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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	HWPII-1004-3
	Application Number	
Title of Invention	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING	

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	Jose		Tellado	

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Postal Code	94065	Country i	CA

Inventor 2 Remove

Legal Name

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Application Information:

Title of the Invention	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING		
Attorney Docket Number	HWPII-1004-3	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	22	**Suggested Figure for Publication (if any)**	1

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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	non provisional of	61714151	2012-10-15

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Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ 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.
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(•) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
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	Application Number	
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Signature	/Brian Short/			Date (YYYY-MM-DD)	2013-10-14
First Name	Brian	Last Name	Short	Registration Number	41309

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Title of Invention	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

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 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.

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LEGAL NAME OF INVENTOR

Inventor: Jose Tellado Date (Optional): 10/10/13

Signature: _____

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As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

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 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.

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LEGAL NAME OF INVENTOR

Inventor: Gregory G. Raleigh Date (Optional) :_____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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PATENT APPLICATION

USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

Inventor(s): Jose Tellado, a citizen of the United States, residing at
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350 Marine Parkway, Suite 300, Redwood City, CA 94065

Entity: Small

USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

RELATED APPLICATIONS

This patent application claims priority to provisional patent application serial number 61/714,151, filed October 15, 2012, which is herein incorporated by reference.

FIELD OF THE INVENTION

The described embodiments relate to communications. More specifically, the described embodiments relate to estimating a user equipment link quality based on positioning.

BACKGROUND

In many environments the link quality between a plurality of base stations and a plurality of user equipment varies significantly over time, space (for example movement of the user equipment), frequency band, etc., for example due to space/time/frequency selective fading, or shadowing from objects (buildings, trees, etc.), etc.. For many wireless access technologies the base station and user equipment attempt to adapt the transmission mode to exploit high data rates while providing desirable robustness of the data communication. In some systems, for the link to be efficient and robust the link quality should be monitored over space/time/frequency. Link quality information exchanged between the base station and the user equipment may become stale (if not updated fast enough) and may take significant wireless communication resources (for example over a control channel). Therefore it is desirable to have improved systems and methods for estimating a user equipment link quality based on a positioning of the user equipment

SUMMARY

An embodiment includes a system. The system includes a base station and a user equipment (UE), wherein the UE wirelessly communicates with the base station. At least one of a controller of the base station or a controller of the UE is operative to determine a plurality of link qualities (LQs) of the UE for a plurality of positionings of the UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of the UE, store information associated with the plurality of LQs for the plurality of positionings, estimate at least one future positioning of the UE, and estimate a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

Another embodiment includes a method. The method includes determining a plurality of link qualities (LQs) of a user equipment (UE) for a plurality of positionings of the UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of the UE, storing information associated with the plurality of LQs for the plurality of positionings, estimating at least one future positioning of the UE, and estimating a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

Other embodiments are directed to systems, apparatuses, and computer readable media associated with methods described herein.

Reference to the remaining portions of the specification, including the drawings and claims, will realize other features and advantages of the described embodiments. Further features and advantages of the described embodiments, as well as the structure and operation of various embodiments of the described embodiments, are described in detail below with respect to the accompanying drawings. In the drawings, like reference numbers can indicate identical or functionally similar elements.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a wireless communication system, according to an embodiment.

Figure 2 shows a backhaul system, according to an embodiment.

Figure 3 shows another backhaul system, according to an embodiment.

Figure 4 shows another backhaul system, according to an embodiment.

Figure 5 shows another backhaul system, according to an embodiment.

Figure 6 shows another backhaul system, according to an embodiment.

Figure 7a shows another backhaul system, according to an embodiment.

Figure 7b shows another backhaul system, according to an embodiment.

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Figure 8 shows a system for estimating a future link quality of a user equipment (UE) device at a future positioning, according to an embodiment.

Figure 9 shows another system for estimating a link quality of a UE device at a neighboring positioning, according to an embodiment.

Figure 10 shows another system for estimating a future link quality of a UE device at a future time based on a future positioning, according to an embodiment.

Figure 11 shows another system for estimating a future link quality of a second UE device at a future positioning based on link qualities, based on a plurality of positionings of a first UE device, according to an embodiment.

Figure 12 shows a wireless system that includes characterizing of interference at a user equipment, according to an embodiment.

Figure 13 shows another wireless system that includes characterizing of interference at a UE device, according to an embodiment.

Figure 14 shows another wireless system that includes characterizing of interference at a UE device, according to an embodiment.

Figure 15 shows a wireless system that includes characterization of interference at a base station, according to an embodiment.

Figure 16 shows an example of three base stations scheduling resource blocks on the same frequency channel (or carrier) A (represented by rectangular blocks with x-axis in time units and y-axis in frequency units), according to an embodiment.

Figure 17 shows a plurality of base station cells, according to an embodiment.

Figure 18 shows two BS clusters (BS1-BS7 and BS11-BS17) simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel, according to an embodiment.

Figure 19a and 19b show examples of a pattern of a BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel,

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dynamically moving from a first cluster of BS to a second cluster of BS, according to one or more embodiments.

Figure 20 shows an example of a cluster of a BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel, with a plurality of null transmission BS, according to an embodiment.

Figure 21 shows an example of a cluster of a BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel to assist FFR or SFR, according to an embodiment.

DETAILED DESCRIPTION

Figure 1 shows a wireless communication system, according to an embodiment. The system includes a plurality of base stations (BSs) 100, 101, 110, 111, 112. In at least some embodiments the system includes a homogeneous system, wherein the BSs are of the same type (or alternatively classification or tier, etc.). In at least some embodiments the system includes a plurality of BSs types, such as Macro BSs 100, 101 and small cell (SC) BSs 110, 111, 112. In at least some embodiments Macro BSs 100, 101 have a larger coverage area or cell size, or transmit larger power, or have higher performance antenna systems, etc. than the small cell BSs 110, 111, 112. In at least some embodiments the small cell BSs are alternatively called microcell, picocell, relay node, or femtocell BS. In at least some embodiments the small cell BSs are located indoors (inside an enterprise, commercial building, home), such as small cell BS 112.

For at least one embodiment the BS includes a traditional BS, wherein a large portion of the radio access network (RAN) functionality, such as radio frequency (RF), analog and digital baseband and scheduling are co-located. For at least one embodiment at least a portion of the BS functionality is implemented at a second location. For at least one embodiment the BS includes distributed processing elements, such as one or more of remote radio heads (RRH), remote radio units (RRU) or distributed antenna systems (DAS). For at least one embodiment scheduling,

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resource allocation or baseband processing associated with one or more BS are aggregated at a second location, for example a cloud BS or cloud RAN.

In at least some embodiments the plurality of BSs wirelessly communicate with a plurality of user equipment (UE) device, such as UE device 121 (wirelessly communicating with BS 100), UE device 122 (wirelessly communicating with BS 111), UE device 123 (wirelessly communicating with BS 112). The wireless communication access traffic (or data or data payload) associated with UE devices 121, 122, 123 may be associated with one or more data networks 140, 141, 142 (for example a carrier network, or a company network, or the internet, or a core network). The wireless communication access traffic may include downlink (originating from the data network 140, 141, 142) or uplink (originating from the UE devices 121, 122, 123) or both downlink (DL) and uplink (UL) traffic. For at least one embodiment the wireless communication access traffic (or the backhaul traffic) include data associated (for example originating from or terminating at) with the UE device or control information associated with the wireless communication system (for example the X2 interface from the 4G or LTE wireless communication technology). Examples of control information associated with the wireless communicating system includes link performance (for example information associated with received signal quality, path loss, channel between desired BS and one or more UE device or backhaul UE (bUE) device, SNR, interference, interference sources, etc.), traffic/data (for example information associated with QoS, packet delay, traffic loading, jitter, queue states or sizes, PER, etc.).

In at least some embodiments the wireless communication access traffic is communicated to a data network 140, 141, 142, through a backhaul communication technology, such as backhaul 130, 131, 132, 133, 134. The backhaul communication technology may include one or more of a fiber communication technology, a microwave link, a T1/E1, a cable or DSL communication technology or an alternative inband or out of band wireless (for example WiMAX or WiFi) communication technology. In at least some embodiments the backhaul requirements for a BS include parameters associated with the BS or a plurality of UE devices associated with the BS. In at least some embodiments BS 100 may include a large coverage area, and a high density plurality of UE devices and include 2G/3G/4G wireless communication technology. For example BS 100 aggregate access traffic may be large and may require a

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Backhaul 130 with large bandwidth (for example a fiber communication technology or a microwave communication technology). In at least some embodiments BS 100 includes a small coverage area (for example a home), and a small number of UE devices and include 4G wireless communication technology. For example BS 100 aggregate access traffic may be small and may require a Backhaul 130 with small bandwidth (for example a DSL communication technology or a cable modem communication technology). In at least some embodiments the backhaul requirements associated with a BS includes one or more of a latency, a bandwidth, a PER (packet error rate), a packet jitter, a cost, a data cap, etc. In at least some embodiments the access traffic associated with the plurality of UE devices associated with a BS includes a plurality of backhaul requirements. For example a first UE device may be streaming video, which may require large bandwidth, but relaxed latency and PER requirements. For example a second UE device may be performing VoIP, which may require low latency, and small bandwidth. In at least some embodiments the backhaul associated with a BS (for example one or more of BS 100, 101, 110, 111, 112) may not satisfy the access traffic requirements of the plurality of UE devices associated with the BS. In at least some embodiments a BS may not have access to so-called traditional backhaul (such as T1/E1, microwave, fiber) or traditional backhaul installation time or installation costs are too high.

Figure 2 shows an embodiment of a backhaul system, according to an embodiment. The system includes a base station (BS) 201and a plurality of backhaul user equipment (bUE) devices (such as bUE devices 210, 211), each of the plurality of bUE devices 210, 211 operable to wirelessly communicate with the BS (201) through at least a first communication technology (for example wireless communication technologies (WCT) 220, 221 and 222), and the plurality of bUE devices 210, 211 each operable to communicate with at least one data network (such as data networks 241, 242) through at least a second communication technology (for example backhaul communication technologies (CT) 230 and 231). For an embodiment, the BS (201) is operative to wirelessly communicate (for example wireless communication technologies (WCT) 222) with one or more user equipment (UE) devices (such as, UE device 212), and network connect the one or more UE devices (such as, UE device 212) to the at least one data network (241, 242) through one or more of the plurality of bUE devices 210, 211, select one or more of the plurality of bUE devices 210, 211 for backhaul (BH) traffic, wherein the BH traffic includes access traffic associated with the one or more UE devices (such as, UE device 212), aid in selecting a

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transmission power level of at least one of the plurality of bUE devices 210, 211, or at least one of the one or more UE devices (such as, UE device 212), and transmit resource block (RB) scheduling information for the BH traffic of at least one of the plurality of bUE devices 210, 211 and the access traffic of at least one of the one or more UE devices (such as, UE device 212).

It is to be understood that while Figure 2 only shows a single UE device 212, embodiments include the BS 201 wirelessly communicating with any number of UE devices. Further, while Figure 2 only shows two bUE devices 210, 211, embodiments includes any number of bUE devices operable to wirelessly communicate with the BS 201. Further, while Figure 2 depicts the BS 201 operable to perform several steps, it is to be understood that embodiments include the operational steps being performed or aided by other devices. For example, the steps of selecting one or more of the plurality of bUE devices 210, 211 for backhaul (BH) traffic, and selecting a transmission power level of at least one of the plurality of bUE devices 210, 211 can alternatively be wholly or partially performed somewhere else, such as, at a base station controller or in the cloud (for example at a cloud RAN or at a cloud BS).

In at least some embodiments the access traffic associated with UE device 212 (or a plurality of UE devices) includes a plurality of applications (for example streaming video, VoIP, browsing, gaming, etc.), each of which may include one or more plurality of access traffic requirements (for example delay QoS, best effort, foreground, background, DL, UL, etc.) and may map into a set of backhaul requirements for selecting the bUE device. For example UE device 212 may need to upload (access traffic UL) a large file in the background. For this example a first bUE device may include a high bandwidth and high PER backhaul WCT link on the DL (for example a 4G/LTE link limited by bursty interference from aggressive frequency reuse) and a second bUE device may include a low bandwidth and low PER WCT link on the DL (for example a 3G link limited by low SNR). For this example the access traffic requirements are better matched (or alternatively mapped or satisfied) by the first bUE device. For example UE device 212 application may include a VoIP (typically with low bandwidth, symmetrical DL/UL, low latency access traffic requirements). For this example a first bUE device may include a high bandwidth, high latency and high jitter backhaul CT to a VoIP gateway (for example over a cable modem to a cable operator to a VoIP gateway) and a second bUE device may include a low bandwidth, low latency and low jitter CT link (for example a T1 to a core

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network). For this example the VoIP access traffic requirements are better matched (or alternatively mapped or satisfied) by the second bUE device.

For at least one embodiment the bUE device 210 wirelessly communicates with the BS 201 on the same wireless technology (for example 4G or LTE) as the UE device 212 wirelessly communicates with the BS 201 but on a different channel or carrier. For at least one embodiment the bUE device 210 wirelessly communicates with the BS 201 on the first wireless technology (for example 4G/LTE) as the UE device 212 wirelessly communicates with the BS 201 on a second wireless technology (for example 3G/HSPA).

Exemplary embodiments of the BS 201 include a cellular BS, a 3G NodeB, a 4G Long Term Evolution (LTE) eNodeB. It is to be understood that this is not an exhaustive list.

For at least some embodiments, the plurality of bUE devices 210, 211 wirelessly communicate with the BS 201 over one or more of wireless communication technologies, wherein the one or more wireless communication technologies include at least one of WiFi, WiMax, 3G, 4G, LTE, Orthogonal frequency division multiple access (OFDMA), Wideband code division multiple access (WCDMA).

For at least some embodiments, the one or more UE devices (such as, UE device 212) wirelessly communicate with the BS 201 over one or more of wireless communication technologies, wherein the one or more wireless communication technologies include at least one of WiFi, WiMax, 3G, 4G, LTE, OFDMA, WCDMA.

For an embodiment, the one or more UE devices (such as, UE device 212) wirelessly communicate with the BS 201 and the plurality of bUE devices 210, 211 wirelessly communicate with the BS 201 utilizing a same wireless communication technology. Further, for at least one embodiment, the one or more UE devices (such as, UE device 212) wirelessly communicate with the BS 201, and the plurality of bUE devices 210, 211 wirelessly communicate with the BS 201 utilizing the same wireless communication technology and a shared one or more frequency channels.

For at least some embodiments, at least one of the one or more UE devices (such as, UE device 212) or at least one of the plurality of bUE devices 210, 211 includes one or more of a fixed client terminal, mobile terminal, a user terminal, an access terminal, a consumer premises equipment.

For various embodiments, at least one of the one or more UE devices (such as, UE device 212) or at least one of the plurality of bUE devices 210, 211 includes one or more of a cellular phone, a smart phone, a notebook, a laptop, a tablet, a PC.

For at least one embodiment, at least one of the plurality bUE devices 210, 211, is at least one of associated with or a part of a small cell BS, wherein the small cell BS includes client side modem functionality. More specifically, for at least one embodiment the small cell BS includes one or more of a microcell, a picocell, a relay node, a femtocell. For at least one embodiment a small cell BS (for example one or more of a microcell, a picocell, a relay node, femtocell) includes client side modem functionality (for example a subset of a UE device or bUE device functionality). For at least one embodiment the small cell BS includes a backhaul CT to one or more data networks. For these embodiments a small cell BS with client side modem functionality could function as a bUE device. For at least one embodiment each of the first BS and the small cell BS including bUE device functionality include backhaul CT and the access traffic associated with the first BS could be communicated over the WCT through the small cell BS including bUE device functionality. For at least one embodiment each of the first BS and the small cell BS including bUE device functionality include backhaul CT and the access traffic associated with the small cell BS including bUE device functionality could be communicated over the WCT through the first BS. For at least one embodiment each of the first BS and the small cell BS including bUE device functionality include backhaul CT and the access traffic associated with the small cell BS including bUE device functionality is communicated over the first BS backhaul CT or the small cell BS backhaul CT based on first parameters of the first BS backhaul CT or second parameters of the small cell BS backhaul CT. For at least one embodiment the first parameters or second parameters include one or more of bandwidth, latency, PER, jitter, QoS, cost, sponsoring, rebates. At least some embodiments of both Figure 2 and Figure 3 utilize these embodiments.

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For at least one embodiment, the at least one data network (such as, data networks 241, 242) includes one or more of a wide area network, mobile core, core network, a company network, carrier network, broadband network, internet. For at least one embodiment accessing a data service (for example video streaming, cloud back-up, software update) over one or more data networks and one or more backhaul CT includes a common operator with improved control of parameters (for example latency, bandwidth, PER). This is typically the case for wireless service providers with carrier class backhaul CT (for example fiber CT, microwave CT, T1/E1) to mobile core or core networks. For at least one embodiment accessing a data service (for example video streaming, cloud back-up, software update) over one or more data networks and one or more backhaul CT includes a plurality of operators with a plurality of control of parameters (for example latency, bandwidth, PER). This is typically the case for femtocell backhaul CT over a CT and data network operated by a DSL or cable modem service provider.

