients, and synchronize AP and client information between the two ACs in real time. When one AC fails, VRRP automatically switches services to the backup AC. The APs and clients still use the virtual IP address to access the external network without any service interruption.

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Electronic Patent Application Fee Transmittal

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Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE			
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL			
Filer:	Han-Wei Chen/Christine Ort			
Attorney Docket Number:	110729-8058.US02			
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International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Ortt
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	29-MAR-2018
Filing Date:	
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Application Type:	Utility under 35 USC 111(a)

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37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	110729-8058US02_ADS.PDF	1823150	no	9
			b264fffc286e72e92be787c1b0a102caacbc52ef		
Warnings:					
Information:					
2		110729-8058US02_Application.PDF	167473	yes	25
			4eef1123fba2e21917ce1dac220ced67726617d8		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Abstract		25	25	
	Claims		21	24	
	Specification		1	20	
Warnings:					
Information:					
3	Drawings-only black and white line drawings	110729-8058US02_Drawings.PDF	11161077	no	12
			290c0b51a0511405481a16236277dbdc8ea00cd		
Warnings:					
Information:					
4	Oath or Declaration filed	110729-8058US02_Declaration.pdf	217160	no	2
			6cc72c4af09eda211fbf60b1f3cc682b0ec30a3d		
Warnings:					
Information:					
5	Power of Attorney	110729-8058US02_POA.PDF	519277	no	2
			dcf6d6d507193b4e8309ea45ef7c3cdcfcd87c10		
TP Link Ex. 1004					

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	110729-8058US02_IDS.PDF	1039568	no	6
			5a207f49c3e224521a2346e733eba1feb59a8bfd		
Warnings:					
Information:					
7	Non Patent Literature	NPL-WLAN-high-availability.pdf	289021	no	8
			50fa38ba391007c88554f81aa7cedd37ecdf9177		
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	35347	no	2
			517d1d16b70fd06b5c168e57716cd3268cd51fc		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Joseph	Amalan Arul	EMMANUEL		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Cupertino	State/Province	CA	Country of Residence	US

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Address 1	350 East Plumeria Drive				
Address 2					
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Postal Code	95134	Country	US		

Inventor	2				Remove
Legal Name					
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	Peiman		AMINI		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Mountain View	State/Province	CA	Country of Residence	US

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City	San Jose	State/Province	CA		
Postal Code	95134	Country	US		

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For further information see 37 CFR 1.33(a).

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Page 23

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

☐ An Address is being provided for the correspondence information of this application.

Customer Number	22918		
Email Address	patentprocurement@perkinscoie.com	Add Email	Remove Email

Application Information:

Title of the Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		
Attorney Docket Number	110729-8058.US02	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	22918		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15271912	2016-09-21
Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15271912	Claims benefit of provisional	62336503	2016-05-13
Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15271912	Claims benefit of provisional	62253540	2015-11-10
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			Remove
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)
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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1		Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section. Clear			
Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	NETGEAR, INC.		
Mailing Address Information For Applicant:			
Address 1	350 East Plumeria Drive		
Address 2			
City	San Jose	State/Province	CA
Country	US	Postal Code	95134
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button. Add			

Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

Assignee	1			
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
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Address 2				
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Phone Number		Fax Number		
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Signature:	Remove			
NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).				
This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, all joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of all joint inventor-applicants.				
See 37 CFR 1.4(d) for the manner of making signatures and certifications.				
Signature	/Han-Wei Chen/		Date (YYYY-MM-DD)	2018-03-29
First Name	Han-Wei	Last Name	Chen	Registration Number
				75350
Additional Signature may be generated within this form by selecting the Add button. Add				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	110729-8058.US02
		Application Number	
Title of Invention	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

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ABSTRACT

A dedicated backhaul for whole home coverage variously applies optimization techniques, e.g. using the 5 GHz high band or low band as a dedicated backhaul; using the 2.4 GHz band as backup if the 5 GHz band fails to reach between
10 nodes; using Ethernet when it is better than the 5 GHz and 2.4 GHz bands and it is available; and using a spanning tree protocol or a variant to avoid loops. The dedicated backhaul is used if the received signal strength indication (RSSI) of the dedicated channel is above a threshold. In embodiments, a daisy chain uses probe request contents to communicate hop count and link quality between the
15 nodes by attempting to route directly if link quality is better than a defined threshold. For each extra hop, there must be some percentage gain over smaller hops. If the link is below some threshold, it is not used.

CLAIMS

What is claimed is:

1. A computer-implemented method for establishing a backhaul communication among nodes in a mesh wireless network, the method comprising:

performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and

upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a channel in a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,

wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.

2. The method of claim 1, wherein said attempts are performed on a first radio, the method further comprising:

upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.

3. The method of claim 2, wherein said different radio is the same radio as the front haul.

4. The method of claim 1, further comprising:

measuring received signal strengths of probes from all nodes within a communication range; and

selecting the second node based on the measured received signal strengths of the probes.

5. The method of claim 1, further comprising:
utilizing a spanning tree based protocol to avoid loops in said attempts.
- 5 6. The method of claim 1, further comprising:
measuring a link quality among one or more of the nodes in the network;
and
selectively causing a number of nodes in the network to form a particular
connection topology based on the measured link quality.
- 10 7. The method of claim 6, wherein the formed connection topology is a star
topology if the link quality exceeds a predetermined threshold.
8. The method of claim 6, wherein the formed connection topology is a daisy
15 chain topology if the link quality does not exceed a predetermined threshold.
9. The method of claim 8, further comprising:
maintaining a hop count for nodes connected in the daisy chain topology,
wherein whether a given node can be added to the daisy chain topology as an
20 extra hop is further based on the hop count.
10. The method of claim 1, further comprising:
receiving, via the backhaul, a configuration from the second node.
- 25 11. The method of claim 10, further comprising:
causing the configuration from the second node to be pushed through the
backhaul to a target node, wherein said causing is triggered by an initiation from
a user.

12. A network device capable of establishing a backhaul communication among nodes in a mesh wireless network, the device including a network controller configured to perform operations comprising:

performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and

upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,

wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.

13. The device of claim 12, wherein said attempts are performed on a first radio, the operations further comprising:

upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.

14. The device of claim 13, wherein said different radio is the same radio as the front haul.

15. The device of claim 12, the operations further comprising:

measuring received signal strengths of probes from all nodes within a communication range; and

selecting the second node based on the measured received signal strengths of the probes.

16. The device of claim 12, the operations further comprising:

utilizing a spanning tree based protocol to avoid loops in said attempts.

17. The device of claim 12, the operations further comprising:

5 measuring a link quality among one or more of the nodes in the network;
and

selectively causing a number of nodes in the network to form a particular
connection topology based on the measured link quality.

10 18. The device of claim 17, wherein the formed connection topology is a star
topology if the link quality exceeds a predetermined threshold.

19. The device of claim 17, wherein the formed connection topology is a daisy
chain topology if the link quality does not exceed a predetermined threshold.

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20. The device of claim 19, the operations further comprising:

maintaining a hop count for nodes connected in the daisy chain topology,
wherein whether a given node can be added to the daisy chain topology as an
extra hop is further based on the hop count.

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21. The device of claim 12, the operations further comprising:

receiving, via the backhaul, a configuration from the second node.

22. The device of claim 21, the operations further comprising:

25 causing the configuration from the second node to be pushed through the
backhaul to a target node, wherein said causing is triggered by an initiation from
a user.

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DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

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CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation (CON) application of U.S. utility patent application no. 15/271,912, entitled DEDICATED BACKHAUL FOR WHOLE
10 HOME COVERAGE (Attorney Docket No. 110729-8058.US01), filed September 21, 2016, which claims priority to U.S. provisional patent application no. 62/253,540, entitled METHOD AND APPARATUS FOR WHOLE HOME WI-FI COVERAGE (Attorney Docket No. 110729-8045.US00), filed November 10, 2015, and to U.S. provisional patent application no. 62/336,503, entitled
15 DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE (Attorney Docket No. 110729-8058.US00), filed May 13, 2016; all of which are incorporated herein in their entirety by this reference thereto.

FIELD

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The invention relates to telecommunications networks. More particularly, the invention relates to a dedicated backhaul for whole home coverage.

BACKGROUND

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In a hierarchical telecommunications network the backhaul portion of the network comprises the intermediate link between the core network, or backbone network and the small subnetworks at the edge of the entire hierarchical network. In the home, such network can comprise an access point (AP) with links to various
30 repeaters. A mesh network is often used to establish a wireless backhaul

between the AP and the various repeaters. With mesh networking, access points are connected wirelessly and exchange data frames with each other to forward traffic to/from a gateway point, such as the AP. However, a mesh network is difficult to set up and maintain, especially where intermediate links between the edge and the access point are added, such as when intermediate repeaters relay traffic between the AP and a remote repeater that is out of range of the AP.

SUMMARY

A dedicated backhaul for whole home coverage variously applies optimization techniques, e.g. using the 5 GHz high band or low band as a dedicated backhaul; using the 2.4 GHz band as backup if the 5 GHz band fails to reach between nodes; using Ethernet when it is better than the 5 GHz and 2.4 GHz bands and it is available; and using a spanning tree protocol or a variant to avoid loops. The dedicated backhaul is used if the received signal strength indication (RSSI) of the dedicated channel is above a threshold. In embodiments, a daisy chain uses probe request contents to communicate hop count and link quality between the nodes by attempting to route directly if link quality is better than a defined threshold. For each extra hop, there must be some percentage gain over smaller hops. If the link is below some threshold, it is not used.

DRAWINGS

Figure 1 is a schematic diagram showing a dedicated backhaul for whole home coverage according to the invention;

Figure 2 is a schematic diagram showing a 5 GHz backhaul according to the invention;

Figure 3 is a schematic diagram showing a 5 GHz backhaul (Figure 2A) 2.4 GHz and 5 GHz backhaul (Figure 2B) according to the invention;

Figure 4 is a flow diagram showing a star topology boot up operational phase of a dedicated backhaul for whole home coverage according to the invention;

- 5 Figure 5 is a flow diagram showing a daisy chain operational phase of a dedicated backhaul for whole home coverage according to the invention;

- Figure 6 is a flow diagram showing an 802.11k/v client roaming operational phase of a dedicated backhaul for whole home coverage according to the
10 invention;

Figure 7 is a flow diagram showing a legacy client steering operational phase of a dedicated backhaul for whole home coverage according to the invention;

- 15 Figure 8 is a flow diagram showing a 2.4 GHz channel selection operational phase of a dedicated backhaul for whole home coverage according to the invention;

- Figure 9 is a flow diagram showing a system ACS operational phase of a
20 dedicated backhaul for whole home coverage according to the invention;

- Figure 10 is a flow diagram showing a router or bridge determination operational phase of a dedicated backhaul for whole home coverage according to the
invention;
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Figure 11 is a flow diagram showing a detailed star topology boot up operational phase of a dedicated backhaul for whole home coverage according to the invention; and

- 30 Figure 12 shows a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions for causing the

machine to perform one or more of the methodologies discussed herein may be executed.

DESCRIPTION

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Embodiments of the invention provide several techniques for establishing and maintaining a dedicated backhaul for whole home coverage. Figure 1 is a schematic diagram showing a dedicated backhaul for whole home coverage according to the invention. In Figure 1, a system of smart Wi-Fi nodes 10 includes a dedicated backhaul 12 to provide whole home coverage and the fastest speed to the Internet. In operation, a router is placed in service as the access point (AP). A satellite device is then added, synced to the AP, and a dedicated backhaul is established there between. LEDs on the devices indicate progress and success with syncing of the devices.

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Embodiments of the invention variously apply optimization techniques, such as using the 5 GHz high band or low band as a dedicated backhaul; using the 2.4 GHz band as backup if the 5 GHz band fails to reach between nodes; using Ethernet when it is better than the 5 GHz and 2.4 GHz bands and it is available; and using a spanning tree protocol or a variant to avoid loops.

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In connection with embodiments of the invention, a spanning tree protocol is a network protocol that builds a logical loop-free topology for Ethernet networks, the basic function of which is to prevent bridge loops and the broadcast radiation that results from them. Spanning tree also allows a network design to include spare (redundant) links to provide automatic backup paths if an active link fails. This is done without the danger of bridge loops, or the need for manual enabling or disabling of these backup links. As the name suggests, the spanning tree algorithm creates a spanning tree within a network of connected layer-2 bridges, and disables those links that are not part of the spanning tree, leaving a single active path between any two network nodes. The spanning tree algorithm was

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originally standardized as IEEE 802.1D, but the functionality, spanning tree, rapid spanning tree and multiple spanning tree previously specified in 802.1D, 802.1s and 802.1w respectively has been incorporated into IEEE 802.1Q-2014.

- 5 In embodiments of the invention, the dedicated backhaul is used if the received signal strength indication (RSSI) of the dedicated channel is above a threshold. The threshold is a parameter that can be defined and modified on the hardware after hardware qualification is done.
- 10 Some embodiments of the invention apply a daisy chain approach (discussed below), which uses probe request contents to communicate hop count and link quality between the nodes. Such embodiments attempt to route directly if link quality is better than a defined threshold. For each extra hop, there must be some percentage gain over smaller hops. If the link is below some threshold, it is
- 15 not used; and Wi-Fi protected setup (WPS) is extended across several nodes so the node can join on anyone.

When a new node is added to the network, the node sees the contents of the information element for a daisy chain from all neighboring nodes. In addition to

20 the content, the node checks signal strength of other APs using the content of the information element (hop count, data rate to main AP) and RSSI of the neighboring node. The node then decides to which AP it is to connect. Preference is given to the main AP or nodes with less hop to avoid extra delay and the overhead of multiple hops.

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In some embodiments of the invention the backhaul is used to push a configuration. In such embodiments of the invention the nodes that are in the network and are talking over backhaul channels can configure a new node. Configuration can be pushed by pressing buttons or by an app on a smartphone.

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There is a sync button on each unit. A user can press the sync button on a new unit and press the sync button on any previously present unit. The sync triggers a software process which results in the new unit being programmed by units that are already on the network. In the process, the new unit receives a Wi-Fi configuration, networking configuration, and other configuration files.

The phone app can trigger the sync process by communicating with the new unit and previously existing units using Wi-Fi, Bluetooth, or both.

The 5 GHz high band is defined as a dedicated backhaul in embodiments of the invention. The high band is defined in US as channels 100 to 140 + 149 to 165 and in Europe as DFS band channels 100 to 140. If the dedicated wireless link falls below the quality threshold, the 2.4 GHz band may be used as a backup option. The decision as which band is used for backhaul may differ from satellite to satellite.

Figure 2 is an example in which the dedicated 5 GHz band is used as a method of communication between two devices. In Figure 2, a plurality of client devices 20a-20c are associated with respective nodes 22a-22c. The nodes each include one or more 2.4 GHz radios and one or more 5 GHz radios. The nodes are connected by dedicated 5 GHz backhaul connections 23, 24. A 2.4 GHz connection 25 may be used as a backhaul when a 5 GHz connection is not available. When a 2.4 GHz connection is used as the backhaul it is shared for both clients and for the backhaul. Those skilled in the art will appreciate that any other connection may be substituted for the 5 GHz backhaul connection when such connection is not available, including for example another 5 GHz radio, a radio in a band other than 5 GHz and 2.4 GHz, *etc.*

Figure 3 is an example in which the dedicated 5 GHz band is used for one satellite and the 2.4 GHz is used for another satellite. In Figure 3, a plurality of client devices 26a-26c are associated with respective nodes 27a-27c. The

nodes each include one or more 2.4 GHz radios and one or more 5 GHz radios. The nodes 27a, 27b are connected by a dedicated 5 GHz backhaul connection 28. A 2.4 GHz connection 29 is used as a dedicated backhaul between the nodes 27a, 27c when a 5 GHz connection is not available.

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Figures 4-11 are flow diagrams showing operational phases of a dedicated backhaul for whole home coverage according to the invention, where Figure 4 shows a star topology boot up, Figure 5 shows a daisy chain flow chart, Figure 6 shows 802.11k/v client roaming, Figure 7 shows legacy client steering, Figure 8 shows 2.4 GHz channel selection, Figure 9 shows system ACS, Figure 10 shows router or bridge determination, and Figure 11 shows a detailed star topology boot up. In some embodiments, 802.11r is used to speed up key exchange.

Topology defines the arrangement in which nodes are connected in the network, including which nodes are directly connected and which communication channel and technology is used for different nodes to talk. Star topology is an arrangement in which all the nodes are directly connected to the base node. The base node is the node that is connected to the home gateway. In star topology, the software running on the satellite and base nodes makes a decision as which wireless band works the best for connection between the satellite and the base. A dedicated wireless band is the preferred method of wireless communication if the dedicated band is available for communication and the quality of the dedicated link is better than a defined threshold.

Wireless features in embodiments of the invention include star topology or daisy chain topology given network topology and channel conditions, client steering, unit on-boarding using a vendor specific information element (VIE) and WPS, auto channel selection (ACS) and 2.4G bandwidth, Bluetooth low energy (BLE), and channel planning. For purposes of the discussion herein, a VIE is an information element (IE) that a vendor, such as Netgear, can add to

communicate information that is specific to that vendor. All of the IEs that are described herein are vendor IEs.

For star only, the 5 GHz dedicated channel is the primary backhaul channel. If 5
5 GHz does not work, the system tries to use the 2.4 GHz band. The unit
associates on both bands and uses 5 GHz if the RSSI is above a predefined
threshold, e.g. -80dBm. If the RSSI is below the threshold, the satellite unit uses
the 2.4 GHz band as backhaul and the 5 GHz backhaul is not used. If the RSSI
of the 2.4 GHz and 5 GHz bands is below a threshold (-80dBm), an LED
10 indicates that the unit needs to be moved closer.

In Figure 4, a star topology boot up sequence begins with a start/reconnect
(100), where a boot up Scan_count=0 (102). A scan is performed on all radios,
where Scan_count=Scan_count+1 (104). If base radios are detected (106), they
15 are associated to a base in a dedicated 5 GHz and 2.4 GHz band (108). If a
determination $RSSI_{D_{base}} > Threshold_{D_{base}}$ (110) is made, then a dedicated radio
is used as backhaul (112) and the system waits for T (114). The system then
tries to associate a dedicated 5 GHz radio if one is not already associated (116)
and a determination $RSSI_{D_{base}} > Threshold_{D_{base}}$ (110) is made. If a
20 determination $RSSI_{D_{base}} > Threshold_{D_{base}}$ (110) is not made, where $RSSI_{2G_{base}} > Threshold_{2G}$ (120), then 2.4 GHz is used as backhaul if possible (118)
and, if not, then the system turns a move closer notification on (122). If base
radios are not detected (106), and Scan_count < Scan_threshold (124), then the
system turns a no connection notification on (126).

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In embodiments of the invention, a daisy chain is used. In daisy chain 5 GHz
dedicated band is preferred if the RSSI meets predetermined thresholds. The
system tries to use 5 GHz dedicated and star, if possible. If 5 GHz star cannot be
used, the system tries using a 5 GHz daisy chain. If 5 GHz does not work in star
30 or daisy chain topologies, the system tries using 2.4G as a last resort. A 5 GHz

dedicated daisy chain is preferred over the 2.4 GHz band if the RSSI is good enough.

5 In Figure 5, a daisy chain sequence starts (200), and the system scans on all three radios (202). If a radio is not found (204), the system indicates that the user should move closer (228). The system measures the following RSSI values:

- RSSI $2G_{base}$ = RSSI in 2.4 GHz,
- RSSI $2G_{max}$ = Max RSSI in 2.4 GHz,
- 10 • RSSI D_{base} = RSSI of dedicated backhaul,
- RSSI D_{max} = Max RSSI of dedicated backhaul (206) and,

then determines if $RSSI\ D_{base} > \text{Threshold 1}$ (208). If so, the system associates to a base AP in a dedicated band and 2.4 GHz (210). If, however, $RSSI\ D_{base} >$
15 Threshold 2 and $\text{hop count} < \text{max_hop}$ (212), then the system associates to an AP with $RSSI\ D_{max}$ in 2.4 GHz and 5 GHz dedicated (214). Further, if $RSSI\ D_{base} > \text{Threshold 3}$, the system checks max hop count (216) and, if so, then associates to the base in the 2.4 GHz and 5 GHz backhaul (218). Again, if $RSSI\ D_{base} > \text{Threshold 4}$ and $\text{hop count} < \text{max_hop}$ (220), then the system associates
20 to the highest 2.4 GHz RSSI (222), and indicates that the user should move closer (226).

In embodiments of the invention, for client steering using basic service set (BSS) transition management (BTM), the system relies on 802.11v and 802.11k when
25 available and when the client behaves. This is the safest steering. For on-band steering, the system uses the RSSI and loads to move clients from 2.4 GHz to 5 GHz. The system does not use load to move clients from 5 GHz to 2.4G. On moving clients from unit to unit, if the RSSI drops below some threshold, the system checks the RSSI of the other APs. If the RSSI of other APs is above a
30 threshold on 5 GHz, the system moves to 5 GHz; if the RSSI of other APs is

above some other threshold in the 2.4 GHz band, the system moves the clients to 2.4G of the other AP.

5 In Figure 6, for 802.11k/v client roaming, if $RSSI < threshold_{vk}$ (300) is not true, then the system waits for T1 (310); and, if true, the system performs measurement 11k (302). If $max\ RSSI_{5G} > thresh_{5G}_{vk}$ (304), the system sends BTM to best 5 GHz (312). If not, the system determines if $max\ RSSI_{2G} > thresh_{2.G}_{vk}$ (306) and, if so, the system sends BTM to best 2.4 GHz (314), else the system waits for T2 (308).`

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In embodiments of the invention, wireless features for legacy client steering are used for clients that do not support 802.11v/k or clients that do not have the correct implementation. This client steering occurs during an idle period if the client has no uplink packets for X seconds. The RSSI threshold is below that
15 which disconnects the client. The RSSI may be different for 2.4 GHz and 5 GHz. When the client connects back, the system tries to steer the client to the right AP by having it associate to an AP which has an RSSI above a threshold and hop count above a threshold. The system rejects a probe response and measures RSSI for X tries. The system then lets the client associate to any band of any
20 radio it desires.

In Figure 7, in a legacy client steering, on each unit, a determination is made if $num_rejected_probe > X$ in past n seconds (400) and, if so, the unit responds and is allowed (402). The system for allowed units determines if $RSSI < thresh_{de-auth}$ (404), sends a de-auth (406), measures a probe on all interfaces (408),
25 and determines $RSSI_{best\ 5G} > RSSI_{5G}$ (410). If the later is true, then the system responds and allows a backhaul on the best 5 GHz (412); else, the system responds and allows a backhaul on the best 2.4 GHz (414).

30 In embodiments of the invention, WPS is used for on-boarding new units on the backhaul and for addition of a unit with different backhaul credential to the

network. WPS works with a hidden SSID on the backhaul. Only units with a VIE can go through WPS procedure on a dedicated channel.

5 In embodiments of the invention, the VIE is used to mark a device. The VIE is included in probes, beacons, association, and authentication frames, or a subset of these packets. A device looks for the VIE to see the other side. If the VIE is present, then the device goes through an eight-way handshake.

10 The vendor IE content includes capability, dedicated band, hop count, steering capabilities, and transmit power, 2.4 GHz channel planning, and 5 GHz channel planning.

15 There may be one or more VIEs that are defined by the vendor and that are used to give information about the node to new devices that have not connected or joined the network. The new devices must know what other devices are in the network, what capabilities the other nodes have, and how each device is connected to Internet, *i.e.* what data rate is available to the main router, how many hops, 2.4 GHz backhaul, 5 GHz backhaul. There is a version of software in the VIE with which each device can know what software the other devices are
20 using, and with which the device can talk over using same application programming interface (API) structure.

On the satellite unit, if a backhaul connection not in place, WPS is used to find a backhaul connection. Once a credential is acquired on one backhaul channel, it
25 is copied to the other one. If the backhaul credential is already in place and the unit is connected, a WPS button is used to initiate WPS with clients or other satellite units on a dedicated channel.

30 In embodiments of the invention, 2.4 GHZ channel selection is used if there are no APs in the vicinity. If there is an AP in the vicinity, the channel where the AP with highest RSSI resides is picked. The system only considers APs with an

RSSI that is higher than -80dBm for 20/40MHz coexistence (enable by default) and ignores a 20/40 coexistence bit reported by clients (enable by default).

5 In Figure 8, a 2.4 GHz channel selection starts (500). If max RSSI > threshold 1 (-50dBm) (502), then the system uses the channel with highest RSSI (506); else, the system goes through the ACS and is aggressive on picking 40MHz (504).

10 In embodiments of the invention, BLE sets up the SSID and password. BLE is also used for Wi-Fi diagnosis purposes. BLE may be used to allow guest access and BLE mesh.

15 BLE has a mode which is referred to as Generic Attribute Profile (GATT). In GATT, it is not necessary for two device to pair and go through a pairing process before they can communicate over BLE. As a result, any BLE capable device can get information over BLE. Thus, new devices in a home can get an SSID and password using BLE, and they can use that SSID and password to connect to Wi-Fi if the user wants to use Wi-Fi and if the network owner gives permission to the new device.

20 Moreover, when the Wi-Fi network is down due to any failure, BLE may be used for debugging the issues, resetting the network setting, or any other diagnosis or action that needs to be taken when there is a problem.

25 BLE range is very limited compared to Wi-Fi. Because the dedicated backhaul has a range that can be as high 20x that of BLE, embodiment of the invention can use the dedicated backhaul to propagate the information on all devices. When the device is close to any of the other devices, the device can talk to close devices, and the close device can use the dedicated backhaul to send the information back to main device or any other device that needs diagnosis or any
30 actions.

The dedicated backhaul can also be used to extend range of BLE to different points around the home. For example, an LED light can be controlled using a device better than a traditional access point because any device can receive an LED BLE signal and can repeat back the information using the dedicated
5 backhaul to any other devices or to a cloud backend that controls the LED light. The same is true for any BLE sensor or BLE controlled device.

In embodiments of the invention, the 5 GHz backhaul includes MU-MIMO support. A different 2.4G channel may be used for different units and different 5
10 GHz client facing channels may be used on different units. Because MU-MIMO requires both sides of the link to have MU-MIMO support and have a good transmit and receive algorithm for MU-MIMO, embodiments of the invention use MU-MIMO between the devices, especially if there is only one base station.

15 Embodiments of the invention provide auto channel selection (ACS) during initial boot up. The algorithm for this feature scans all of the channels, then collects appropriate statistics, such as interferences (both WLAN and non-WLAN) and assigns weights to each channel.

20 In Figure 9, a system ACS starts (600). If $ma\ RSSI > threshold\ 1$ (602) is not true, then the system goes through ACS (604); else the system determines if $highest = 11$ (606). If so, then the system uses channel 10 (608); else, the system determines if $highest = 1$ (610). If so, then the system uses channel 2 (612); else, the system uses the channel with the highest RSSI (614).

25 In Figure 10, a router or bridge determination starts (700). The system boots up the OS on the base unit (702), initiates DHCP, and wait for x seconds (704). If a DHCP server is not available (706), the base unit comes up as an AP (714); else, the base unit comes up as a router (708). If an Internet connection is not
30 available (710), the system indicates a connection issue (716); else, the system indicates that the Internet is available (712).

In Figure 11, a star topology boot up starts (800) and the boot up, scan_count = 0 (802). The system scans on all three radios, where scan_count = scan_count +1 (804).

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If base radios are not detected (806), then scan_count < scan_threshold (814), and the system turns move closer indicator on (816).

If base radios are detected (806), and $RSSI_{D_{base}} > threshold_{D_{base}}$ (808) is true, then the system associates to a base in the dedicated and 2.4 GHz (810) and uses a dedicated radio as a backhaul (812).

If base radios are detected (806) and $RSSI_{D_{base}} > threshold_{D_{base}}$ (808) is false, then if $RSSI_{other_5G_base} > threshold_{other_5G}$ (822) is false and $RSSI_{other_2G_base} > threshold_{2G}$ (820) is false, the system turns a move closer indicator on (818).

If base radios are detected (806) and $RSSI_{D_{base}} > threshold_{D_{base}}$ (808) is false, then if $RSSI_{other_5G_base} > threshold_{other_5G}$ (822) is true, then the system associates to a base in the dedicated and 2.4 GHz band (824) and uses the other 5 GHz radio as a backhaul (826).