For at least one embodiment, the second communication technology includes one or more of broadband internet connectivity, wired communication technology, T1, E1, digital subscriber line (DSL), Data Over Cable Service Interface Specification (DOCSIS), cable modem, wireless communication technology, WiFi, WiMax, point to point (P2P) or point to multi-point (P2mP) microwave, fiber communication technology, 3G, 4G. For example the access or backhaul WCT may be one of 2G or 3G WCT and the backhaul CT may be a 4G WCT). For at least one embodiment the bUE device may be a UE device (for example a smartphone or tablet or notebook) with one or more of 2G, 3G, 4G cellular access WCT and one or more of WiFi, Bluetooth, USB, Ethernet backhaul CT. For at least one embodiment the one or more of WiFi, Bluetooth, USB, Ethernet backhaul CT may be configured to connect to one or more of a WiFi access point, or a Ethernet LAN over a Bluetooth or a USB or Ethernet modem. Clearly many other permutations or combinations of one or more WCT and one or more backhaul CT are possible. For at least one embodiment the bUE device is a dedicated (or alternatively called a specialized or custom) device to improve the performance of the backhaul WCT link or backhaul CT link or the connection (for example by performing one or more of the following functions: collecting additional information, mapping, bridging, routing, network connecting, controlling) between the backhaul WCT and the backhaul CT. For example the dedicated bUE device may improve the backhaul WCT by improving hardware or software capability (for example increased transmit power, lower receiver noise figure, additional transmit or receiver antennas,

higher antenna gain, improved link performance statistics gathering and exchange), by improving the installation or deployment of the bUE device for better signal quality parameters (lower path loss, lower interference, etc.), by deploying the dedicated bUE device at a location with favorable backhaul CT parameters (for example at closer to a cable or DSL head-end for improved data communication performance) or by improving the connection between the backhaul WCT and the backhaul CT (for example by improved packet processing, protocol conversion, header conversion, PER monitoring, ARQ handling, QoS mapping, etc.).

For at least one embodiment, the BS 201 is further operative to obtain one or more first parameters associated with the wireless communication between one or more of the plurality of bUE devices 210, 211 and the BS 201. Specifically, for at least one embodiment, the selection of the one or more of the plurality of bUE devices 210, 211 for the BH traffic is based on the first parameters. At least some embodiments of both Figure 2 and Figure 3 implement these embodiments.

In at least some embodiments selecting the bUE device (such as, one of bUE device 210, 211) is based on a bUE device backhaul wireless communication technology (WCT) between the plurality of bUE devices 210, 211 and the BS 201. For example bUE device 210 may include a WCT 220 with large bandwidth (exemplary first parameter) (for example 4G or LTE) and bUE device 211 may include a WCT 221 with low PER (exemplary first parameter) (for example 2G/3G). For this example bUE device 210 may be better suited for a streaming video application and bUE device 211 may be better suited for a VoIP or gaming application. For example bUE device 210 may include a WCT 220 with a high SNR (exemplary first parameter) and bursty interference (exemplary first parameter) (for example 4G/LTE with aggressive frequency reuse resulting in high average throughput and high PER and frequent retransmissions) and bUE device 211 may include a WCT 221 with low average and low variance CQI (channel quality information) (exemplary first parameter). For this example bUE device 210 may be better suited for video streaming and bUE device 211 may be better suited for VoIP application. In at least some embodiments the bUE device 210 may include a WCT 220 with low interference footprint (for example by using directional antennas or low transmission power which results in lower interference to other surrounding WCT links) (exemplary first parameter), which could make it more desirable for selection. In at least some embodiments a

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WCT 220 DL (shown as a dashed arrow) parameters are more desirable than the WCT 221 DL parameters and an UL access traffic (WCT 222) associated with UE 212 is network connected through bUE device 210. In at least some embodiments a WCT 220 UL (shown as a solid arrow) parameters are less desirable than the WCT 221 UL parameters and DL access traffic (WCT 222) associated with UE 212 is network connected through bUE device 211. For example WCT parameters relevant for selecting a bUE device based on bUE WCT include one or more of a link quality, link quality statistics, link quality variation, path loss, fading, shadowing, Signal to Noise Ratio (SNR), Signal to Interference and Noise Ratio (SINR), Packet Error Rate (PER), received interference, interference generated to other devices, Channel Quality Indicator (CQI), Channel State Information (CSI), Modulation and Coding Scheme (MCS), Precoding Matrix Indicator (PMI), rank indicator (RI), single user or multiuser Multiple Input Multiple Output (SU-MIMO or MU-MIMO) information.

For at least one embodiment, the BS 201 is further operative to obtain one or more second parameters associated with the at least one data network (such as, data networks 241, 242) through at least the second communication technology. More specifically, for at least one embodiment, the selection of the one or more of the plurality of bUE devices 210, 211 for the BH traffic is based on the one or more second parameters. A non-exhaustive list of exemplary second parameters includes one or more of a link quality, bandwidth, throughput, cost, latency, jitter, QoS, PER.

In at least some embodiments selecting the bUE device is based on a bUE device backhaul CT parameter (second parameter associated with second communication technology) between the plurality of bUE devices 210, 211 and one or more data networks. For example bUE device 210 may include a backhaul CT 230 with large bandwidth (exemplary second parameter) (for example cable modem) and bUE device 211 may include a backhaul CT 231 with low latency (exemplary second parameter) (for example T1). For this example bUE device 210 may be better suited for a streaming video application and bUE device 211 may be better suited for a VoIP or gaming application. For example bUE device 210 may include a backhaul CT 230 with a monthly data cap (exemplary second parameter) (for example cable modem) and bUE device 211 may include a backhaul CT 231 with unlimited data usage (exemplary second parameter) and high latency (exemplary second parameter) (for example a home DSL). For this

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example bUE device 210 may be better suited for VoIP or gaming and bUE device 211 may be better suited for background data (for example software updates or local content preloading) application.

For at least one embodiment, the access traffic associated with the one or more UE devices (such as, UE device 212) is classified into two or more data flows based on a data flow parameter and the selection of the one or more plurality of bUE devices 210, 211 for the BH traffic is based in part on the data flow parameter. More specifically, for at least one embodiment, the data flow parameter includes one or more of a data flow bandwidth, latency, Quality of Service (QoS), PER, UE device state, application, user state, cost, sponsoring, data plan. For at least one embodiment a UE device has a plurality of applications using communication resources over the access WCT and at least two data communications associated with the plurality of active applications have a common a data flow parameter within a tolerance threshold. For example a first data communication may be associated with a gaming application with maximum latency of requirement parameter 5ms and a second data communication may be associated with a VoIP application with maximum latency requirement of 10ms and the classification is all data flow with latency requirements below 10ms. For at least one embodiment the data flow classification includes a plurality of parameters, for example bandwidth and latency, or bandwidth and cost, or QoS and cost. For at least one embodiment the plurality of applications includes a plurality of UE devices. For example a first data communication associated with a first application associated with a first UE device may be aggregated with a second data communication associated with a second application associated with a second UE device when they first and second data communications based on a data flow parameter (for example the data flow parameter requirements are within a threshold tolerance).

Figure 3 shows an embodiment of the backhaul system wherein a BS 301 is further operable to communicate with at least one data network (such as, data network 340) over at least a third communication technology (for example Backhaul CT 332). For at least some embodiments, the BS 301 is further operative to select the third communication technology for BH traffic, wherein the BH traffic of the third communication technology including access traffic from the one or more UE devices (such as, UE device 212).

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An exemplary, non-exhaustive list of technology that can be utilized as the third communication technology include one or more of wired communication technology, T1, E1, DSL, DOCSIS, cable modem, wireless communication technology, WiFi, WiMax, P2P or P2mP microwave, fiber communication technology.

For at least some embodiments, the BS is further operative to obtain one or more third parameters associated with the at least one data network through at least the third communication technology 332. An exemplary, non-exhaustive list of parameters that can be utilized as the one or more third parameters includes one or more of a link quality, bandwidth, throughput, cost, latency, jitter, QoS, PER. For at least one embodiment, the third communication technology for BH traffic includes a carrier grade communication technology. For at least one embodiment, the BH traffic of the third communication technology includes legacy access traffic. For at least one embodiment the BH traffic of the third communication technology 332 includes legacy access traffic, wherein the legacy access traffic includes one or more of 2G access WCT traffic, 2G+3G access WCT traffic, low latency access WCT traffic. For at least one embodiment the BH traffic of the third communication technology includes low bandwidth or low latency access traffic, wherein the access traffic includes one or more of 2G access traffic, 2G+3G access traffic, access traffic associated with voice or gamming applications or real time applications.

In at least some embodiments the BS 301 includes traditional backhaul (for example carrier grade or narrowband—such as a small number of T1 or E1) that is insufficient to satisfy the access traffic demands of the plurality of UE (such as, UE 212). For example a BS 301 that is upgraded from 3G WCT to 3G+4G WCT may not have sufficient bandwidth to support the additional services or applications. For example the BS 301 may include a small number of T1 (for example based on legacy 2G or 3G requirements) that may be able to support latency or jitter or PER requirements (for example for a 2G or 3G cellular service) but may not be able to support the bandwidth requirement of additional 4G services. For example a BS 301 may have been dimensioned for a small number of UE devices or UE devices with lower access traffic capability but over the deployment lifetime a growth in the number of UE devices or additional enhanced access traffic generating capability UE device (for example smartphones or tablets) or additional services or applications on existing UE device may require additional demands on backhaul. In at least some embodiments the BS 301 requires a bUE device 210 to network

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connect at least a portion of the access traffic (for example additional access traffic from new UE, services or higher bandwidth WCT) to a data network over a bUE device and selecting between the traditional backhaul 332 and the bUE device 210 backhaul. In at least some embodiments the bUE device backhaul is used as an interim solution. In at least some embodiments the bUE device backhaul is used as an interim solution until additional traditional backhaul is available (for example while upgrading a BS backhaul from one or more of T1 to microwave or fiber communication technology). For example a BS deployment with 2G or 2G+3G WCT may be been equipped with a small number of T1/E1, wherein the small number of T1/E1 is sufficient to satisfy an initial or legacy access traffic parameters/requirement (for example bandwidth and latency). For at least one embodiment additional backhaul CT performance (bandwidth, capacity, latency, etc.) is required (for example to include additional UE devices, additional services, additional UE device with enhanced requirements/capabilities, additional WCT—such as 4G) may be required at a later time, wherein the additional backhaul CT performance is achieved with assistance of one or more bUE device 210. For at least one embodiment the additional backhaul CT performance is achieved with assistance of one or more bUE device 210 as in interim solution. For at least one embodiment the interim solution is used until the BS backhaul is upgraded (for example from a small number of T1/E1 to a fiber CT—which may take several years to deploy/install). At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

For at least one embodiment, the BS 201 (or 301) operative to aid in selecting the transmission power level of at least one of the plurality of bUE devices 210, 211, or the one or more UE devices (such as, UE device 212) is assisted by a signal transmitted by the BS 201 (or 310). More specifically, or at least one embodiment, the assisting by the signal transmitted by the BS 201 (or 310) includes one or more of a control message from the BS 201 (or 310), or a reference signal transmitted by the BS 201 (or 310). At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments. For at least one embodiment the reference signal transmitted by the BS 201 (or 310) includes one or more of a pilot, a synchronization sequence, a reference symbol, a training sequence, a data symbol, wherein one o more of the plurality of bUE devices or at least one of the one or more UE devices may use to estimate a received signal strength and/or derive a transmission path loss from which the transmission power level may be selected (or alternatively estimated, derived, or refined). For at least one

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embodiment the BS 201 (or 310) estimates a received signal strength (for example based on one or more of a pilot, a synchronization sequence, a reference symbol, a training sequence, a data symbol) from at least one of the plurality of bUE devices or at least one of the one or more UE devices and/or derives a transmission path loss from which a desired transmission power level for at least one of the bUE device or UE device may be selected. For at least one embodiment, information associated with the particular bUE device or UE device desired transmission power may be communicated to the particular bUE device or UE device over a control message from the BS 201 (or 310).

For at least one embodiment, a resource block (RB) includes a partition of a carrier or frequency channel for the wirelessly communicating. More specifically, for at least one embodiment, the partition includes one or more of a unit of time, a unit of frequency, a code. For an embodiment, the partition includes one or more of a time slot, a frequency band, a time-frequency allocation, a time-code allocation, a time-frequency-code allocation. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

For at least one embodiment, the wireless communication between the plurality of bUE devices 210, 211 and the BS 201 is enhanced relative to the wireless communication between the BS 201 and at least one of the one or more UE devices (such as, UE device 212), wherein the enhanced wireless communication includes one or more of better antenna gain, more antennas, outdoor installation, better processing power, better transmit or receive analog or digital performance, lower transmit power, higher or outdoor installation, improved link parameters, improved number of antennas. For at least one embodiment the bUE devices are selected from the one or more UE devices based on enhanced (or alternatively higher performance or favorable) WCT parameters. For example the bUE device may be selected from the population of one or more UE devices based on better path loss (less path loss), higher MCS, lower PER. For at least one embodiment the bUE device may be a dedicated device with hardware or software functionality that results in better WCT parameters. For at least one embodiment the dedicated bUE device have better antennas (for example higher gain or more antennas), higher transmission power or lower receiver sensitivity or are installed at favorable locations relative to the BS 201 (for example lower shadowing or higher K-factor channels). At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

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At least one embodiment further includes classifying and prioritizing the BH traffic based on the access traffic (for example access traffic is classified based on QoS parameters of the access traffic data or control payload and this information is mapped onto associated BH traffic), and wherein the RB scheduling information for the BH traffic is based on the BH traffic prioritization. At least one embodiment further includes classifying and prioritizing the access traffic, wherein the RB scheduling information for the access traffic and the BH traffic is based on the access traffic prioritization and BH traffic prioritization. For example a DL scheduler may assign RBs to DL access traffic for a first UE device and DL backhaul traffic for a bUE device which includes UL access traffic from a second UE (or the first UE) to be sent over the bUE device backhaul CT. For this example the DL scheduler RB assignments may be based on the first UE DL access traffic classification and the DL backhaul traffic which is associated with second UE (or first UE) UL access traffic. For at least one embodiment, classifying the BH traffic includes best effort access traffic having a lower priority than classified access traffic having a delay QoS below a threshold. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

In at least some embodiments the access traffic associated with a plurality of UE (such as, UE 212) is classified (for example based on delay QoS, best effort, DL, UL, foreground, background). In at least some embodiments the classified access traffic is aggregated (for example across a plurality of UE (such as, UE 212)). In at least some embodiments the classified aggregated traffic is assigned into queues prior to assigning of resource blocks for BH traffic of at least one of the plurality of bUE devices. For example the VoIP access traffic from the plurality of UE (such as, UE 212) could be assigned to one VoIP queue and based on the plurality of bUE WCT or CT parameters this queue may be carried by a selected bUE device.

For at least one embodiment, a bUE device selection of one or more of the plurality of bUE devices 210, 211 is based on one or more first parameters of the wireless communication between the bUE device and the BS 201 or one or more second parameters of associated with at least one data network through at least the second communication technology. For example bUE devices 210, 211 may be selected from a larger pool of available bUE devices for providing backhaul traffic functionality or alternatively bUE devices 210, 211 may have been deployed at desirable locations based on favorable WCT parameters (for example near a BS or with favorably channel parameters—for example one or more of low loss, low interference, etc.) or

backhaul CT parameters (for example near a fiber CT with high bandwidth and low latency or near a microwave CT with line of sight--LOS). More specifically, for at least one embodiment, the bUE device deployment selection includes one or more of selecting a bUE device deployment configuration, selecting a bUE device type, selecting a bUE device configuration, selecting a bUE device installation positioning, selecting a bUE device site. More specifically, for at least one embodiment, the first parameter of the bUE device selection is based on a joint first parameter between at least two of the plurality of bUE devices 210, 211. More specifically, for at least one embodiment, the joint first parameter enables joint or simultaneous wireless communication on a shared resource block (RB) of at least two of the plurality of bUE devices 210, 211. For a more specific embodiment, the joint or simultaneous wireless communication includes one or more of multi user (MU)-MIMO, successive interference cancelling (SIC), multilevel constellation and/or modulation. For at least one embodiment the BS (for example 201 or 301) includes a plurality of antennas (for example for transmission or reception) and in combination with the at least two of the plurality of bUE devices generate a matrix wireless communication channel between the BS and the at least two of the plurality of bUE devices. For this embodiment the matrix channel may support at least two simultaneous transmissions over the same RB based on a channel parameter. For at least one embodiment the channel parameter includes a channel matrix rank. For at least one embodiment the channel parameter includes a plurality of singular values (or alternatively eigenvalues or eigen-directions or some other property of the matrix channel that may assists in quantifying a number of simultaneous transmissions). For at least one embodiment the channel parameter includes a parameter greater than a threshold (for example the number of singular values above a threshold—for example singular values that are at least 2 times larger than the background one or more of noise or interference or distortion). For at least one embodiment the plurality of bUE devices (for example 210, 211) are selected based channel matrix parameters between one or more subsets of the plurality of bUE devices (for example at least a minimum number of subsets of size 2 of bUE devices selected from the plurality of bUE devices including channel matrix of rank 2 when combined with a BS with at least 2 antennas or at least a minimum number of subsets of size 3 of bUE devices having rank 3 when combined with a BS with at least 3 antennas). For at least one embodiment the matrix channel parameter includes information associated with one or more of multi user (MU)-MIMO, successive interference cancelling (SIC), multilevel constellation and/or modulation. For at least one embodiment at least one of the plurality of bUE devices are

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selected to enable simultaneous wireless communication between the BS with the at least one bUE device and at least one UE of the plurality of UE.

In at least some embodiments one or more of the plurality of UE devices (such as, UE device 212), in addition to a first CT for communication with the BS 201, include a second CT (for example 3G WCT combined with 4G WCT or cellular WCT combined WiFi CT or cellular WCT combined with Bluetooth or USB or Ethernet CT, etc.) and based on the parameters associated with the second CT, one of the one or more UE device may be operated (or alternatively selected or converted or chosen for consideration) to a bUE device (for example provisioned or dynamically). In at least some embodiments the bUE devices are dedicated (for example a specialized bUE device) for network connecting access traffic over backhaul. In at least some embodiments the dedicated bUE device includes improved WCT parameters (for example higher antenna gain, higher transmit power, lower received noise figure) relative to a majority of the plurality of UE devices. In at least some embodiments the bUE devices are deployed under favorable conditions (for example installed at a higher location, or lower mobility/fixed, pointed in the direction of improved link quality, installed at a location with lower shadowing or lower path loss, etc.) relative to a majority of the plurality of UE device. In at least some embodiments better bUE device deployment improves the efficiency of the backhaul WCT link (for example more efficient modulation and coding scheme (MCS)) or lower interference to other links. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

Figure 4 shows another embodiment of a backhaul system. For this embodiment, the plurality of bUE devices (such as, bUE devices 410b, 411b) are selected such that at least one of the one or more UE devices (such as, UE devices 410a, 411a) has an associated bUE device, thereby enabling joint or simultaneous wireless communication (for example backhaul wireless communication technologies (WCT) 422 and 423 and access wireless communication technologies (WCT) 421 and 424) over one or more shared resource blocks (RB). For at least one embodiment, the joint wireless communication over the one or more shared RB includes joint wireless communication utilizing one or more of communication separable in space, multilevel constellation, transmitter pre-coding or receiver separation. For at least some embodiments, the at least one of the plurality of bUE devices 410b, 411b includes a plurality of transmit antennas, wherein the at least one bUE device includes more transmit antennas than the

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one or more UE devices 410a, 411a the at least one bUE device is associated with, or at least one of the plurality of bUE devices includes a plurality of receive antennas, wherein the at least one bUE device includes more receive antennas than the one or more UE devices the at least one bUE device is associated with. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

In at least some embodiments an access WCT (for example 421 and 424) and a BH WCT (for example 422 and 423) may be operated simultaneously for improved usage of the WCT resources (for example improved spectral efficiency, lower interference, joint RB utilization). For example space division multiple access (SDMA), beamforming (BF), multiple input multiple output (MIMO), successive interference cancelling (SIC), transmit precoding (TP), dirty paper coding (DPC) may be enabled between a BS and at least two clients (for example a bUE device and a UE or two bUE devices or two UE devices) over a shared resource (for example a shared time-frequency resource block). In at least some embodiments an UL RB may be shared between access WCT 421 link and backhaul WCT 423 link (for example using multiuser-MIMO or BF or SIC). For at least one embodiment the BS (for example 201 or 301) includes a plurality of antennas (for example for transmission or reception) and in combination with the at least one of the plurality of bUE devices (for example bUE device 410b) and one of the plurality of UE (for example UE 410a) generate a matrix wireless communication channel between the BS and the at least two of the plurality of bUE devices (for example based on access WCT 421 link and backhaul WCT 423 link). For this embodiment the matrix channel may support at least two simultaneous transmissions over the same RB based on a channel parameter. For at least one embodiment the channel parameter includes a channel matrix rank. For at least one embodiment the channel parameter includes a plurality of singular values (or alternatively eigenvalues or eigen-directions or some other property of the matrix channel that may assists in quantifying a number of simultaneous transmissions). For at least one embodiment the channel parameter includes a parameter greater than a threshold (for example the number of singular values above a threshold—for example singular values that are at least 2 times larger than the background one or more of noise or interference or distortion). For at least one embodiment the plurality of bUE devices (for example bUE devices 410b, 411b) are selected based channel matrix parameters between one or more subsets of the plurality of bUE devices combined with one or more of the plurality of UE devices (for example at least a minimum number of subsets of size 2 of a bUE

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device selected from the plurality of bUE devices combined with a UE device including channel matrix of rank 2 when communicating with a BS with at least 2 antennas). For at least one embodiment the matrix channel parameter includes information associated with one or more of multi user (MU)-MIMO, successive interference cancelling (SIC), multilevel constellation and/or modulation. For at least one embodiment at least one of the plurality of bUE devices are selected to enable simultaneous wireless communication between the BS with the at least one bUE device and at least one UE of the plurality of UE. In at least some embodiments the backhaul WCT 423 link has better parameters than the WCT 421 link over shared resource and a lower transmit power is transmitted from bUE device 410b than UE device 410a. In at least some embodiments a DL RB may be shared between access WCT 424 link and backhaul WCT 422 link. In at least some embodiments the backhaul WCT 424 link has better parameters (for example bUE device 411b has additional antennas or additional receiver processing for shared signal separation) than the WCT 422 link over the shared resource and a lower receiver complexity is required from UE 411a. In at least some embodiments improved BH WCT of bUE device is based on one or more of additional transmit or receive antennas, higher antenna gain, better deployment, bUE device selection, lower transmit power enabled deployment of backhaul with small degradation in WCT efficiency relative to a traditional backhaul. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

For at least some embodiments, the BS 201 (or alternatively BS 301) is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a soft frequency reuse (SFR) scheme with at least a low transmit power level and a high transmit power level, and wherein at least one of the plurality of bUE devices are assigned a resource block (RB) at the low transmit power level. For at least some embodiments, the BS 201 (or alternatively BS 301) is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a soft frequency reuse (SFR) scheme with at least a low transmit power level and a high transmit power level, and wherein a majority (for example greater than 50%) of the plurality of bUE devices are assigned a resource block (RB) at the low transmit power level. For at least some embodiments, the BS 201 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a fractional frequency reuse (FFR) scheme with at least a first frequency reuse scheme and a second frequency reuse scheme, the first frequency reuse scheme including a higher frequency

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reuse (or alternatively higher frequency efficiency usage) than the second frequency reuse scheme and wherein at least one of the plurality of bUE devices 210, 211 are assigned a resource block (RB) having the first frequency reuse or at least one of the one or more UE devices are assigned a resource block (RB) having a second frequency reuse. For at least some embodiments, the BS 201 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a fractional frequency reuse (FFR) scheme with at least a first frequency reuse scheme and a second frequency reuse scheme, the first frequency reuse scheme including a higher frequency reuse (or alternatively higher frequency efficiency usage) than the second frequency reuse scheme and wherein a majority (for example greater than 50%) of the plurality of bUE devices (for example 210, 211) are assigned a resource block (RB) having the first frequency reuse or at least one of the one or more UE devices are assigned a resource block (RB) having a second frequency reuse. For at least one embodiment the bUE devices are one or more of selected (for example from a plurality of UE) or provisioned (for example a transmit power setting) or deployed (for example based on a frequency reuse plan) or installed (for example an installation height or pointing angle) to enable a majority of bUE devices to be assigned a RB at the low transmit power level of a SFR and/or first frequency reuse (higher efficiency) of a FFR. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

For at least some embodiments, a first bUE device of the plurality of bUE devices 210, 211 is assigned a wireless communication uplink (UL) resource block (RB) for BH traffic and a second bUE device of the plurality of bUE devices is assigned a downlink (DL) RB for BH traffic. For at least one embodiment a first bUE device includes a backhaul CT with desirable DL parameters (for example wide bandwidth—for example VSDL) for an application on a UE device requiring DL access and a second bUE device includes a backhaul CT with desirable UL parameters (for example low latency --for example carrier T1) for an application requiring UL access (for example a real-time video download—DL--with ACKs--UL). For at least one embodiment a first bUE device of the plurality of bUE devices 210, 211 is assigned a wireless communication uplink (UL) resource block (RB) for BH traffic and a second bUE device of the plurality of bUE devices is assigned a downlink (DL) RB for BH traffic to enable joint or simultaneous transmission (for example shared RB) between the first bUE device and a first UE device in the UL and between the second bUE device and a second UE device in the DL. For at

least one embodiment a first bUE device of the plurality of bUE devices 210, 211 is assigned a wireless communication uplink (UL) resource block (RB) for BH traffic and a second bUE device of the plurality of bUE devices is assigned a downlink (DL) RB for BH traffic to assist in balancing wireless communication resources (for example RB) between the access WCT and backhaul WCT usage of the wireless communication resources.

For at least some embodiments, at least a first bUE device of the plurality of bUE devices 210, 211 transmits or receives access traffic associated with the first bUE device. For at least one embodiment the first bUE device (for example 210) communicates self-generated access traffic over the backhaul CT (for example 230). For at least one embodiment the first bUE device (for example 210) communicates self-generated access traffic over the WCT (for example 220) through the BS (for example BS 201). For at least one embodiment the first bUE device (for example 210) communicates self-generated access traffic over the backhaul CT (for example 230) or over the WCT (for example 220) through the BS (for example BS 201) based on an access traffic parameter (for example latency or bandwidth).

For at least some embodiments, a first bUE device is dynamically added to or deleted from the plurality of bUE devices 210, 211 based on one or more first parameters associated with the wireless communication between the first bUE device and the BS 201 or one or more second parameters associated with the at least one data network through at least the second communication technology associated with the first bUE device. For at least one embodiment a particular bUE device is dynamically added to the plurality of bUE devices 210, 211 based on one or more first parameters associated with the wireless communication between the first bUE device and the BS 201 relative to a threshold (for example a particular bUE device could be added to the plurality of bUE devices when the SNIR exceeds a threshold, or a MCS exceeds a threshold, or a link quality variation is below a threshold). For at least one embodiment a particular bUE device is dynamically deleted from the plurality of bUE devices 210, 211 based on one or more first parameters associated with the wireless communication between the first bUE device and the BS 201 relative to a threshold (for example a particular bUE device could be deleted from the plurality of bUE devices when the SNIR drops below a threshold, or a transmit power exceeds a threshold, or a PER is above a threshold). At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

For at least some embodiments, the BS 201 is further operative to select at least a first bUE device of the plurality of bUE devices 210, 211 for backhaul (BH) traffic, wherein the BH traffic includes access traffic from a second bUE device of the plurality of bUE devices 210, 211.

For at least some embodiments, a first bUE device of the plurality of bUE devices 210, 211 is assigned a first channel, and a second bUE device of the plurality of bUE devices 210, 211 is assigned a second channel. For at least one embodiment one of the plurality of UE devices access WCT is assigned to the first or second channel. For at least one embodiment one of the plurality of UE devices access WCT is assigned to the first or third channel.

For at least some embodiments, the selection of the one or more of the bUE devices 210, 211 is based on evaluating, obtaining and/or classifying a characteristic or parameter of the access, payload, communication, or data flow of the at least one UE device (such as, UE device 212) and the BS 201. At least some embodiments of both Figure 2 and Figure 3 can implement these embodiments.

Figure 5 shows another backhaul system, according to an embodiment. For this embodiment, the system includes a first base station (BS) 510, one or more backhaul user equipment (bUE) devices (such as, bUE device 522) , the one or more bUE devices 522 operable to wirelessly communicate with the first BS 510 through at least a first communication technology (for example wireless communication technology (WCT) 531), and the one or more bUE devices 522 operable to communicate with at least one data network (such as, data network 551) through at least a second communication technology (for example backhaul communication technology (CT) 541), and a second base station (BS) 500 operable to wirelessly communicate (for example through backhaul WCT 530) with the first BS 510, the second BS 500 further operable to communicate with a second data network (such as, data network 550 through backhaul CT 540). For this embodiment, the first BS 510 is operative to wirelessly communicate (for example access WCT 534) with one or more user equipment (UE) devices (such as, UE device 521), and network connect the one or more UE devices 521 to the at least one data network 551 or the second data network 550 through at least one of the one or more bUE devices 522 or the second BS 500, select at least one of the one or more bUE devices 522 or the second

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BS 500 for backhaul (BH) traffic, wherein the BH traffic includes access traffic from the one or more UE devices 521, aid in selecting the transmission power level of at least one of the one or more bUE devices 522, or at least one of the one or more UE devices 521, and transmit resource block (RB) scheduling information for the BH traffic transmission of at least one of the one or more bUE devices 522 and the access traffic of at least one of the one or more UE devices 521. An exemplary second UE device 520 is shown connected to the second BS 500 through access WCT 533. In at least some embodiments, the second BS 500 shares wireless communication resources (for example one or more frequency bands or one or more frequency channels or one or more resource blocks) between the backhaul WCT 530 and the access WCT 533 for access traffic associated with UE device 520.

In at least some embodiment the first BS 510 assigns at least a portion of the access traffic to be communicated over the BH WCT 530 connection between the first BS and the second BS. In at least some embodiment, the first BS includes a Relay Node. In at least some embodiments, the first BS 510 may communicate all of the access traffic associated with the first BS's associated UE (for example UE device 521) through backhaul WCT 530. In at least some embodiments, BH WCT 530 includes a scarce or shared or expensive wireless resource (such as 3G/4G wireless spectrum) or generates interference to other BS or UE device (for example access WCT 533 or access WCT 534). In at least some embodiments, the access traffic associated with one of the one or more UE device associated with first BS 510 (for example UE device 521) includes a plurality of services or applications with one or more backhaul requirements (for example one or more of latency, bandwidth, QoS, PER, cost, a data usage cap, etc.). In at least some embodiments, at least one of the one or more backhaul requirements of a service or application generating access traffic exceed the backhaul parameters of BH WCT 530 (for example cost or bandwidth). In at least some embodiments, one or more of the backhaul parameters of BH WCT 530 exceed the requirements of services or applications of the one or more UE device (for example UE device services or applications may include background data or best effort data). In at least some embodiments, it may be desirable to add (for example deploy a bUE device or select and/or reconfigure a particular UE device from the one or more UE device) a bUE device and selecting between the BH WCT 530 associated with BS 500 and BH WCT 531 associated with the bUE device 522 for backhauling access traffic from UE device 521. For example BH WCT 531 may include one or more of a first cost, a first latency, first

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interference, first bandwidth to a data network 551, and the BH WCT 530 to second data network 550 over BH CT 540 may include one or more of a second cost, a second latency, second interference, second bandwidth to a data network 551. In at least some embodiments, the first cost of BH WCT 531 is lower than a second cost of BH WCT 530 and services or applications requiring low cost are communicated over BH WCT 531 (for example streaming video). In at least some embodiments, the first latency of BH WCT 531 is higher than a second latency of BH WCT 530 and services or applications requiring low latency are communicated over BH WCT 530 (for example VoIP).

In at least some embodiments, the BH CT 540 to data network 550 is a carrier core network (for example carrier class), but is low bandwidth or expensive (for example a few T1). In at least some embodiments, the BH to data network 551 through bUE device 522 is over a consumer grade (for example DSL or cable modem) network. In at least some embodiments, latency sensitive access traffic is carried over BH WCT 530. In at least some embodiments, BH WCT 531 through bUE device 522 is selected based on one or more of peak traffic events or to communicate overflow traffic or offload traffic or best effort traffic or background access traffic.

For at least some embodiments the first BS 510 includes one or more of a cellular BS or a Relay Node (RN).

For at least some embodiments the one or more bUE devices (such as, bUE device 522) wirelessly communicate with the first BS 510 over one or more of wireless communication technologies (WCT 531), wherein the one or more wireless communication technologies include at least one of WiFi, WiMax, 3G, 4G, LTE, Orthogonal frequency division multiple access (OFDMA), Wideband code division multiple access (WCDMA).

For at least some embodiments the one or more UE devices (such as, UE device 521) wirelessly communicate (WCT 534) with the first BS 510 over one or more of wireless communication technologies, wherein the one or more wireless communication technologies include at least one of WiFi, WiMax, 3G, 4G, LTE, OFDMA, WCDMA.