If base radios are detected (806) and $RSSI_{D_{base}} > threshold_{D_{base}}$ (808) is false, then if $RSSI_{other_5G_base} > threshold_{other_5G}$ (822) is false and $RSSI_{other_2G_base} > threshold_{2G}$ (820) is true, then the system associates to 2.4 GHz and any other radio (828) and uses 2.4 GHz as the backhaul (830).

Statistic Collection and Algorithm Guidelines. The following discussion describes the statistics that are collected during a scan and general guidelines on how to use the statistics. The following is a list of items that must be taken into account in embodiments of the invention:

1) The number of APs on each channel is counted accurately during the scan. The buffer size is limited for the scan and as a result, when there are many APs, the APs on higher channels do not fit into the limited buffer size. As a result,
5 scanning in 2.4G is broken into at least three separate scans in three subsets of the channel to make sure all APs are seen on all channels.

2) Scan time is increased on each channel such that all the APs are seen.

10 3) If one or more APs with an RSSI of -45dBm or higher are within vicinity, the channel of the AP which has highest RSSI is picked. If the AP is 40MHz, the same primary channel is picked.

15 4) Interference from neighboring channels is taken into account. The channel with smallest grade is the best.

E = constant which depends on AP RSSI

20 • If 20MHz AP is on Z= channel CH, CH-1, CH+1, $\text{Grade_on_channel_Z} = \text{Grade_on_channel_Z} + 2 * E$

• If 20MHz AP is on Z= CH-2, CH+2, $\text{Grade_on_channel_Z} = \text{Grade_on_channel_Z} + E$

25 • If 40MHz AP, for both 20MHz subchannels of the 20MHz, apply grade calculation as described above.

30 5) The RSSI of APs is taken into account. Grade in the following is the grade on the AP channel and all affected neighboring channels. The following may be used to start for 4x4:

- AP RSSI < -70dBm $\Rightarrow$ E=1
- -70dB < AP RSSI < -40dB $\Rightarrow$ E=1.5

- 5 • RSSI > -40dB $\Rightarrow$ E=2

6) Noise floor on each channel is measured during scan:

- 10 • tmpnoise = (noise_db < -95) ? -95 : noise_db
- tmpnoise = (noise_db >= -65) ? -65 : noise_db
- noise_grade = (tmpnoise+95)/5*4

- 15 7) For a 40MHz channel selection, the 20/40 coexistence (wl obss_coex) is taken into account. If there is no 40MHz channel available because of coexistence requirement, the best 20MHz channel is selected.

- 20 8) Transmit power on each channel is taken into account. Channel 1 and channel 11 shall be avoided in the US and Australia.

- 25 9) Channel utilization on each channel is measured during scan. Channel utilization includes CCA stats and percentage of the time that the channel is clean.

- 10) Interference statistics on each channel are measured during the scan and may be used.

- 30 11) Each unit may take into account the channels that are used by other APs in the network. For example, ACS may decide to use different channels on different units.

Notes

Dynamic Frequency Selection (DFS). In embodiments of the invention, the backhaul channel in European Telecommunications Standards Group (ETSI) is on the radar band. In an FCC locale, the radar band may be used when the non-radar backhaul channel has interference. If radar shows up, it is necessary to change the backhaul, e.g. moving the channel in coordinated way; and communication of dynamic frequency selection (DFS) detection between different nodes in the mesh network, e.g. using 2.4 GHz, the other 5 GHz, and/or 802.11h. Action frames and/or beacon frames from 802.11h may be extended for use-case of mesh.

When radar shows up, the units use layer 2, 3, or the application layer to notify each other of radar entry and coordinate a backhaul move. This coordination and move must be performed during the time that is allowed by regulatory bodies. The client facing coordinating radios, including 2.4 GHz radio, may be used to communicate and move the backhaul, if backhaul communication coordination can be performed within the time that the regulatory bodies allow before shutting down communication. In this case, the other two radios, which are not dedicated backhaul radios, move to the same channel and start communication to pick a new backhaul. If not, a new backhaul can be chosen, and the two other radios are shared for backhaul and front haul. This not a desired outcome and is done only if no backhaul channel is available due to radar events.

Channel planning for client facing radios. In embodiments of the invention, different 2.4 GHz channels are used when 2.4G is not used as backhaul. Changing the channel of the 5 GHz band; and/or changing of the channel is used to avoid congestion. Channel coordination is done to use the cleanest channels among multiple nodes depending on available traffic

Changing basic rate set per topology. In embodiments of the invention the beacon rate is changed to force clients to roam; and/or the management frame rate is changed.

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Changing transmit (TX) power per distance. In embodiments of the invention maximum transmit power may be dropped on mesh nodes if the mesh node coverage is smaller than what its peak power allows. Transmit power of some management or control frames may be dropped. Transmit power of some certain modulation and or coding may be dropped. Transmit power to some certain client may be dropped

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Mobility control over dedicated backhaul. In embodiments of the invention data is sent between different modules and used to decide how to roam, when to roam, and send packets to client to roam. Roaming is done based on best effective rate, interference, and type of data.

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The AP over which a client is connected is monitoring the client wireless state, as well as the traffic the client sends over Wi-Fi. Once the AP sees any reason for a client to be considered for roaming, it communicates to the other APs and gets information from them on the state of wireless channels that the other APs see. Moreover, the AP queries the client on what the client sees from the network. Once all of the information is gathered, a final decision is made by the AP whether the client is connected to another AP, depending on the network configuration. The decision is communicated over the dedicated backhaul, and then an attempt is made to roam the client. Coordination of roaming, including what time to send a roaming trigger to the client and which AP to respond to after roaming has started, happens over the dedicated backhaul as well.

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Bluetooth mesh/Bluetooth over Wi-Fi. Embodiments of the invention extend Bluetooth across home over Wi-Fi or over Bluetooth mesh. The Bluetooth signal

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may be decoded the bits may be sent over Wi-Fi backhaul to a node which is close to destination and Bluetooth packet may be transmitted at that node.

Computer System

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Figure 12 is a block diagram of a computer system as may be used to implement certain features of some of the embodiments. The computer system may be a server computer, a client computer, a personal computer (PC), a user device, a tablet PC, a laptop computer, a personal digital assistant (PDA), a cellular
10 telephone, an iPhone, an iPad, a Blackberry, a processor, a telephone, a web appliance, a network router, switch or bridge, a console, a hand-held console, a (hand-held) gaming device, a music player, any portable, mobile, hand-held device, wearable device, or any machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that
15 machine.

The computing system 30 may include one or more processors 35; memory 31; input/output devices 32, e.g. keyboard and pointing devices, touch devices, display devices; storage devices 34, e.g. disk drives; and network adapters 33,
20 e.g. network interfaces, that are connected to an interconnect 36. The interconnect 36 is illustrated as an abstraction that represents any one or more separate physical buses, point to point connections, or both connected by appropriate bridges, adapters, or controllers. The interconnect 36, therefore, may include, for example, a system bus, a Peripheral Component Interconnect (PCI)
25 bus or PCI-Express bus, a HyperTransport or industry standard architecture (ISA) bus, a small computer system interface (SCSI) bus, a universal serial bus (USB), IIC (12C) bus, or an Institute of Electrical and Electronics Engineers (IEEE) standard 1394 bus, also called Firewire.

30 The memory 31 and storage devices 34 are computer-readable storage media that may store instructions that implement at least portions of the various

embodiments. In addition, the data structures and message structures may be stored or transmitted via a data transmission medium, *e.g.* a signal on a communications link. Various communications links may be used, *e.g.* the Internet, a local area network, a wide area network, or a point-to-point dial-up connection. Thus, computer readable media can include computer-readable storage media, *e.g.* non-transitory media, and computer-readable transmission media.

The instructions stored in memory 31 can be implemented as software and/or firmware to program the processor 35 to carry out actions described above. In some embodiments, such software or firmware may be initially provided to the processing system 30 by downloading it from a remote system through the computing system 30, *e.g.* via network adapter 33.

The various embodiments introduced herein can be implemented by, for example, programmable circuitry, *e.g.* one or more microprocessors, programmed with software and/or firmware, or entirely in special-purpose hardwired (non-programmable) circuitry, or in a combination of such forms. Special-purpose hardwired circuitry may be in the form of, for example, one or more ASICs, PLDs, FPGAs, *etc.*

Although the invention is described herein with reference to the preferred embodiment, one skilled in the art will readily appreciate that other applications may be substituted for those set forth herein without departing from the spirit and scope of the present invention. Accordingly, the invention should only be limited by the Claims included below.