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For at least some embodiments the one or more UE devices (such as, UE device 521) wirelessly communicate with the first BS 510 and the one or more bUE devices (such as, bUE device 522) wirelessly communicate with the first BS 510 utilizing a same wireless communication technology (that is, WCT 531 and WCT 534 are the same). More specifically, for at least some embodiments the one or more UE devices (such as, UE device 521) wirelessly communicate with the first BS 510, and the one or more bUE devices (such as, bUE device 522) wirelessly communicate with the first BS 510 utilizing the same wireless communication technology and a shared one or more frequency channels.

For at least some embodiments the at least one of the one or more UE devices (such as, UE device 521) or at least one of the one or more bUE devices (such as, bUE device 522) includes one or more of a fixed client terminal, mobile terminal, a user terminal, an access terminal, a consumer premises equipment. For at least some embodiments the at least one of the one or more UE devices or at least one of the one or more bUE devices (such as, bUE device 522) includes one or more of a cellular phone, a smart phone, a notebook, a laptop, a tablet, or a PC.

For at least some embodiments the at least one of the one or more bUE devices (such as, bUE device 522) is at least one of associated with or a part of a small cell BS, wherein the small cell BS includes client side modem functionality. More specifically, for at least some embodiments the small cell BS includes one or more of a microcell, a picocell, a relay node, a femtocell.

For at least some embodiments the at least one data network includes one or more of a wide area network, mobile core, core network, a company network, carrier network, broadband network, internet.

For at least some embodiments the second communication technology includes one or more of broadband internet connectivity, wired communication technology, T1, E1, digital subscriber line (DSL), Data Over Cable Service Interface Specification (DOCSIS), cable modem, wireless communication technology, WiFi, WiMax, 4G, point to point (P2P) or point to

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multi-point (P2mP) microwave, fiber communication technology (for example 4G carrying 3G/2G).

For at least some embodiments the first BS 510 is further operative to obtain one or more first parameters associated with the wireless communication (such as, WCT 531) between at least one of the one or more bUE devices (such as, bUE device 522) and the first BS 510. More specifically, for at least some embodiments the selection of the at least one of the one or more bUE devices (such as, bUE device 522) for the BH traffic is based on the one or more first parameters. For at least some embodiments the one or more first parameters includes one or more of a link quality, link quality statistics, link quality variation, path loss, fading, shadowing, Signal to Noise Ratio (SNR), Signal to Interference and Noise Ratio (SINR), Packet Error Rate (PER), received interference, interference generated to other devices, Channel Quality Indicator (CQI), Channel State Information (CSI), Modulation and Coding Scheme (MCS), Precoding Matrix Indicator (PMI), rank indicator (RI), single user or multiuser Multiple Input Multiple Output (SU-MIMO or MU-MIMO) information.

For at least some embodiments the first BS 510 is further operative to obtain one or more second parameters associated with the at least one data network (such as data network 510 through at least the second communication technology. More specifically, for at least some embodiments the selection of the at least one of the one or more bUE devices (such as, bUE device 522) for the BH traffic is based on the one or more second parameters. An exemplary, non-exhaustive list of second parameters includes one or more of a link quality, bandwidth, throughput, cost, latency, jitter, QoS, PER.

For at least some embodiments the access traffic associated with the one or more UE devices (such as, UE device 521) is classified into two or more data flows based on a data flow parameter and the selection of at least one of the one or more bUE devices (such as, bUE device 522) for the BH traffic is based in part on the data flow parameter. For at least some embodiments the data flow parameter includes one or more of a data flow bandwidth, latency, Quality of Service (QoS), PER, UE device state, application, user state, cost, sponsoring, data plan.

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For at least some embodiments the first BS 510 operative to aid in selecting the transmission power level of at least one of the one or more bUE devices (such as, bUE device 522), or the one or more UE devices (such as, UE device 521) is assisted by a signal transmitted by the first BS 510. For at least some embodiments the assisting by the signal transmitted by the first BS 510 includes one or more of a control message from the first BS 510, or a reference signal transmitted by the first BS 510.

For at least some embodiments a resource block includes a partition of a carrier or frequency channel for the wirelessly communicating. For at least some embodiments the partition includes one or more of a unit of time, a unit of frequency, or a code. For at least one other embodiment, the partition includes one or more of a time slot, a frequency band, a time-frequency allocation, a time-code allocation, a time-frequency-code allocation.

For at least some embodiments the wireless communication between the one or more bUE devices (such as, bUE device 522) and the first BS 510 is enhanced relative to the wireless communication between the first BS 510 and at least one of the one or more UE devices (such as, UE device 521), wherein the enhanced wireless communication includes one or more of better antenna gain, more antennas, outdoor installation, better processing power, better transmit or receive analog or digital performance, lower transmit power, higher or outdoor installation, improved link parameters, improved number of antennas.

At least some embodiments further include classifying and prioritizing the BH traffic based on the access traffic, and wherein the RB scheduling information for the BH traffic is based on the BH traffic prioritization. At least some embodiments further include classifying and prioritizing the access traffic, wherein the RB scheduling information for the access traffic and the BH traffic is based on the access traffic prioritization and BH traffic prioritization. More specifically, at least some embodiments include classifying the BH traffic including best effort access traffic having a lower priority than classified access traffic having a delay QoS below a threshold.

At least some embodiments further includes selecting the one or more bUE devices (such as, bUE device 522) such that at least one of the one or more UE devices (such as, UE device 521) has an associated bUE device, thereby enabling joint or simultaneous wireless

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communication over one or more shared resource blocks (RB). At least some embodiments further includes selecting the one or more bUE devices (such as, bUE device 522) such that a majority of the one or more UE devices (such as, UE device 521) has an associated bUE device, thereby enabling joint or simultaneous wireless communication over one or more shared resource blocks (RB). For at least some embodiments, the joint wireless communication over the one or more shared RB includes joint wireless communication utilizing one or more of communication separable in space, multilevel constellation, transmitter pre-coding or receiver separation. For at least some embodiments the at least one of the one or more bUE devices (such as, bUE device 522) includes a plurality of transmit antennas, wherein the at least one bUE device includes more transmit antennas than the one or more UE devices (such as, UE device 521). For at least some embodiments, the at least one of the one or more bUE devices (such as, bUE device 522) includes a plurality of transmit antennas, wherein the at least one bUE device includes more transmit antennas than the majority (for example 50% or more) of the one or more UE devices (such as, UE device 521). For at least some embodiments a majority (for example 50% or more) of the one or more bUE devices (such as, bUE device 522) includes a plurality of transmit antennas, wherein the majority of the one or more bUE device includes more transmit antennas than the majority (for example 50% or more) of the one or more UE devices (such as, UE device 521). For at least some embodiments the at least one of the one or more bUE devices (such as, bUE device 522) includes a plurality of receiver antennas, wherein the at least one bUE device includes more receiver antennas than the one or more UE devices (such as, UE device 521). For at least some embodiments the at least one of the one or more bUE devices (such as, bUE device 522) includes a plurality of receiver antennas, wherein the at least one bUE device includes more receiver antennas than the majority (for example 50% or more) of the one or more UE devices (such as, UE device 521). For at least some embodiments a majority (for example 50% or more) of the one or more bUE devices (such as, bUE device 522) includes a plurality of receiver antennas, wherein the majority of the one or more bUE device includes more receiver antennas than the majority (for example 50% or more) of the one or more UE devices (such as, UE device 521).

In at least one embodiment, the at least one bUE device is associated with at least one of the one or more UE devices (such as, UE device 521) includes a plurality of transmit (or alternatively receive) antennas, wherein the at least one bUE device includes more transmit (or

alternatively receive) antennas than the one or more UE devices (such as, UE device 521) the at least one bUE device is associated with.

For at least some embodiments the first BS 510 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a soft frequency reuse (SFR) scheme with at least a low transmit power level and a high transmit power level, and wherein at least one of the one or more bUE devices (such as, bUE device 522) are assigned a resource block (RB) at the low transmit power level. For at least some embodiments the first BS 510 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a soft frequency reuse (SFR) scheme with at least a low transmit power level and a high transmit power level, and wherein at least a majority (for example 50% or more) the one or more bUE devices (such as, bUE device 522) are assigned a resource block (RB) at the low transmit power level.

For at least some embodiments the first BS 510 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a fractional frequency reuse (FFR) scheme and wherein at least one of the one or more bUE devices (such as, bUE device 522) are assigned a resource block (RB) having a higher frequency reuse than a resource block (RB) assigned to the one or more UE devices (such as, UE device 521). For at least some embodiments the first BS 510 is one of a plurality of BSs, wherein the plurality of BSs are each assigned one or more frequency channels based on a fractional frequency reuse (FFR) scheme and wherein at least a majority (for example 50% or more) of the one or more bUE devices (such as, bUE device 522) are assigned a resource block (RB) having a higher frequency reuse than a resource block (RB) assigned to the one or more UE devices (such as, UE device 521).

For at least one embodiment, the one of more bUE devices includes a plurality of bUE devices, and wherein a first bUE device of the plurality of bUE devices is assigned a wireless communication uplink (UL) resource block (RB) for BH traffic and a second bUE device of the plurality of bUE devices assigned a downlink (DL) RB for BH traffic.

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For at least one embodiment, at least a first bUE device of the one or more bUE devices (such as, bUE device 522) transmits or receives access traffic associated with the first bUE device (for example self-generated access traffic form services or applications associated with the bUE device). For at least one embodiment a first bUE device is dynamically added to or deleted from the one or more bUE devices (such as, bUE device 522) based on one or more first parameters associated with the wireless communication between the first bUE device and the first BS 510 or one or more second parameters associated with the at least one data network through at least the second communication technology associated with the first bUE device.

For at least one embodiment, the first BS 510 is further operative to select at least a first bUE device of the one or more bUE devices (such as, bUE device 522) for backhaul (BH) traffic, wherein the BH traffic includes access traffic from at least a second bUE device of the one or more bUE devices (such as, bUE device 522).

Figure 6 shows another backhaul system, according to an embodiment. This embodiment further includes multiple bUE devices 522, 623, wherein a first bUE device 522 operable to communicate with at least one data network (such as, data network 551) through at least a second communication technology (such as backhaul CT 541), and second bUE device 623 is operable to communicate with at least one data network (such as, data network 652) through, for example, backhaul CT 642. At least some embodiments of both Figure 2 and Figure 4 (which include a plurality of bUE devices) may be utilized for the embodiments related (or alternatively associated with or in conjunction with or jointly with or to enhance) to Figure 6.

For at least some embodiments, the selecting at least one of the one or more bUE devices (such as, bUE devices 522, 623) is based on one or more first parameters associated with the wireless communication between the one or more bUE devices (such as, bUE devices 522, 623) and the first BS 510 or one or more second parameters associated with one or more first data network through at least one or more second communication technology. For at least one embodiment, the selection at least one of the one or more bUE devices (such as, bUE devices 522, 623) includes one or more of selecting a deployment, selecting a type, selecting a configuration, selecting an installation, selecting a site. For at least one embodiment, the one of

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more bUE devices (such as, bUE devices 522, 623) includes a plurality of bUE devices (such as, bUE devices 522, 623), and wherein the first parameter of the bUE device selection is based on a joint first parameter between at least two of the plurality of bUE devices (such as, bUE devices 522, 623). For at least one embodiment the joint first parameter enables joint or simultaneous wireless communication on a shared resource block (RB) of at least two of the plurality of bUE devices (such as, bUE devices 522, 623). For at least one embodiment the joint or simultaneous wireless communication includes one or more of multi user (MU)-MIMO, successive interference cancelling (SIC), multilevel constellation/modulation.

In at least one embodiment, the backhaul system in Figure 5 is improved as shown in the backhaul system Figure 6 by including an additional bUE device (for example bUE device 623). For example access traffic associated with UE device 521 could be selected between backhauling paths BH WCT 530, BH WCT 531 and BH WCT 632 based on one or more of the WCT parameters (for example spectrum efficiency, throughput, PER, received or generated interference, channel variation, mobility, handoff) or the one or more BH CT parameters (for example latency, bandwidth, PER, jitter) of BH CT (such as 540, 541, 642), associated with one or more data networks (such as 550, 551, 652). In at least some embodiments, the one or more data networks 550, 551, 652 may be the same network. In at least some embodiments, two out of the 3 networks 550, 551, 652 may be the same network. In at least some embodiments, the one or more data networks 550, 551, 652 may be the same or different networks. In at least some embodiments, selecting a backhaul path between a plurality of bUE devices enables (or improves) sharing (or joint or simultaneously) of WCT resources between the bUE device and the UE device (SDMA, BF, MU-MIMO, SIC). In at least some embodiments, backhaul selecting between a plurality of bUE devices enables higher spectrum utilization (higher MCS utilization, better frequency reuse, improved FFR, improved SFR, lower interference, lower transmit power).

Figure 7a shows another backhaul system, according to an embodiment. For this embodiment, the first BS 510 is further operable to communicate with at least a third data network (such as, data network 752) over at least a third communication technology (backhaul CT 742). For at least some embodiments, the third communication technology includes one or more of wired communication technology, T1, E1, DSL, DOCSIS, cable modem, wireless

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communication technology, WiFi, WiMax, P2P or P2mP microwave, fiber communication technology. For an embodiment, the first BS 510 is further operative to select the third communication technology for BH traffic, wherein the BH traffic of the third communication technology including access traffic from the one or more UE devices 521. For an embodiment, the first BS 510 is further operative to obtain one or more third parameters associated with the at least one data network (such as, data network 752) through at least the third communication technology. For at least some embodiments, the one or more third parameters include one or more of a link quality, bandwidth, throughput, cost, latency, jitter, QoS, PER.

For at least some embodiments, the third communication technology for BH traffic includes a carrier grade communication technology (for example, fiber CT, T1, wireless microwave). For at least some embodiments, the BH traffic of the third communication technology includes legacy access traffic.

Figure 7b shows another backhaul system, according to an embodiment. It is to be noted that the embodiment as shown does not include any bUE devices. This system includes a first base station (BS) 510. A second base station (BS) 500 is operable to wirelessly communicate with the first BS 510. The second BS 500 is further operable to communicate with a second data network 550. Further, the first BS 510 is operative communicate with at least a third data network over at least a third communication, to wirelessly communicate with one or more user equipment (UE) devices (such as, UE device 521), and network connect the one or more UE devices (such as, UE device 521), to at least the third data network 752 or to the second data network 550 through the second BS, select at least one of the third data network over at least a third communication technology or the second data network through the second BS for backhaul (BH) traffic, wherein the BH traffic includes access traffic from the one or more UE devices, aid in selecting the transmission power level of at least one of the one or more UE devices, and transmit resource block (RB) scheduling information for the BH traffic transmission of at least one of the second BS for BH traffic and the access traffic of at least one of the one or more UE devices.

As previously noted, Figure 7a shows another backhaul system, according to an embodiment. BS 510 may include BH CT to a data network 752. For example BH CT 742 may

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include one or more carrier class T1/E1 which provides one or more of low bandwidth, low latency, high cost and legacy data communications. In at least some embodiments, BS 510 also includes BH WCT 530 and BH WCT 531. In at least some embodiments, BH CT 742 has lowest latency followed by BH WCT 530 and then BH WCT 531. In at least some embodiments, BH WCT 531 has highest bandwidth, followed by BH WCT 530 and then BH CT 742. Based on the last two sentences access traffic associated to low latency low bandwidth services or applications (such as VoIP or gaming) may be assigned to BH CT 742, access traffic associated to best effort and large bandwidth services or applications (such as video streaming, software download, file sharing, cloud backup) may be assigned to BH CT 531. In at least some embodiments, one of the BH paths 530, 531, 752 may have BH parameters associated with DL or UL direction that may favor a first BH path for DL access traffic and a second BH path for UL access traffic. For example DSL CT may be asymmetric and favor DL access traffic. For example the access DL WCT resources may be oversubscribed relative to UL WCT resources favoring selection of BH WCT UL.

As previously noted, Figure 7b shows another backhaul system, according to an embodiment. In at least some embodiments, BS 510 may include BH CT 742 to a data network 752. For example BH CT 742 may include one or more carrier class T1/E1 which provide one or more of low bandwidth and/or low latency and/or high cost. In at least some embodiments, BS 510 may also include BH WCT 530. In at least some embodiments, BH CT 742 has lower latency than BH WCT 530. In at least some embodiments, BH WCT 530 has higher bandwidth than BH CT 742. Based on the last two prior parameters access traffic associated to low latency and/or low bandwidth services or applications (such as VoIP or gaming) may be assigned to BH CT 742, access traffic associated to best effort and/or large bandwidth services or applications (such as video streaming, software download, file sharing, cloud backup) may be assigned to BH CT 530. In at least some embodiments, one of the BH paths 530, 752 may have BH parameters associated with DL or UL direction that may favor a first BH path for DL access traffic and a second BH path for UL access traffic. For example DSL CT may be asymmetric and favor DL access traffic. For example the access DL WCT resources may be oversubscribed relative to UL WCT resources favoring selection of BH WCT UL.

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Figure 8 shows a system for estimating a future link quality of a user equipment (UE) at a future positioning, according to an embodiment. This embodiment includes a base station 800 and a UE device (or alternatively a user device or end user device or wireless end user device) 820, wherein the UE device 820 wirelessly communicates with the base station 800. According to at least some embodiments, at least one of a controller of the base station 800, a controller of the UE device 820, a controller (not shown) associated with the system, or a combination of the listed controllers is operative to determine a plurality of link qualities (LQs) 830a, 830b, of the UE device 820 for a plurality of positionings 860a, 860b of the UE device 820, wherein at least one of the plurality of positionings 860a, 860b includes at least a location or an orientation of the UE device 820. The one or more controllers are further operative to store information associated with the plurality of LQs 830a, 830b, for the plurality of positionings 860a, 860b, estimate at least one future positioning 870 of the UE device 820, and estimate a future link quality (LQ) 831 of the UE device 820 at the at least one future positioning 870 of the UE device 820 based on the stored information associated with the plurality of LQs 830a, 830b at the plurality of positionings of the UE device 820. For at least one embodiment the plurality of LQs are one or more of obtained, communicated, received, sent, transmitted, computed, post-processed, extrapolated, interpolated, derived in addition to or instead off stored. For at least one embodiment the estimated future LQ are one or more of obtained, communicated, received, computed, post-processed, extrapolated, interpolated, derived in addition to or instead off estimated.

As shown, a neighboring base station (BS) 810 generates interference 841 which can be received by the UE device 820. For at least one embodiment one or more LQ 830a, 830b includes information associated with interference 841.

For at least one embodiment UE device 820 wirelessly communicates with a first BS (for example BS 800) at a first UE positioning (for example UE positioning 860a) and wirelessly communicates with a second BS (for example BS 810) at a second positioning (for example positioning 860b). For this embodiment a handoff between the first BS 800 and the second BS 810 may occur when the UE device 820 moves from the first UE positioning 860a to the second positioning 860b.

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For at least one embodiment a scheduler (for example a scheduler within BS 800 for DL or UL) assigns resources (for example resource allocation of frequency channels, resource blocks, time slots to one of a plurality of UE device) or transmission modes (for example transmit power, modulation and coding scheme (MCS), transmit diversity or pre-coding or MIMO or BF) based on information associated with a link quality between the UE device 820 and a link partner wirelessly communicating with the UE device 820. For at least one embodiment a scheduler assigns resources (for example a plurality of time-frequency RBs) to a plurality of UE devices at a plurality of future time slots. The information associated with the LQ of at least one of the plurality of UE devices at the plurality of future time slots may improve one or more of the link efficiency, link robustness, PER, spectral efficiency, latency, of the wireless communication directed by scheduler. For at least one embodiment a scheduler assigns resources or transmission mode based on a UE device future positioning LQ. For at least one embodiment the future LQ is based on a future positioning of the UE device. For at least one embodiment the future positioning of the UE device 820 is based on a future time. For at least one embodiment the future LQ is based on positioning. For example a UE device may be located (stationary or mobile) within a home or office building and the path loss (or short /long term fading) of the desired signal and interfering signals may change based on the location due to shadowing of windows or walls or reflections of objects surrounding the UE device. For example a UE device may be located (stationary or mobile) within a home or office building and the path loss (or short and/or long term fading) of the desired signal and interfering signals may change based on the orientation due shadowing of windows or walls or reflections of objects surrounding the UE device or polarization of the transmit or receive antennas. For example the LQ of a UE device may be further based on a transmit mode selection (for example transmit power or transmit BF, etc.). For at least one embodiment it may be beneficial to account for transmit mode selecting when storing or estimating LQs. For at least one embodiment the stored or estimated future LQ is based on a carrier (or frequency channel) between the UE device and the link partner. For at least one embodiment the stored or estimated future LQ is based on a link partner selection (for example if the UE device at a location where two serving BS may wirelessly communicate with the UE device). For at least one embodiment the stored or estimated future LQs may be based on surrounding objects. For example the positioning of at least a part of a user associated with the UE device (for example using sensors at the UE device—such as touch sensors, camera, etc.). For example the location of the user's hands or

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head relative to the UE device. For at least one embodiment the stored information associated with the plurality of LQs includes a number of parameters. For example the stored information could be a multidimensional table including Cartesian (x,y,z) location (for example relative to a home or office origin) and two angle coordinates (for example azimuth and elevation relative to North-South axis), user positioning (for example hand and head offset relative to a UE device origin), and interference level (for example max, min, typical). For at least one embodiment to reduce storage, the LQs information may be compressed (for example by decimating location or angle granularity, or by fitting the information to a function). For at least one embodiment the LQs information may be reduced by applying interpolation or extrapolation operations on the stored LQs for estimating the future LQ. For at least one embodiment a correction factor is applied to some of the LQs information (for example the user hand and/or head information could be included as a correction factor that is independent of UE device location). For at least one embodiment the contributions of transmit mode in the estimated future LQ may be included as a correction factor.

For at least one embodiment the information associated with the plurality of LQs are stored at the UE device. For at least one embodiment the information associated with the plurality of LQs are stored at the UE device to improve the privacy of the UE device or a user associated with the UE device. For at least one embodiment the information associated with the plurality of LQs are stored at the UE device to reduce control overhead to the wireless communication link. For at least one embodiment a user may select if the information associated with the LQs may be shared with the link partner. For at least one embodiment the information associated with the plurality of LQs of a first UE device are stored at an associated BS (for example one of more of a link partner BS or a neighbor BS or a interfering BS). For at least one embodiment the information associated with the plurality of LQs of a first UE device are stored at a second UE device. For at least one embodiment the information associated with the plurality of LQs of a first UE device are stored at one or more controllers associated with the first UE device, an associated BS, a BS aggregator or cluster or a cloud element (for example a cloud RAN or cloud BS).

For at least one embodiment a BS (for example BS 800) is communicating with a plurality of UE device (including UE device 820). For at least one embodiment the BS includes

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a scheduler for jointly scheduling the plurality of UE device. For at least one embodiment the BS obtains a plurality of estimated future LQs of the plurality of UE devices and the scheduler assigns resources to each of the plurality of UE devices based on the plurality of estimated future LQs (for example if a first UE SNR is estimated to increase and a second UE SNR is estimated to decrease), the second UE device may be scheduled before the first UE device. For at least one embodiment the BS obtains a plurality of estimated future LQs of the plurality of UE devices and the scheduler assigns transmit modes to each of the plurality of UE devices based on the plurality of estimated future LQs (for example the scheduler may assign joint resources to two UE devices using MU-MIMO or BF transmission).

For at least one embodiment, the at least one of the future LQ or the plurality of LQs 830a, 830b includes one or more of a path loss (PL), S, I, SNR, SINR, SIR, CQI, CSI, PER. For at least one embodiment, the at least one of the future LQ or the plurality of LQs 830a, 830b is associated with an uplink or downlink transmission. For at least one embodiment, the at least one of the future LQ or the plurality of LQs 830a, 830b is associated with a frequency band or a frequency channel. A non-exhaustive list of exemplary frequency bands includes a 850MHz GSM band (824–849MHz and 869–894MHz) and a PCS band (1,850–1,910MHz and 1,930–1,990MHz) cellular frequency bands. A non-exhaustive list of exemplary frequency channels include a 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, and 20 MHz used for 4G or LTE. For at least one embodiment one or more channels may be used at each frequency band. For at least one embodiment, at least one of the future LQ or the plurality of LQs 830a, 830b is associated with a wireless communication technology. A non-exhaustive list of exemplary a wireless communication technologies include GSM, CDMA, HSPA, LTE. For at least one embodiment, at least one of the future LQ or the plurality of LQs 830a, 830b is associated with a link partner of the UE device 820.

For at least one embodiment, a link quality positioning information includes at least one of the determined plurality of LQs 830a, 830b, the stored information, the estimated future positioning 870 or the estimated future LQ 831. For at least one embodiment, the UE device 820 obtains at least a portion of the link quality positioning information from a link partner. More specifically, for at least one embodiment, the UE device 820 communicates at least a portion of the link quality positioning information to a link partner.

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At least one embodiment further includes allocating a resource to a UE link, wherein the allocation of the resource to the UE link is based on the estimated future LQ 831. For at least one embodiment, the allocating can be performed by a controller, wherein the controller can be located within a base station or equivalent – such as, a combination of base stations, a base station controller, or cloud (for example a cloud RAN or cloud BS). More specifically, for at least one embodiment, the resource is one or more of a carrier, a frequency channel, a resource block, a time slot, a frequency band, a code.

At least one embodiment, further includes selecting a transmission mode for a UE link, wherein the selecting the transmission mode for the UE link is based on the estimated future LQ 831. Again, for at least some embodiments, the selecting can be performed by a controller, wherein the controller can be located within a base station or equivalent – such as, a combination of base stations, a base station controller, or cloud. For at least one embodiment, the transmission mode includes one or more of a modulation, a code, a modulation and coding scheme (MCS), a MIMO mode, a beamforming parameter, a transmit power.

At least some embodiments further include obtaining at least one future time, and wherein the estimating the at least one future positioning 870 is based on the at least one future time. For at least one embodiment a scheduler assigns resources (for example time-frequency RB or time slots—either DL or UL) to a UE device at a particular time slot or particular time-frequency block or a particular time-code or a particular time-frequency-code blocks. For at least one embodiment the estimated future LQ (at one or more future times) may be used by the scheduler for improving the wireless communication between the UE device and the link partner (for example one or more BS) by assigning the particular resource or a particular resource at a particular transmission mode.

At least some embodiments further include a second plurality of positionings wherein the second plurality of positionings includes the at least one future positioning 870, and further includes estimating a second plurality of LQs based on the second plurality of positionings. More specifically, for at least one embodiment, the second plurality of positionings includes a

current positioning. More specifically, at least one embodiment further includes allocating a resource block (RB) to a UE device 820 link based on the estimated second plurality of LQs.

For at least some embodiments, the plurality of positionings is constrained to a physical area. More specifically, for at least some embodiments, the constrained physical area includes one or more of at least a portion of a home, an office, or an office building.

For at least some embodiments, at least one of the plurality of positionings or the estimated at least one future positioning 870 of the UE device 820 further includes at least one of an error, an accuracy, a deformation, a velocity, an acceleration. For at least one embodiment a velocity and/or acceleration (for example a current or past one or more of location or velocity or acceleration may be used to estimate a future position, for example using motion equations) may be used to obtain the estimated at least one future positioning. For at least one embodiment a positioning error or a positioning accuracy may be used to assign a quality measure or a confidence interval or a statistic measure to the positioning or the associated LQ. For example if the positioning error is below a first threshold, the associated plurality of LQ of future estimated LQ error may be below a second threshold. For at least one embodiment if an error (or alternatively accuracy) of at least one of a plurality of LQ or estimated future LQ are below a first threshold, the associated wireless communication PER may be below a second threshold. For at least one embodiment a data communication over wireless communication between UE device 820 and BS 800 requires a low PER and the estimated future positioning error must be below a threshold or the transmission mode must have additional margin (above a threshold) or robustness.

At least some embodiments further include determining a UE device 820 usage information, wherein at least a portion of the link quality positioning information is based on the UE device 820 usage information. More specifically, for at least some embodiments, the UE device 820 usage information includes UE device 820 information indicating one or more of a user handheld mode, a hands-free mode, a speaker phone mode, a car Bluetooth mode, a headset Bluetooth mode. For at least one embodiment the UE device 820 being in handheld mode results in additional signal loss or attenuation from the users' hand (and/or head). For at least one embodiment the UE device 820 being in car Bluetooth mode results in additional signal loss

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from car walls/exterior but typically less attenuation from not being indoors and typically additional channel fluctuations from car mobility. For at least one embodiment the UE device 820 being in speaker phone mode results in lower loss from head attenuation.

At least some embodiments further include determining a UE device 820 environment information, wherein at least a portion of the link quality positioning information is based on the UE device 820 environment information. More specifically, for at least some embodiments, the UE device 820 environment information includes information associated to one or more of a traffic load, a network load, an interference. For at least some embodiments, the UE device 820 environment information includes one or more time of day, whether information (for example, temperature, wind, or humidity), day of year, or season. For at least some embodiments, the UE device 820 environment information includes information associated with surrounding objects. For at least some embodiments, the UE device 820 environment information includes information associated with a user of the UE device. For at least some embodiments, the information associated with the user of the UE device includes positioning of the user of the UE device 820. For at least some embodiments, the information associated with the user of the UE device includes positioning of the user of the UE device 820 relative to the UE device 820. At least some embodiments further include assisting determining the UE device 820 environment information using sensors of the UE device 820. The sensors include, for example, a camera a touchscreen and/or gyroscope.

Figure 9 shows another system for estimating a link quality of a UE device at a neighboring positioning, according to an embodiment. It is to be understood that the embodiments of Figure 8 can be applied to the embodiments of Figure 9.

For at least one embodiment it is desirable to estimate (or alternatively derive or obtain or predict or interpolate or extrapolate) a link quality at one or more positionings that are within a positioning threshold of a current positioning of a UE device. For example, the link quality from one or more possible changes of positioning may be estimated for attempting to improve the link quality (for example if the current LQ is not adequate). For at least one embodiment moving to a neighboring positioning may include rotating the UE device from a vertical to a horizontal

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positioning, or moving from the left side to the right side of a user's head, or walking the UE device to a different location in a room or a building.

The embodiment of Figure 9 includes a base station 800 and user equipment 820 (UE), wherein the UE device 820 wirelessly communicates with the base station 800. According to at least some embodiments, at least one of a controller of the base station 800, a controller of the UE device 820, a controller (not shown) associated with the system, or a combination of the listed controllers is operative to determine a plurality of link qualities (LQs) 830a, 830b, of the UE device 820 for a plurality of positionings 860a, 860b of the UE device 820, wherein at least one of the plurality of positionings 860a, 860b includes at least a location or an orientation of the UE device 820. The controller(s) are further operative to store information associated with the plurality of LQs 830a, 830b for the plurality of positionings 860a, 860b, estimate at least a positioning of the UE device, determine at least one neighboring positioning 970 of the positioning of the UE device 820, and estimate a link quality (LQ) 931 of the UE device 820 at the at least one neighboring positioning 970 of the UE device 820 based on the stored information associated with the plurality of LQs 830a, 830b at the plurality of positionings 860a, 860b of the UE device 820.

At least some embodiments further include adjusting or changing a configuration of the UE device 820 based on the estimated LQ 931. At least some embodiments further include presenting the estimated LQ 931 of the UE device 820 at the at least one neighboring positioning 970. That is, present estimated LQ 931 of the UE device 820 at the at least one neighboring positioning 970 to a user of the UE device 820. At least some embodiments further include selecting a candidate positioning from the at least one neighboring positioning 970 based on the estimated LQ 931. At least some embodiments further include presenting the selected candidate positioning to a user of the UE device 820. For at least some embodiments a link quality neighboring positioning information includes at least one of the determined plurality of LQs 830a, 830b, the stored information, the estimated at least a positioning of the UE device 820, the determined at least one neighboring positioning 970, or the estimated LQ. At least some embodiments further include determining a UE device 820 environment information, wherein at least a portion of the link quality neighboring positioning information is based on the UE device 820 environment information. For at least some embodiments the UE device 820 environment

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information includes information associated with a user of the UE device 820. At least some embodiments further include selecting a joint candidate positioning of the UE device 820 and a user of the UE device 820, wherein the joint candidate positioning includes a combination of a UE device 820 positioning and a user positioning relative to the UE device 820. At least some embodiments further include presenting the selected joint candidate positioning.

For at least one embodiment it may be beneficial to estimate a LQ at a neighboring positioning based on a first positioning. For at least one embodiment the first UE positioning may be a UE current positioning 975. For at least one embodiment it may be beneficial to estimate a LQ at a plurality of neighboring positioning based on a first positioning. The estimated future LQ at the plurality of neighboring positioning may be presented to a user of the UE device (for example in a color coded map of a first positioning and a plurality of neighboring positioning). For at least one embodiment the plurality of estimated future LQ at the plurality of neighboring positioning may be used to select a desired neighboring positioning. For at least one embodiment the plurality of estimated future LQ at the plurality of neighboring positioning may be used to select a desired neighboring positioning with improved wireless communication parameters (lower PER, higher data rates, higher spectral efficiency, lower transmit power, lower received or generated interference, better coverage, etc.). For at least one embodiment the selected neighboring positioning may be presented to a user of the UE device (for example by voice command or in a color coded map or diagram of a first positioning and one or more selected positioning). For example a UE device may determine that moving the UE device by a given amount in a given direction improves LQ (for example due to wall shadowing loss). For example the UE device may determine that rotating the UE device around a horizontal axis improves LQ (for example due to antenna polarization gain). For at least one embodiment the plurality of estimated future LQ at the plurality of neighboring positioning may be used to select a desired neighboring positioning for a user. For example moving the UE device user's hand relative to a phone or tablet or a user rotating relative to a vertical axis to reduce head or body attenuation (combined effects of hands and head are known to reduce path loss by 5-10dB). For at least one embodiment the selection of neighboring positioning for estimating LQ is based on a user selection (for example only evaluate neighboring positioning within 5 ft). For at least one embodiment a neighboring positioning is selected if the future LQ improves by a given threshold

(for example a neighboring candidate position is only presented if the path loss improved by 3dB). For at least one embodiment the threshold is provided by a user of the UE device.