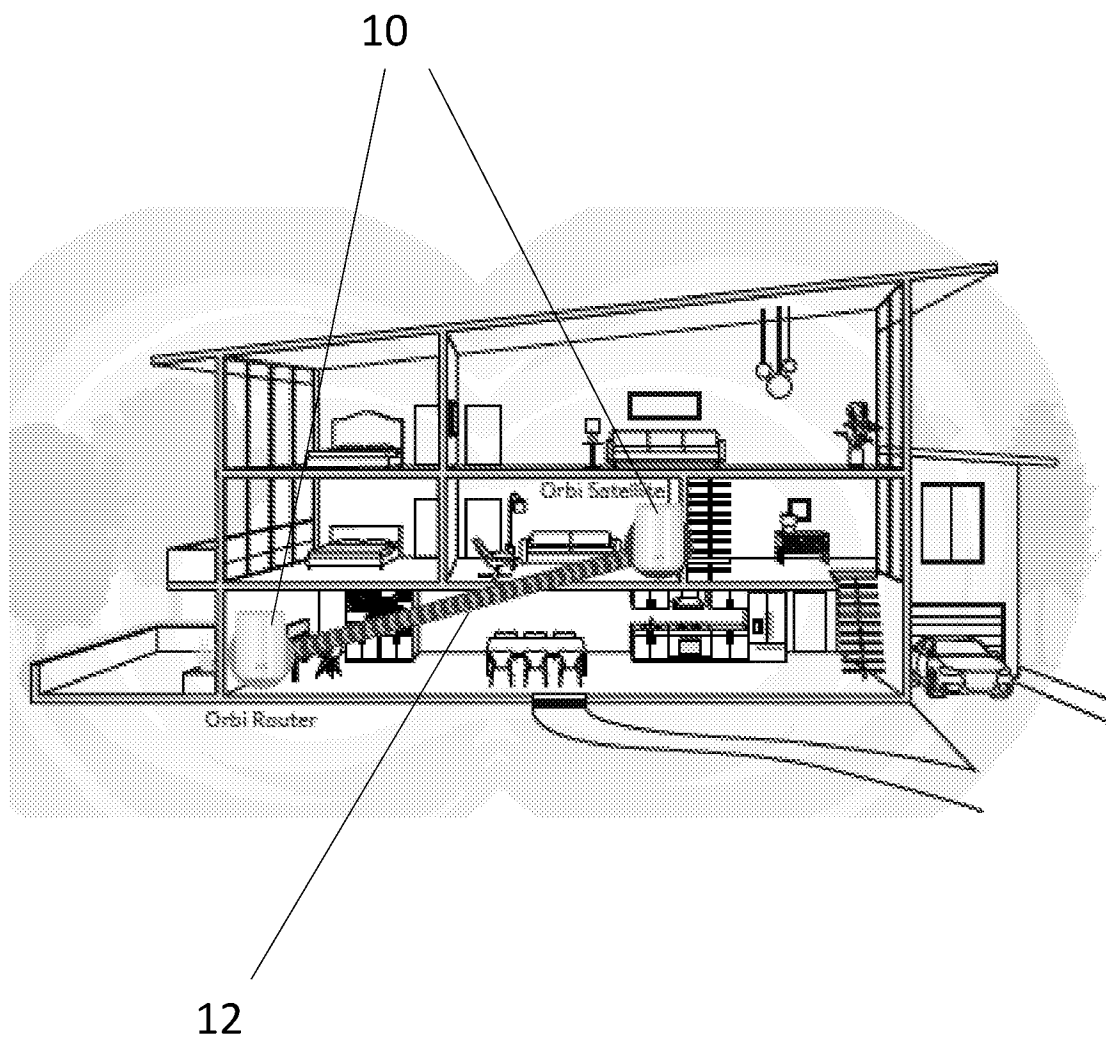


FIGURE 1

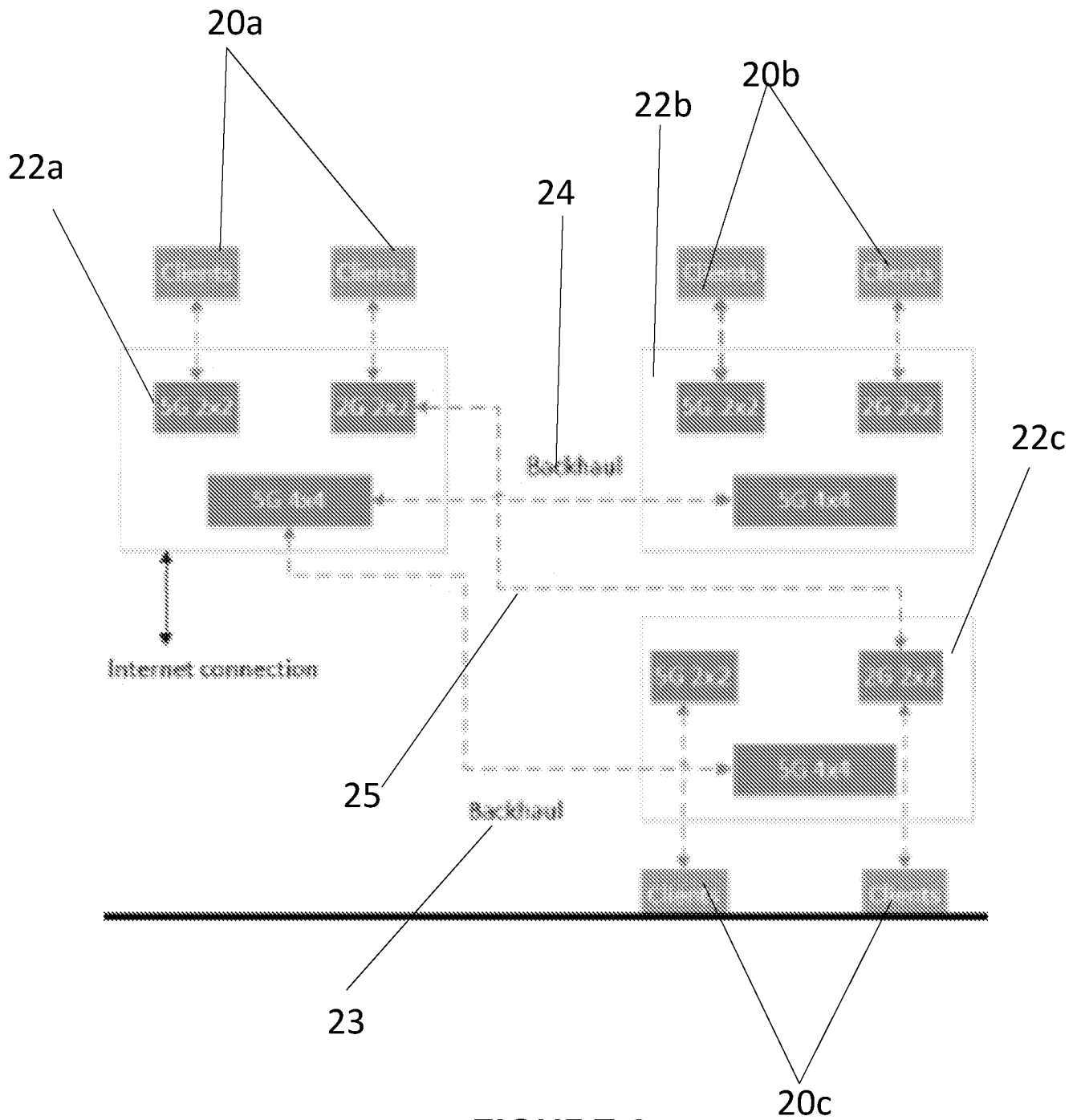


FIGURE 2

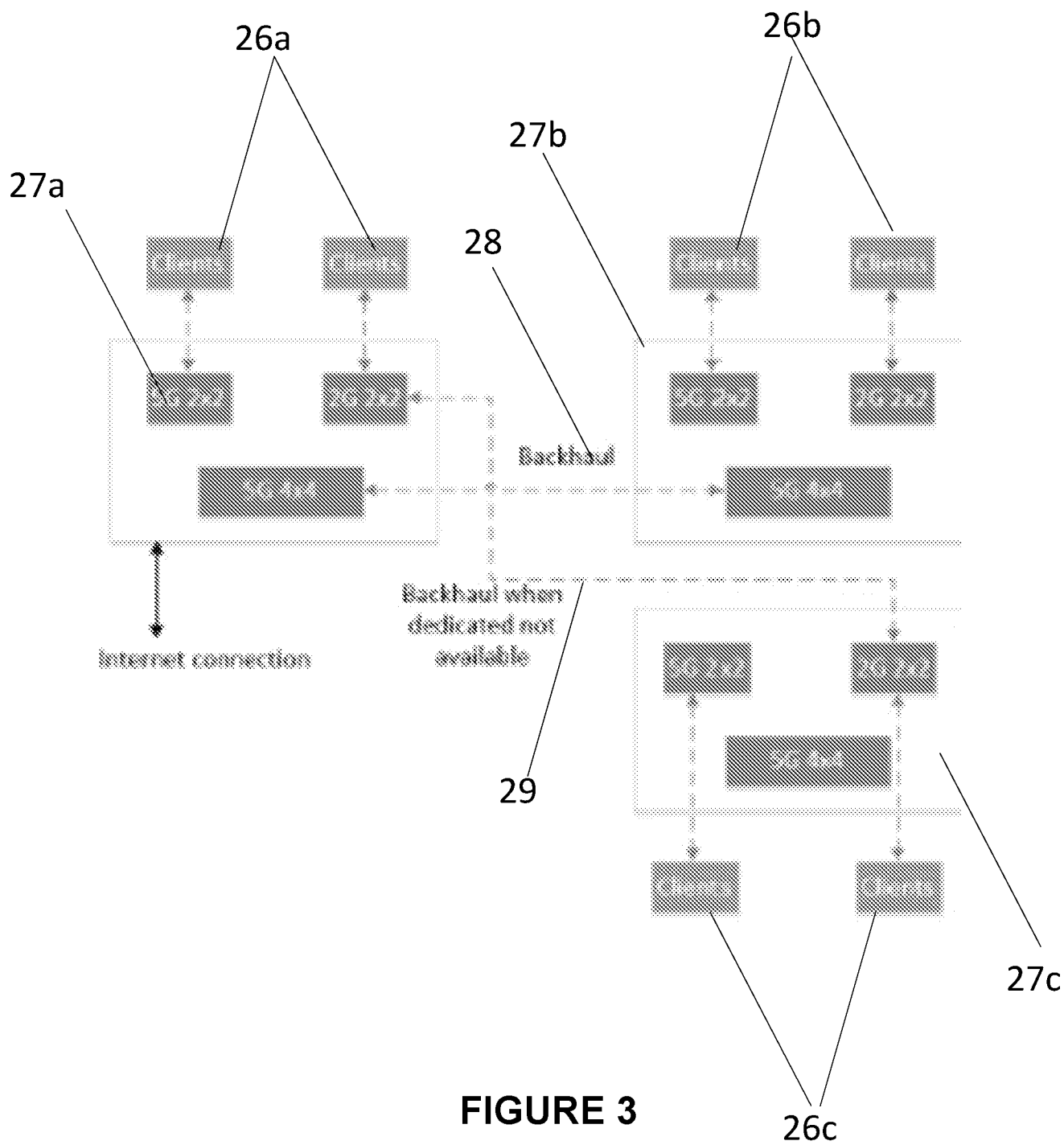


FIGURE 3

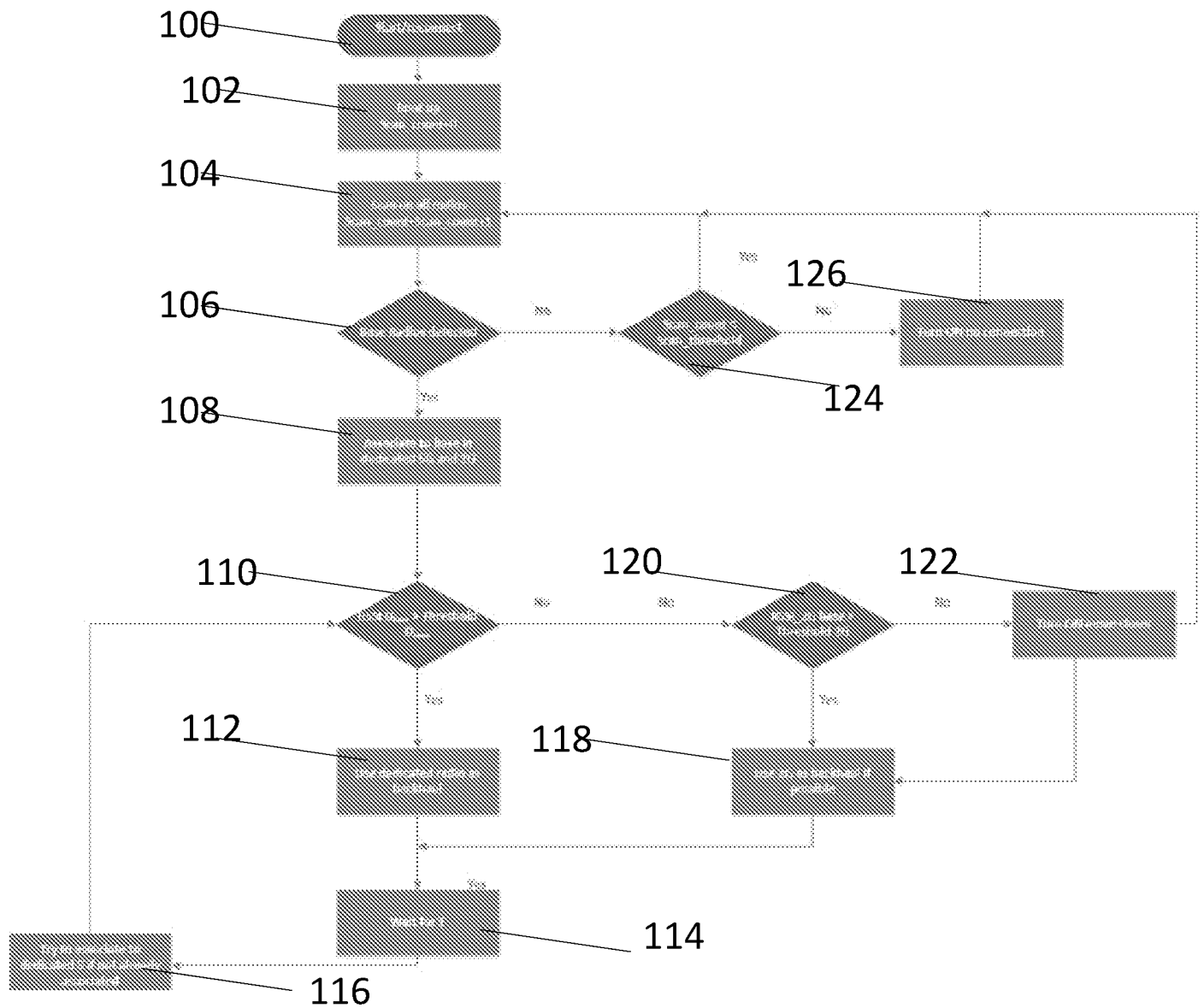


FIGURE 4

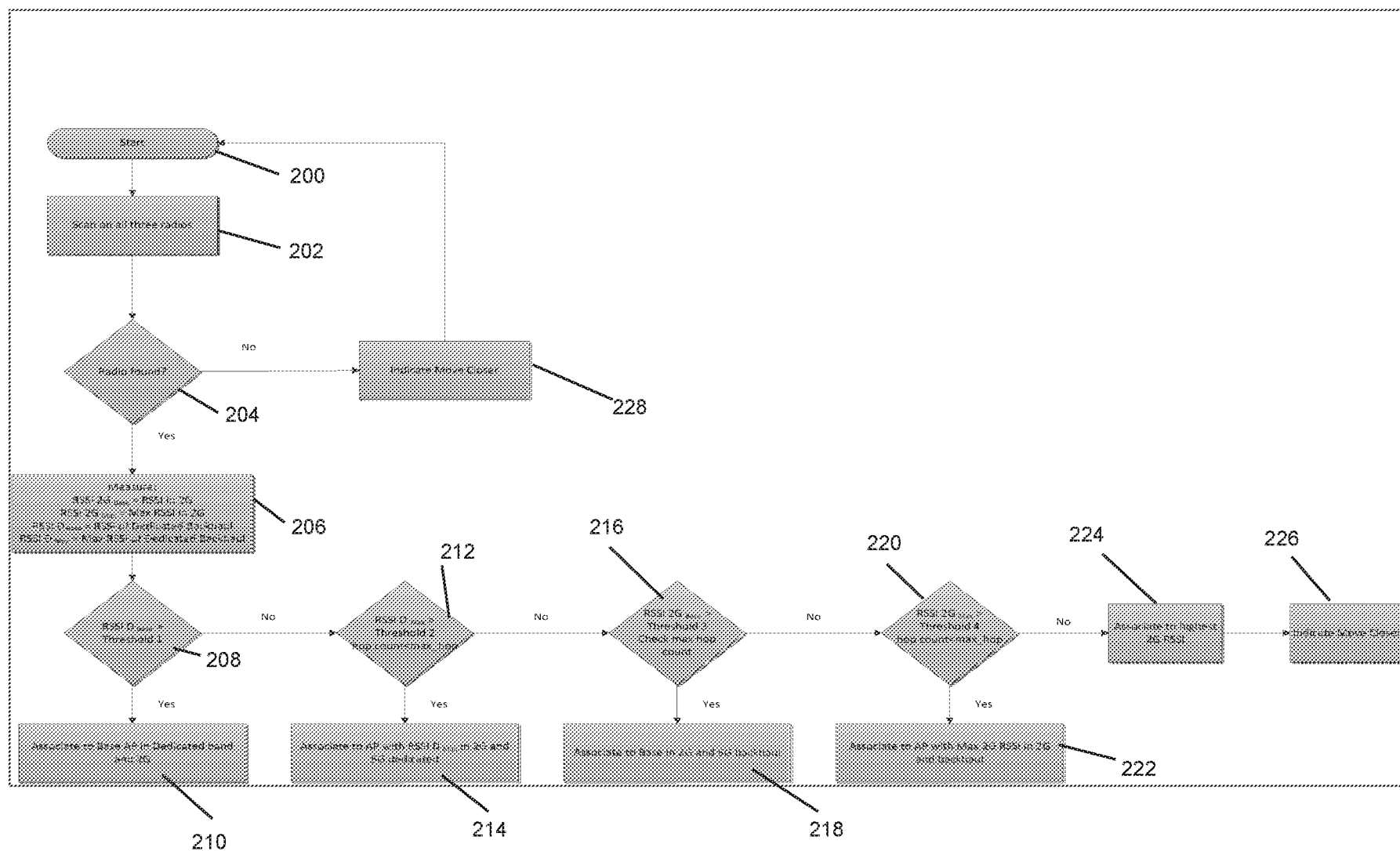


FIGURE 5

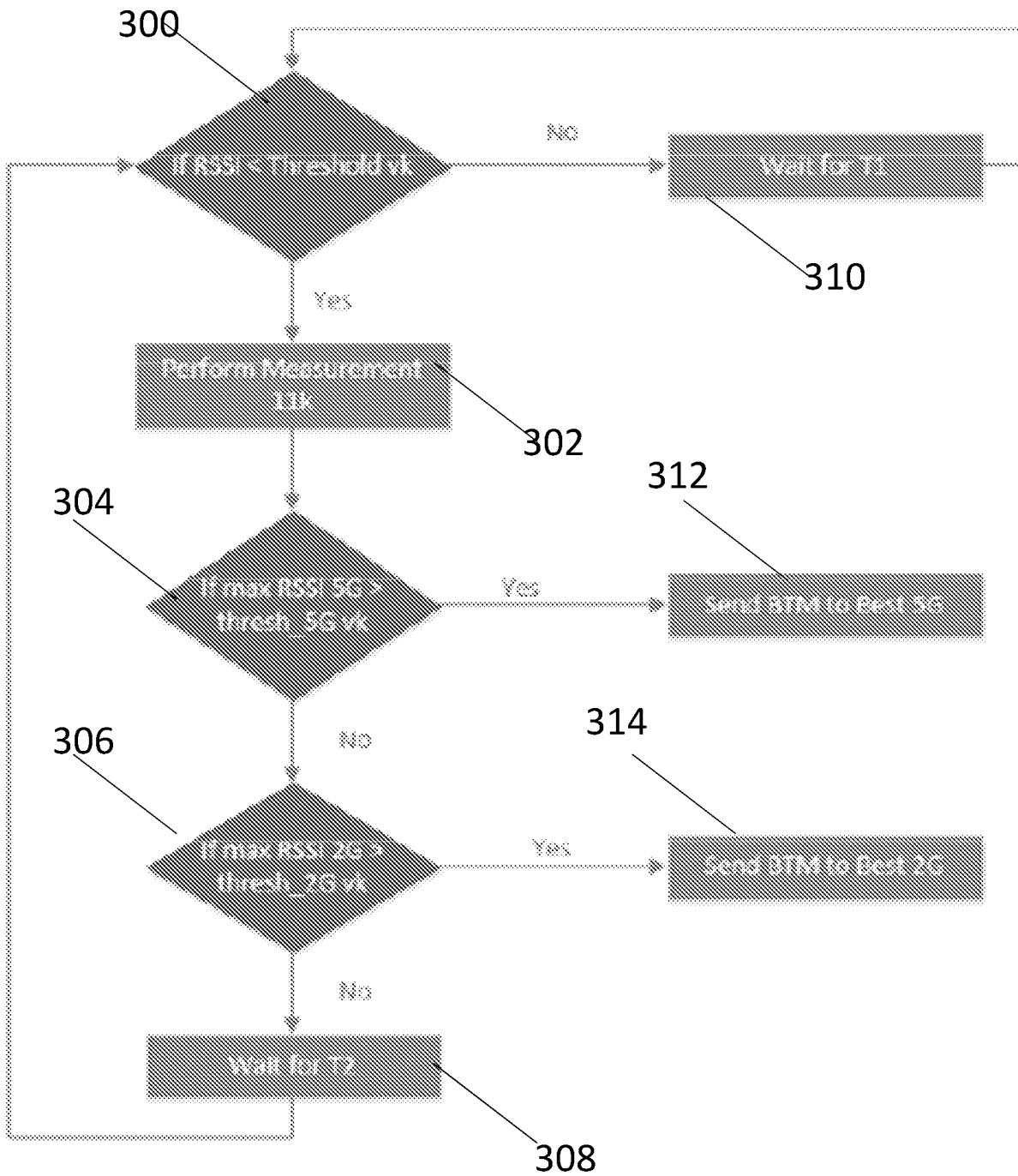


FIGURE 6

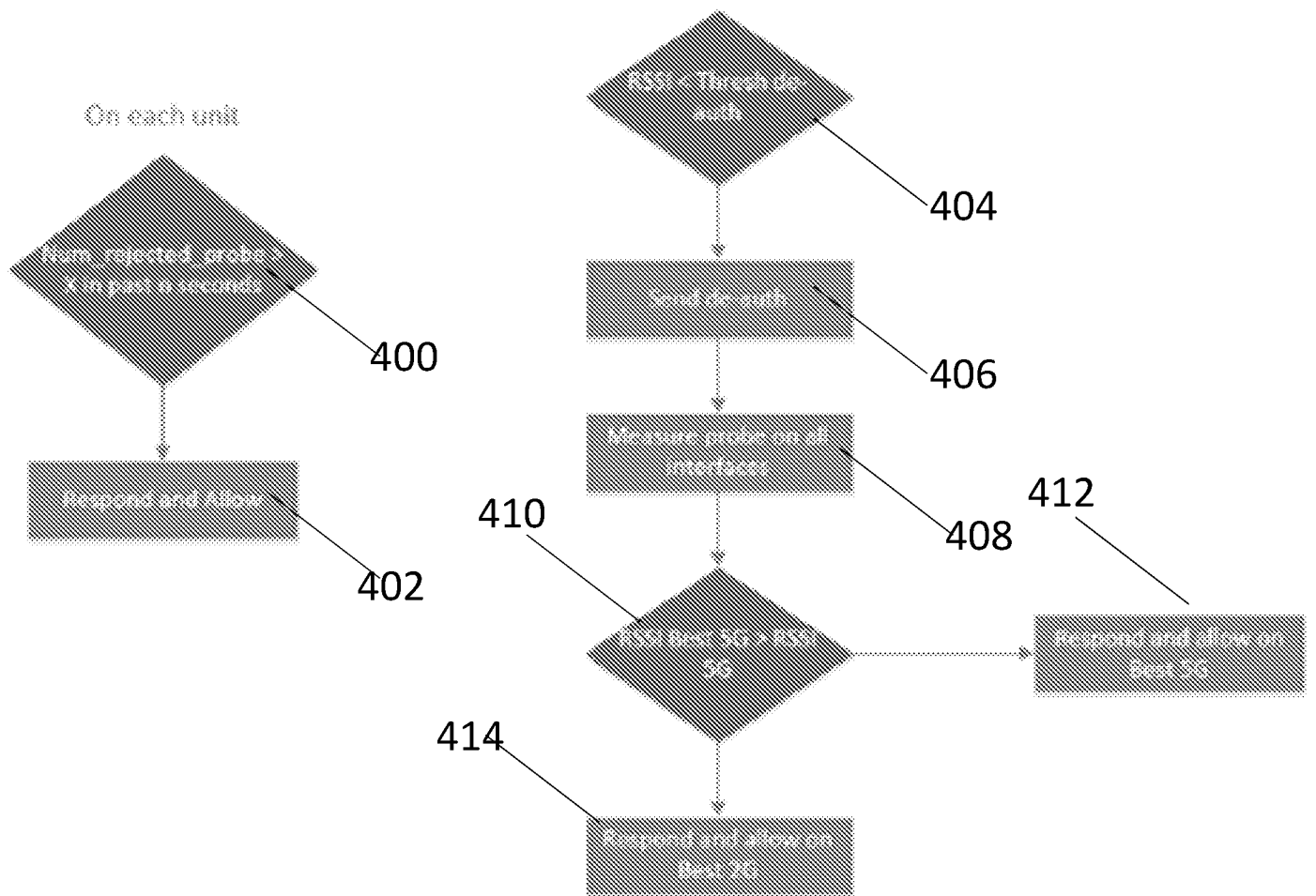


FIGURE 7

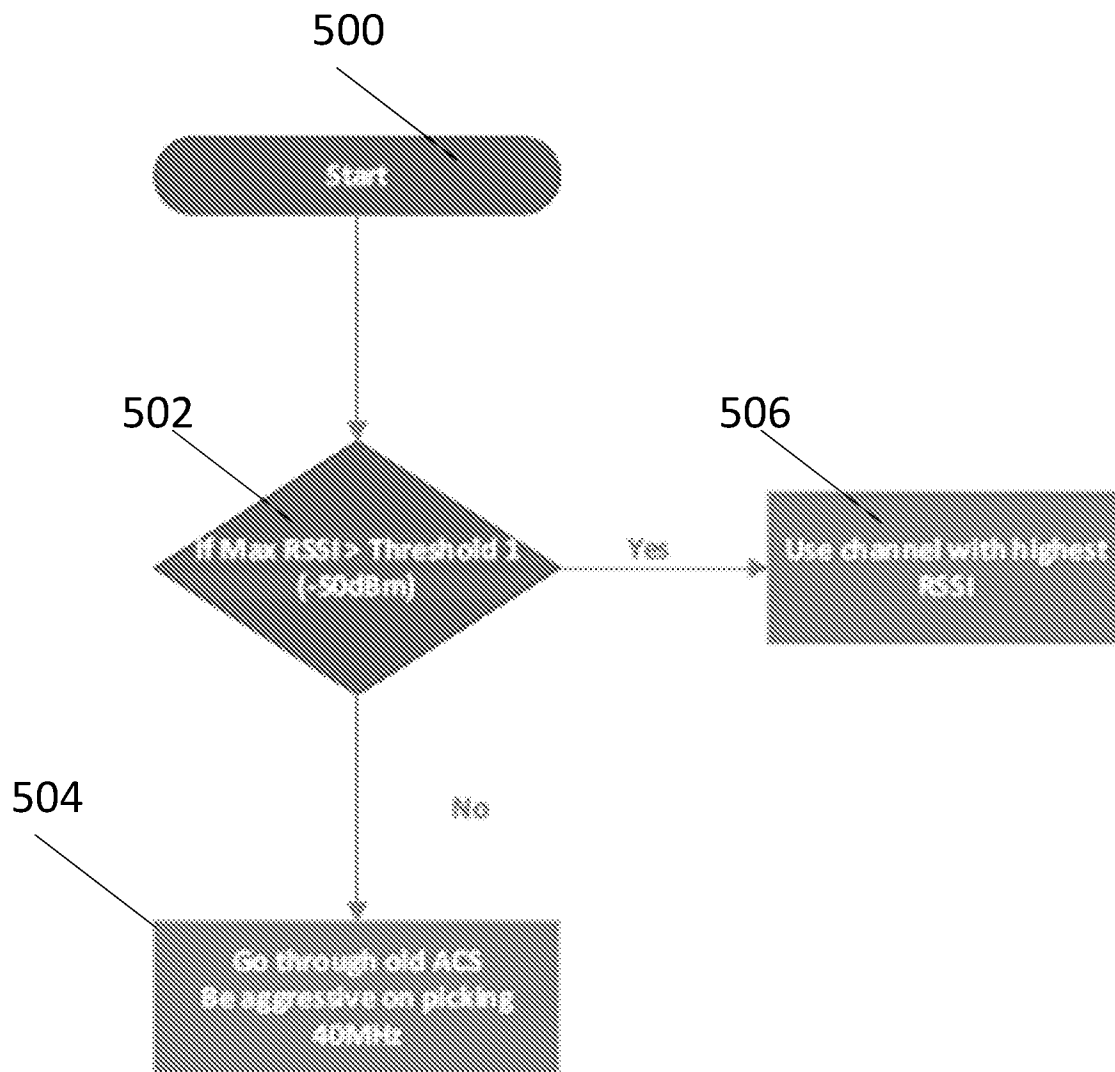


FIGURE 8

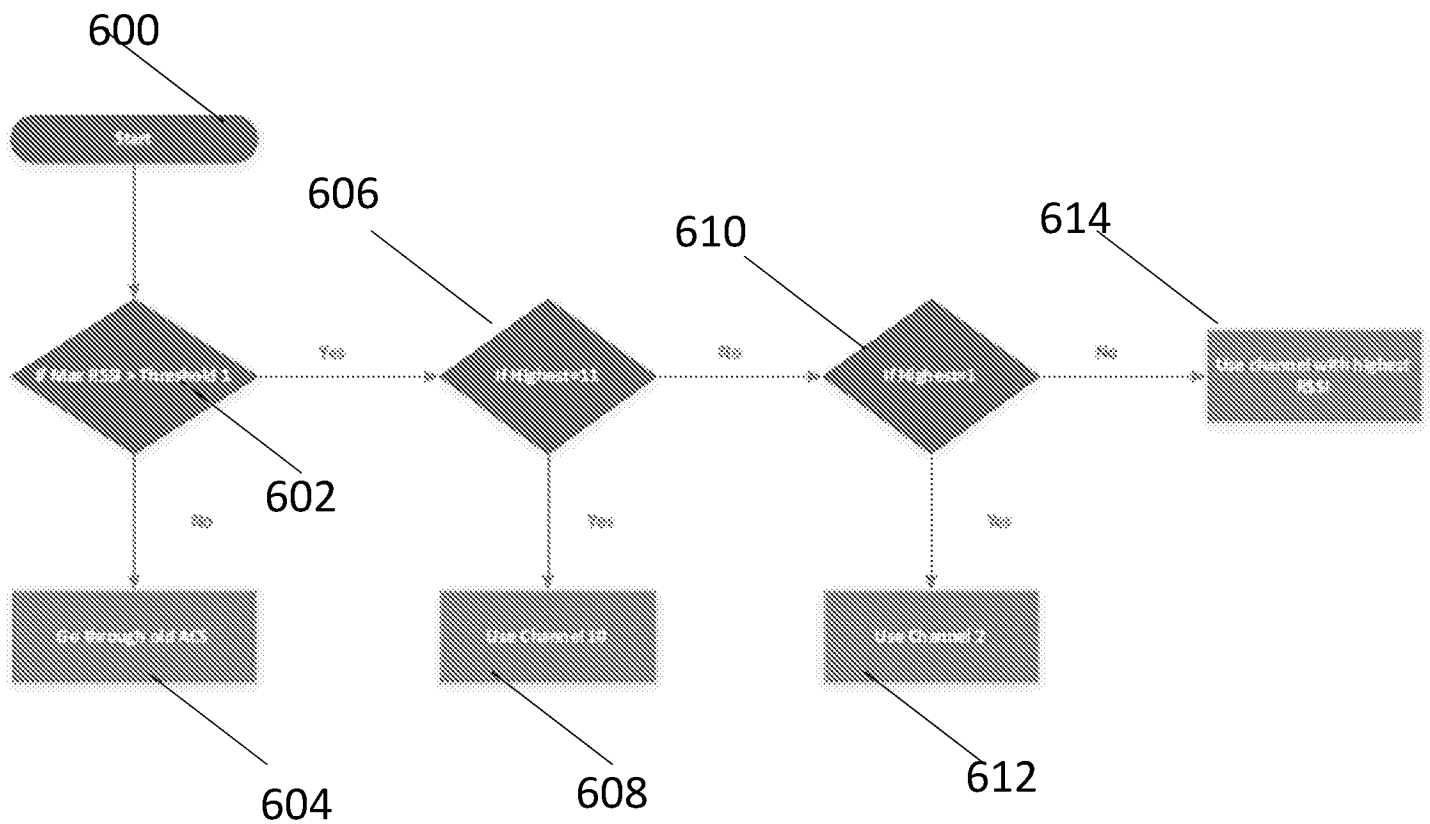


FIGURE 9

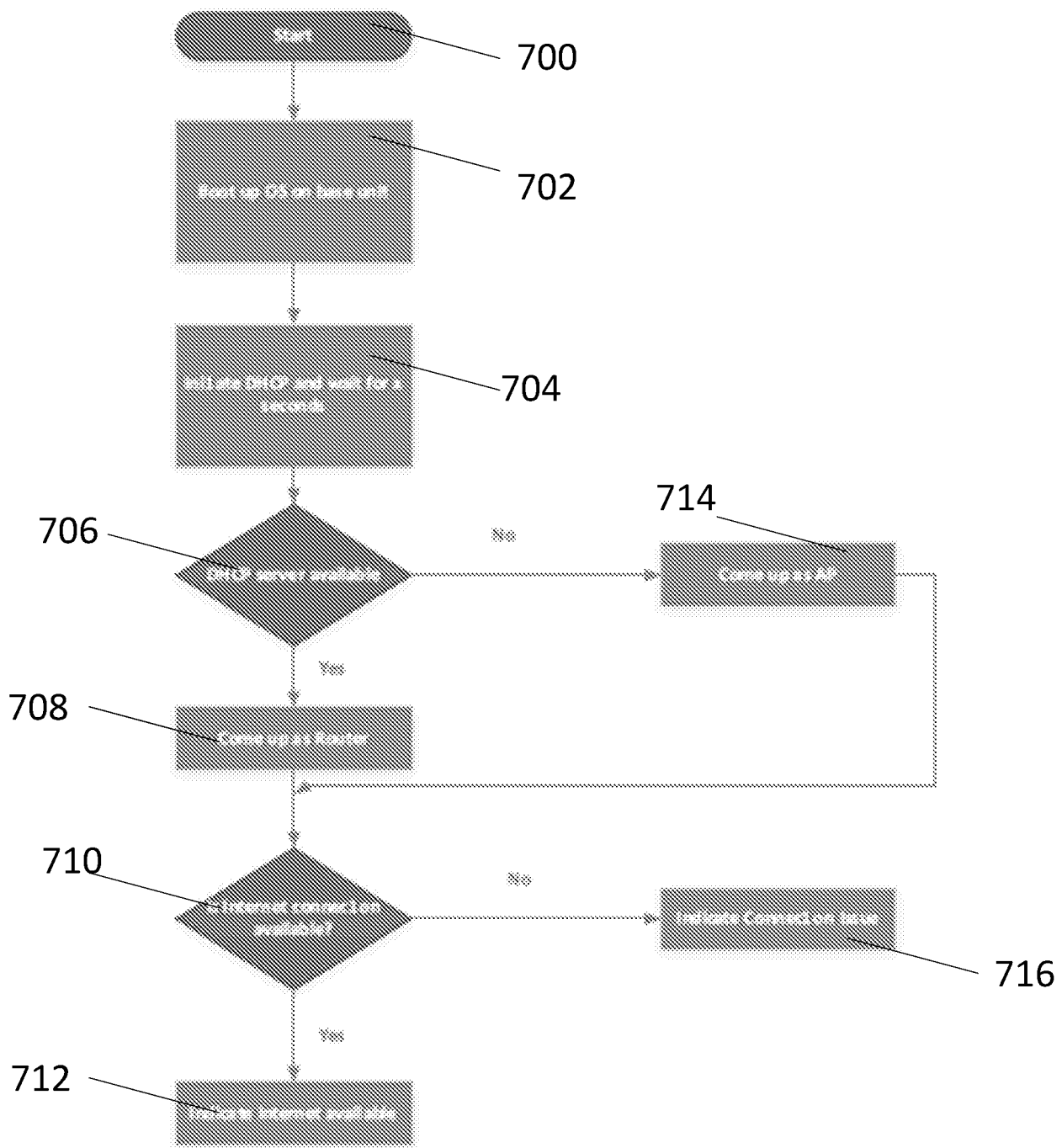


FIGURE 10

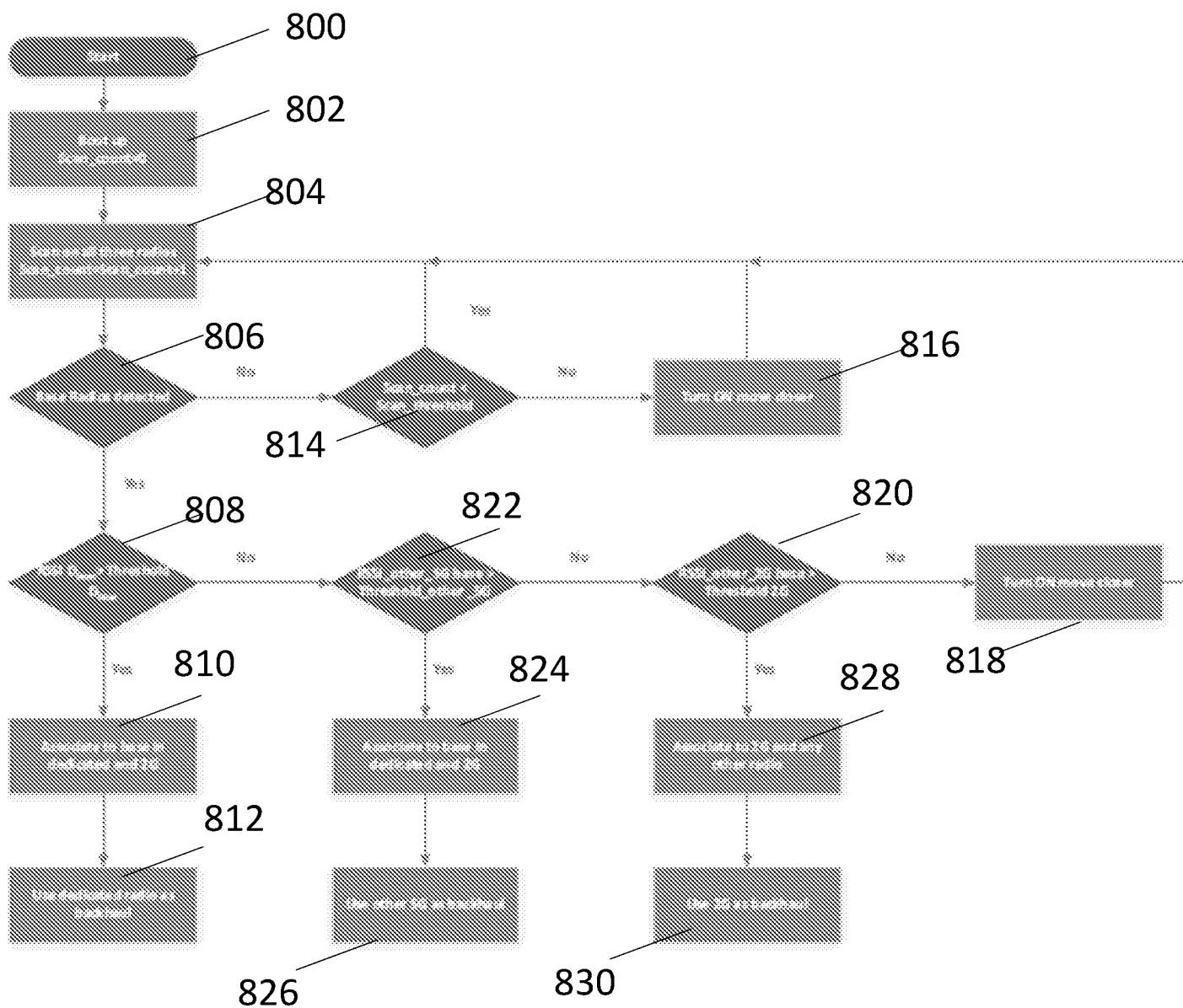


FIGURE 11

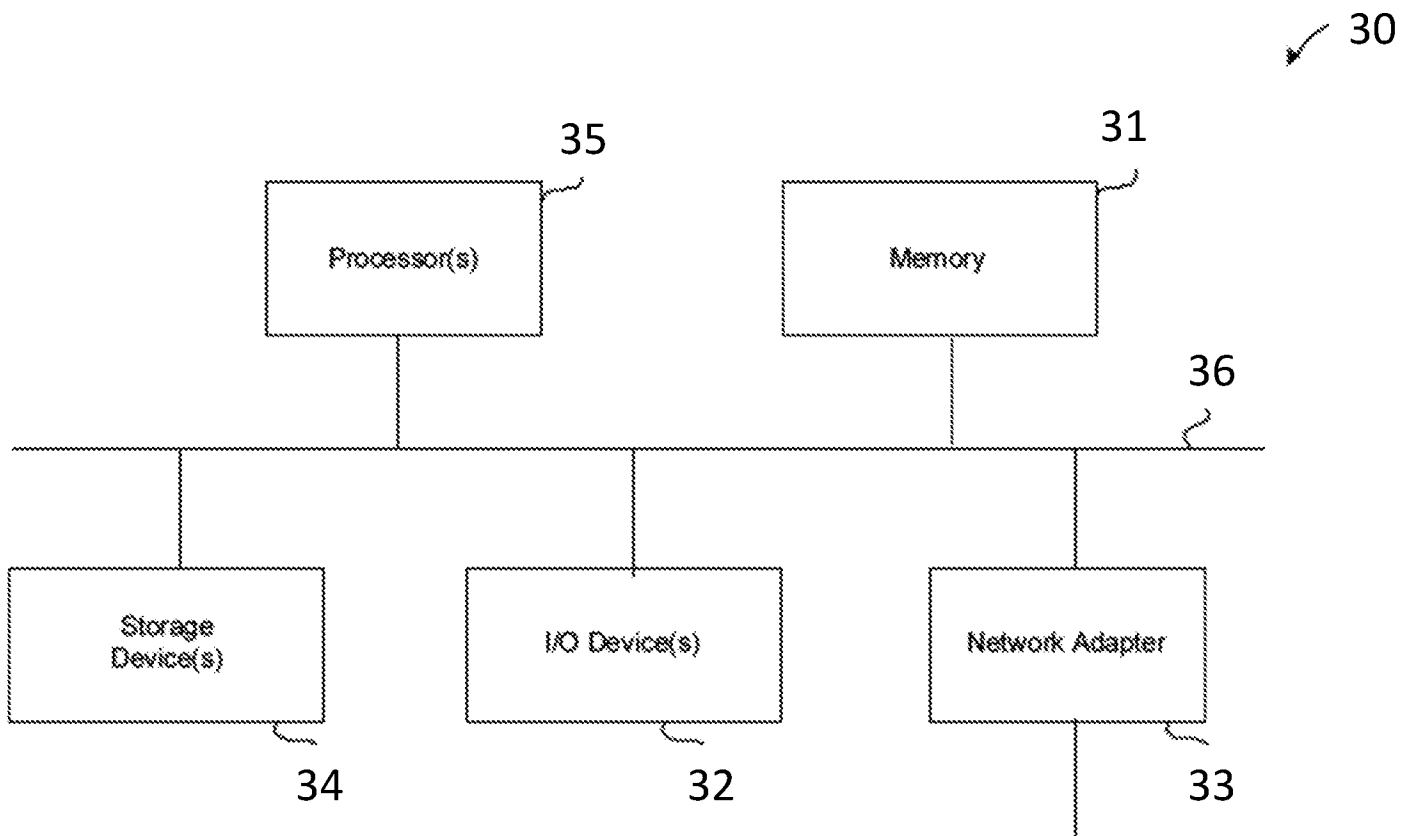


FIGURE 12

**DECLARATION (37 C.F.R. 1.63) FOR UTILITY OR DESIGN PATENT APPLICATION
USING AN APPLICATION DATA SHEET (37 C.F.R. 1.76) AND ASSIGNMENT**

Title of Invention: DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

As a below named inventor, I hereby declare that:

This declaration is directed to the attached application, or (if following box is checked):

☒ United States application or PCT international application number 15/271,912, filed
on September 21, 2016.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the application, including the claims.

I am aware of the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. Section 1.56.

Whereas, the undersigned inventor(s) has/have made certain inventions, improvements, and discoveries (herein referred to as the "Invention") disclosed in the above-identified patent application and further identified by the Attorney Docket Number provided above in the header of this document;

Whereas, **NETGEAR, Inc.**, a corporation duly organized under and pursuant to the laws of the state of California, having its principal place of business at 350 East Plumeria Drive, San Jose, CA 95134, desires to acquire and each undersigned inventor desires to grant to **NETGEAR, Inc.** the entire worldwide right, title, and interest in and to the Invention and in and to any and all patent applications and patents directed thereto;

Now, therefore, for one dollar (\$1.00) and good and valuable consideration, the receipt and sufficiency thereof being hereby acknowledged, each undersigned inventor, hereinafter referred to as **ASSIGNOR**, hereby sells or has sold, assigns or has assigned, and otherwise transfers or has transferred to **NETGEAR, Inc.**, hereinafter referred to as **ASSIGNEE**, its successors, legal representatives, and assigns, the entire worldwide right, title, and interest in and to the Invention, the above-identified United States patent application, and any and all other patent applications and patents for the Invention which may be applied for or granted therefor in the United States and in all foreign countries and jurisdictions, including all divisions, continuations, reissues, reexaminations, renewals, extensions, counterparts, substitutes, and extensions thereof, and all rights of priority resulting from the filing of such applications and granting of such patents. In addition, each undersigned inventor hereby authorizes and requests the Director of the United States Patent and Trademark Office to issue any United States Patent, and foreign patent authorities to issue any foreign patent, granted for the Invention, to the Assignee, its successors, legal representatives, and assigns, the entire worldwide right, title, and interest in and to the same to be held and enjoyed by the Assignee, its successors, legal representatives, and assigns to the full end of the terms for which any and all such patents may be granted, as fully and entirely as would have been held and enjoyed by the undersigned had this Assignment not been made; and each undersigned inventor agrees to execute, without charge to said Assignee but at the Assignee's expense, any and all documents and instruments and perform all lawful acts reasonably related to recording this Assignment or perfecting title to the Invention and all related patents and applications, in Assignee, its successors, legal

representatives, and assigns, whenever requested by the Assignee, its successors, legal representatives, or assigns.