Figure 10 shows another system for estimating a future link quality of a UE device at a future time based on a future positioning (for example UE positioning at second time 1060b), according to an embodiment. It is to be understood that the embodiments of Figure 8 can be applied to the embodiments of Figure 10.

For at least one embodiment the estimated future LQ at a future time is based on a UE positioning history (for example the UE positioning at first time 1060a over access WCT at a first time 1030a), wherein the UE positioning history includes at least one UE positioning prior to the future positioning (for example at the future time). For at least one embodiment the estimated future LQ at a future time is based on a UE positioning path (for example UE positioning path 1070), wherein a positioning path may include a plurality of UE positioning (for example UE positioning at two or more times or time instances) or a UE positioning trajectory or UE positioning function of time (for example derived from equations of motion based on a first positioning and/or first velocity and/or first acceleration). For at least one embodiment Figure 10 shows a system for estimating a plurality of LQ based on one or more of a UE positioning at first time 1060a, UE positioning path 1070 or UE positioning at a second time 1060b (over access WCT at a second time 1030b), for example based on one or more of positioning and positioning motion (for example velocity, acceleration, etc.).

Figure 11 shows another system for estimating a future link quality 1031 of a second UE device 830 at a future positioning 1170 based on link qualities 830a, 830b based on a plurality of positionings 1160a, 1160b of a first UE device 820, at according to an embodiment. It is to be understood that the embodiments of Figure 8 can be applied to the embodiments of Figure 11.

For at least one embodiment one or more parameters associated with UE device 820 or UE device 830 (for example device type—smartphone, tablet--transmit power, number of antennas, receiver processing, receiver noise figure, etc.) are included in the estimation of the LQ of UE device 830 based on the LQ 830a, 830b associated with UE device 820. For at least one embodiment information associated with the plurality of LQs for a plurality of positioning of UE

device 820 are combined with information associated with the plurality of LQs for a plurality of positioning of UE device 830 for improving the stored information for estimating a future link quality. For example an office building with multiple UE devices and users may combine the plurality of LQs (for example by device type) for improving the estimated future LQ. In contrast with the embodiment of Figure 8, the UE device 820 does not need to estimate its own future link quality. However, the link quality of the UE device 830 is estimated.

Figure 12 shows a wireless system that includes characterizing of interference at a user equipment, according to an embodiment. The system includes a base station (BS) 1200 (for example with coverage shown as BS cell 1220), wherein the BS 1200 is operative to wirelessly communicate with a plurality of user equipment (UE) (such as, UE device 1211 as shown by the solid arrow between BS 1200 and UE device 1211). The system includes one or more controllers operative to select one or more base stations (BSs) 1201, 1203 (as shown by a thicker cell boundaries for BS cell 1221 and BS cell 1223) associated with base station 1200. For example BS 1203 may communicate with UE device 1212. It is to be noted, for example, that BS 1202 is associated with BS 1200 based on control 1240, but has not been selected as shown by standard thickness for BS cell 1222. Further, the same or different or a combination of same a different controllers are operative to schedule the selected one or more BSs 1201, 1203 associated with the BS 1200 to transmit according to at least one transmission mode during a scheduled transmission (in some embodiments the transmission generates interference at UE device 1211 as represented by the dashed-arrows between BS 1201 and UE device 1211 and BS 1203 and UE device 1211). Further, at least one of the plurality of UE devices (such as UE device 1211) are operative to characterize interference at the at least one of the plurality of UE devices (such as UE device 1211) during the scheduled transmission.

The characterized interference includes, for example, one or more of co-channel interference, adjacent channel interference, intersector interference, intercell interference, intrasystem interference, intersystem interference.

For at least some embodiments, the wireless system includes at least one of a WiFi system, a WiMAX system, a cellular system, a 3G system, a 4G system, a HSPA system, an LTE system. Further, for at least some embodiments, the BS 1200 includes at least one of an AP, a

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NodeB, a eNodeB, a macrocell BS, a microcell BS, a relay node, a femtocell, a Distributed Antenna System (DAS) BS, a Remote Radio Head (RRH) BS, a small cell BS.

For at least some embodiments, the BS 1200 and one or more BSs (for example a subset of 1201, 1202, 1203, 1204) are part of a heterogeneous network. For an embodiment, the BS 1200 includes one or more sectors or cells. For an embodiment, the BS 1200 includes a coverage area or a cell. As shown, BS 1204 is connected to a separate control 1241, and communicating with UE device 1213 within BS cell 1224 (shown as a house). For example this is a femtocell which is part of the heterogeneous network.

For at least some embodiments, the at least one UE device includes one or more of an mobile terminal (MT), an access terminal (AT), a customer premises equipment (CPE).

For at least some embodiments, selecting the one or more BSs (for example a subset of BS 1201, 1202, 1203, 1204) associated with the BS 1200 is based on physical proximity. More specifically, for an embodiment the selecting of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 is based on the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) being located within a threshold distance from the BS. For an embodiment, at least one of the selected one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 is a neighboring BS. For an embodiment, the BS 1200 includes a coverage area or a cell, and wherein at least one of the selected one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 is within the coverage area of the BS.

For an embodiment, the BS 1200 and at least one of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) are classified, and wherein the selecting of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204)is based on the classification. For an embodiment, the classification is based on one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) parameters. A non-exhaustive list of exemplary parameters include at least one of BS 1200 height, BS 1200 coverage area, BS 1200 transmit power, BS 1200 antenna configuration, and/or BS 1200 type (macro, micro, relay node, femto).

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For an embodiment, the BS 1200 and the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) are a subset of a plurality of BSs from a cellular wireless system, and wherein the plurality of BS from the cellular system are grouped into one or more clusters, and wherein the BS 1200 and the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) are part of a same cluster.

For at least some embodiments, selecting at least one of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 is based on an interference estimate. For an embodiment, the interference estimate is based on at least one of a distance between at least one of the selected one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) and the at least one of the plurality of UE devices, a path loss model applied to at least one of the selected one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) and the plurality of UE devices, a propagation loss application, an interference measurement data, or an interference estimate by the at least one of the plurality of UE devices.

For at least some embodiments, the BS 1200 and the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) are synchronized. For an embodiment, the synchronization includes one or more of time, timing phase, timing frequency, carrier phase or carrier frequency synchronization. For an embodiment, the synchronization further includes transmitting the at least one transmission mode with a time offset associated with a wireless communication propagation time. For at least one embodiment synchronizing the BS 1200 with one or more BSs simplifies the interference characterization and/or improves the time and/or frequency alignment of the desired and interfering transmission modes. For at least one embodiment transmitting the at least one transmission mode with a time offset associated with a wireless communication propagation time improves the time alignment of a the at least one transmission mode signal and a one or more second transmission mode signal as received by one or more UE devices (for example a desired and interfering signal may be better aligned at a UE device receiver or a interfering signal and a Null transmission signal may be better aligned simplifying an interference measurement).

For at least some embodiments, the at least one transmission mode includes an active transmission mode. For at least one embodiment the active transmission mode includes one or

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more of a training mode, control mode or data mode. For at least one embodiment the active transmission mode is a non-zero or non-null transmission mode. For an embodiment, the at least one transmission mode includes a data transmission mode. For an embodiment, the data transmission mode includes a data or a data payload. For an embodiment, the data transmission mode includes data intended to be received by at least one UE device wirelessly communicating with the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204). For an embodiment, the data transmission mode includes data intended to be transmitted to a virtual UE device wirelessly communicating with the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) or data without a target destination. For at least one embodiment at least one of the one or more BSs is scheduled to send a transmission mode but no (link partner) UE device is expecting a data communication at the scheduled transmission. In such an embodiment the at least one BS may send a data transmission to a virtual UE device (for example a special or ghost or imaginary or out of range UE device). This embodiment allows for transmission of data without requiring a UE device communicating with the BS at the scheduled transmission.

For an embodiment, the data transmission mode includes random data or pseudo-random data or scrambled data. For at least one embodiment, if the BS does not have data to transmit at the scheduled transmission it may transmit filler data, for example random or pseudo-random or stuffed data.

For an embodiment, the at least one transmission mode includes one or more of a transmission power, a MIMO mode, a beamforming parameter, a PMI, a MCS, a selected transmit antenna.

For an embodiment, the at least one transmission mode includes a high interference mode, low interference mode or typical interference mode. For at least one embodiment the at least one transmission mode includes a high interference mode to assist at least one of the plurality of UE device (such as UE device 1211) to characterize high interference levels, for example to improve the estimation accuracy or to characterize an upper range of possible interference levels (for example if an inferring BS has transmit power control, or SFR (soft frequency reuse). For at least one embodiment the at least one transmission mode of a first BS includes a low interference mode to assist at least one of the plurality of UE device (such as UE

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device 1211) to characterize low interference levels, for example to improve the estimation accuracy of a second BS or to characterize a lower range of possible interference levels (for example if an inferring BS has transmit power control, or SFR).

For an embodiment, the scheduled at least one transmission mode includes a periodic schedule. For at least one embodiment the transmission mode includes the periodic schedule to reduce a control of the scheduled transmissions or to reduce the complexity of at least one of the plurality of UE devices to characterize the interference (for example reducing a search time or control message decoding).

For an embodiment, the scheduled at least one transmission mode includes a wireless communication resource. For an embodiment, the wireless communication resource includes one or more of a resource block, a code, a time slot, a frequency band.

For an embodiment, the wirelessly communicating includes a frame structure, the frame structure including a control signal having a placement relative to the frame structure, wherein the scheduled transmission is scheduled relative (for example a time or frequency offset) to the control signal. For an embodiment, the placement is fixed and/or known. For an embodiment, the frame structure is for transmission. For an embodiment, the wirelessly communicating includes a frame structure, the frame structure including a control signal having a placement relative to the frame structure, wherein the scheduled transmission is directed or enabled by the control signal. For an embodiment, the placement includes a timing and/or frequency offset. For an embodiment, the wirelessly communicating includes a periodic frame structure, including a periodic control signal having a placement relative to the periodic frame structure, wherein the scheduled transmission is scheduled relative to the periodic control signal. For an embodiment, the placement is fixed and/or known. For an embodiment, the frame structure is for transmission. For an embodiment, the scheduled transmission is scheduled at a fixed time or frequency offset relative to a known placement of the periodic control signal. For an embodiment, the scheduled transmission is scheduled at a structured known time or frequency offset relative a known placement of the periodic control signal.

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For at least some embodiments, scheduling the selected one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 includes transmitting according to the at least one transmission mode during a plurality of scheduled transmissions. For an embodiment, the plurality of scheduled transmissions have a duty cycle relative to the wireless communication below a threshold. For an embodiment, the plurality of scheduled transmissions occupy a fraction (for example below a threshold, typically <10%) of wireless communication resources. For an embodiment, the plurality of scheduled transmissions are periodically or quasi-periodically scheduled relative to a wireless communication frame control signal. For an embodiment, the plurality of scheduled transmissions are dynamically allocated by a wireless communication frame control signal. For an embodiment, each of the plurality of scheduled transmissions includes at least one of a plurality of transmission modes. For an embodiment, selecting at least one of the plurality of transmission modes for each of the plurality of scheduled transmissions is based on a regular pattern. For an embodiment, the regular pattern is dynamically modified by a frame control signal. For at least one embodiment a regular pattern simplifies the control for transmission of the plurality of transmission modes. For at least one embodiment a regular pattern simplifies at least one of the plurality of UE devices (such as UE device 1211) are operative to characterize interference at the at least one of the plurality of UE devices (such as UE device 1211) during the scheduled transmission by reducing complexity for decoding of control signals or complexity to remove desired signals or other interfering signals from the received signals. For at least one embodiment the regular pattern is dynamically modified based on data traffic transmission parameters associated with the BS (for example based on BS data traffic load—highly loaded vs lightly loaded, or based on distribution of data traffic transmission modes—for example SISO vs. MIMO vs. BF or SFR). For at least one embodiment a regular pattern is dynamically modified based on a BS becoming active or inactive (for example a femto cell).

For at least some embodiments, the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS 1200 dynamically changes.

At least some embodiments further include a plurality of scheduled transmissions, and further including dynamically selecting the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204) associated with the BS. For an embodiment, a fifth UE device of the plurality

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of UE devices is configured to characterize interference during the plurality of scheduled transmission and dynamic selection of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204). For an embodiment, the fifth UE device is configured to characterize interference of the dynamic selection of one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204), enables estimation of an interference contribution from at least one of the one or more BSs (for example a subset of BSs 1201, 1202, 1203, 1204).

For at least some embodiment, the wirelessly communicating includes a frame structure, the frame structure including at least a control subframe and a data subframe, wherein the data subframe includes the scheduled transmission.

Figure 13 shows another wireless system that includes characterizing of interference at a user equipment, according to an embodiment. The system includes a base station (BS) 1200, wherein the BS 1200 is operative to wirelessly communicate with a plurality of user equipment (UE) (such as, UE device 1211). The system includes one or more controllers operative to control BS 1200 to transmit a null transmission mode (shown as the dotted BS cell 1220) during at least a portion of the scheduled transmission of BS 1201 or BS 1203 (shown as thicker cell boundaries of BS cell 1221 and BS cell 1223).

More specifically, for at least some embodiments further include scheduling the BS 1200 to transmit a null transmission mode during at least a portion of the scheduled transmission. For an embodiment, the null transmission includes a non-active transmission, wherein an active transmission is one or more of a training transmission mode, a control transmission mode and a data mode. For at least one embodiment the null transmission includes a BS transmission signal (or power) level below a threshold. For at least one embodiment the null transmission is a constant transmission or contains mostly noise or other non-desired transmission due to imperfections of a transmitter. For at least one embodiment the null transmission is intended to be a zero transmission but may include some spurious or undesired signals or noise.

At least some embodiment further include characterizing, by at least a second UE device of the plurality of UE devices, interference during the null transmission mode at the at least a portion of the scheduled transmission.

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Figure 14 shows another wireless system that includes characterizing of interference at a user equipment, according to an embodiment. The system includes a base station (BS) 1200, wherein the BS 1200 is operative to wirelessly communicate with a plurality of user equipment (UE) (such as, UE device 1211). The system includes one or more controllers operative to selecting a BS 1201 to schedule the selected BS 1201 to transmit a null transmission mode (shown as the dotted BS cell 1221) during at least a portion of the scheduled transmission of BS 1203 (shown as thicker cell boundary of BS cell 1223).

At least embodiments, further include selecting a second BS, and scheduling the selected second BS 1201 (selected BS) to transmit a null transmission mode during at least a second portion of the scheduled transmission. For an embodiment, the selection of the second BS 1201 is based on one or more of a physical proximity of the second BS 1201 relative to the BS 1200, being a designated as a neighbor of the BS 1200, being within a coverage area of the BS 1200, a classification of the second BS 1201 and the BS 1200. For an embodiment, the second BS 1201 is selected based on an estimate of its generated interference to one or more of the plurality of UE devices being above a threshold. For an embodiment, selecting the second BS 1201 is based on an interference estimate. For an embodiment, the interference estimate is based on at least one of a distance between the second BS 1201 and at least one of the plurality of UE device, a path loss model applied to the second BS 1201 and the plurality of UE devices, a propagation loss application, an interference measurement data, an interference estimate by at least one of the plurality of UE devices. An embodiment further includes characterizing, by at least a third UE device of the plurality of UE devices, interference during the null transmission mode of the at least the second portion of the scheduled transmission. For an embodiment, the characterizing of the interference occurs during null transmission of second BS 1201. At least some embodiments further include characterizing, by at least a fourth UE device of the plurality of UE devices, an interference contribution of the second BS and the one or more BSs during the null transmission mode of the at least the second portion of the scheduled transmission. For an embodiment, the characterizing of the interference occurs during null transmission of second BS 1201. Figure 16 shows an example of three BS, BS1, BS2, BS3 scheduling resource blocks on the same frequency channel (or carrier) A (represented by rectangular blocks with x-axis in time units and y-axis in frequency units), according to an embodiment. In the example of Figure 16, the unused

RB are represented as blank rectangles, and the active scheduled RB are represented as three different angles of hatching: horizontal hatching for transmit mode (TM) c, vertical hatching for TMb and diagonal hatching for TMa (for example the angles of hatching may represent a transmit power level). In the example of Figure 16 all BS are active during time slot 1 (including all frequency bands), which may represent control or reference signals simultaneously transmitted from all three BS. For example BS1 allocates contiguous RB between time units 1 to 5. For example BS2 allocates time unit 1 and has a gap until units 5-6. BS3 allocated time units 1-2. A receiver (for example UE1) may receive a linear combination of all three BS transmissions, attenuated by respective gains G1, G2 and G3. From this example the interference will be worst at time unit (or slot) 1, since all three BS are active and interference would be minimum at time units 7 and 8. Other time units 2 through 6 would have intermediate interference levels. From this example the measured interference is a function of the resource block that is selected for measuring interference and is dependent on scheduling decisions (and traffic load) of the interfering BS. For at least one embodiment it may be advantageous to schedule a resource block and a transmit mode so that the interference measurement at UE1 has less variability. For at least one embodiment improved interference measurements results in one or more of improved resource allocation and improved MCS selection, lower PER, reduced retransmissions for UE1.