ASSIGNOR(S) grants the attorney of record the power to insert on this Assignment any further identification that may be necessary or desirable in order to comply with the rules of the United States Patent and Trademark Office for recordation of this document.

Each undersigned inventor acknowledges their prior and ongoing obligations to sell, assign, and transfer the rights under this Assignment to the Assignee and is unaware of any reason why they may not have the full and unencumbered right to sell, assign, and transfer the rights hereby sold, assigned, and transferred, and has not executed, and will not execute, any document or instrument in conflict herewith. Each undersigned inventor also hereby grants the assignee, its successors, legal representatives, and assigns, the right to insert in this Assignment any further identification (including, but not limited to, patent Application Number) which may be necessary or desirable for recordation of this Assignment.

This Assignment may be executed in one or more counterparts, each of which shall be deemed an original and all of which may be taken together as one and the same Assignment.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

1) Legal Name of Inventor: Joseph Amalan Arul Emmanuel

Signature: Joseph Amalan Arul Date: 10/10/2016

2) Legal Name of Inventor: Peiman Amini

Signature: [Signature] Date: 10/10/2016

CD Submission Review Results

Internal Worksheet Only - Do Not Scan

Application Number Receipt Date

☒ New Application ☐ Response To Notice Date Of Response

☐ Jumbo – Large tables are included on the CD

☒ **There are no problems with the CDs in the submission.**

Items checked below are to be selected in the PALM Pre-Exam CD problem list.

Omitted Items

☐	Files on compact disc are unreadable:
☐	Disc(s) of either set not readable:
☐	Disc(s) do not contain file names listed:
☐	Amended CD missing unamended files
☐	Missing compact discs

Missing Parts

☐	Disc(s) do not contain file names listed
☐	Discs contains files that are non-ASCII files:
☐	Only one copy of the CD, no duplicate:
☐	Wrong media type, e.g., CD-RW:
☐	The transmittal letter and specification do not list information:
☐	Both disc(s) contain unreadable files:
☐	One disc(s) contain unreadable files:
☐	Compact disc(s) contain viruses, but are still readable:
☐	EFS/Paper Submission:
☐	Table does not maintain data in proper alignment:
☐	Not proper subject matter for CD's:

Informality

☐	No statement in transmittal letter that CD's are the same:
☐	No incorporation by reference statement for the CD's:
☐	CD's not labeled "Copy 1" and "Copy 2":
☐	Deficient CD packaging:
☐	Deficient Labeling on CD's:
☐	The transmittal letter does not list information:
☐	The specification does not list information:
☐	Table less than 51 pages submitted on CD:

File Directory Attachment

☐	Copy of file directory listing is attached and should be mailed to applicant
☐	Copy of file directory listing is not attached
☐	Copy of file directory listing is not attached because it is over one page long

Additional Comments

Internal Worksheet Only - Do Not Scan

SCORE Placeholder Sheet for IFW Content

Application Number: 15940890

Document Date: 03/29/2018

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via eDAN using the Supplemental Content tab, or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/940,890	03/29/2018		1720	110729-8058.US02	22	2

CONFIRMATION NO. 8990

22918
PERKINS COIE LLP - PAO General
P.O. BOX 1247
SEATTLE, WA 98111-1247

FILING RECEIPT



Date Mailed: 04/26/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Joseph Amalan Arul EMMANUEL, Cupertino, CA;
Peiman AMINI, Mountain View, CA;

Applicant(s)

NETGEAR, INC., San Jose, CA

Power of Attorney: The patent practitioners associated with Customer Number 22918

Domestic Priority data as claimed by applicant

This application is a CON of 15/271,912 09/21/2016 PAT 9967884
which claims benefit of 62/336,503 05/13/2016
and claims benefit of 62/253,540 11/10/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 04/24/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/940,890**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No

Title

DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/940,890	03/29/2018	Joseph Amalan Arul EMMANUEL	110729-8058.US02

22918
PERKINS COIE LLP - PAO General
P.O. BOX 1247
SEATTLE, WA 98111-1247

CONFIRMATION NO. 8990
FORMALITIES LETTER



OC000000099016836

Date Mailed: 04/26/2018

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
 - The drawings submitted to the Office are not electronically reproducible because portions of figures 2, 3, and 5 are missing and/or blurry.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

- Additional claim fees of \$ **200** as an undiscounted entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- \$ **200** for **2** total claims over 20.
- \$(**0**) previous unapplied payment amount.
- \$ **200** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice".
<https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html>

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at <http://www.uspto.gov/ebc>.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/elbanaybanay/

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/940,890				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760			
TOTAL CLAIMS (37 CFR 1.16(j))	22	minus 20 = *				x 100 =	200			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *				x 460 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	1920			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										

To: patentprocurement@perkinscoie.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 22918

Apr 26, 2018 03:38:44 AM

Dear PAIR Customer:

PERKINS COIE LLP - PAO General
P.O. BOX 1247
SEATTLE, WA 98111-1247
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 22918 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:

The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
15940890	APP.FILE.REC	04/26/2018	110729-8058.US02
	NT.CR.APP.PA	04/26/2018	110729-8058.US02

To view your correspondence online or update your email addresses, please visit us anytime at <https://portal.uspto.gov/secure/myportal/privatepair>.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Joseph Amalan Arul EMMANUEL et al.

Customer No.: 22918

Application No.: 15/940,890

Confirmation No.: 8990

Filed: March 29, 2018

Art Unit: unassigned

For: DEDICATED BACKHAUL FOR WHOLE HOME
COVERAGE

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

MAIL STOP MISSING PARTS

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

This is in response to the Notice to File Corrected Application Papers dated April 26, 2018. Applicant submits herewith \$200 for two excess claims over 20.

In the Drawings begins on page 2.

DRAWINGS

Submitted herewith are Formal Drawings of Figures 2, 3 and 5 (4 sheets), each labeled as "Replacement Sheet" for the above-identified patent application.

CONCLUSION

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 50-0665, under Order No. 110729-8058.US02 from which the undersigned is authorized to draw.

Dated: 6/22/2018

Respectfully submitted,

By /Han-Wei Chen/
Han-Wei Chen
Registration No.: 75,350
PERKINS COIE LLP
P.O. Box 1247
Seattle, WA 98111-1247
Phone: (650) 838-4303
Fax: (206) 359-7198
Attorney for Applicant

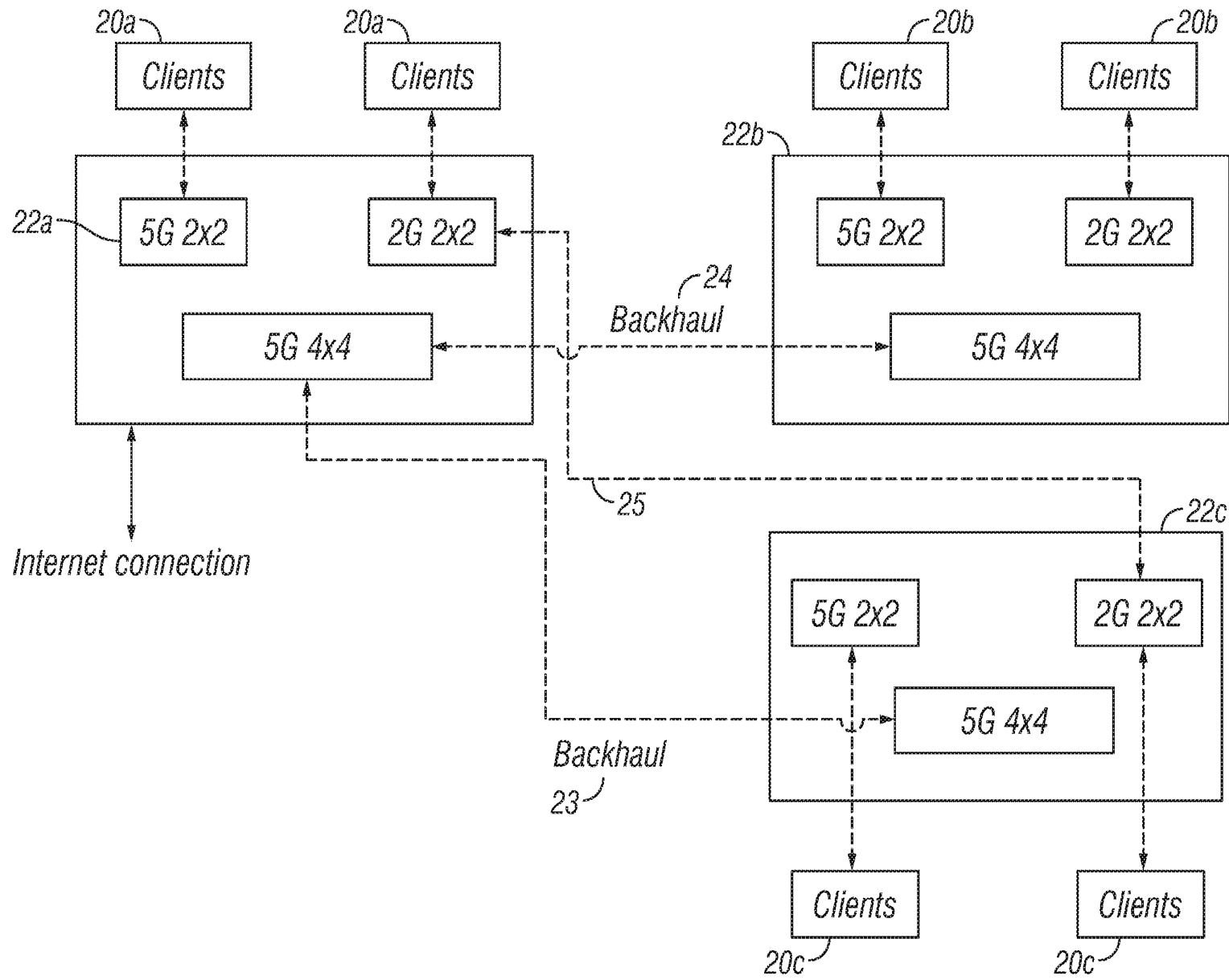


FIG. 2

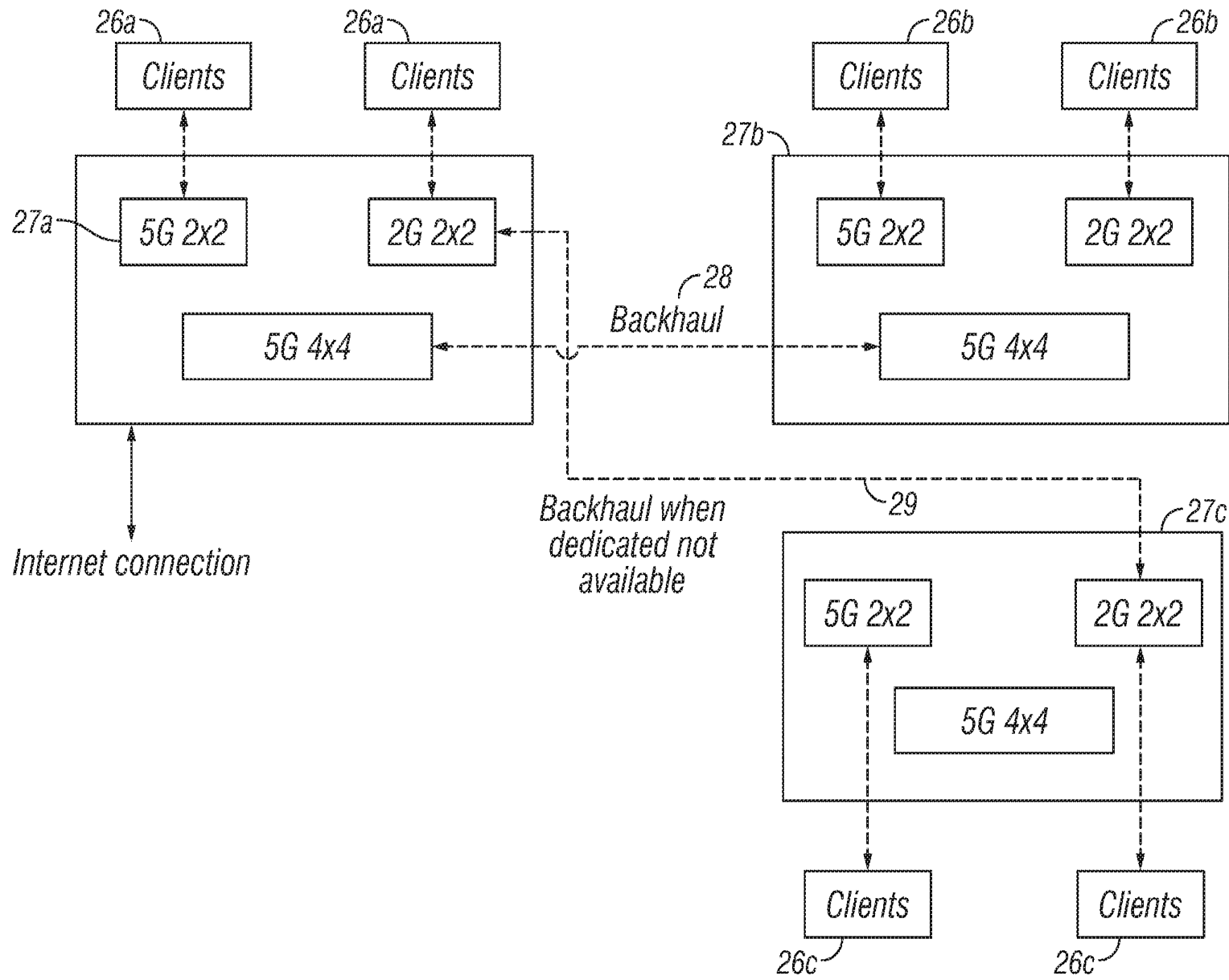


FIG. 3

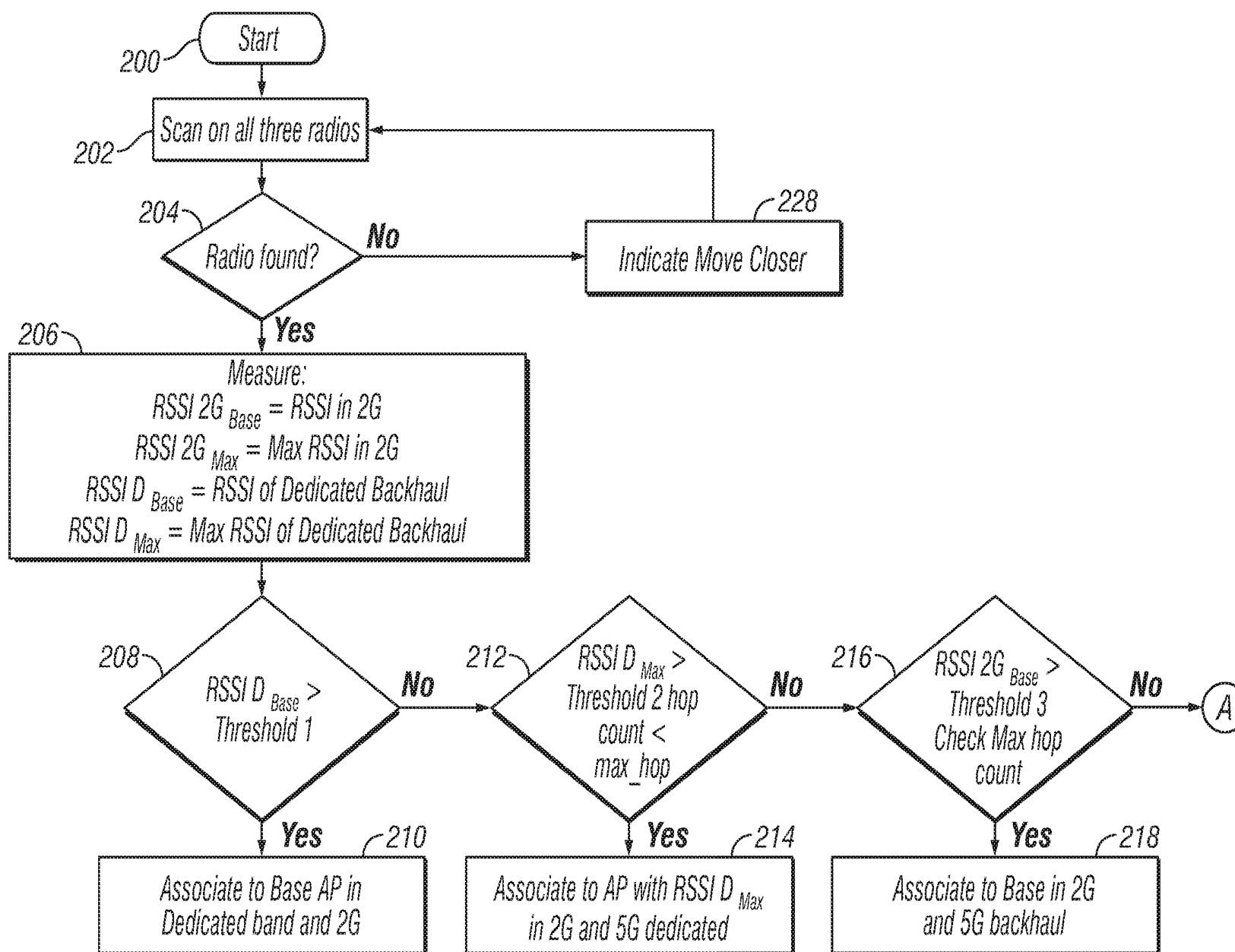


FIG. 5

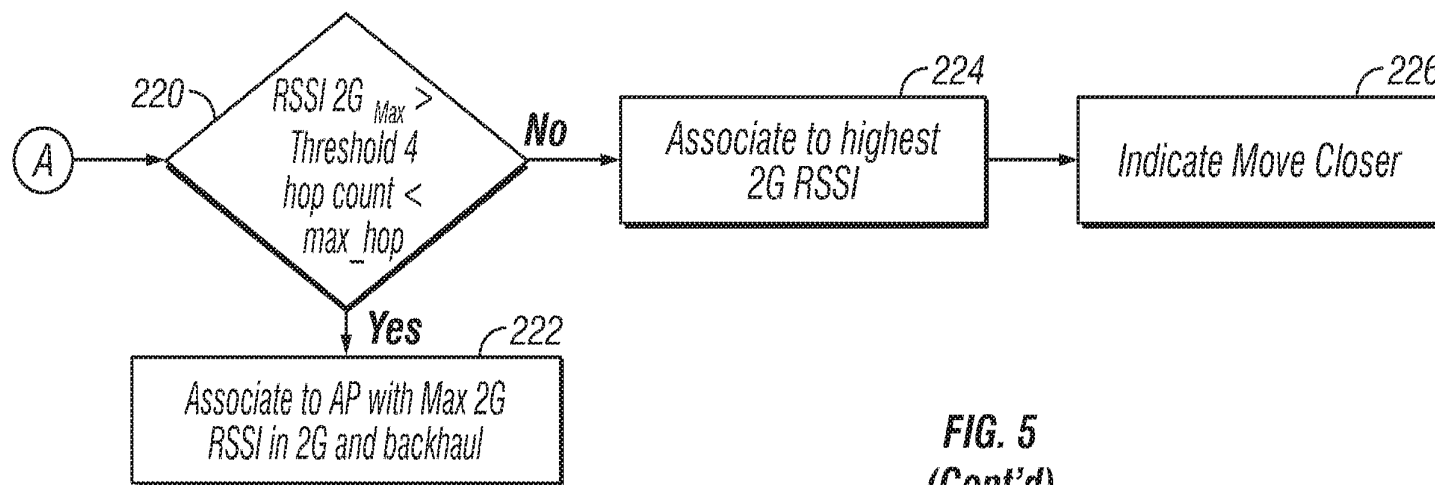


FIG. 5
(Cont'd)

Electronic Patent Application Fee Transmittal

Application Number:	15940890			
Filing Date:	29-Mar-2018			
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE			
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL			
Filer:	Han-Wei Chen/Christine Ortt			
Attorney Docket Number:	110729-8058.US02			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	2	100	200
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				200

Electronic Acknowledgement Receipt

EFS ID:	32997545
Application Number:	15940890
International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Ortt
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	25-JUN-2018
Filing Date:	29-MAR-2018
Time Stamp:	17:57:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$200
RAM confirmation Number	062618INTEFSW17581800
Deposit Account	500665
Authorized User	Christine Ortt

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:
37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2018-06-25_Response_110729-8058US02.pdf	95882	yes	3
			9f0e912d8be7f22f69ecfd53a0d093a6620f5c1a		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Applicant Response to Pre-Exam Formalities Notice		1	1	
	Drawings-only black and white line drawings		2	2	
	Applicant Arguments/Remarks Made in an Amendment		3	3	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	110729-8058US02_Replacement_Drawings.pdf	737067	no	4
			3fa153fabb7f90206da8d680022dd62cba80acc4		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30490	no	2
			e490e3e9f3c0267248082d1759ddacadbf686eb9		
Warnings:					
Information:					
Total Files Size (in bytes):			863439		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/940,890	03/29/2018		1920	110729-8058.US02	22	2

CONFIRMATION NO. 8990

UPDATED FILING RECEIPT

22918
PERKINS COIE LLP - PAO General
P.O. BOX 1247
SEATTLE, WA 98111-1247



Date Mailed: 06/29/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Joseph Amalan Arul EMMANUEL, Cupertino, CA;
Peiman AMINI, Mountain View, CA;

Applicant(s)

NETGEAR, INC., San Jose, CA

Power of Attorney: The patent practitioners associated with Customer Number 22918

Domestic Priority data as claimed by applicant

This application is a CON of 15/271,912 09/21/2016 PAT 9967884
which claims benefit of 62/336,503 05/13/2016
and claims benefit of 62/253,540 11/10/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 04/24/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/940,890**

Projected Publication Date: 10/04/2018

Non-Publication Request: No

Early Publication Request: No

Title

DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

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Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/940,890			
APPLICATION AS FILED - PART I									
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300		
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660		
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760		
TOTAL CLAIMS (37 CFR 1.16(j))	22	minus 20 = *			OR	x 100 =	200		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *				x 460 =	0.00		
APPLICATION SIZE FEE (37 CFR 1.16(s)) If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).							0.00		
							0.00		
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00		
			TOTAL			TOTAL	1920		
* If the difference in column 1 is less than zero, enter "0" in column 2.									
APPLICATION AS AMENDED - PART II									
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY	
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)	RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x
	Application Size Fee (37 CFR 1.16(s))							OR	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)	RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x
	Application Size Fee (37 CFR 1.16(s))							OR	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.									

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From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
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Jun 29, 2018 04:04:54 AM

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PERKINS COIE LLP - PAO General
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SEATTLE, WA 98111-1247
UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
15940890	APP.FILE.REC	06/29/2018	110729-8058.US02

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Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	15940890
	Filing Date	2018-03-29
	First Named Inventor	Joseph Amalan Arul Emmanuel
	Art Unit	2466
	Examiner Name	Faruk Hamza
	Attorney Docket Number	110729-8058.US02

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9001767	B1	2015-04-07	GATEWOOD, et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080080414	A1	2008-04-03	THUBERT, et al.	
	2	20100260146	A1	2010-10-14	LU	
	3	20160212755	A1	2016-07-21	CAO, et al.	

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	1							

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
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EXAMINER SIGNATURE

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2018-07-30
Name/Print	Han-Wei Chen	Registration Number	75350

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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Electronic Acknowledgement Receipt

EFS ID:	33324186
Application Number:	15940890
International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Ortt
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	30-JUL-2018
Filing Date:	29-MAR-2018
Time Stamp:	20:09:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2018-07-30_IDS_110729-8058US02.pdf	1038598 21f76f80411831f8a822906126e2eef3195fd35c	no	4

Warnings:

TP Link Ex. 1004

Page 102

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15940890
	Filing Date		2018-03-29
	First Named Inventor	Joseph Amalan Arul Emmanuel	
	Art Unit	2466	
	Examiner Name	Faruk Hamza	
	Attorney Docket Number	110729-8058.US02	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7155167	B1	2006-12-26	CARTY	
	2	7502354	B1	2009-03-10	MAUFER	
	3	7567822	B2	2009-07-28	HART, et al.	
	4	8248948	B2	2012-08-21	WEIL, et al.	
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	1	20020042274	A1	2002-04-11	ADES	
	2	20050048963	A1	2005-03-03	KUBLER, et al.	

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3	20070206528	A1	2007-09-06	WALTON, et al.	
4	20070280453	A1	2007-12-06	KELLEY, et al.	
5	20080247317	A1	2008-10-09	WEIL, et al.	
6	20090067369	A1	2009-03-12	STAMOULIS, et al.	
7	20090135738	A1	2009-05-28	MHATRE, et al.	
8	20090135794	A1	2009-05-28	SU, et al.	
9	20090221238	A1	2009-09-03	KO, et al.	
10	20100157888	A1	2010-06-24	AGGARWAL, et al.	
11	20100231473	A1	2010-09-16	SHTROM, et al.	
12	20100246416	A1	2010-09-30	SINHA, et al.	
13	20100291931	A1	2010-11-18	SUEMITSU, et al.	

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14	20110250926	A1	2011-10-13	WIETFELDT, et al.
15	20110299422	A1	2011-12-08	KIM, et al.
16	20120129517	A1	2012-05-24	FOX, et al.
17	20120224484	A1	2012-09-06	BABIARZ, et al.
18	20120225646	A1	2012-09-06	MOCHIDA, et al.
19	20140254400	A1	2014-09-11	ZHOU, et al.
20	20150092681	A1	2015-04-02	FERNANDO, et al.
21	20150103685	A1	2015-04-16	BUTCHKO, et al.
22	20150215791	A1	2015-07-30	GELLER, et al.
23	20160029384	A1	2016-01-28	SIDHU, et al.
24	20160066249	A1	2016-03-03	DUKES, et al.

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25	20160094946	A1	2016-03-31	KEITHLEY
26	20160227544	A1	2016-08-04	KATAR, et al.
27	20160269097	A1	2016-09-15	ISLAM, et al.
28	20160308755	A1	2016-10-20	GARG
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Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2018-09-28
Name/Print	Han-Wei Chen	Registration Number	75350

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Electronic Acknowledgement Receipt

EFS ID:	33871234
Application Number:	15940890
International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Ortt
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	28-SEP-2018
Filing Date:	29-MAR-2018
Time Stamp:	19:42:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2018-09-28_IDS_110729-8058US02.pdf	1039589 3b8c812933a673717fd16c9211874c3ab9aeb670	no	7

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/940,890	03/29/2018	Joseph Amalan Arul EMMANUEL	110729-8058.US02

CONFIRMATION NO. 8990

PUBLICATION NOTICE



OC000000102835071

22918
PERKINS COIE LLP - PAO General
P.O. BOX 1247
SEATTLE, WA 98111-1247

Title:DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

Publication No.US-2018-0288768-A1

Publication Date:10/04/2018

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	Filing Date	2018-03-29
	First Named Inventor	Joseph Amalan Arul Emmanuel
	Art Unit	2466
	Examiner Name	Faruk Hamza
	Attorney Docket Number	110729-8058.US02

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	1	20090116407	A1	2009-05-07	SHII	
	2	20120224481	A1	2012-09-06	BABIARZ, et al.	
	3	20150018028	A1	2015-01-15	UPLENCHWAR, et al.	
	4	20160192203	A1	2016-06-30	GOKTURK, et al.	

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Attorney Docket Number	110729-8058.US02

5	20170164323	A1	2017-06-08	MARKHOVSKY, et al.
6	20170238189	A1	2017-08-17	NOLAN, et al.

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Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2019-01-04
Name/Print	Han-Wei Chen	Registration Number	75350

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	34777026
Application Number:	15940890
International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Ortt
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	07-JAN-2019
Filing Date:	29-MAR-2018
Time Stamp:	13:28:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2019-01-07_IDS_110729-8058US02.PDF	1038785 9d9c4de8b12d78e8b1bcf047516e8f7d43ed892f	no	4

Warnings:

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Page 119

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Total Files Size (in bytes):	1038785
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/940,890	03/29/2018	Joseph Amalan Arul EMMANUEL	110729-8058.US02	8990
22918	7590	04/29/2019		
PERKINS COIE LLP - PAO General			EXAMINER	
P.O. BOX 1247			PATEL, JAY P	
SEATTLE, WA 98111-1247				
			ART UNIT	PAPER NUMBER
			2466	
			NOTIFICATION DATE	DELIVERY MODE
			04/29/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentprocurement@perkinscoie.com

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):

(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph: The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-22 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

With regards to the independent claims 1 and 12, in the “upon detecting...” limitation, the utilizing of the channel and the frequency band is presented as an “and” and “or”. It is unclear whether the applicant desires coverage for the two utilizations in the alternative or coverage for the two utilizations together.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

Claim(s) 1-4, 10-15 and 21-22 are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Mallik et al. (US Publication 2013/0194948 A1).

1. In regards to claims 1 and 12, Mallik et al. (US Publication 2013/0194948 A1) teaches in figure 6, A computer-implemented method for establishing a backhaul communication among nodes in a mesh wireless network (see figure 6), the method comprising: performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network (see figure 6, by definition, the backhaul provides the functions outlined in this present limitation of the claims); and upon detecting that a received signal strength of the first channel from the second node is below a threshold (see steps 610, 620, 622 in figure 6), performing an attempt to utilize a different channel in the default frequency band (see figure 6, step 622) and/or a channel in a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node (see figure 6, step 622, since figure 6 performs a backhaul based method, a handover of step 622 means a handover for the backhaul communications), wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength (see paragraph 8, ranks of cells and links are based on received signal strength).

2. In regards to the claims 2-3 and 13-14 Mallik teaches, wherein said attempts are performed on a first radio, the method further comprising: upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio where the different radio is same as the front haul (see the handover in step 622 in figure 2 and the direct link 112 in figure 1).
3. In regards to claims 4 and 15, Mallik teaches, measuring received signal strengths of probes from all nodes within a communication range and selecting the second node based on the measured received signal strengths of the probes (see step 610 in figure 6, the yes or no step after step 610 if based on what the signal strength).
4. In regards to claims 10-11 and 21-22, Mallik teaches, receiving, via the backhaul, a configuration from the second node (see paragraph 45, 67) and causing the configuration from the second node to be pushed through the backhaul to a target node, wherein said causing is triggered by an initiation from a user (see paragraph 45; the mapping conveyed to the UE for the backhaul geometry).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5 and 16 are rejected under 35 U.S.C. 103 as being unpatentable over Mallik et al. (US Publication 2013/0194948 A1) further in view of Ho et al. (US Publication 2015/0049616 a1).

In regards to claims 5 and 16, Mallik teaches all the limitations of the parent claims as stated above.

However, Mallik fails to teach utilizing a spanning tree based protocol to avoid loops in said attempts.

Ho however teaches, utilizing a spanning tree based protocol to avoid loops in said attempts (see paragraph 17).

Therefore, it would have been obvious for one of ordinary skill in the art before the effective filing date of the present application to incorporate the use of spanning tree algorithm as taught by Ho into the teachings of Mallik. The motivation to do so would be to prevent network failure by avoiding loops.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY P PATEL whose telephone number is (571)272-3086. The examiner can normally be reached on M-F 9:30-6.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Faruk Hamza can be reached on 571-272-7969. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JAY P PATEL/
Primary Examiner, Art Unit 2466

Notice of References Cited	Application/Control No. 15/940,890		Applicant(s)/Patent Under Reexamination EMMANUEL et al.	
	Examiner JAY P PATEL		Art Unit 2466	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Code-Number-Kind Code	Country	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20150201334-A1		07-2015	Li; Bingzhao	H04W12/08	726/3
*	B	US-20160127969-A1		05-2016	Pao; Wei-Chen	H04W48/20	455/437
*	C	US-20160337960-A1		11-2016	NAGASAKA; Yushi	H04W48/18	1/1
*	D	US-20170127306-A1		05-2017	Tan Bergstrom; Mattias	H04W24/10	1/1
*	E	US-20170070919-A1		03-2017	VERGER; Luciano M.	H04L65/1083	1/1
*	F	US-20150334612-A1		11-2015	Ray Chaudhuri; Kausik	H04W36/0094	455/437
*	G	US-20140064133-A1		03-2014	Kazmi; Muhammad	H04W24/10	370/252
*	H	US-20130331115-A1		12-2013	Falconetti; Laetitia	H04L5/0053	455/452.2
*	I	US-20130260777-A1		10-2013	GORMLEY; Eamonn	H04W72/0473	455/452.1
*	J	US-20130194948-A1		08-2013	MALLIK; Siddhartha	H04W24/00	370/252
*	K	US-20090003279-A1		01-2009	Abusch-Magder; David	H04W36/00835	370/331
*	L	US-20160302096-A1		10-2016	Chari; Amalavoyal	H04W40/12	1/1
*	M	US-20150195033-A1		07-2015	Maric; Ivana	H04B7/15592	455/418

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U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 20190424

Notice of References Cited	Application/Control No. 15/940,890		Applicant(s)/Patent Under Reexamination EMMANUEL et al.	
	Examiner JAY P PATEL		Art Unit 2466	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Code-Number-Kind Code	Country	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20150173111-A1		06-2015	Agarwal; Kaitki	H04W8/04	370/329
*	B	US-20150215853-A1		07-2015	Ling; Curtis	H04W64/003	370/254
*	C	US-20150049616-A1		02-2015	Ho; Sai Yiu Duncan	H04W24/02	370/252
	D						
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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 20190424

<i>Index of Claims</i> 	Application/Control No. 15/940,890	Applicant(s)/Patent Under Reexamination EMMANUEL et al.
	Examiner JAY P PATEL	Art Unit 2466

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47										
CLAIM		DATE								
Final	Original	04/25/2019								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
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	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								
	22	✓								

<i>Search Notes</i> 	Application/Control No. 15/940,890	Applicant(s)/Patent Under Reexamination EMMANUEL et al.
	Examiner JAY P PATEL	Art Unit 2466

CPC - Searched*		
Symbol	Date	Examiner
(H04W72/0453 or H04W76/15 or H04L12/44 or H04L43/16 or H04W40/12 or H04W24/06 or H04W36/36 or H04W36/30 or H04W24/08 or H04W4/023 or H04L43/10 or H04L43/0894 or H04L43/0888 or H04L45/20 or H04W76/10 or H04W72/085 or H04W24/04 or H04W84/12 or H04W84/18);PLUS TEXT	04/24/2019	JPP

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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Search Notes		
Search Notes	Date	Examiner
EAST (USPAT, USPGPUB, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB);PLUS TEXT	04/24/2019	JPP
EAST INVENTORSHIP SEARCH	04/24/2019	JPP
IP.COM SEARCH FOR CHOOSING BACKHAUL CHANNELS BASED ON SIGNAL STRENGTHS AND USING THE FRONT HAUL CHANNEL AS LAST RESORT	04/25/2019	JPP

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/JAY P PATEL/ Primary Examiner, Art Unit 2466	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9467929	B2	2016-10-11	SEKINE	
	2	9942709	B2	2018-04-10	SUNG	

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20090116407	A1	2009-05-07	SHII	
	2	20120224481	A1	2012-09-06	BABIARZ, et al.	
	3	20150018028	A1	2015-01-15	UPLENCHWAR, et al.	
	4	20160192203	A1	2016-06-30	GOKTURK, et al.	

/JAY P PATEL/

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

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Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

5	20170164323	A1	2017-06-08	MARKHOVSKY, et al.
6	20170238189	A1	2017-08-17	NOLAN, et al.

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2019-01-04
Name/Print	Han-Wei Chen	Registration Number	75350

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

04/25/2019

/JAY P PATEL/

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The information provided by you in this form will be subject to the following routine uses:

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

/JAY P PATEL/

04/25/2019

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.P.P./ TP Link Ex. 1004

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number

Filing Date

First Named Inventor

Art Unit

Examiner Name

Attorney Docket Number

2018-03-29

Joseph Amalan Arul Emmanuel

110729-8058.US02

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	1	9179495	B1	2015-11-03	SCHERZER, et al.	
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	1	20080025208	A1	2008-01-31	CHAN	
	2	20090046655	A1	2009-02-19	ZHAO, et al.	
	3	20090252127	A1	2009-10-08	RANGARAJAN, et al.	
	4	20100118830	A1	2010-05-13	STEPHENSON, et al.	

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04/25/2019

**INFORMATION DISCLOSURE
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(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel	
Art Unit		
Examiner Name		
Attorney Docket Number	110729-8058.US02	

5	20110081903	A1	2011-04-07	CAI, et al.	
6	20110286404	A1	2011-11-24	ABRAHAM, et al.	
7	20120020319	A1	2012-01-26	SONG, et al.	
8	20120294200	A1	2012-11-22	WANG, et al.	
9	20130194948	A1	2013-08-01	MALLIK, et al.	
10	20140233412	A1	2014-08-21	MISHRA, et al.	
11	20140270306	A1	2014-09-18	LUNA, et al.	
12	20150029067	A1	2015-01-29	DONALDSON, et al.	
13	20150049616	A1	2015-02-19	COWAN, et al.	
14	20150264614	A1	2015-09-17	STAGER, et al.	
15	20150334750	A1	2015-11-19	MEHTA	

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16	20160007273	A1	2016-01-07	PANG, et al.	
17	20160142163	A1	2016-05-19	SIROTKIN	
18	20160286374	A1	2016-09-29	PATIL, et al.	
19	20160366632	A1	2016-12-15	CUI, et al.	
20	20170048913	A1	2017-02-16	TEYEB, et al.	
21	20170070919	A1	2017-03-09	CHANDOK, et al.	
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26	20170215091	A1	2017-07-27	LING	

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27	20170251410	A1	2017-08-31	COMSTOCK
28	20170325243	A1	2017-11-09	YASUKAWA, et al.

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FOREIGN PATENT DOCUMENTS

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	"WLAN High Availability", Technical white paper; Hewlett-Packard Development Company, L.P., Oct. 2014, 8 pages	

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First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	
Examiner Name	
Attorney Docket Number	110729-8058.US02

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That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2018-03-29
Name/Print	Han-Wei (Harvey) Chen	Registration Number	75350

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	"15271912"	USPAT	OR	OFF	2019/04/25 09:29
L3	146	((("EMMANUEL") near3 ("Joseph") near3 ("Amalan") near3 ("Arul"))).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/04/25 09:40
L4	200	((("AMINI") near3 ("Peiman"))).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/04/25 09:40
L5	24	I3 AND BACKHAUL\$.CLM.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/04/25 09:41
L6	24	I4 AND BACKHAUL\$.CLM.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/04/25 09:41
L7	0	"15940890"	USPAT	OR	OFF	2019/04/25 09:42
L8	2	"15940890"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/25 09:42
S1	76	("20090116407" "20120224481" "20150018028" "20160192203" "20170164323" "20170238189" "9467929" "9942709" "20020042274" "20050048963" "20070206528" "20070280453" "20080247317" "20090067369" "20090135738" "20090135794" "20090221238" "20100157888" "20100231473" "20100246416" "20100291931" "20110250926" "20110299422" "20120129517" "20120224484" "20120225646" "20140254400" "20150092681" "20150103685" "20150215791" "20160029384" "20160066249" "20160094946" "20160227544" "20160269097" "20160308755" "20170006431" "20170118705" "7155167" "7502354" "7567822" "8248948" "20080080414" "20100260146" "20160212755" "9001767" "20080025208" "20090046655" "20090252127" "20100118830" "20110081903" "20110286404" "20120020319" "20120294200" "20130194948" "20140233412"	US-PGPUB; USPAT	OR	OFF	2019/04/22 09:01

		"20140270306" "20150029067" "20150049616" "20150264614" "20150334750" "20160007273" "20160142163" "20160286374" "20160366632" "20170048913" "20170070919" "20170125920" "20170127295" "20170127325" "20170164260" "20170215091" "20170251410" "20170325243" "9179495" "9832796").PN.				
S2	5	S1 and ((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3)))	US-PGPUB; USPAT	OR	OFF	2019/04/22 09:02
S3	21	((backhaul\$3) same ((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT	OR	OFF	2019/04/22 09:41
S4	113466	(H04W72/0453 or H04W76/15 or H04L12/44 or H04L43/16 or H04W40/12 or H04W24/06 or H04W36/36 or H04W36/30 or H04W24/08 or H04W4/023 or H04L43/10 or H04L43/0894 or H04L43/0888 or H04L45/20 or H04W76/10 or H04W72/085 or H04W24/04 or H04W84/12 or H04W84/18).cpc.	US-PGPUB; USPAT	OR	OFF	2019/04/22 09:43
S5	365566	(H04W72/0453 or H04W76/15 or H04L12/44 or H04L43/16 or H04W40/12 or H04W24/06 or H04W36/36 or H04W36/30 or H04W24/08 or H04W4/023 or H04L43/10 or H04L43/0894 or H04L43/0888 or H04L45/20 or H04W76/10 or H04W72/085 or H04W24/04 or H04W84/12 or H04W84/18).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 09:43
S6	22	((backhaul\$3) same ((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 09:44
S7	19	S6 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 09:45
S8	4	"9967884".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 09:45
S9	36	S5 and (backhaul\$3 same (RSSI or (signal adj2 strength\$3))) and (((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT	OR	OFF	2019/04/22 10:09
S10	33	S9 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR;	OR	OFF	2019/04/22 10:10

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S11	0	(backhaoul with mesh) and ((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 12:34
S12	13	(backhaul with mesh) and ((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 13:53
S13	11	S12 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/22 13:55
S14	836	((backhaul\$3 same mesh)) and (((RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 07:35
S15	836	(backhaul\$3 same mesh) and (((RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 07:35
S16	50	(backhaul\$3 same mesh) and ((((RSSI or (signal adj2 strength\$3)))) with (below or less) with threshold)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 07:36
S17	25	S16 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 07:36
S18	15	(fail\$4 with backhaul\$3) same (front\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 08:57
S19	15	S18 and (@rlad<"20151110" or	US-PGPUB;	OR	OFF	2019/04/24

		@ad<"20151110")	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			08:57
S20	365712	(H04W72/0453 or H04W76/15 or H04L12/44 or H04L43/16 or H04W40/12 or H04W24/06 or H04W36/36 or H04W36/30 or H04W24/08 or H04W4/023 or H04L43/10 or H04L43/0894 or H04L43/0888 or H04L45/20 or H04W76/10 or H04W72/085 or H04W24/04 or H04W84/12 or H04W84/18).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:21
S21	36	S20 and (backhaul\$3 same (RSSI or (signal adj2 strength\$3))) and (((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT	OR	OFF	2019/04/24 12:21
S22	33	S21 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:21
S23	0	S22 and (spanning)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:21
S24	0	S22 and (star)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:22
S25	0	S22 and (daisy)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:22
S26	13	(backhaul with mesh) and (((prioritiz\$4 or rank\$4) with (RSSI or (signal adj2 strength\$3))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:23
S27	11	S26 and (@rlad<"20151110" or @ad<"20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:23

S28	3	S27 and (spanning or daisy or star)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:23
S29	5	S22 and (topolog\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:28
S30	0	("does not use" or "not used") with backhaul\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:52
S31	0	("does not use" or "not used") same backhaul\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 12:53
S32	0	("when") with backhaul\$3 with fail\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:04
S33	0	("when") with "backhaul" with fail\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:05
S34	0	("when") with "back haul" with fail\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:05
S35	0	("when") with "back-haul" with fail\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:05
S36	888	("spanning tree") with avoid\$4 with loop\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2019/04/24 13:07

			DERWENT; IBM_TDB			
S37	3	(("spanning tree") with avoid\$4 with loop\$3) with backhaul	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:07
S38	0	S37 and (@rlad< "20151110" or @ad< "20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:07
S39	10	(("spanning tree") with avoid\$4 with loop\$3) same backhaul	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:08
S40	0	S39 and (@rlad< "20151110" or @ad< "20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:08
S41	17	(("spanning tree") with avoid\$4 with loop\$3) and backhaul	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:08
S42	6	S41 and (@rlad< "20151110" or @ad< "20151110")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/24 13:08

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Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

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	1	9001767	B1	2015-04-07	GATEWOOD, et al.	

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	1	20080080414	A1	2008-04-03	THUBERT, et al.	
	2	20100260146	A1	2010-10-14	LU	
	3	20160212755	A1	2016-07-21	CAO, et al.	

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First Named Inventor	Joseph Amalan Arul Emmanuel
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Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2018-07-30
Name/Print	Han-Wei Chen	Registration Number	75350

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

/JAY P PATEL/

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

/JAY P PATEL/

04/25/2019

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.P.P./ TP Link Ex. 1004

Bibliographic Data

Application No: 15/940,890

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged:

/JAY P PATEL/

JPP

Examiner's Signature

Initials

Title:

DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/29/2018	370	2466	110729-8058.US02
RULE			

APPLICANTS

NETGEAR, INC., San Jose, CA,

INVENTORS

Joseph Amalan Arul EMMANUEL Cupertino, CA, UNITED STATES

Peiman AMINI Mountain View, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 15271912 09/21/2016 PAT 9967884

15271912 has PRO of 62336503 05/13/2016

15271912 has PRO of 62253540 11/10/2015

FOREIGN APPLICATIONS

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Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

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	1	7155167	B1	2006-12-26	CARTY	
	2	7502354	B1	2009-03-10	MAUFER	
	3	7567822	B2	2009-07-28	HART, et al.	
	4	8248948	B2	2012-08-21	WEIL, et al.	

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	1	20020042274	A1	2002-04-11	ADES	
	2	20050048963	A1	2005-03-03	KUBLER, et al.	

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Attorney Docket Number		110729-8058.US02

3	20070206528	A1	2007-09-06	WALTON, et al.
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Attorney Docket Number	110729-8058.US02	

14	20110250926	A1	2011-10-13	WIETFELDT, et al.
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26	20160227544	A1	2016-08-04	KATAR, et al.
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Examiner Name	Faruk Hamza
Attorney Docket Number	110729-8058.US02

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Examiner Signature	/JAY P PATEL/	Date Considered	04/25/2019
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Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2018-09-28
Name/Print	Han-Wei Chen	Registration Number	75350

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15940890	CTNF	04/29/2019	110729-8058.US02
	892	04/29/2019	110729-8058.US02
	1449	04/29/2019	110729-8058.US02
	1449	04/29/2019	110729-8058.US02
	1449	04/29/2019	110729-8058.US02
	1449	04/29/2019	110729-8058.US02

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In re Application of:

JOSEPH AMALAN ARUL EMMANUEL et al.

Application No.: 15/940,890

Filed: 03/29/2018

Conf. No.: 8990

Art Unit: 2466

Examiner: PATEL, JAY P

For: DEDICATED BACKHAUL FOR
WHOLE HOME COVERAGE

RESPONSE TO NON-FINAL OFFICE ACTION UNDER 37 C.F.R. § 1.111

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed on April 29, 2019, please reconsider the above-identified application in view of the following remarks:

A Listing of the Claims begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

A LISTING OF THE CLAIMS

1. (Original) A computer-implemented method for establishing a backhaul communication among nodes in a mesh wireless network, the method comprising:
performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and
upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a channel in a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,
wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.
2. (Original) The method of claim 1, wherein said attempts are performed on a first radio, the method further comprising:
upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.
3. (Original) The method of claim 2, wherein said different radio is the same radio as the front haul.
4. (Original) The method of claim 1, further comprising:
measuring received signal strengths of probes from all nodes within a communication range; and
selecting the second node based on the measured received signal strengths of the probes.

5. (Original) The method of claim 1, further comprising:
utilizing a spanning tree based protocol to avoid loops in said attempts.
6. (Original) The method of claim 1, further comprising:
measuring a link quality among one or more of the nodes in the network; and
selectively causing a number of nodes in the network to form a particular connection
topology based on the measured link quality.
7. (Original) The method of claim 6, wherein the formed connection topology is a
star topology if the link quality exceeds a predetermined threshold.
8. (Original) The method of claim 6, wherein the formed connection topology is a
daisy chain topology if the link quality does not exceed a predetermined threshold.
9. (Original) The method of claim 8, further comprising:
maintaining a hop count for nodes connected in the daisy chain topology, wherein
whether a given node can be added to the daisy chain topology as an extra hop is further based
on the hop count.
10. (Original) The method of claim 1, further comprising:
receiving, via the backhaul, a configuration from the second node.
11. (Original) The method of claim 10, further comprising:
causing the configuration from the second node to be pushed through the backhaul to a
target node, wherein said causing is triggered by an initiation from a user.

12. (Original) A network device capable of establishing a backhaul communication among nodes in a mesh wireless network, the device including a network controller configured to perform operations comprising:

performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and

upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,

wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.

13. (Original) The device of claim 12, wherein said attempts are performed on a first radio, the operations further comprising:

upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.

14. (Original) The device of claim 13, wherein said different radio is the same radio as the front haul.

15. (Original) The device of claim 12, the operations further comprising:
measuring received signal strengths of probes from all nodes within a communication range; and
selecting the second node based on the measured received signal strengths of the probes.

16. (Original) The device of claim 12, the operations further comprising:

utilizing a spanning tree based protocol to avoid loops in said attempts.

17. (Original) The device of claim 12, the operations further comprising:
measuring a link quality among one or more of the nodes in the network; and
selectively causing a number of nodes in the network to form a particular connection
topology based on the measured link quality.

18. (Original) The device of claim 17, wherein the formed connection topology is a
star topology if the link quality exceeds a predetermined threshold.

19. (Original) The device of claim 17, wherein the formed connection topology is a
daisy chain topology if the link quality does not exceed a predetermined threshold.

20. (Original) The device of claim 19, the operations further comprising:
maintaining a hop count for nodes connected in the daisy chain topology, wherein
whether a given node can be added to the daisy chain topology as an extra hop is further based
on the hop count.

21. (Original) The device of claim 12, the operations further comprising:
receiving, via the backhaul, a configuration from the second node.

22. (Original) The device of claim 21, the operations further comprising:
causing the configuration from the second node to be pushed through the backhaul to a
target node, wherein said causing is triggered by an initiation from a user.

REMARKS

Summary of Office Action

Rejections Under 35 U.S.C. § 112

Claims 1-22 stand rejected under 35 U.S.C. § 112 as allegedly being indefinite.

Rejections Under 35 U.S.C. § 102

Claims 1-4, 10-15, and 21-22 stand rejected under 35 U.S.C. § 102 as allegedly being anticipated by Mallik et al. (US Publication 2013/0194948 A1)(hereinafter “Mallik”).

Rejections Under 35 U.S.C. § 103

Claims 5 and 16 stand rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Mallik in view of Ho et al. (US Publication 2015/0049616 A1)(hereinafter “Ho”).

Summary of the Response

Claims 1-22 were pending prior to this response. In this response, no claim has been amended, canceled, or added. No new matter has been added. Accordingly, after this response, claims 1-22 remain pending in this application.

Reconsideration of the present application is respectfully requested.

Request for Telephone Interview

Applicant believes that the present application is in condition for allowance. In the event the Examiner does not find the present application to be allowable after considering this response. Applicant respectfully requests that the Examiner contact the undersigned at (650) 838-4303 for a speedy resolution.

Discussion of Rejections

Rejections Under 35 U.S.C. § 112

Claims 1-22 stand rejected under 35 U.S.C. § 112 as allegedly being indefinite. Applicant disagrees with the examiner's allegations. The Examiner's sole basis for the rejections appears to be that, in claims 1 and 12, an "and/or" conjunction is used. Office Action at p. 2.

The Examiner's attention is respectfully directed to *Ex parte Gross*, Appeal No. 2011-004811 (PTAB January 3, 2014). In *Ex parte Gross*, the examiner rejected Gross's claim 1 as indefinite based upon the "and/or" term. On appeal, however, the PTAB reversed – finding that "A and/or B" does have a meaning and that meaning is A alone, B alone, or A and B together.

Because the PTAB has confirmed that there is nothing inherently wrong with "and/or," Applicant's claims 1 and 12 are not indefinite if the sole reason is the use of the "and/or" conjunction. Indeed, the Examiner has not indicated any other reason in the Office Action. Consequently, Applicant respectfully requests withdrawal of the § 112 rejections.

Rejections Under 35 U.S.C. § 102

Claims 1-4, 10-15, and 21-22 stand rejected under 35 U.S.C. § 102 as allegedly being anticipated by Mallik. Applicant disagrees with the examiner's allegations.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference."¹ Applicant submits that Mallik does not disclose, either expressly or inherently, each and every element of claim 1, and therefore does not anticipate Applicant's claim 1 under 35 U.S.C. § 102.

Applicant's claim 1 recites, in part:

upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a **different channel in the default frequency band and/or a channel in a different frequency band that has a lower frequency range than the default frequency band**, to establish the backhaul with the second node,

(Emphasis added.)

¹ *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987); M.P.E.P. § 2131 (emphasis added).

The Office Action appears to rely on Mallik's FIG. 6 and, more specifically, step 622 to reject the above-recited limitation. However, the entire Mallik's specification only has one mentioning of step 622, that is, "[h]andover occurs in step 622 and the process ends at step 624." Mallik at ¶ [0075]. Throughout Mallik, the specification is silent on "performing an attempt to **utilize a different channel in the default frequency band**" and/or "**a channel in a different frequency band that has a lower frequency range than the default frequency band**," as recited in claim 1. Indeed, the Examiner has not specified in the Office Action where or how Mallik explicitly anticipates these limitations.

Moreover, a closer review shows that Mallik's so-called handover is about the mechanism of the UE relay handling over served UEs (e.g., to another UE relay). Mallik does not talk about the establishment of the backhaul itself. As such, Mallik also fails to disclose the feature of "upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt . . . to **establish the backhaul with the second node**," also recited in Applicant's claim 1.

At least for the reasons stated above, Applicant submits that Mallik fails to anticipate at least the above-recited limitations of claim 1, and that claim 1 is patentable over Mallik. Withdrawal of the rejections is respectfully requested.

Dependent Claims

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicant's silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Reservation of Rights

For the sake of conciseness and clarity, Applicant may not have addressed every assertion or rejection made in the Office Action, particularly where Applicant has presented amendments

or arguments that Applicant believes render such assertions/rejections moot. Therefore, Applicant's silence regarding any such assertions or rejections does not constitute an admission or acquiescence regarding such assertions/rejections or a waiver of any argument relating to such assertions/rejections. Applicant reserves the right to challenge at a later time any rejection or any factual or legal assertion made by the Office in relation to the present application. Applicant does not admit that any of the references cited in the Office Action are prior art. Applicant reserves the right to swear behind any cited reference at a later date, to the extent permitted by law.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

Authorization for Email Communications

Recognizing that Internet communications are not secure, Applicant hereby authorizes the USPTO to communicate with Applicant's attorney concerning any subject matter of this application by electronic mail. *See* M.P.E.P. § 502.03. Applicant understands that a copy of these communications may be made of record in the application file.

CONCLUSION

At least for the foregoing reasons, the present application is believed to be in condition for allowance, and such action is earnestly requested.

Please charge any underpayment or credit any overpayment to Deposit Account No. 50-0665, under Order No. 110729-8058.US02 from which the undersigned is authorized to draw.

Dated: 10/25/2019

Respectfully submitted,

By /Han-Wei Chen/

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Attorney for Applicant

Electronic Patent Application Fee Transmittal

Application Number:	15940890			
Filing Date:	29-Mar-2018			
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE			
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL			
Filer:	Han-Wei Chen/Christine Dunn			
Attorney Docket Number:	110729-8058.US02			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension - 3 months with \$0 paid	1253	1	1400	1400
Miscellaneous:				
Total in USD (\$)				1400

Electronic Acknowledgement Receipt

EFS ID:	37570660
Application Number:	15940890
International Application Number:	
Confirmation Number:	8990
Title of Invention:	DEDICATED BACKHAUL FOR WHOLE HOME COVERAGE
First Named Inventor/Applicant Name:	Joseph Amalan Arul EMMANUEL
Customer Number:	22918
Filer:	Han-Wei Chen/Christine Dunn
Filer Authorized By:	Han-Wei Chen
Attorney Docket Number:	110729-8058.US02
Receipt Date:	25-OCT-2019
Filing Date:	29-MAR-2018
Time Stamp:	20:17:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 1400
RAM confirmation Number	E201900K17533537
Deposit Account	500665
Authorized User	Christine Dunn

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1		2019-10-25_Response_110729-8058US02.pdf	161119	yes	10
			4e97d5f00a0f870a19f1454c00322a1a8f0f41d9		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	5	
	Applicant Arguments/Remarks Made in an Amendment		6	10	
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30870	no	2
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New International Application Filed with the USPTO as a Receiving Office

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	15940890
	Filing Date	2018-03-29
	First Named Inventor	Joseph Amalan Arul Emmanuel
	Art Unit	2466
	Examiner Name	Jay P. Patel
	Attorney Docket Number	110729-8058.US02

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	1	20120230206	A1	2012-09-13	BALIGA, et al.		
	2	20170251429	A1	2017-08-31	KAPOOR, et al.		