Figure 17 shows a plurality of BS cells, according to an embodiment. In this example (and following figures) all cells are homogenous hexagons for simplicity of representation. In practice BS cells may be heterogeneous (for example different sizes and shapes) and a smaller BS cell (for example micro, pico, femto, or relay node) may be within the coverage area of a larger cell (for example macro or micro). In this example (and several following figures) a cell with a scheduled null transmission is represented as a blank (or white) hexagon. In this example (and several following figures) a cell with a scheduled transmission mode is represented as a diagonally hatched hexagon. In this example (and several following figures) a cell that is not constrained to a transmission mode or a null transmission is represented as a horizontally hatched hexagon. In the example of Figure 17, a receiver in BS1 (UL) or a receiver of a plurality of UE devices (DL) wirelessly communicating with BS1 may measure joint interference from all six nearest neighboring BS: BS2-BS7 which have all been scheduled to follow a transmission mode. For at least one embodiment all remaining farther neighbors are unrestricted and may transmit

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(or not) based on local traffic requirements. In the example of Figure 17 BS1 (or all the UE devices associated with BS1 for UL measurements at BS1) is scheduled to transmit a null transmission. For at least one embodiment a null transmission reduced the complexity of estimating interference. For at least one embodiment BS1 (or a selected UE device) may transmit and the interference may be estimated after subtracting the contribution of the desired signal.

Figure 18 shows an example where two BS clusters (BS1-BS7 and BS11-BS17) may be simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel, according to an embodiment. For at least one embodiment if the two BS clusters are sufficiently separated the interference coupling between the two clusters may be negligible. For at least one embodiment simultaneous scheduling of transmission active and null modes with a reuse factor (or minimum separation or cluster size) increases interference measurement rate or transmission efficiencies.

Figure 19a and 19b show an example of a pattern (for example regular) of BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel, dynamically moving from a first cluster of BS (BS2, BS1, BS7, BS17, BS12, BS13, BS3) to a second (for example partially overlapping) cluster: BS1, BS5, BS6, BS7, BS2, BS3, BS4) cluster of BS, according to an embodiment.

Figure 20 shows an example of a cluster of BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel, with a plurality of null transmission BS (for example neighboring cluster BS1, BS3, BS4), such as a hand-off associated list of BS, according to an embodiment.

Figure 21 shows an example of a cluster of BS simultaneously scheduling transmission modes or null transmissions or characterizing interference in parallel to assist FFR or SFR including at least a high transmit power and/or a low transmit power plurality of BS (for example BS3, BS5, BS7 transmitting at lower transmit power TMb represented by a smaller cell), according to an embodiment.

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Figure 15 shows a wireless system that includes characterizing of interference at a base station, according to an embodiment. The wireless system includes a first base station (BS) 1200, wherein the first BS 1200 is operative to wirelessly communicate with a first plurality of user equipment (UE) (such as UE device 1510). One or more controllers (associated with the control 1240, associated with at least the first or second base stations 1200, 1201, or an combination of) are operative to select a second BS 1201 associated with first BS 1200. The second BS 1201 is operative to wirelessly communicate with a second plurality of UE devices (such as UE devices 1511, 1512). Further, the one or more controllers (which can be a different, same or combination of the prior controller) are operative to select a UE device 1511 from the second plurality of UE devices 1511, 1512. Further, the one or more controllers (which can be a different, same or combination of the prior controller) are operative to schedule the selected UE device 1511 to transmit according to a transmission mode during a scheduled transmission. Further, the first BS 1200 is operative to characterize interference at a least a portion of the scheduled transmission.

It is to be understood that the embodiments of Figure 12, Figure 13, Figure 14 can be modified from DL transmission mode to UL transmission mode and applied to the embodiments of Figure 15.

The characterized interference includes, for example, one or more of co-channel interference, adjacent channel interference, intersector interference, intercell interference, intrasystem interference, intersystem interference.

For at least some embodiments, the wireless system includes at least one of a WiFi system, a WiMAX system, a cellular system, a 3G system, a 4G system, a HSPA system, an LTE system. Further, for at least some embodiments, the BS 1200 includes at least one of an AP, a NodeB, a eNodeB, a macrocell BS, a microcell BS, a relay node, a femtocell, a Distributed Antenna System (DAS) BS, a Remote Radio Head (RRH) BS, a small cell BS.

For at least some embodiments, the BS 1200 and one or more BSs 1201, 1202 are part of a heterogeneous network. For an embodiment, the BS 1200 includes one or more sectors or cells. For an embodiment, the BS 1200 includes a coverage area or a cell (such as BS cell 1220).

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For at least some embodiments, the at least one of the first or second plurality of UE devices (such as, UE devices 1511, 1512) includes one or more of an MT, an AT, a CPE.

For at least some embodiments, the selected second BS 1201 associated with the first BS 1200 is a neighboring BS.

For at least some embodiments, the first BS 1200 includes a coverage area or a cell (such as BS Cell 1220), and wherein the selected second BS 1202 associated with the first BS 1200 or the selected UE device from the second plurality of UE devices (such as, UE device 1514) is within the coverage area of the first BS 1200.

For at least some embodiments, the first BS 1200 and the second BS 1201 are classified, and wherein the selecting of the second BS 1201 is based on the classification. For at least some embodiments, the classification is based on one or more BS parameters. A non-exhaustive list of exemplary BS parameters include at least one of BS height, BS coverage area, BS transmit power, BS antenna configuration, BS type (macro, micro, relay node, femto).

For at least some embodiments, the second plurality of UE devices (such as, UE devices 1511, 1512) are classified, and wherein the selecting the UE device is based on the classification. A non-exhaustive list of exemplary UE device classifications include at least one of UE device height, UE device transmit power, UE device antenna configuration, UE device type (macro, micro, relay node, femto), UE device mobility, UE device data/resource usage.

For at least some embodiments, the first BS 1200 and the second BS 1201 are a subset of a plurality of BSs from a cellular wireless system, and wherein the plurality of BS from the cellular system are grouped into one or more clusters, and wherein the first BS 1200 and the second BS 1201 are part of a same cluster.

For at least some embodiments, selecting the second BS 1201 associated with the first BS 1200 or the UE device from the second plurality of UE devices (such as, UE devices 1511, 1512) is based on an interference estimate. For an embodiment, the interference estimate is based on at

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least one of a distance between the selected UE device and the first BS 1200, a path loss model applied to the selected UE device and the first BS 1200, a propagation loss application, an interference measurement data, an interference estimate by the first BS 1200.

For at least some embodiments, the first BS 1200 and the second BS 1201 are synchronized. For an embodiment, the synchronization includes one or more of time, timing phase, timing frequency, carrier phase or carrier frequency synchronization. For an embodiment, the synchronization further includes transmitting the transmission mode with a time offset associated with a wireless communication propagation time.

For at least some embodiments, the transmission mode includes an active transmission mode. For an embodiment, the transmission mode includes a data transmission mode. For an embodiment, the data transmission mode includes a data carrying or a data payload. For an embodiment, the data transmission mode includes data intended to be received by the second BS 1201. For an embodiment, the data transmission mode includes virtual data or data without a target destination. For an embodiment, the data transmission mode includes random data or pseudo-random data or scrambled data.

For at least some embodiments, the transmission mode includes one or more of a transmission power, a MIMO mode, a beamforming parameter, a PMI, a MCS, a selected transmit antenna. For an embodiment, the transmission mode includes a high interference mode, low interference mode or typical interference mode.

For at least some embodiments, the scheduled transmission mode includes a periodic schedule. For an embodiment, the scheduled transmission mode includes a wireless communication resource. For an embodiment, the wireless communication resource includes one or more of a resource block, a code, a time slot, a frequency band.

For at least some embodiments, the wirelessly communicating includes a frame structure, the frame structure including a control signal having a placement (for example one or more of a time slot, frequency or time offset) relative to the frame structure, wherein the scheduled transmission is scheduled relative to the control signal. For an embodiment, the scheduled

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transmission placement is fixed and/or known. For an embodiment, the frame structure is for transmission. For an embodiment, the frame structure includes a DL subframe and an UL subframe and wherein the DL subframe includes the control signal (for example one or more of a frame boundary, synch, RS, etc.) and the UL subframe includes the scheduled transmission.

For at least some embodiments the wirelessly communicating includes a frame structure, the frame structure including a control signal having a placement relative to the frame structure, wherein the scheduled transmission is directed or enabled by the control signal. For an embodiment, the wirelessly communicating includes a periodic frame structure, including a periodic control signal having a placement relative to the periodic frame structure, wherein the scheduled transmission is scheduled relative to the periodic control signal. For an embodiment, the placement is fixed and/or known. For an embodiment, the frame structure is for transmit. For an embodiment, the scheduled transmission is scheduled at a fixed time or frequency offset relative to a known placement of the periodic control signal. For an embodiment, the scheduled transmission is scheduled at a structured known time or frequency offset relative a known placement of the periodic control signal.

For at least one embodiment, scheduling the selected UE device includes transmitting according to at least one transmission mode during a plurality of scheduled transmissions.

At least one embodiment further includes selecting at least two UE devices from the second plurality of UE devices (such as, UE devices 1511, 1512) including the selected UE device, wherein scheduling the at least two UE devices includes transmitting according to at least one transmission mode for each of the selected at least two UE devices during a plurality of scheduled transmissions. For an embodiment, the plurality of scheduled transmissions have a duty cycle relative to the wireless communication below a threshold. For at least one embodiment, the plurality of scheduled transmissions occupy a fraction (for many embodiments the fraction will be low, for example <10%) of wireless communication resources. For an embodiment, the plurality of scheduled transmissions are periodically or quasi-periodically scheduled relative to a wireless communication frame control signal. For an embodiment, the plurality of scheduled transmissions are dynamically allocated by a wireless communication frame control signal. For an embodiment, each of the plurality of scheduled transmissions

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includes at least one of a plurality of transmission modes. For an embodiment, selecting at least one of the plurality of transmission modes for each of the plurality of scheduled transmissions is based on a regular pattern. For an embodiment, the regular pattern is dynamically modified by a frame control signal.

For at least one embodiment, the selected second BS 1201 associated with the first BS 1200 or the selected UE device from the second plurality of UE devices (such as, UE devices 1511, 1512) wirelessly communicating with the second BS 1201 dynamically changes. At least one embodiment further includes a plurality of scheduled transmissions, and further includes dynamically selecting the second BS 1201 associated with the first BS 1200 or the selected UE device from the second plurality of UE devices (such as, UE devices 1511, 1512) wirelessly communicating with the second BS 1201. For an embodiment, first BS 1200 is configured to characterize interference of the selected UE device during the plurality of scheduled transmission and dynamic selection of the second BS 1201 or the selected UE device from the second plurality of UE devices (such as, UE devices 1511, 1512) wirelessly communicating with the second BS 1201. For an embodiment, the first BS 1200 is configured to characterize interference of the dynamic selection of the second BS 1201 and the selected UE device, enables estimation of an interference contribution from at least one of the second plurality of UE devices (such as, UE devices 1511, 1512) wirelessly communicating with the second BS 1201.

At least some embodiment include the wirelessly communicating includes a frame structure, the frame structure including at least a control subframe and a data subframe, wherein the data subframe includes the scheduled transmission.

In at least one embodiment, one or more controlers are operative to scheduling the first plurality of UE device (such as UE device 1510) to transmit a null transmission mode during at least a portion of the scheduled transmission. Further, the first BS 1200 is operative to characterize interference at a least a portion of the scheduled null transmission.

At least one embodiment further includes characterizing, by the first BS 1200, interference during the null transmission mode at the at least a portion of the scheduled transmission.

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In at least one embodiment, one or more controllers (associated with the control 1240, associated with the first or second or third base stations 1200, 1201, 1202 or an combination of) are operative to select a third BS 1202 associated with first BS 1200. The third BS 1202 is operative to wirelessly communicate with a third plurality of UE devices (such as UE device 1514 within BS cell 1222). Further, the one or more controllers (which can be a different, same or combination of the prior controller) are operative to schedule the third plurality of UE devices (such as UE device 1514) to transmit according to a null transmission mode during at least a portion of a second BS 1201 scheduled transmission. Further, the first BS 1200 is operative to characterize interference at a least a portion of the null scheduled transmission. For an embodiment, a null transmission mode includes not assigning any of the third plurality of UE devices any transmission resources.

For at least some embodiments, the selecting of the third BS is based on one or more of a physical proximity (for example a physical proximity below a threshold distance) of the third BS or the third plurality of UE devices relative to the first BS 1200, being a designated as a neighbor of the first BS 1200, being within a coverage area of the first BS 1200, a classification of the third BS and the first BS 1200. For an embodiment, the third BS is selected based on an estimate of interference generated from one or more of the third plurality of UE devices to the first BS 1200 being above a threshold. For an embodiment, selecting the third BS is based on an interference estimate. For an embodiment, the interference estimate is based on at least one of a distance between at least one of the third plurality of UE devices and first BS 1200, a path loss model applied to at least one of the third plurality of UE devices and the plurality of UE devices, a propagation loss application, an interference measurement data, an interference estimate by first BS 1200. An embodiment further includes characterizing, by the first BS 1200, interference during the null transmission mode at the at least the second portion of the scheduled transmission. For an embodiment, the characterizing occurs during null transmission of at least one of the third plurality of UE devices. For an embodiment, the first BS 1200 is configured to jointly characterize an interference contribution of at least one of the third plurality of UE devices and at least one of the second plurality of UE devices (such as, UE devices 1511, 1512) during the null transmission mode of the at least the second portion of the scheduled transmission..

For at least one embodiment a BS (such as BS 201) includes a plurality of sectors wherein the plurality of bUE devices (such as, bUE devices 210, 211) are distributed over the plurality of sectors and access traffic from a UE device (such as, UE device 212) associated with the BS is wirelessly communicated over one or more of the plurality of bUE devices. For an embodiment the BS may include three sectors and the plurality of bUE devices may include two bUE devices located within the coverage area of a first sector of the three sectors and access traffic from a UE device located within the coverage area of a second sector of the three sectors may be wirelessly communicated over the at least one of the two bUE devices located within the coverage area of the first sector.

For an embodiment a BS may include three sectors and the plurality of bUE devices may include two bUE devices located within the coverage area of a first sector and a second sector of the three sectors and access traffic from a UE device located within the coverage area of one of the three sectors may be wirelessly communicated over the at least one of the two bUE devices located within the coverage area of the first sector and second sectors. Clearly other embodiments are possible wherein the access traffic of a UE device may be wirelessly communicated over two or more bUE devices that are within the same sector as the UE device, a different sector than the UE device or both the same sector and a different sector as the UE device.

For at least one embodiment a BS (such as BS 201) includes a plurality of channels wherein the plurality of bUE devices are distributed over the plurality of channels and access traffic from a UE device associated with the BS is wirelessly communicated over one or more of the plurality of bUE devices. For an embodiment a BS may include three channels and the plurality of bUE devices may include two bUE devices located within the first channel of the three channels and access traffic from a UE device associated with the second channel of the three channels may be wirelessly communicated over the at least one of the two bUE devices associated with the first channel. For an embodiment a BS may include three channels and the plurality of bUE devices may include two bUE devices associated with a first channel and a second channel of the three channels and access traffic from a UE device associated with of one of the three channels may be wirelessly communicating over the at least one of the two bUE devices associated with the first channel and the second channel. Clearly other embodiments are

possible wherein the access traffic of a UE device may be wirelessly communicating over two or more bUE devices that are within the same channel as the UE device, a different channel than the UE device or both the same channel and a different channel as the UE device.

For at least one embodiment a BS includes a plurality of sectors and a plurality of channels and the plurality of bUE devices are assigned resources from the plurality of sectors and a plurality of channels and the plurality of bUE devices and a particular UE device of the one or more UE devices is assigned one or more bUE devices for the plurality of bUE devices that could be in the same sector and/or channel or a different sector and/or channel.