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	1	101523809	CN	A	2009-09-02	QUALCOMM INC.		

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STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		15940890
Filing Date		2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel	
Art Unit	2466	
Examiner Name	Jay P. Patel	
Attorney Docket Number	110729-8058.US02	

2	101610558	CN	A	2009-12-23	HONGFUJIN PRECISION INDUSTRY (SHENZHEN) CO., LTD.		
3	101796869	CN	A	2010-08-04	QUALCOMM INC.		
4	102387553	CN	A	2012-03-21	ZTE CORPORATION		
5	102740306	CN	A	2012-10-17	FUJITSU LTD.		
6	102907141	CN	A	2013-01-30	DEUTSCHE TELEKOM AG		
7	104301957	CN	A	2015-01-21	HANGZHOU H3C TECHNOLOGIES CO., LTD.		
8	2844020	EP	A1	2015-03-04	ITRON, INC.		
9	104703193	CN	A	2015-06-10	HANGZHOU H3C TECHNOLOGIES CO., LTD.		
10	104756474	CN	A	2015-07-01	ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.		
11	104854901	CN	A	2015-08-19	DEUTSCHE TELEKOM AG		
12	104885378	CN	A	2015-09-02	INTEL CORPORATION		

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		15940890
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First Named Inventor	Joseph Amalan Arul Emmanuel	
Art Unit	2466	
Examiner Name	Jay P. Patel	
Attorney Docket Number	110729-8058.US02	

13	105027604	CN	A	2015-11-04	TELEFONAKTIEBOLAG ET LM ERICSSON		
14	2016125055	WO	A1	2016-08-11	KONINKLIJKE PHILIPS N.V.		

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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	15940890
Filing Date	2018-03-29
First Named Inventor	Joseph Amalan Arul Emmanuel
Art Unit	2466
Examiner Name	Jay P. Patel
Attorney Docket Number	110729-8058.US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

- ✓ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ✓ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Han-Wei Chen/	Date (YYYY-MM-DD)	2019-10-25
Name/Print	Han-Wei Chen	Registration Number	75350

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



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Bibliographic data: CN101523809 (A) — 2009-09-02

Methods and apparatus for determining communication link quality

Inventor(s): ARNAUD MEYLAN [US]; RANJITH JAYARAM [US]; SANJIV NANDA [US]; ALOK AGGARWAL [US] ± (MEYLAN ARNAUD, ; JAYARAM RANJITH, ; NANDA SANJIV, ; AGGARWAL ALOK, ; DESHPANDE MANOJ M)

Applicant(s): QUALCOMM INC [US] ± (QUALCOMM INC)

Classification: - international: **H04L12/26**
- cooperative: **H04L43/50 (EP, US)**

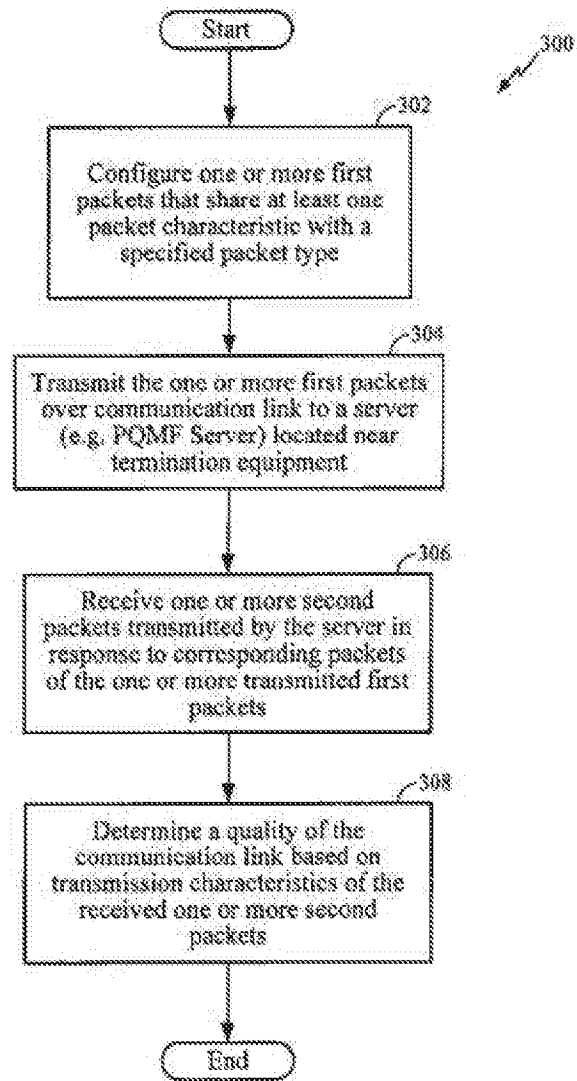
Application number: CN20078036180 20070928

Priority number(s): US20060848415P 20060928 ; WO2007US79813 20070928

Also published as: CN101523809 (B) EP2087650 (A2) JP2010506452 (A)
JP2011254503 (A) JP2014180013 (A) JP5038426 (B2)
JP5864664 (B2) KR101140972 (B1) KR20090075711 (A)
US2009257361 (A1) US9191226 (B2) WO2008039962 (A2)
WO2008039962 (A3) less

Abstract of CN101523809 (A)

Methods and apparatus for determining the quality of a communication link transmitting a specified packet type are disclosed. The methodology includes configuring first packets, which share transmission characteristics with a specific packet type, such as a Voice over IP packet, such that the first packets experience similar communication link treatment as the specific packet type. The first packets are then transmitted over the communication link to a quality monitoring server located near a termination equipment of the particular communication link. Second packets, which are transmitted by the server in response to the first packets, are received and evaluated to determine the quality of the communication link based on characteristics of the second packets. Corresponding apparatus are also disclosed.





Patent Translate

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Notice

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DESCRIPTION CN101523809

A method and apparatus for determining the quality of a communication link for transmitting a specified type of packet is disclosed. The method includes configuring a first packet that shares a transmission characteristic with a specified type of packet, such as an IP voice packet, such that the first packet experiences a similar communication link condition with the designated type of packet. The first packet is then transmitted over the communication link to a quality monitoring server located near the terminating device of the particular communication link. A second packet transmitted by the server in response to the first packet is received and evaluated to determine the quality of the communication link based on characteristics of the second packet. Corresponding devices are also disclosed.

Method and apparatus for determining the quality of a communication link

Priority based on 35 U.S.C. § 119

This application claims the provisional application No. of "Handoff Triggers for WLAN and VoWLAN", "Estimation of the Path Quality to assist handoff Decision" and "Handoff Algorithms for VoIP over WLAN" submitted on September 28, 2006. The priority of the assignee of the present application is hereby incorporated by reference.

Reference to a copending patent application

This patent application relates to the following copending U.S. patent applications:

"METHODS AND APPARATUS FOR DETERMINING QUALITY OF SERVICE IN A COMMUNICATION SYSTEM" by Meylan et al., filed at the same time as the present application, which is assigned to the assignee of the present application and expressly incorporated by reference. Incorporated into this application.

Technical field

The present disclosure relates generally to methods and apparatus for determining the quality of a communication link and, more particularly, to determining the quality of service of a communication link or path having real-time traffic (such as voice data) wireless or wired network transmissions.

Background technique

In communication systems, the use of applications that use real-time services, such as end-to-end voice over IP (VoIP) calls, is increasing. The routes between the endpoints involved in such an application will typically access the IP network (e.g., the Internet) through any one or any combination of a variety of different communication network technologies. Examples of types of network technologies used may include: a wireless local area network (WLAN) such as Wi-Fi (IEEE Standard 802.11), a cellular network such as IX-EVDO, High Speed Packet Access (HSPA), such as WiMAX (IEEE 802.16) Wireless Wide Area Networks (WWANs), femtocells, and various other network technologies known or to be defined. Therefore, real-time services can be exchanged over many networks in the routing between endpoints. For example, in an end-to-end VoIP call between User A and User B in a residential environment, VoIP packets may pass through User A's Wi-Fi access network, User A's DSL or cable broadband network, IP core network, and users. B's DSL or cable broadband network, and User B's Wi-Fi access network.

In the case of VoIP services, for example, VoIP packets carrying voice data must pass through all networks within the maximum allowable delay constraints to achieve acceptable quality of service (QoS). Because VoIP packets pass through many potentially completely different networks between endpoints of a voice call, and because broadband networks such as the Internet typically carry multiple types of data packets, monitoring the QoS of delay-sensitive voice packets in each network link is usually not feasible. Thus, the QoS of VoIP is more easily monitored by one or two devices at the endpoint of the voice call (eg, a terminal such as a mobile phone or computer) because such devices are subject to the presence of the network used to route the call. The impact of QoS degradation that occurs.

Although in some networks for routing voice calls, such as in a Wi-Fi Media Access Control (MAC) Management Information Base (MIB), a quality determination metric can be provided, this metric is not available for all situations. Effectively determine the final path quality. For example, consider a VoIP call that occurs in Wireless Local Area Network Voice (VoWLAN) in a residential environment. In order to determine QoS, at least 4 links need to be monitored: from the LAN access point (AP) to the downlink of the communication terminal, from the communication terminal to the AP, from the call termination device (for example, in a VoIP service provider) The media server at the network) goes through the Internet backbone and the cable/DSL backhaul line to the AP's downlink, and the uplink from the AP through the Internet backbone and cable/DSL backhaul to the call termination device. The communication terminal can monitor at least the first two of the links using locally visible events, such as packet loss or signal strength. However, there is no known mechanism for providing monitoring of the quality of the uplink and downlink between the AP and the terminating device. Accordingly, what is needed is a mechanism for measuring or determining at least a portion of a communication path from an AP to a terminating device at a communication terminal or AP, particularly a QoS carrying a path of real-time traffic.

Summary of the invention

According to one aspect, a method of determining a quality of a communication link for transmitting a packet of a specified type is disclosed. The method includes configuring or forming at least one first packet, the at least one first packet sharing at least one packet characteristic with the specified type of packet such that the at least one first packet experiences a similar communication link with the specified type of packet. Moreover, the method includes transmitting, on the communication link, the at least one first packet to a quality monitoring server located near the terminating unit, and then receiving the at least one second packet transmitted by the server in response to the corresponding first packet. Finally, the method includes determining a quality of the communication link based on characteristics of the received at least one second packet.

According to another aspect, an apparatus for determining the quality of a communication link is disclosed. The apparatus includes means for configuring at least one first packet, the at least one first packet sharing at least one packet characteristic with the designated type packet such that the at least one first packet experiences a similar communication link condition with the specified type of packet. The apparatus also includes means for transmitting, on the communication link, the at least one first packet to a quality monitoring server located adjacent to the terminating unit, for receiving at least one transmitted by the server in response to the corresponding first packet A module of two packets, and means for determining a quality of the communication link based on characteristics of the received at least one second packet.

According to another aspect, a communication device operable in a wireless system is disclosed. The communication device includes a processor having the first module configured to configure at least one first

packet, the at least one first packet sharing at least one packet characteristic with a specified type of packet such that the at least one first packet The specified type of packet experiences a similar communication link condition. The processor also includes a second module for transmitting the at least one first packet to the quality monitoring server located near the terminating unit over the communication link. The processor also includes a third module for receiving at least one second packet transmitted by the server in response to the corresponding first packet. The processor also includes a fourth module for determining a quality of the communication link based on characteristics of the received at least one second packet.

According to another aspect, a computer program product comprising a computer readable medium, the medium comprising code for causing a computer to configure at least one first packet, the at least one first packet sharing at least one packet characteristic with a specified type of packet And causing the at least one first packet to experience a similar communication link condition with the specified type of packet. The medium also includes code for causing a computer to transmit the at least one first packet on the communication link to a quality monitoring server located near the terminating unit for causing the computer to receive transmission by the server in response to the corresponding first packet At least one second grouped code. Finally, the medium includes code for causing a computer to determine the quality of the communication link based on characteristics of the received at least one second packet.

DRAWINGS

1 is a diagram of a communication system for implementing VoIP communication using quality determination.

2 is a block diagram showing the level at which quality determination and metric monitoring are performed in a communication system;

3 is a flow chart of a method for determining a quality of a communication link in a communication system;

4 is a block diagram showing a protocol for a path quality monitoring function;

Figure 5 illustrates a communication system employing an exemplary implementation of path quality monitoring under network control;

Figure 6 illustrates an exemplary apparatus for determining the path quality of a communication link.

detailed description

FIG. 1 is a diagram of an exemplary communication system 100 employing path quality determination. As will be described in detail herein, system 100 can be used to make VoIP calls between two endpoints (e.g., two communication terminals or stations). System 100 can include a local area network 102, such as a wireless local area network (WLAN) 102, which can operate in accordance with any of a number of wireless network standards, such as Wi-Fi (IEEE Standard 802.11). The local area network 102 includes an access point (AP) 104 that communicates with a communication terminal endpoint, such as mobile device 106, or other electronic device, such as computer 108. The AP 104 is also in communication with the backhaul link 110.

The backhaul link 110 can include any of a variety of types of network connections, such as digital subscriber line (DSL) or cable broadband connections. Backhaul link 110 is used to communicatively couple local area network 102 with a wide area network such as Internet backbone 112. Specifically, the backhaul link 110 terminates at the call termination unit 114, which communicates with the Internet backbone 112. In an example of a VoIP service, the call termination unit 114 can be configured as a media server in the network of the VoIP service provider. For example, the Internet backbone 112 is used to transmit real-time traffic, such as VoIP packets, to the final terminal device 116 at the other end of the end-to-end connection via another backhaul link 118 and AP 120.

It is noted that each terminal endpoint (e.g., 106, 108) can be configured to monitor only the quality provided by the LAN 102. Taking the example that the AP 104 is a Wi-Fi AP, the terminal 106 can monitor known WLAN parameters such as Received Signal Strength Indicator (RSSI), Signal to Noise Ratio (SNR), Failed Frame Reception, Downlink Frame Retransmission, and Network Load. To estimate the quality of the Wi-Fi downlink. Similarly, the terminal can also monitor parameters such as uplink frame retransmission and failed frame retransmission to estimate the quality of the Wi-Fi uplink. After determining the degradation of either or both of the Wi-Fi uplink and the Wi-Fi downlink, the communication terminal (106, 108) may take appropriate measures to improve call quality, such as placing the call from the AP 104. Switch to another network (not shown) or adjust the media encoding feature. Furthermore, if a network with the appropriate QoS cannot be found, the terminal can terminate the call.

Although it is desirable for each terminal endpoint to monitor the local WLAN access link and detect any degradation, such support in the terminal is dependent on implementation. In addition to the above WLAN metrics, each terminal can also monitor other WLAN parameters such as RTP layer packet loss, packet jitter, play buffer statistics, and RTCP reports. Although these metrics can be used to identify the loss of end-to-end QoS, they cannot be used to characterize the quality degradation of links other than WLAN local access. For example, consider the VoIP call between terminals 106 and 116 in FIG. 106The loss of RTP packets at the location may be

caused by the degradation of backhaul link 110, which is the AP downlink of terminal 106, and the backhaul link 118, which is the AP uplink of terminal 116. If link 110 is degraded, terminal 106 can improve call quality by switching the call to a network (not shown) that does not use the link. However, if link 118 is degraded, such handover by terminal 106 will not help improve call quality. In this case, terminal 116 will need to take appropriate measures to improve call quality. Thus, for example, a simple method of triggering a handover from a WLAN to a wide area network WAN based only on observed QoS degradation may not always work, and may introduce unnecessary overhead.

It is to be noted that the core network carrying the call service (e.g., Internet backbone 112) is generally well-equipped and supports QoS. Thus, for the purposes of this disclosure, it is assumed that LAN local access and broadband connections (i.e., backhaul link 110) are the primary cause of quality degradation.

Accordingly, the exemplary system 100 can also include a quality monitoring server 122 for assisting in determining the QoS of, for example, the communication link between the terminal 106 and the call termination unit 114. As detailed below in this application, the path quality monitoring function (also abbreviated as "PQMF" in this application) may be implemented by a terminal or station (e.g., mobile communication device 106) in a communication path. The packet information is transmitted to the quality monitoring server 112 on the network, and the quality monitoring server 112 returns the packet information to the terminal or station 106 in response to determine the path quality. Arrow 124 shows this function of Figure 1. Additionally, the quality monitoring server 112 can be located as close as possible to the call termination unit 114 and, as indicated by the dashed line 126, can even be merged or integrated with the unit 114. Therefore, the PQMF is used to measure the uplink and downlink path quality between the terminal and the call termination unit 114. It is noted that server 122 can be implemented as an algorithm executing on a processor or module for receiving PQMF packets, processing the packets, determining what packets to send in response, and transmitting the responses.

In addition, it is noted that the packets used by the PQMF are either imitated or have at least one or more common characteristics with those packets that are of great interest to the quality of the transmission on the link. More specifically, the PQMF packet is configured to have sufficient common characteristics to ensure that the network treats the packet with the same level of service as the service level scored for the data packet of interest. For example, VoIP packets or Real Time Protocol (RTP) packets get a higher level of service than non-real time packets. Thus, the PQMF packets used to determine the QoS of a VoIP packet are configured to have the same VoIP packet characteristics that affect the service level that the network treats for these VoIP packets. Therefore, the use of PQMF packets having a common characteristic with the packet of interest (e.g., RTP or VoIP packets) improves the accuracy of the monitoring function because the PQMF packets are treated the same network (and thus get the same QoS).

By way of example only, and not limitation, the common feature may be the Type of Service (TOS) field in the IP

packet header of the PQMF packet. This common feature can result in the same quality of service between the packets of interest and the PQMF packets. Note also that from an implementation perspective, the packet size of the PQMF packet can also be sized to match any of a number of possible sizes of the packet of interest. For example, the PQMF packet can be configured to match the size of the packet regardless of what encoder/decoder (codec) is used during transmission and reception of the packet.

Measurements based on characteristics of packets addressed to and from the path quality monitoring server 112, such as packet round-trip times, allow the terminal device (e.g., 106, 108) to measure the entire path through the LAN 102 and backhaul link 110 (That is, the quality of the uplink and downlink). It is noted that in an exemplary implementation, the PQMF packets transmitted by the communication terminal 106 and those PQMF packets that are returned by the server 122 to the terminal 106 in response may be configured to be the same such that the quality of the uplink and downlink are treated. The network treatment that is closest to the packet of interest is mimicked.

The terminal device (106 or 108) can then make a more accurate decision using the determined quality, such as whether to trigger a handover to another network or whether to change the data rate or coding rate to improve call quality.

System 100 is an example of a single simple network configuration. However, many additional, more complex configurations of system 100 are contemplated, including alternative electronic devices and various wireless or wired network protocols. Moreover, for example, components in system 100 can be configured to facilitate seamless transition of mobile communication terminal 106 from AP 104 currently utilized by terminal 106 to another network. Furthermore, although the system is specifically described in connection with QoS determination of real-time services, such as voice data (VoIP), it is contemplated that the QoS determination can be used for other packet transmissions on the backhaul line, such as Transmission Control Protocol (TCP) or user data. Reporting Protocol (UDP).

2 is a block diagram showing the various layers on which quality and monitoring metrics are determined in a communication system, such as system 100 of FIG. The endpoint terminal 202 participating in the VoIP call can be configured to monitor different QoS metrics at various layers. As shown, terminal 202 monitors physical layer (PHY) parameters or metrics on the link between terminal 202 and AP 204, as shown by layer 206 and arrow 208. The PHY layer metrics may include, for example, a Received Signal Strength Indicator (RSSI). In addition, terminal 202 can include monitoring of a medium access control (MAC) layer, as illustrated by layer 210 and arrow 212. The metrics measured at the MAC layer may include, for example, the number of acknowledgment failures or frame check sequence (FCS) errors.

To determine if the wireless link is bad in the case of a WLAN, for example, terminal 202 can use MAC layer metrics and PHY layer metrics. However, for other network anomalies, a high level of monitoring can assist the terminal in determining, for example, if there is a problem in the backhaul. Thus, terminal 202 can also monitor metrics at a higher level shown as an "application" layer or RTP layer 214. For example, terminal 202 can monitor the number of lost VoIP packets in the application layer. This is represented in the figure by arrow 218 from VoIP call termination unit 216 to terminal 202 indicating the monitoring of lost downlink packets from call termination unit 216 in the application or RTP layer.

As mentioned earlier, there are still cases where the above metrics are used to help determine if a handover is triggered, QoS cannot be improved, and unnecessary overhead may be introduced. For example, assuming that the source of the quality problem is remote (i.e., after the VoIP call termination unit 216), the application layer metric indicates a large download packet loss even if the local LAN and backhaul link are good. Therefore, the triggering of the handover from the local LAN to another network caused by this detection will not result in QoS improvement because the problem occurs at the far end. This switching introduces unnecessary overhead and undermines the potential advantages of maintaining the call on the LAN. The user may wish to keep the call on the LAN for cost and performance reasons. Conversely, application layer metrics may indicate negligible downlink packet loss, while backhaul uplink degradation causes problems at the far end. Therefore, switching from the local LAN will not be triggered, which will cause the QoS of the far end to continue to deteriorate. In another example, switching from the WAN to the local LAN can be indicated based on a suitably detected signal strength on the LAN. However, if the backhaul quality is degraded, switching to the local LAN in this case will result in poor call quality after handover.

In view of the above examples, the methods and apparatus disclosed herein employ PQMF to correct these and similar situations. As shown in FIG. 2, the application/RTP layer 214 in the terminal 202 can exchange the PQMF packet 220 with the path quality monitoring server 222, as described above in connection with FIG. The PQMF 220 includes a first packet (e.g., RTP) configured and transmitted by the application layer 241 in the terminal 202, the first packet matching the type of packet associated with the QoS determination, such as a VoIP packet in the example disclosed herein. type. Server 222 then assists in receiving the first packet from terminal 202, by issuing a second packet or returning the transmitted packet.

In the network assisted method, as shown in Fig. 2, the server 222 assists the PQMF, detects path quality degradation in the terminal (e.g., 202), and can implement the detection by software, hardware, or a combination thereof. Terminal 202 exchanges packets with PQMF server 222 located upstream or adjacent to call termination unit 216. The PQMF server (e.g., server 122 of Figure 1 or server 222 of Figure 2) is located upstream of VoIP call termination unit 216 to facilitate efficient broadband monitoring (e.g., backhaul monitoring), and all traffic sent from the terminal (signaling and The bearer) is guaranteed to pass through the broadband termination unit.

3 is a flow diagram of a method 300 for determining the quality of a communication link in a communication system, such as the system of FIG. 1 or 2. Method 300 includes configuring one or more first packets having characteristics common to the type of packet for which quality determination is desired, as indicated by block 302. As described above, according to one aspect, the PQMF packet is configured to have the same protocol, type of service (ToS), and size as the data packet of interest to ensure the same transmission characteristics on the network.

It is noted that an endpoint terminal, such as terminal 202 or communication device 106, may implement the process of block 302 (and the initiation of path quality monitoring). Moreover, an alternate implementation of the process of block 302 may include initiating path quality monitoring by the AP or other device in the network, or initiating path quality monitoring in response to another endpoint terminal. For example, terminal 106 can receive a report from a peer to peer communications terminal, such as a device in device 116 indicating poor path quality. In response, the terminal may send one or more first PQMF packets to the PQMF server, initiating QoS determinations for the LAN 202 and the backhaul 110 to see if a problem is present at the terminal 106. Further in accordance with this example, if the quality of the communication link from the terminal 106 to the call termination unit 114 is determined to be good by transmission of the PQMF packet, the terminal 106 can be further configured to transmit to the peer to peer communication terminal 116 for indicating that the communication link is of good quality. Message.

After configuring the first packet, as indicated by block 304, the communication is transmitted over a communication link or network to a server (e.g., PQMF server 122 or 222) located near the terminating device (e.g., terminating unit 114 or 216). Grouping. Also, the endpoint terminal (e.g., 106 or 202) can implement the process. In addition, the server is located near the call termination unit to ensure transmission of the first packet over the LAN and backhaul links. After transmitting the first packet, as indicated by block 306, the server transmits one or more second packets in response to each respective first packet transmitted. That is, the server responds to each of the received first packet types by returning a corresponding second packet to the terminal. It is noted that, according to one aspect, the second packet is configured to have the same common characteristics as the first packet type to ensure the same service treatment level in the downlink path. However, it is foreseen that the first and second packets do not necessarily need to match each other. In addition, the server can be configured to calculate statistical values related to the transmission of the first packet. In this case, one or more second packets can also be configured to carry these calculated statistics to the terminal.

As represented by block 308, after transmission of the second packet, the path quality of the communication link is determined based on the transmission characteristics of the received second packet corresponding to the transmitted first packet. This characteristic includes the time at which the second packet was received at the device transmitting the first packet, the round trip time of the first and second packets being provided, and the round trip time can be utilized to determine the delay. Other characteristics may include determination of packet

loss and jitter when transmitting a plurality of first and second packets, respectively. In one example, packet loss and jitter are calculated from a plurality of packets, including packets exchanged in the past. Following the process of block 308, it is noted that a further process (not shown) may include determining a handover trigger for the terminal based on the path quality determination result.

It is to be noted that it is desirable to perform process 300 in a short time (low latency) to provide fast feedback of path quality estimates. When it is necessary to switch, a quick estimate helps trigger the switch faster and does not introduce a large delay in the final switch. Accordingly, fast switching will ensure QoS for language calls. For example, two methods for better ensuring low latency are conceivable.

First, the PQMF process should be completed quickly. Fast completion of the PQMF process will reduce the latency in determining path QoS and help reduce the overhead required for this determination.

Second, the PQMF program should be started as soon as possible. The earlier the PQMF program begins, the faster the terminal can respond to quality degradation. However, early triggering for initiating a PQMF procedure may be affirmative, resulting in unnecessary path quality determination. This false positive and corresponding overhead can lead to an undesired increase in business. Furthermore, depending on the state of the protocol, the PQMF procedure can be executed more frequently or less frequently. For example, if the returned second packet is not received, the first packet can be sent immediately to sample the link again. When the terminal is idle, the PQMF process can be performed less frequently to minimize network load.

Process 300 also has low overhead in the network. One of the reasons is that if the PQMF process is performed when the path quality deteriorates, the process should not introduce a large amount of traffic in the network that further deteriorates the situation. The number of transmissions for each path quality estimation phase (i.e., sending or receiving packets to the PQMF server) should be small. Also, the total number of stages can be limited by introducing sufficient amount of hysteresis between successive stages.

In addition, process 300 should achieve accuracy in path quality estimation. Errors in the estimate can lead to erroneous handoff decisions, and as previously mentioned, unnecessary handoffs will not improve call quality and will incur additional overhead and therefore undermine any advantages achieved by keeping the call on the local area network. . Conversely, switching without performing handover when switching is required can adversely affect the QoS of the call.

Moreover, the process 300 of FIG. 3 can be initiated based on a variety of different criteria. One of the criteria may be to trigger in response to a particular detection condition. Examples may include, but are not limited to,

detecting two or more consecutively lost RTP frames at the application layer, a set number of lost RTP frames in a predetermined number of expected frames, observing in a predetermined number of consecutive RTP frames To large jitter, or to receive an indication of dissatisfaction with quality from the other end. RTCP reports or other types of reports can be used.

Another criterion for performing process 300 may be based on a predetermined period or cycle. More specifically, according to an example, a large time period or time interval (which may be referred to as "slow PQMF") may be set between transmissions of PQMF packets to allow the terminal to periodically measure link quality without introducing significant Network overhead. According to another example, when a slow PQMF procedure indicates a potential quality problem, the terminal can dynamically switch to a smaller time interval (referred to as "fast PQMF") to more accurately measure link quality statistics, such as groupings. Loss rate. The fast PQMF can also be triggered by other terminal conditions, such as call origination on Wi-Fi, a sudden increase in downlink packet loss, and the like. In this way, the terminal can monitor the link quality at any time while maintaining low network overhead.

Furthermore, it is noted that many applications are known to send packets at uneven intervals. For example, discontinuous speech codecs such as AMR, EVRC, and EVRC-B can change the packet interval from 20 ms to as high as 640 ms during the silent period. The estimated packet loss of such a voice synthesizer can produce an inaccurate estimate of link quality. For example, losing one frame every 3 frames during silence will show an excessively pessimistic 33% loss rate and can trigger unnecessary switching. For codecs that completely stop transmitting frames during silence, such as a particular implementation of G.711, the packet loss metric will not be updated at all. For the case where very few packets are observed during the packet loss measurement interval, the terminal can rely on the PQMF to accurately indicate the link quality.

It is to be noted herein that those skilled in the art will understand the various implementations envisioned by the network assisted method. In the following discussion, some examples of such an implementation for locating a PQMF server are discussed, similar to server 222 shown in FIG. It is further noted that this implementation may utilize a standard or proprietary protocol rather than implementing a dedicated PQMF packet protocol.

In one example, the communication terminal can implement path quality monitoring using the Internet Control Message Protocol (ICMP). In this case, the originating terminal can use a function similar to route tracking to discover the termination of the broadband, and then use the function like ICMP ping to monitor the quality of the broadband. In addition, the 3rd Generation Partnership Project (3GPP) introduces Packet Data Gateway (PDG) functionality as a security gateway into the core network of service providers. The corresponding 3GPP2 function is called the Packet Data Interworking Function (PDIF). The terminal establishes a secure IPsec tunnel with the PDG using an Internet Key Exchange (e.g., IKEv2) protocol. In this case, the PQMF can be located at the PDG because the PDG is located near the end of the VoIP call.

VoIP service providers typically manage the PDG, and thus PQMF deployment at the PDG will be easier. Also, the IKEv2 protocol provides hooks to help PQMF implementation. The operator can configure the VoIP service so that the signaling and bearer services to and from the terminal pass through the IPsec tunnel. In this implementation, the traffic from the terminal to the PQMF server has the same characteristics as the VoIP traffic on the shared network path.

It is to be noted that in one instance of a Skype<TM> type network, bearer traffic is typically routed via a super node. A similar technical solution is standardized to route all traffic to and from the terminal via an intermediate media repeater. In the case of such a media repeater, the PQMF "server" can be located at the media repeater. The Path Quality Monitoring (PQM) protocol exchange and corresponding metrics will then indicate the quality of the shared network path to the VoIP service.

In addition, the Generic Access Network (GAN) proposes a structure in which a handset and a GAN Controller (GANC) encapsulates GSM NAS signaling and GSM encoded speech into an Internet Protocol Security (IPsec) tunnel. The GANC interfaces with the GSM core network and performs the necessary emulation to maintain the interface to the Mobile Switching Center MSC and the Gb interface to the Serving GPRS Support Node (SGSN). In the GAN network, the PQMF can be located at the GANC. All signaling and services are routed through GANC. By placing the PQMF at the GANC, the PQMF "server" and the terminal can coordinate to determine the path quality. Therefore, degradation of path quality can serve as a necessary trigger for performing handovers (roaming out) from GAN to GSM. Alternatively, the terminal, media gateway, and GANC may renegotiate media characteristics, such as coding rate, redundancy, packing, etc., when path quality degradation is detected. This renegotiation may be useful when the coverage of the WAN is insufficient to perform the handover.

The presently illustrated examples of Figures 1 and 2 illustrate a network assisted method in which a terminal includes intelligence for initiating and detecting path quality, while a server located at or near the terminating end of the call makes a packet to the terminal. Out of response. It is to be noted that those skilled in the art will appreciate that other methods can be utilized to implement the path quality monitoring functionality disclosed herein. For example, it may be changed to a method using network control in which intelligence for initiating and detecting path quality is located in the network and not in the terminal. In this example, the network will detect QoS degradation and notify the terminal if a handover is approved. Another approach envisaged is an end-to-end approach in which intelligence for detecting path quality degradation is located in the endpoint terminal. After QoS degradation, the terminals coordinate with each other to determine the source of the problem, and the terminal at the path downgrade takes appropriate action to improve call quality.

4 is a block diagram showing a protocol for an exemplary implementation of a path quality monitoring function.

As shown, the quality monitored path is the path between terminal 402 and PQMF server 404. As shown in block 406, terminal 402 is associated with a local area network, such as a wireless LAN (WLAN). Moreover, in the case of VoIP services, terminal 402 can perform VoIP registration for those particular LAN network infrastructures, where those specific LAN network infrastructures converge on the convergence of data, voice, and mobile network technologies over IP-based infrastructure.

As indicated by block 408, after the terminal is associated with the LAN, PQMF discovery can then be initiated. The terminal discovers the IP address of the PQMF server or function body 404. The specific process used to perform the discovery depends on the choice of the base layer protocol. As indicated by block 410, path quality monitoring calibration can be performed when a PQMF server or function is discovered. In particular, terminal 402 can calibrate the path quality by initiating a path quality monitoring exchange. For example, terminal 402 can transmit xc path quality measurement request messages to PQMF server 404 in each yc duration. The PQMF server 404 responds with a path quality measurement response message. Terminal 402 collects the response and determines metrics such as delay, jitter, and loss rate. For example, the calibration process can be performed during a VoIP call or while idle. The calibration process can be repeated as needed. In addition, each new calibration measurement can be used to filter previous calibration measurements.

The calibration process 410 is not required to be performed each time it is registered. The terminal can store the results of the last calibration and associate these results with, for example, a WLAN identity. For example, in the case of a Wi-Fi network, the WLAN identity may be the MAC address of the AP. Terminal 402 can again use these results in subsequent associations. Alternatively, the terminal can also write the value of the required QoS parameters and therefore does not require a calibration process. The calibration process can also be used to determine if a VoIP call is taking place on the WLAN. If the calibration result indicates that there is insufficient QoS on the path involving the WLAN, the terminal can decide to place the call on the WAN instead of the LAN. In addition, the terminal can store the results of the calibration in a local database. In addition, the inability to support the required QoS repeatedly can also be used to blacklist specific WLANs in future calls.

As indicated by block 412, after calibration, a path quality assessment is performed. According to an example, terminal 402 can perform a PQMF exchange at a predefined time interval or after a trigger occurs. The terminal 402 transmits xt path quality measurement request messages to the PQMF server 404 in each yt duration (e.g., the first packet described above with respect to FIG. 3). The length and rate at which the request message is sent should be optimized to ensure accurate measurements without substantially affecting the traffic on the path being measured. The PQMF server 404 responds with a path quality measurement response message (e.g., the second packet described in connection with FIG. 3). Terminal 402 can collect the response and determine metrics such as delay, jitter, and loss rate.

After the path quality assessment in block 412, as indicated by block 414, terminal 420 can initiate a further path

quality analysis and determine a handover decision based on the analysis results. Terminal 402 compares the trigger metric to the previously determined calibrated metric. Upon detecting a degradation in path quality, terminal 402 can initiate a handover to another network, such as a WAN, or alternatively, its data rate and coding rate can be adjusted.

It is to be noted that some of the functional blocks of Figure 4 are optional, such as registration and discovery. And the functions of blocks 408, 410, 412, and 414 are not necessarily performed in order, and two or more of these functions may be performed in parallel.

It is also noted that the PQMF methods and apparatus disclosed herein above may be implemented using a packet/message customization protocol. Moreover, those skilled in the art will appreciate that currently known protocols, such as Internet Control Message Protocol (ICMP) and Internet Key Exchange (IKE), can also be reused or modified to implement the path quality monitoring disclosed herein. These alternative protocols are described in the context of Figure 4.

Regarding ICMP, if the PQMF server 404 is located at the PDG/PDIF, the discovery program 408 will identify the IP address of the PQMF server so that the terminal (e.g., 402 of Figure 4) discovers the PQMF server. By using ICMP, the terminal 402 can use the ICMP Echo Request packet as a path quality measurement request message. The PQMF performed by the server 404 can then use the ICMP Echo Response Packet as a Path Quality Measurement Response message. Reusing the ICMP process for PQMF eliminates the need to develop new protocols, thus minimizing the latency and complexity of the deployment process.

It is noted that if the terminal 402 attempts to perform an ICMP process with a DSLAM or CMTS router, the ICMP process may fail because the network element often disables the ICMP process for security reasons. To ensure the success of PQMF discovery and evaluation, the PQMF server can be located at PDG/PDIF. To this end, VoIP service providers can support ICMP processes at PDG/PDIF. The terminal can then perform an ICMP procedure with the PDG/PDIF through an IPsec tunnel. Since it is beneficial for the intermediate router to process ICMP packets similarly to handling media traffic (eg, VoIP traffic), terminal 402 can tag the ICMP echo request carrying the same Type of Service (TOS) field (differentiated service tag) as the media service. IP datagram. The PQMF can also properly flag the ICMP echo response.

In general, it is not sufficient to only mark the TOS field of an ICMP packet because the intermediate router may look at additional fields, such as protocol types, to schedule packet processing. However, since an IPsec tunnel is used to route ICMP packets, the intermediate router cannot check internal packets. The markings made on the external packets ensure that ICMP packets and VoIP packets are processed identically on the network path between the terminal and the PQMF to ensure accurate path quality measurements for the media traffic of

interest.

The second option is to use the IKE (for example, IKEv2) protocol, which provides hooks to aid in the implementation of the Path Quality Monitoring Function (PQMF). Specifically, IKEv2 supports information exchange, wherein the request message in the IKEv2 information exchange may not include a payload. According to this protocol, the IKEv2 peer must respond to the request with a response message. This keep-alive feature can be used to estimate path characteristics. It is contemplated that terminal 402 and PQMF server 404 can use these IKEv2 messages for path quality measurement requests and path quality measurement response messages. Also, terminal 402 marks the IKEv2 information request with the same differentiated service tag as the VoIP service to ensure that the transmission of the request matches the transmission of the network to the VoIP service, and thus ensures accurate measurements. Likewise, the PQMF server 404 will also properly flag the IKEv2 information response.

As mentioned previously, a network controlled method for implementing PQMF in a communication system is also contemplated. FIG. 5 illustrates an exemplary implementation of a PQMF of network control mode in communication system 500. Specifically, this method places the PQMF function at PDG/PDIF 502, which observes the VoIP traffic flow. By monitoring the flow from each endpoint, the PQMF at PDG/PDIF 502 can identify where quality degradation has occurred. When the PQMF determines that the path between the terminal 504 and the PQMF (e.g., AP 506 and backhaul 508) is degraded, then the PQMF can coordinate with the PCRF 510 and the P-CSCF 512 to notify the terminal 502 of the associated quality degradation and handover. need. The PQMF located at PDG 502 uses the Diameter protocol (Gx Diameter) to report any quality degradation to PCRF 510. PCRF 510 relays this information to P-CSCF 512 using the Diameter protocol (Gx Diameter). The P-CSCF 512 then notifies the terminal 502 of the QoS deficit using, for example, a Session Initiation Protocol (SIP) signal 514. Alternatively, the PQMF and terminal 504 at the PDG 502 can communicate directly with each other using a custom protocol to notify the terminal 502 that a handover needs to be performed.

Another example of a PQMF implementation controlled by a network may include the use of a femtocell instead of a WLAN AP. The femtocell base station can be configured to perform a PQMF procedure, exchange PQMF packets with the PQMF server. The femtocell base station server will then initiate a handover of the terminal.

FIG. 6 illustrates an exemplary apparatus for determining the quality of a communication link path. It is to be noted that the device 600 can be configured as a communication terminal or device, or a processor or the like used in a communication terminal, device, or AP. As shown, the apparatus includes a module 602 for configuring one or more first packets to have characteristics common to packet types that require quality determination.

The first packet is passed to block 606 via bus 604 or similar communication coupling, and module 606 is for transmitting one or more first packets on a communication link to a server (i.e., the PQMF server shown in Figure 6). As previously mentioned, the PQMF server returns one or more second packets, and module 608 receives the second packet. Module 610 then evaluates the characteristics of the received second packet to determine the quality of the communication link based on the characteristics of the received second packet. Apparatus 600 can also include a module 612 for initiating or triggering the device to switch from a connection to a current network, such as a WLAN, to another network, such as a WAN. Moreover, where device 600 is configured as a communication terminal rather than a processor, device 600 can optionally include a processor 614. In this case, processor 614 can implement the initiation or scheduling of the processes performed by these modules. And apparatus 600 can also include an optional computer readable medium or memory 616 for storing computer readable instructions and data for implementing the modules or processors disclosed herein (at device 600 being configured as a terminal The case or behavior of the method or method.

It will be understood that the specific order or hierarchy of any steps in the above process is only one example of the exemplary method. It is understood that the specific order or hierarchy of steps in the process can be rearranged in accordance with the design. The method claims present elements of the various steps in the exemplary order, but are not intended to be limited to the specific order or hierarchy.

Those skilled in the art will appreciate that information and signals can be represented using a variety of different techniques and methods. For example, data, instructions, commands, information, signals, bits, symbols, and chips referred to throughout the specification may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, light fields or particles, or any combination thereof.

Those skilled in the art will also appreciate that any of the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments of the present application can be implemented as electronic hardware, computer software, or a combination of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps are generally described in terms of their functionality. Whether such functionality is implemented as hardware or as software depends on the particular application and design constraints imposed on the overall system. A person skilled in the art can implement the described functions in a modified manner for each specific application, but such implementation decisions should not be interpreted as departing from the scope of the invention.

A general purpose processor, digital signal processor (DSP), application specific integrated circuit (ASIC), field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic device, discrete hardware component or design can be used The various illustrative logical blocks, modules, and circuits described in connection with the embodiments of the present application are implemented or executed in any combination of the above-described functions. A general purpose processor may be a microprocessor.

Alternatively, the general purpose processor may be any conventional processor, controller, microcontroller, or state machine. The processor can also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, a combination of one or more microprocessors and a DSP core, or any other such structure.

The steps of a method or algorithm described in connection with the embodiments of the present application can be directly embodied as hardware, a software module executed by a processor, or a combination thereof. The software modules can reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, removable disk, CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium (not shown) is coupled to the processor to enable the processor to read information from, and write information to, the storage medium. Alternatively, the storage medium may be an integral part of the processor. The processor and the storage medium can be located in an ASIC. The ASIC can be located in the user terminal. Of course, the processor and the storage medium can also exist as discrete components in the user terminal.

The above-described examples are merely exemplary, and those skilled in the art can make various uses from the above examples without departing from the inventive concepts disclosed herein. Various modifications to these examples can be readily made by those skilled in the art, and the general principles defined herein may be applied to other examples without departing from the spirit and scope of the inventive concepts disclosed herein. For example, in an instant messaging service or an example of any general wireless data communication application. Therefore, the scope of the disclosure is not intended to be limited to the examples shown herein. It is to be noted that the term "exemplary" is used exclusively herein to mean "serving as an example, instance, illustration." Any "exemplary" examples described herein are not necessarily to be construed as preferred or preferred. Accordingly, the scope of the novel aspects described herein is defined by the appended claims.

Notice

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CLAIMS CN101523809

1、

A method for determining a quality of a communication link for transmitting a packet of a specified type, the method comprising:

Configuring at least one first packet, the at least one first packet sharing at least one packet characteristic with the specified type of packet such that the at least one first packet experiences a similar communication link condition with the specified type of packet;

Transmitting the at least one first packet to the quality monitoring server located near the terminating unit on the communication link;

Receiving at least one second packet transmitted by the server in response to the corresponding first packet;

A quality of the communication link is determined based on characteristics of the received at least one second packet.

2、

The method of claim 1 wherein said communication link comprises at least one of a wireless network and a wired network.

3、

The method of claim 1 wherein said first and second packets are packets of the same type.

4、

The method of claim 1 wherein the at least one second packet is further configured to carry a statistical value calculated at the server to the terminal.

5、

The method of claim 1 wherein the size of the first and second packets matches at least one of a plurality of possible sizes of the specified type of packet.

6、

The method of claim 1 wherein the first and second packets are configured as a standardized packet type or a private packet type.

7、

The method of claim 1 wherein said transmission characteristic comprises at least one of:

The time between transmitting the first packet to receiving the second packet;

a link loss rate calculated from a set of first and second packets passing through the communication link; and

Packet jitter calculated from a set of first and second packets passing through the communication link.

8、

The method of claim 1 further comprising one of:

Initiating a handover of the communication terminal to another communication link based on the determination of the quality;

Initiating a change to at least one of a data rate and a coding rate of the communication terminal based on the determining of the quality;

Terminate the call.

9、

The method of claim 8 wherein the switching to another communication link comprises at least one of:

Handover to another network, handover to another serving cell in the same network, and switching to another frequency in the same network.

10、

The method of claim 1 wherein said at least one first packet is transmitted from said one of a communication terminal and an access terminal to said server.

11、

The method of claim 1 wherein the frequency for transmitting the plurality of first packets is variable.

12、

The method of claim 1 wherein the frequency for transmitting the plurality of first packets is dependent on at least one of:

Communication terminal activity, past measurements, and roaming locations.

13、

The method of claim 1 wherein said at least one first packet is transmitted in response to receiving a report indicating a poor link quality from a peer to peer communications terminal.

14、

The method of claim 13 further comprising:

When the determined quality of the communication link indicates that the communication link is of good quality, a message indicating that the communication link is of good quality is sent to the peer to peer communication terminal.

15、

The method of claim 1 wherein said specified type of packet is one of a real time protocol packet or a non-real time packet.

16、

An apparatus for determining the quality of a communication link, the apparatus comprising:

a configuration module, configured to configure at least one first packet, the at least one first packet sharing at least one packet characteristic with a specified type of packet, such that the at least one first packet experiences a similar communication link condition with the specified type of packet ;

a transmission module, configured to transmit, on the communication link, the at least one first packet to a quality monitoring server located near the terminating unit;

a receiving module, configured to receive at least one second packet transmitted by the server in response to the corresponding first packet;

And a determining module, configured to determine a quality of the communication link based on characteristics of the received at least one second packet.

17、

The apparatus of claim 16 wherein said communication link comprises at least one of a wireless network and a wired network.

18、

The apparatus of claim 16 wherein said first and second packets are packets of the same type.

19、

The apparatus of claim 16 wherein the at least one second packet is further configured to carry a statistical value calculated at the server to the terminal.

20、

The apparatus of claim 16, wherein the size of the first and second packets matches at least one of a plurality of possible sizes of the specified type of packet.

21、

The apparatus of claim 16, wherein the first and second packets are configured as a standardized type of packet or a private type of packet.

22、

The apparatus of claim 16 wherein said transmission characteristic comprises at least one of:

a time from when the first packet is transmitted to when the at least one second packet is received;

a link loss rate calculated from a set of first and second packets passing through the communication link; and

Packet jitter calculated from a set of first and second packets passing through the communication link.

23、

The apparatus of claim 16 further comprising means for performing one of:

Initiating a handover of the communication terminal to another communication link based on the determination of the quality;

Initiating a change to at least one of a data rate and a coding rate of the communication terminal based on the determining of the quality;

Terminate the call.

24、

The apparatus of claim 23 wherein the switching to the other communication link comprises at least one of:

Handover to another network, handover to another serving cell in the same network, and switching to another frequency in the same network.

25、

The apparatus of claim 16, wherein the at least one first packet is transmitted from the one of the communication terminal or the access terminal to the server.

26、

The apparatus of claim 16 wherein the frequency for transmitting the plurality of first packets is variable.

27、

The apparatus of claim 16, wherein the frequency for transmitting the plurality of first packets is dependent on at least one of the following:

Communication terminal activity, past measurements, and roaming locations.

28、

The apparatus of claim 16 further comprising:

A module for transmitting the at least one first packet in response to receiving a report indicating a poor link quality from a peer to peer communications terminal.

29、

The apparatus of claim 28, the processor is further configured to:

When the determined quality of the communication link indicates that the communication link is of good quality, a message indicating that the communication link is of good quality is sent to the peer to peer communication terminal.

30、

The apparatus of claim 16, wherein the specified type of packet is one of a real-time protocol packet or a non-real-time packet.

31、

A communication device operating in a communication system, the communication device comprising:

a processor comprising:

a first module, configured to configure at least one first packet, the at least one first packet sharing at least one packet characteristic with a specified type of packet, such that the at least one first packet experiences a similar communication link with the specified type of packet Happening;

a second module, configured to transmit the at least one first packet to the quality monitoring server located near the terminating unit on the communication link;

a third module, configured to receive at least one second packet transmitted by the server in response to the corresponding first packet;

And a fourth module, configured to determine a quality of the communication link based on characteristics of the received at least one second packet.

32、

The communication device of claim 32 wherein said communication link comprises at least one of a wireless network and a wired network.

33、

The communication device of claim 32 wherein said first and second packets are packets of the same type.

34、

The communication device of claim 32, wherein the at least one second packet is further configured to carry a statistical value calculated at the server to the terminal.

35、

The communication device of claim 32, wherein the size of the first and second packets matches at least one of a plurality of possible sizes of the specified type of packet.

36、

The communication device of claim 32, wherein the first and second packets are configured as a standardized type of packet or a private type of packet.

37、

The communication device of claim 32, wherein said transmission characteristic comprises at least one of:

a time from when the first packet is transmitted to when the at least one second packet is received;

a link loss rate calculated from a set of first and second packets passing through the communication link; and

Packet jitter calculated from a set of first and second packets passing through the communication link.

38、

The communication device of claim 32, wherein said processor further comprises a fifth module for performing one of:

Initiating a handover of the communication terminal to another communication link based on the determination of the quality;

Initiating a change to at least one of a data rate and a coding rate of the communication terminal based on the determining of the quality;

Terminate the call.

39、

The communication device of claim 38, wherein the switching to the other communication link comprises at least one of the following:

Handover to another network, handover to another serving cell in the same network, and switching to another frequency in the same network.

40、

The communication device of claim 32 wherein the frequency for transmitting said one or more first packets is variable.

41、

The communication device of claim 32, wherein the frequency for transmitting the plurality of first packets is dependent on at least one of:

Communication terminal activity, past measurements, and roaming locations.

42、

The communication device of claim 32, wherein the first module is further for transmitting the plurality of first packets in response to receiving a report indicating a poor link quality from the peer to peer communications terminal.

43、

The communication device of claim 42, wherein the first module is further configured to:

When the determined quality of the communication link indicates that the communication link is of good quality, a message indicating that the communication link is of good quality is sent to the peer to peer communication terminal.

44、

The communication device of claim 32, wherein the specified type of packet is one of a real-time protocol packet

or a non-real-time packet.

45、

A computer program product comprising a computer readable medium, the computer readable medium comprising:

a configuration code for causing a computer to configure at least one first packet, the at least one first packet sharing at least one packet characteristic with a specified type of packet such that the at least one first packet experiences a similar communication chain with the specified type of packet Road condition

Transmitting a code for causing a computer to transmit the at least one first packet to the quality monitoring server located near the terminating unit on the communication link;

Receiving code for causing a computer to receive at least one second packet transmitted by the server in response to the corresponding first packet;

Determining a code for causing a computer to determine a quality of the communication link based on characteristics of the received at least one second packet.

46、

The computer program product of claim 45, wherein the communication link comprises at least one of a wireless network and a wired network.

47、

The computer program product of claim 45, wherein the first and second packets are packets of the same type.

48、

The computer program product of claim 45, wherein the at least one second packet is further configured to carry a statistical value calculated at the server to the terminal.

49、

The computer program product of claim 45, wherein the size of the first and second packets matches at least one

of a plurality of possible sizes of the specified type of packet.

50、

The computer program product of claim 45, wherein the first and second packets are configured as a standardized type of packet or a private type of packet.

51、

The computer program product of claim 45, wherein the transmission characteristic comprises at least one of:

The time between transmitting the first packet to receiving the second packet;

a link loss rate calculated from a set of first and second packets passing through the communication link; and

Packet jitter calculated from a set of first and second packets passing through the communication link.

52、

The computer program product of claim 45, wherein the computer readable medium further comprises code for causing a computer to perform one of:

Initiating a handover of the communication terminal to another communication link based on the determination of the quality;

Initiating a change to at least one of a data rate and a coding rate of the communication terminal based on the determining of the quality;

Terminate the call.

53、

The computer program product of claim 52 wherein the switching to another communication link comprises at least one of:

Handover to another network, handover to another serving cell in the same network, and switching to another frequency in the same network.

54、

The computer program product of claim 46, wherein the at least one first packet is transmitted from one of a communication terminal or an access terminal to the server.

55、

The computer program product of claim 46, wherein the frequency for transmitting the plurality of first packets is variable.

56、

The computer program product of claim 46, wherein the frequency for transmitting the plurality of first packets is dependent on at least one of:

Communication terminal activity, past measurements, and roaming locations.

57、

The computer program product of claim 46, wherein the computer readable medium further comprises:

A code for causing a computer to transmit the at least one first packet in response to receiving a report indicating a poor link quality from a peer to peer communications terminal.

58、

The computer program product of claim 58, wherein the computer readable medium further comprises:

A code for causing a computer to transmit a message indicating that the communication link is of good quality to the peer to peer communications terminal when the determined quality of the communication link indicates that the communication link is of good quality.

59、

The computer program product of claim 46, wherein the specified type of packet is one of a real-time protocol packet or a non-real-time packet.

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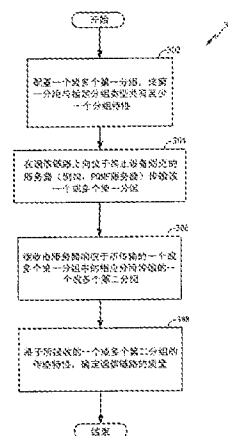
权利要求书 9 页 说明书 17 页 附图 6 页

[54] 发明名称

用于确定通信链路质量的方法和装置

[57] 摘要

本发明公开了一种用于确定对指定类型分组进行传输的通信链路的质量的方法和装置。该方法包括配置第一分组，该第一分组与诸如 IP 语音分组的指定类型分组共有传输特性，使得该第一分组与该指定类型分组经历相似的通信链路情况。然后在该通信链路上将第一分组传输到位于该特定通信链路的终止设备附近的质量监视服务器。对服务器响应于第一分组而传输的第二分组进行接收和评估，以基于该第二分组的特性确定该通信链路的质量。本发明还公开了对应的装置。



1、一种用于确定对指定类型分组进行传输的通信链路的质量的方法，所述方法包括：

配置至少一个第一分组，所述至少一个第一分组与所述指定类型分组共有至少一个分组特性，使得所述至少一个第一分组与所述指定类型分组经历相似的通信链路情况；

在所述通信链路上向位于终止单元附近的质量监视服务器传输所述至少一个第一分组；

接收由所述服务器响应于对应的第一分组而传输的至少一个第二分组；以及

基于所接收的至少一个第二分组的特性，确定所述通信链路的质量。

2、如权利要求 1 所述的方法，其中，所述通信链路包括无线网络和有线网络中的至少一个。

3、如权利要求 1 所述的方法，其中，所述第一和第二分组是相同类型的分组。

4、如权利要求 1 所述的方法，其中，将所述至少一个第二分组进一步配置为向所述终端携带在所述服务器处计算的统计值。

5、如权利要求 1 所述的方法，其中，所述第一和第二分组的大小与所述指定类型分组的多个可能大小中的至少一个大小匹配。

6、如权利要求 1 所述的方法，其中，将所述第一和第二分组配置为标准化的分组类型或私有的分组类型。

7、如权利要求 1 所述的方法，其中，所述传输特性包括以下至少一个：从传输所述第一分组到接收所述第二分组之间的时间；

根据一组经过所述通信链路的第一和第二分组计算的链路丢失率；以及

根据一组经过所述通信链路的第一和第二分组计算的分组抖动。

8、如权利要求 1 所述的方法，还包括以下其中之一：

基于所述质量的确定，发起通信终端到另一个通信链路的切换；

基于所述质量的确定，发起对所述通信终端的数据速率和编码速率中的至少一个的改变；以及
终止呼叫。

9、如权利要求 8 所述的方法，其中，到另一个通信链路的切换包括以下至少一个：

到另一个网络的切换、到相同网络中的另一个服务小区的切换和到相同网络中的另一个频率的切换。

10、如权利要求 1 所述的方法，其中，所述至少一个第一分组从通信终端和接入终端中的一个传输到所述服务器。

11、如权利要求 1 所述的方法，其中，用于传输多个第一分组的频率是可变的。

12、如权利要求 1 所述的方法，其中，用于传输多个第一分组的频率取决于以下至少一个：

通信终端活动、过去的测量结果和漫游位置。

13、如权利要求 1 所述的方法，其中，响应于从对等通信终端接收到指示差链路质量的报告，来传输所述至少一个第一分组。

14、如权利要求 13 所述的方法，还包括：

当所确定的所述通信链路的质量表明通信链路质量良好时，向所述对

等通信终端发送指示通信链路质量良好的消息。

15、如权利要求 1 所述的方法，其中，所述指定类型分组是实时协议分组或非实时分组中的一个。

16、一种用于确定通信链路的质量的装置，所述装置包括：

配置模块，用于配置至少一个第一分组，所述至少一个第一分组与指定类型分组共有至少一个分组特性，使得所述至少一个第一分组与所述指定类型分组经历相似的通信链路情况；

传输模块，用于在所述通信链路上向位于终止单元附近的质量监视服务器传输所述至少一个第一分组；

接收模块，用于接收由所述服务器响应于对应的第一分组而传输的至少一个第二分组；以及

确定模块，用于基于所接收的至少一个第二分组的特性，确定所述通信链路的质量。

17、如权利要求 16 所述的装置，其中，所述通信链路包括无线网络和有线网络中的至少一个。

18、如权利要求 16 所述的装置，其中，所述第一和第二分组是相同类型的分组。

19、如权利要求 16 所述的装置，其中，将所述至少一个第二分组进一步配置为向所述终端携带在所述服务器处计算的统计值。

20、如权利要求 16 所述的装置，其中，所述第一和第二分组的大小与所述指定类型分组的多个可能大小中的至少一个大小匹配。

21、如权利要求 16 所述的装置，其中，将所述第一和第二分组配置为标准化类型的分组或私有类型的分组。

22、如权利要求 16 所述的装置，其中，所述传输特性包括以下至少一个：

从传输所述第一分组到接收所述至少一个第二分组之间的时间；

根据一组经过所述通信链路的第一和第二分组计算的链路丢失率；以及

根据一组经过所述通信链路的第一和第二分组计算的分组抖动。

23、如权利要求 16 所述的装置，还包括用于执行以下其中之一的模块：

基于所述质量的确定，发起通信终端到另一个通信链路的切换；

基于所述质量的确定，发起对所述通信终端的数据速率和编码速率中的至少一个的改变；以及

终止呼叫。

24、如权利要求 23 所述的装置，其中，到另一个通信链路的切换包括以下至少一个：

到另一个网络的切换、到相同网络中的另一个服务小区的切换和到相同网络中的另一个频率的切换。

25、如权利要求 16 所述的装置，其中，所述至少一个第一分组从通信终端或接入终端中的一个传输到所述服务器。

26、如权利要求 16 所述的装置，其中，用于传输多个第一分组的频率是可变的。

27、如权利要求 16 所述的装置，其中，用于传输多个第一分组的频率取决于以下至少一个：

通信终端活动、过去的测量结果和漫游位置。

28、如权利要求 16 所述的装置，还包括：

用于响应于从对等通信终端接收到指示差链路质量的报告来传输所述至少一个第一分组的模块。

29、如权利要求 28 所述的装置，所述处理器还用于：

当所确定的所述通信链路的质量表明通信链路质量良好时，向所述对等通信终端发送指示通信链路质量良好的消息。

30、如权利要求 16 所述的装置，其中，所述指定类型分组是实时协议分组或非实时分组中的一个。

31、一种在通信系统中操作的通信设备，所述通信设备包括：
处理器，其包括：

第一模块，用于配置至少一个第一分组，所述至少一个第一分组与指定类型分组共有至少一个分组特性，使得所述至少一个第一分组与所述指定类型分组经历相似的通信链路情况；

第二模块，用于在所述通信链路上向位于终止单元附近的质量监视服务器传输所述至少一个第一分组；

第三模块，用于接收由所述服务器响应于对应的第一分组而传输的至少一个第二分组；以及

第四模块，用于基于所接收的至少一个第二分组的特性，确定所述通信链路的质量。

32、如权利要求 32 所述的通信设备，其中，所述通信链路包括无线网络和有线网络中的至少一个。

33、如权利要求 32 所述的通信设备，其中，所述第一和第二分组是相同类型的分组。

34、如权利要求 32 所述的通信设备，其中，将所述至少一个第二分组进一步配置为向所述终端携带在所述服务器处计算的统计值。

35、如权利要求 32 所述的通信设备，其中，所述第一和第二分组的大小与所述指定类型分组的多个可能大小中的至少一个大小匹配。

36、如权利要求 32 所述的通信设备，其中，将所述第一和第二分组配置为标准化类型的分组或私有类型的分组。

37、如权利要求 32 所述的通信设备，其中，所述传输特性包括以下至少一个：

从传输所述第一分组到接收所述至少一个第二分组之间的时间；

根据一组经过所述通信链路的第一和第二分组计算的链路丢失率；以及

根据一组经过所述通信链路的第一和第二分组计算的分组抖动。

38、如权利要求 32 所述的通信设备，其中，所述处理器还包括第五模块，用于执行以下其中之一：

基于所述质量的确定，发起通信终端到另一个通信链路的切换；

基于所述质量的确定，发起对所述通信终端的数据速率和编码速率中的至少一个的改变；

终止呼叫。

39、如权利要求 38 所述的通信设备，其中，到另一个通信链路的切换包括以下至少一个：

到另一个网络的切换、到相同网络中的另一个服务小区的切换和到相同网络中的另一个频率的切换。

40、如权利要求 32 所述的通信设备，其中，用于传输所述一个或多个第一分组的频率是可变的。

41、如权利要求 32 所述的通信设备，其中，用于传输多个第一分组的

频率取决于以下至少一个：

通信终端活动、过去的测量结果和漫游位置。

42、如权利要求 32 所述的通信设备，其中，所述第一模块还用于：响应于从对等通信终端接收到指示差链路质量的报告，来传输多个第一分组。

43、如权利要求 42 所述的通信设备，其中，所述第一模块还用于：

当所确定的所述通信链路的质量表明通信链路质量良好时，向所述对等通信终端发送指示通信链路质量良好的消息。

44、如权利要求 32 所述的通信设备，其中，所述指定类型分组是实时协议分组或非实时分组中的一个。

45、一种包括计算机可读介质的计算机程序产品，所述计算机可读介质包括：

配置代码，用于使计算机配置至少一个第一分组，所述至少一个第一分组与指定类型分组共有至少一个分组特性，使得所述至少一个第一分组与所述指定类型分组经历相似的通信链路情况；

传输代码，用于使计算机在所述通信链路上向位于终止单元附近的质量监视服务器传输所述至少一个第一分组；

接收代码，用于使计算机接收由所述服务器响应于对应的第一分组而传输的至少一个第二分组；以及

确定代码，用于使计算机基于所接收的至少一个第二分组的特性，确定所述通信链路的质量。

46、如权利要求 45 所述的计算机程序产品，其中，所述通信链路包括无线网络和有线网络中的至少一个。

47、如权利要求 45 所述的计算机程序产品，其中，所述第一和第二分组是相同类型的分组。

48、如权利要求 45 所述的计算机程序产品，其中，将所述至少一个第二分组进一步配置为向所述终端携带在所述服务器处计算的统计值。

49、如权利要求 45 所述的计算机程序产品，其中，所述第一和第二分组的大小与所述指定类型分组的多个可能大小中的至少一个大小匹配。

50、如权利要求 45 所述的计算机程序产品，其中，将所述第一和第二分组配置为标准化类型的分组或私有类型的分组。

51、如权利要求 45 所述的计算机程序产品，其中，所述传输特性包括以下至少一个：

从传输所述第一分组到接收所述第二分组之间的时间；

根据一组经过所述通信链路的第一和第二分组计算的链路丢失率；以及

根据一组经过所述通信链路的第一和第二分组计算的分组抖动。

52、如权利要求 45 所述的计算机程序产品，其中，所述计算机可读介质还包括用于使计算机执行以下其中之一的代码：

基于所述质量的确定，发起通信终端到另一个通信链路的切换；

基于所述质量的确定，发起对所述通信终端的数据速率和编码速率中的至少一个的改变；以及

终止呼叫。

53、如权利要求 52 所述的计算机程序产品，其中，到另一个通信链路的切换包括以下至少一个：

到另一个网络的切换、到相同网络中的另一个服务小区的切换和到相同网络中的另一个频率的切换。

54、如权利要求 46 所述的计算机程序产品，其中，所述至少一个第一

分组从通信终端或接入终端中的一个传输到所述服务器。

55、如权利要求 46 所述的计算机程序产品，其中，用于传输多个第一分组的频率是可变的。

56、如权利要求 46 所述的计算机程序产品，其中，用于传输多个第一分组的频率取决于以下至少一个：

通信终端活动、过去的测量结果和漫游位置。

57、如权利要求 46 所述的计算机程序产品，其中所述计算机可读介质还包括：

用于使计算机响应于从对等通信终端接收到指示差链路质量的报告来传输所述至少一个第一分组的代码。

58、如权利要求 58 所述的计算机程序产品，其中，所述计算机可读介质还包括：

用于使计算机当所确定的所述通信链路的质量表明通信链路质量良好时，向所述对等通信终端发送指示通信链路质量良好的消息的代码。

59、如权利要求 46 所述的计算机程序产品，其中，所述指定类型分组是实时协议分组或非实时分组中的一个。

用于确定通信链路质量的方法和装置

基于 35 U.S.C. §119 要求优先权

本申请要求于 2006 年 9 月 28 日递交的、标题分别为“Handoff Triggers for WLAN and VoWLAN”、“Estimation of the Path Quality to assist handoff Decision”和“Handoff Algorithms for VoIP over WLAN”的临时申请 No.60/848,414、60/848,415 和 60/945,054 的优先权，该临时申请已经转让给本申请的受让人，故以引用方式将其明确地并入本文。

共同未决的专利申请的引用

本专利申请涉及以下共同未决的美国专利申请：

与本申请同时递交的，代理人号为 No. 070007 的 Meylan 等人的“METHODS AND APPARATUS FOR DETERMINING QUALITY OF SERVICE IN A COMMUNICATION SYSTEM”，其已转让给本申请的受让人并且以引用的方式明确并入本申请。

技术领域

本公开一般涉及用于确定通信链路的质量的方法和装置，并且更具体地，涉及确定具有实时业务（诸如语音数据）无线或有线网络传输的通信链路或路径的服务质量。

背景技术

在通信系统中，对使用了实时业务（诸如端到端 IP 语音（VoIP）呼叫）的应用的利用正在日益增加。在这种应用中所涉及的端点之间的路由一般将通过多种不同的通信网络技术中的任意一种或任何组合来接入 IP 网络（例如，因特网）。所使用的网络技术的类型的实例可以包括：诸如 Wi-Fi（IEEE 标准 802.11）的无线局域网（WLAN）、诸如 1X-EVDO 的蜂窝网络、高速分组接入（HSPA）、诸如 WiMAX（IEEE 802.16）的无线广域网

(WWAN)、毫微微蜂窝 (femtocell)、以及其它各种已知的或将要定义的网络技术。因此,在端点之间的路由中,可以在众多网络上交换实时业务。例如,在居住环境中的用户 A 和用户 B 之间的端到端 VoIP 呼叫中,VoIP 分组可能经过用户 A 的 Wi-Fi 接入网、用户 A 的 DSL 或有线宽带网、IP 核心网、用户 B 的 DSL 或有线宽带网、和用户 B 的 Wi-Fi 接入网。

在 VoIP 业务的情况下,例如,携带语音数据的 VoIP 分组必须在可允许的最大延迟约束之内经过所有网络,以达到可接受的服务质量 (QoS)。因为 VoIP 分组经过语音呼叫的端点之间的许多可能完全不同的网络,并且因为诸如因特网的宽带网络一般携带多种类型的数据分组,所以监视每个网络链路中对延迟敏感的语音分组的 QoS 通常是不可行的。因此,VoIP 的 QoS 更易于由语音呼叫的端点处的一个或两个设备(例如,诸如移动电话或计算机的终端)来监视,因为这种设备受到用于对该呼叫进行路由的网络中随处所发生的 QoS 降级的影响。

尽管在某些用于路由语音呼叫的网络中,例如在 Wi-Fi 介质接入控制 (MAC) 管理信息库 (MIB) 中,可以提供质量确定度量,但是这种度量并不是对于所有情况都能有效地确定最终的路径质量。例如,考虑在居住环境中的无线局域网语音 (VoWLAN) 中发生的 VoIP 呼叫。为了确定 QoS,至少需要监视 4 个链路:从 LAN 接入点 (AP) 到通信终端的下行链路、从通信终端到 AP 的上行链路、从呼叫终止设备(例如,在 VoIP 服务提供商的网络处的媒体服务器)经过因特网骨干和线缆/DSL 回程线路到 AP 的下行链路、以及从 AP 经过因特网骨干和线缆/DSL 回程线路到呼叫终止设备的上行链路。通信终端可以使用本地可见的事件,例如分组丢失或信号强度,来监视这些链路中的至少前两个链路。然而,不存在对 AP 和终止设备之间的上行链路和下行链路的质量提供监视的已知机制。因此,需要一种用于在通信终端或 AP 处测量或确定从 AP 到终止设备的通信路径的至少一部分的 QoS、尤其是携带实时业务的路径的 QoS 的机制。

发明内容

根据一个方面,公开了一种确定用于传输指定类型分组的通信链路的质量的方法。该方法包括配置或形成至少一个第一分组,该至少一个第一

分组与该指定类型分组共有至少一个分组特性，使得该至少一个第一分组与该指定类型分组经历相似的通信链路对待。此外，该方法包括在该通信链路上向位于终止单元附近的质量监视服务器传输该至少一个第一分组，然后接收由该服务器响应于对应的第一分组而传输的至少一个第二分组。最后，该方法包括基于所接收的至少一个第二分组的特性，确定该通信链路的质量。

根据另一个方面，公开了一种用于确定通信链路的质量的装置。该装置包括用于配置至少一个第一分组的模块，该至少一个第一分组与指定类型分组共有至少一个分组特性，使得该至少一个第一分组与该指定类型分组经历相似的通信链路情况。该装置还包括用于在该通信链路上向位于终止单元附近的质量监视服务器传输该至少一个第一分组的模块、用于接收由该服务器响应于对应的第一分组而传输的至少一个第二分组的模块、以及用于基于所接收的至少一个第二分组的特性来确定该通信链路的质量的模块。

根据另一个方面，公开了一种可在无线系统中操作的通信设备。该通信设备包括处理器，该处理器具有该第一模块，用于配置至少一个第一分组，该至少一个第一分组与指定类型分组共有至少一个分组特性，使得该至少一个第一分组与该指定类型分组经历相似的通信链路情况。该处理器还包括第二模块，该第二模块用于在该通信链路上向位于终止单元附近的质量监视服务器传输该至少一个第一分组。该处理器还包括第三模块，该第三模块用于接收由该服务器响应于对应的第一分组而传输的至少一个第二分组。该处理器还包括第四模块，该第四模块用于基于所接收的至少一个第二分组的特性来确定通信链路的质量。

根据另一个方面，公开了一种包括计算机可读介质的计算机程序产品，该介质包括用于使计算机配置至少一个第一分组的代码，该至少一个第一分组与指定类型分组共有至少一个分组特性，使得该至少一个第一分组与该指定类型分组经历相似的通信链路情况。该介质还包括用于使计算机在该通信链路上向位于终止单元附近的质量监视服务器传输该至少一个第一分组的代码、用于使计算机接收由该服务器响应于对应的第一分组而传输的至少一个第二分组的代码。最后，该介质包括用于使计算机基于所接收

的至少一个第二分组的特性来确定该通信链路的质量的代码。

附图说明

图 1 是用于实现采用了质量确定的 VoIP 通信的通信系统的图。

图 2 是示出了在通信系统中用于在其上执行质量确定和度量监视的级别的方框图；

图 3 是用于在通信系统中确定通信链路质量的方法的流程图；

图 4 是示出了用于路径质量监视功能的协议的方框图；

图 5 示出了采用在网络控制之下进行路径质量监视的示例性实现的通信系统；

图 6 示出了用于确定通信链路的路径质量的示例性装置。

具体实施方式

图 1 是采用了路径质量确定的示例性通信系统 100 的图。正如本文将要详述的，系统 100 可用于在两个端点（例如，两个通信终端或站）之间进行 VoIP 呼叫。系统 100 可以包括局域网 102，例如无线局域网（WLAN）102，局域网 102 可以根据诸如 Wi-Fi（IEEE 标准 802.11）的多个无线网络标准中的任意一个来操作。局域网 102 包括接入点（AP）104，AP 104 与诸如移动设备 106 的通信终端端点或诸如计算机 108 的其它电子设备通信。AP 104 还与回程链路 110 通信。

回程链路 110 可以包括诸如数字用户线路（DSL）或线缆宽带连接的多种类型的网络连接中的任意一种。回程链路 110 用于将局域网 102 与诸如因特网骨干 112 的广域网可通信地耦合。具体地，回程链路 110 在呼叫终止单元 114 处终止，呼叫终止单元 114 与因特网骨干 112 通信。在 VoIP 服务的实例中，呼叫终止单元 114 可以被配置为 VoIP 服务提供商的网络中的媒体服务器。例如，因特网骨干 112 用于经由另一个回程链路 118 和 AP 120，向端到端连接的另一端的最终终端设备 116 传输诸如 VoIP 分组的实时业务。

要注意，每个终端端点（例如，106、108）可以配置为仅监视 LAN 102 所提供的质量。以 AP 104 是 Wi-Fi AP 为例，终端 106 可以监视已知的 WLAN

参数，例如接收信号强度指示符（RSSI）、信噪比（SNR）、失败帧接收、下行链路帧重传和网络负载，以估计 Wi-Fi 下行链路的质量。同样的，终端也可以监视例如上行链路帧重传和失败帧重传的参数，以估计 Wi-Fi 上行链路的质量。在确定了 Wi-Fi 上行链路和 Wi-Fi 下行链路中的任意一个或两者的降级之后，通信终端（106、108）可以采取适当的措施来改善呼叫质量，例如将呼叫从 AP 104 切换到另一个网络（未显示），或者调整媒体编码特性。此外，如果不能找到具有合适 QoS 的网络，则终端可以终止该呼叫。

尽管希望每个终端端点监视本地 WLAN 接入链路并且检测任意降级，终端中的这种支持是依赖于具体实现的。除了以上 WLAN 度量之外，每个终端还可以监视其它 WLAN 参数，例如 RTP 层分组丢失、分组抖动、播放缓存统计和 RTCP 报告。尽管这些度量可用于识别端到端 QoS 的损失，但是它们不能用于表征 WLAN 本地访问之外的链路的质量降级。例如，考虑图 1 中的终端 106 和 116 之间的 VoIP 呼叫。106 处的 RTP 分组丢失可能是由回程链路 110 或回程链路 118 的降级引起的，其中回程链路 110 是终端 106 的 AP 下行链路，回程链路 118 是终端 116 的 AP 上行链路。如果链路 110 降级，则终端 106 可以通过将呼叫切换到未使用该链路的网络（未显示）来改善呼叫质量。然而，如果链路 118 降级，则这种由终端 106 的切换将无助于改善呼叫质量。在这种情况下，终端 116 将需要采取适当的措施来改善呼叫质量。因此，例如仅基于所观察到的 QoS 降级来触发从 WLAN 到广域网 WAN 的切换这样的简单方法可能不会永远起作用，并且可以引入不必要的开销。

要注意，携带呼叫业务的核心网（例如因特网骨干 112）一般配备完善并且支持 QoS。因此，为了本公开说明的目的，假设 LAN 本地访问和宽带连接（即，回程链路 110）是质量降级的主要原因。

因此，示例性系统 100 还可以包括质量监视服务器 122，其用于辅助确定例如终端 106 与呼叫终止单元 114 之间的通信链路的 QoS。如本申请的下文所详述，路径质量监视功能（在本申请中又被缩写为“PQMF”）可以由终端或站（例如，移动通信设备 106）来实现，终端或站 106 在通信路径中的网络上向质量监视服务器 112 传输分组信息，质量监视服务器 112 作为响应向终端或站 106 返回分组信息以便确定路径质量。箭头 124 示出了

图 1 的这个功能。此外，质量监视服务器 112 可以位于与呼叫终止单元 114 尽可能近的位置，并且如虚线 126 所示，甚至可以与单元 114 合并或集成在一起。因此，PQMF 用于测量终端和呼叫终止单元 114 之间的上行链路和下行链路路径质量。要注意，服务器 122 可以实现为在处理器或模块上执行的算法，该处理器或模块用于接收 PQMF 分组、处理该分组、确定发送什么分组来作为响应、并且发送该响应。

此外，要注意，PQMF 所使用的分组是模仿的，或者与对链路上的传输质量很关注的那些分组具有至少一个或多个共有的特性。更具体地，将 PQMF 分组配置为具有足够的共有特性，以确保网络以与所关注的分组得到的服务等级相同的服务等级来对待该分组。例如，VoIP 分组或实时协议（RTP）分组比非实时分组得到更高的服务等级。因此，用于确定 VoIP 分组的 QoS 的 PQMF 分组被配置为具有相同的 VoIP 分组特性，该 VoIP 分组特性影响网络对待这些 VoIP 分组的服务等级。因此，使用与所关注的分组（例如，RTP 或 VoIP 分组）具有共有特性的 PQMF 分组提高了监视功能的准确性，这是因为 PQMF 分组得到相同的网络对待（并且因此得到相同的 QoS）。

仅作为实例而非限制性地，共有的特性可以是 PQMF 分组的 IP 分组头部中的服务类型（TOS）字段。该共有的特性可以在所关注的分组和 PQMF 分组之间造成相同的服务质量。还要注意，从实现的角度来看，PQMF 分组的分组大小还可以进行大小调整，以匹配所关注分组的多个可能大小中的任意一个。例如，无论在分组的传输和接收期间使用了什么编码器/解码器（编解码器），都可以将 PQMF 分组配置为与该分组的大小匹配。

基于发往和发自路径质量监视服务器 112 的分组的特性所做出的测量，例如分组往返时间，允许终端设备（例如，106、108）测量经过了 LAN 102 和回程链路 110 的整个路径（即，上行链路和下行链路）的质量。要注意，在示例性的实现中，通信终端 106 所发送的 PQMF 分组以及作为响应由服务器 122 返回终端 106 的那些 PQMF 分组可以被配置为是相同的，使得上行链路和下行链路的对待质量最接近地模仿所关注分组得到的网络对待。

终端设备（106 或 108）然后可以利用所确定的质量做出更准确的判决，例如是否触发到另一个网络的切换或者是否改变数据速率或编码速率，以

改善呼叫质量。

系统 100 是单个简单网络配置的实例。然而，可以想到系统 100 的许多额外的、更复杂的配置，包括可替换的电子设备和各种无线的或有线的网络协议。此外，例如，系统 100 中的组件可被配置为便于移动通信终端 106 从终端 106 当前所利用的 AP 104 无缝地切换到另一个网络。此外，尽管结合对实时业务（诸如语音数据（VoIP））的 QoS 确定具体描述了系统，但是可以想到，该 QoS 确定可用于回程线路上的其它分组传输，例如传输控制协议（TCP）或用户数据报协议（UDP）。

图 2 是示出了在诸如图 1 的系统 100 的通信系统中，用于在其上确定质量和监视度量的各个层的方框图。参与 VoIP 呼叫的端点终端 202 可以配置为在各个层上监视不同的 QoS 度量。如图所示，终端 202 监视终端 202 和 AP 204 之间链路上的物理层（PHY）参数或度量，如层 206 和箭头 208 所示。PHY 层度量可以包括例如接收信号强度指示符（RSSI）。此外，终端 202 可以包括对介质访问控制（MAC）层的监视，如层 210 和箭头 212 所示。在 MAC 层测量的度量可以包括例如，确认失败或帧检验序列（FCS）误差的数量。

为了确定在 WLAN 的情况下无线链路是否恶劣，例如，终端 202 可以使用 MAC 层度量和 PHY 层度量。然而，对于其它网络异常，高级别的监视可以辅助终端确定例如在回程中是否存在问题。因此，终端 202 还可以在示为“应用”层或 RTP 层 214 的更高级别上监视度量。例如，终端 202 可以在应用层中监视丢失的 VoIP 分组的数量。这由从 VoIP 呼叫终止单元 216 到终端 202 的箭头 218 在图中表示，指示在应用或 RTP 层中对来自呼叫终止单元 216 的丢失的下行链路分组的监视。

如前所述，仍然存在使用以上度量来帮助确定是否触发切换也无法改善 QoS 并且可能引入不必要的开销的情况。例如，假设质量问题的源头发生在远端（即，在 VoIP 呼叫终止单元 216 之后），则即使本地 LAN 和回程链路良好，应用层度量也指示大的下载分组丢失。因此，这种检测所导致的从本地 LAN 到另一个网络的切换触发将不会得到 QoS 改善，因为问题出现在远端。这种切换引入不必要的开销，并且破坏了在 LAN 上保持该呼叫的潜在优势。用户可能由于费用和性能的原因而希望将该呼叫保持在 LAN

上。反之，应用层度量可能指示可忽略的下行链路分组丢失，而回程上行链路降级导致远端出现问题。因此，不会触发从本地 LAN 切换出去，将导致远端的 QoS 的持续恶化。在另一个实例，可以基于 LAN 上合适地检测的信号强度，指示从 WAN 到本地 LAN 的切换。然而如果回程质量降级，在这种情况下切换到本地 LAN 将导致切换之后具有差的呼叫质量。

考虑到以上实例，本申请所公开的方法和装置采用 PQMF 来修正这些以及类似的情况。如图 2 所示，终端 202 中的应用/RTP 层 214 可以与路径质量监视服务器 222 交换 PQMF 分组 220，如以上结合图 1 所述。PQMF 220 包括由终端 202 中的应用层 241 所配置和传输的第一分组（例如，RTP），该第一分组匹配于与 QoS 确定有关的分组的类型，例如本申请所公开的实例中的 VoIP 分组的类型。服务器 222 然后响应于从终端 202 接收到第一分组，通过发出第二分组或返回所传输的分组来进行辅助。

在网络辅助的方法中，如图 2 所示，服务器 222 辅助 PQMF，在终端（例如 202）中检测路径质量降级，并且可以通过软件、硬件或它们的组合来实现该检测。终端 202 与位于呼叫终止单元 216 上游或附近的 PQMF 服务器 222 交换分组。PQMF 服务器（例如，图 1 的服务器 122 或图 2 的服务器 222）位于 VoIP 呼叫终止单元 216 的上游有助于有效的宽带监视（例如，回程监视），并且从终端发出的所有业务（信令和承载）都保证经过该宽带终止单元。

图 3 是用于确定诸如图 1 或 2 所示系统的通信系统中的通信链路质量的方法 300 的流程图。方法 300 包括配置一个或多个第一分组，该第一分组与希望得到质量确定的分组类型具有共有的特性，如方框 302 所示。如前所述，根据一个方面，将 PQMF 分组配置为与所关注的的数据分组具有相同的协议、服务类型（ToS）和大小，以确保在网络上具有相同的传输特性。

要注意，端点终端，例如终端 202 或通信设备 106，可以实现方框 302 的过程（以及路径质量监视的发起）。此外，方框 302 的过程的可替换实现可以包括由 AP 或网络中的其它设备发起路径质量监视，或者与另一个端点终端相呼应地发起路径质量监视。例如，终端 106 可以从对等通信终端，例如设备 116 中指示恶劣路径质量的一个设备，接收报告。作为响应，该终端可以向 PQMF 服务器发送一个或多个第一 PQMF 分组，发起对于 LAN