For at least one embodiment (for example embodiments associated with Figure 3) the bUE device (such as bUE device 210) may be selected to wirelessly communicate troubleshooting or fault isolation information. For at least one embodiment the backhaul WCT 220 wireless communication path is used to transmit access traffic when backhaul CT 332 path is not operating correctly or to detect if backhaul CT 332 path is operating correctly. For at least one embodiment the backhaul WCT 220 wireless communication path is used to transmit control information to help isolate a source of a backhaul communication to Data network 340 over backhaul CT 332 is operating within a threshold or to isolate which of the one or more of the BS (such as 301) or the access WCT 222 or the data network 340 are operating with a threshold of performance. For at least one embodiment, the bUE device is used to diagnose a BS (such as BS 301) remotely. For example one or more control information may be sent over backhaul WCT and backhaul CT 220 and diagnosed at one or more data network locations. For example the bUE device (for example a smartphone) may be a UE device with cellular and WiFi connectivity and the WiFi backhaul path wirelessly communicating to data network 241 may be used to verify a performance parameter (or alternatively a fault) of the cellular access WCT 222.

For at least one embodiment a first backhaul path including a backhaul CT (such as 332) includes circuit switched connectivity (for example TDM, T1) and a second backhaul path including backhaul CT (such as 230) includes packet switched (for example IP, Ethernet) connectivity. For at least one embodiment access traffic associated with a UE device 212 is used to select a first backhaul path or a second backhaul path based on circuit switched or packet switched backhaul.

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For at least one embodiment a first backhaul path (such as 332) includes legacy backhaul CT (for example T1) and a second backhaul path (such as 230) includes subsequent generation based backhaul CT (for example VDSL). For at least one embodiment, access traffic associated with a UE device 212 is used to select a first backhaul path or a second backhaul path based on legacy or subsequent generation based backhaul.

For at least one embodiment a first backhaul path (such as 332) parameters are suited for legacy access traffic (for example 2G voice traffic) and a second backhaul path (such as 230) parameters are suited for subsequent generation access traffic (for example 4G data). For at least one embodiment, access traffic associated with a UE device 212 is used to select a first backhaul path or a second backhaul path based on legacy or subsequent generation access traffic.

For at least one embodiment backhaul CT 230 over bUE device 210 is selected for improving resilience (or alternatively as a backup) for the primary backhaul CT 332 to data network 340 or as an alternative route for BH. For at least one embodiment backhaul CT 230 over bUE device 210 is selected as a temporary or interim deployment during the upgrade or ramp up or installation of backhaul CT 332 to data network 340.

For at least one embodiment one or more of a first access WCT includes one or more first QoS parameters, a first backhaul WCT includes one or more second QoS parameters and a first backhaul CT includes one or more third QoS parameters and a mapping (or alternatively a conversion or best fit) between at least two out of the first, second or third QoS parameters is required.

For at least one embodiment (for example Figure 5) a handoff between a first BS and a second BS is based on a bUE device. For example UE device 520 is wirelessly communicating to Data network 550 over BS 500 and backhaul 540. For at least one embodiment based on one or more parameters associated with BS 510 to data network 551 (such as a parameter associated with backhaul WCT 531 or backhaul CT 541) a UE device 520 could be handoff from BS 500 to BS 510 (for example if UE device 520 requests a data communication that could be better handled by the backhaul path to data network 551). For at least one embodiment one or more of

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a network entity (for example cloud or BS controller) or BS or UE device is aware of a backhaul parameter prior to (or during) one or more of associating a UE device to a BS, handover or handoff of UE device to a BS. For at least one embodiment the backhaul parameter includes one or more of a carrier core network backhaul or a carrier partner core network backhaul or a roaming backhaul core network. For at least one embodiment the handover or handoff of a UE device to a BS wirelessly communicating backhaul traffic over a bUE device is based on a backhaul CT ownership (for example carrier owned or partner carrier owned or owned by a roaming network carrier).

For at least one embodiment (for example embodiments associated with Figure 3 or Figure 2) the backhaul WCT 220 includes a wireless communication mode that could be differentiated from the access WCT 222. For at least one embodiment the mode could be a differentiated MCS (for example a higher modulation and/or code rate and/or bits/sec/Hz) or a differentiated MIMO or SIC or beamforming mode (for example additional MIMO streams, additional number of transmit or receive antennas for bUE device) or differentiated ARQ scheme (for example larger buffers, block ARQ, intermediate MAC termination point) or differentiated control message or differentiated control code or a differentiated scheduling (for example reserved or special RB). For at least one embodiment the mode could enable simultaneous or joint access and backhaul WCT transmission (for example with differentiated frame control indicators). For at least one embodiment the mode includes a more robust modulation and coding for overcoming channel impairments and/or interference or allocating high priority queues to improve on mean access delay (for example reducing backhaul traffic latency below a threshold). For at least one embodiment the mode includes a transmit power level (for example a lower transmit power to reduce backhaul WCT interference to access WCT links).

For at least one embodiment the mode may enable MU-MIMO or beamforming simultaneously from (to) a BS to (from) a UE device and bUE device on the same BS resource. For at least one embodiment the mode includes specialized symbols (for example training, reference symbols, control) for the backhaul CT. For at least one embodiment the mode includes differentiated link adaptation, resource allocation or scheduling of wireless communication resources to the backhaul WCT (for example due to differentiated channel characteristics—better LoS or K-factor or better antennas). For at least one embodiment backhaul WCT has

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differentiated capabilities/features/modes for interference generation (transmission) or interference characterization (for example estimation) or interference suppression (for example reception cancellation algorithms). For at least one embodiment the (transmission/reception) mode enables scheduling of super-position frames wherein access and BH traffic overlap on one or more time, frequency, code resources (for example using single or multiple antennas).

For at least one embodiment (for example embodiments of Figure 2) two or more backhaul paths (for example over bUE device 210 and bUE device 211) may be used for backhaul diversity (for example for traffic load balancing, channel or interference diversity). For at least one embodiment (for example embodiments of Figure 2) two or more backhaul paths (over bUE device 210 and bUE device 211) may include, more than one WCT (for example WiFi and cellular, 3G and 4G).

For at least one embodiment channel and/or interference information associated with bUE device embodiments (for example embodiments of Figure 2) are communicated to a cloud or network entity (for example cloud RAN or cloud BS or multi-BS control) based interference monitoring and/or mitigation in order to select one or more of frequency channel, resource allocation, scheduling for backhaul traffic. For at least one embodiment one or more bUE devices include better interference monitoring and/or cancellation and/or mitigation than the UE device. For at least one embodiment wireless communications resource (for example channels, resource allocation, transmit power level) monitoring and/or assignment algorithms for backhaul WCT are centralized. For at least one embodiment wireless communications resource (for example channels, resource allocation, transmit power level) monitoring and/or assignment algorithms for backhaul WCT are distributed.

For at least one embodiment a resource allocation (for example one or more of a frequency channel allocation, a frequency channel reuse, a SFR, a FFR) of a wireless communication resource is based on one or more bUE devices or one or more bUE parameters, which are differentiated relative to at least a subset of the plurality UE device or plurality of UE device parameters. For example the bUE device may include additional transmit or receiver analog (such as number of antennas, antenna gain) or baseband capability (such as transmit precoding, interference cancelling) that allow for more aggressive use of wireless

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communication resources. For at least one embodiment the resource allocation jointly assigns resources to backhaul and access traffic with differentiated parameters used in the assignments. For at least one embodiment a backhaul traffic to a bUE device has preferential treatment (for example higher priority) relative to access traffic in a scheduling assignment. For at least one embodiment a backhaul traffic has differentiated QoS parameters relative to access traffic QoS parameters wherein one or more of the resource allocation, scheduling and link adaptation are based on differentiated QoS parameters. For at least one embodiment the backhaul traffic QoS parameters are based on the associated access traffic QoS parameters. For at least one embodiment the backhaul QoS parameters are consistent and/or coordinated between the UE device and the associated BS or the associated bUE device. For at least one embodiment the interference characterization includes (or alternatively accounts for) transmit or receive interference processing capability (for example a transmit precoding or dirty paper coding or a receiver nulling or successive interference cancelling). For at least one embodiment resource allocation (or scheduling or link adaptation) is based on the interference characterization including transmit or receive interference processing capability. For at least one embodiment interference characterization matrices associated to a plurality of transmit nodes (for example BS in the DL or UE device in the UL) and a plurality of receiver nodes are based on transmit or received interference mitigation capability. For at least one embodiment the resource allocation (or alternatively scheduling) of one or more of access traffic or backhaul traffic associated with the access traffic is based at least in part on a revenue (or alternatively one or more of a a cost or a profit or a service plan or a data plan) obtained from the access traffic data communication. For at least one embodiment the resource allocation (or scheduler) is based at least in part of on information obtained from DPI of the access or backhaul traffic (for example based on the content or the application or the service). For at least one embodiment the resource allocation (or alternatively scheduling) of one or more of access traffic or backhaul traffic associated with the access traffic is based at least in part on a sponsored service or application (or alternatively a revenue share or a special or a coupon or a zero-rated or a good customer status) obtained from the access traffic data communication.

For at least one embodiment (for example embodiments associated with Figure 3), access traffic associated with UE device 212 is backhauled over a bUE device 210 to data network 241

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or backhaul CT 332 to data network 340 based on energy efficiency of one or more elements of the system (for example battery state or energy consumption of bUE device 210 or BS 301, etc.).

For at least one embodiment a receiver (for example a UE device) stores interference information (for example raw samples or post-processed received signal and/or noise symbols) from one or more of reference symbols (RS), control symbols and data symbols, and receives from a link partner (for example a BS) interference activity scheduling information (for example active transmission mode RB, on/off tables, null intervals), and refines interference characterization based on stored interference information and (delayed) interference activity scheduling information. For at least one embodiment the interference activity scheduling information may be delayed.

For at least one embodiment a receiver storing interference information reduces a requirement (such as latency, BW) on the backhaul for exchange of control messages between one or more of a BS or one or more UE device. For example control messages may be compressed (for example one or more of on/off, power control, BF, MIMO parameters). For at least one embodiment a receiver stored interference information includes a first covariance matrix, and based on an interference activity scheduling information including information based on a interference source configuration, the receiver refines the first covariance matrix to a second covariance matrix. For at least one embodiment a receiver computes a plurality of covariance matrix (for example a first covariance matrix based on the leading 25% of received frame, and a second covariance matrix based on the leading 75% of received frame) and based on interference activity scheduling information from neighbor BS may obtain a new covariance matrix based on the plurality of covariance matrices.

For at least one embodiment a resource allocation or scheduler agent (for example executed by a BS controller) clusters (for example allocates contiguous frequency and/or time resource blocks) transmission modes within a transmission frame (for example DL or UL frames or sub-frames). For example a first set (or alternatively group or cluster or classification) of transmission time slots (or alternatively time and/or frequency RBs) may be assigned a beamforming transmission mode, followed by a second set of transmission time slots assigned a MIMO (multiple input, multiple output) transmission mode, followed by a third set of

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transmission time slots assigned a SISO (single input, single output) transmission mode, followed by empty slots. In at least a second embodiment a first set of RB may include transmission at a maximum transmit power level, followed by a median transmit power level, followed by a minimum transmit power level. Other group classifications criteria may be based on one or more of path loss (for example for UL), MCS, transmit power, number of transmit antennas, SFR, FFR. For at least one embodiment a plurality of UE device (or bUE device) may be classified into sets based on path loss, for example with high path loss UL UE (which typically will transmit higher power) transmitting the first cluster of RB, followed by typical path loss UE, followed by low path loss UE.

For at least one embodiment a plurality of UE devices (or bUE devices) may be classified into sets based on distance to a BS (or location relative to two neighboring BS), for example cell edge UL UE (which typically will transmit higher power and/or often interfere with a neighboring BS) transmitting the first cluster of RB, followed by median cell UE device, followed by close-in UE device.

For at least one embodiment classifying transmission mode into clusters reduces the variation of interference generated or received over time or enables more predictable interference levels versus frame location (for example time and/or frequency RB relative to frame boundaries) making scheduling or link adaptation more robust based on frame location interference characterization information. For at least one embodiment reduced interference variation based on transmission mode clustering enables resource allocation (for example frequency channel assignments, SFR, FFR) to be allocated at larger time intervals (for example higher latency feedback, more accurate estimators, larger time constant assignments—for example at central or distributed controller at a cloud node). For at least one embodiment a resource allocation or schedulers is based on an inner and outer loop control. For example outer loop (typically resource allocation agent) based on longer term S and/or I statistics, and inner loop (typically scheduler) based on instantaneous channel or queue status.

For at least one embodiment a bUE device is managed (or alternatively controlled) at least in part by a user (for example a cellular subscriber). For at least one embodiment a user may one or more of allow, block, restrict, a bUE device functionality. For example a bUE

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device user (or subscriber) may limit the amount of backhaul traffic communicating over the bUE device. For at least one embodiment the bUE device may restrict the amount of backhaul traffic based on bUE device state (for example battery state or a data plan associated with the bUE WCT or CT). For at least one embodiment the bUE device includes a user policy. For example a UI for user notification of bUE device information (status, usage, battery usage or projections, etc.), user control (for example one or more of request for permission, approval, block, restrict, allow, throttle, shape) or offers to the user, such as a data plan sponsor. For at least one embodiment the user-managed bUE device is sponsored or awards credits and/or points to the user.

For at least one embodiment a wireless access provider (or WCT provider) pays (or alternatively compensates or is billed by) a second CT provider (for example a cellular carrier may compensate a DSL and/or cable service provider backhauling data through the bUE device). For at least one embodiment, revenue generated from access traffic over backhaul CT is revenue-shared between the WCT provider and one or more backhaul CT provider or some other partnership.

It should be understood that any of the embodiments of the described embodiments can be implemented in the form of control logic using hardware and/or using computer software in a modular or integrated manner. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will know and appreciate other ways and/or methods to implement embodiments of the described embodiments using hardware or a combination of hardware and software.

Any of the software components or functions described in this application may be implemented as software code to be executed by a processor using any suitable computer language such as, for example, Java, C++ or Perl using, for example, conventional or object-oriented techniques. The software code may be stored as a series of instructions or commands on a computer readable medium for storage and/or transmission, suitable media include random access memory (RAM), a read only memory (ROM), a magnetic medium such as a hard-drive or a floppy disk, or an optical medium such as a compact disk (CD) or DVD (digital versatile disk), flash memory, and the like. The computer readable medium may be any combination of such storage or transmission devices.

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Such programs may also be encoded and transmitted using carrier signals adapted for transmission via wired, optical, and/or wireless networks conforming to a variety of protocols, including the Internet. As such, a computer readable medium according to an embodiment of the described embodiments may be created using a data signal encoded with such programs. Computer readable media encoded with the program code may be packaged with a compatible device or provided separately from other devices (e.g., via Internet download). Any such computer readable medium may reside on or within a single computer program product (e.g. a hard drive, a CD, or an entire computer system), and may be present on or within different computer program products within a system or network. A computer system may include a monitor, printer, or other suitable display for providing any of the results mentioned herein to a user.

Any of the methods described herein may be totally or partially performed with a computer system including a processor, which can be configured to perform the steps. Thus, embodiments can be directed to computer systems configured to perform the steps of any of the methods described herein, potentially with different components performing a respective steps or a respective group of steps. Although presented as numbered steps, steps of methods herein can be performed at a same time or in a different order. Additionally, portions of these steps may be used with portions of other steps from other methods. Also, all or portions of a step may be optional. Additionally, any of the steps of any of the methods can be performed with modules, circuits, or other means for performing these steps.

The specific details of particular embodiments may be combined in any suitable manner without departing from the spirit and scope of embodiments of the invention. However, other embodiments of the invention may be directed to specific embodiments relating to each individual aspect, or specific combinations of these individual aspects.

The above description of exemplary embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form described, and many modifications and variations are possible in light of the teaching above. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated.

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CLAIMS

What is claimed:

1. A method, comprising:

determining a plurality of link qualities (LQs) of a user equipment (UE) for a plurality of positionings of the UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of the UE;

storing information associated with the plurality of LQs for the plurality of positionings;

estimating at least one future positioning of the UE; and

estimating a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

2. The method of claim 1, wherein at least one of the future LQ or the plurality of LQs comprises one or more of a path loss (PL), S, I, SNR, SINR, SIR, CQI, CSI, PER.

3. The method of claim 1, wherein at least one of the future LQ or the information associated with the plurality of LQs is associated with an uplink or downlink transmission.

4. The method of claim 1, wherein at least one of the future LQ or the plurality of LQs is associated with a frequency band or a frequency channel.

5. The method of claim 1, wherein at least one of the future LQ or the plurality of LQs is associated with a wireless communication technology.

6. The method of claim 1, wherein at least one of the future LQ or the plurality of LQs is associated with a link partner of the UE.

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7. The method of claim 1, wherein a link quality positioning information includes at least one of the determined plurality of LQs, the stored information, the estimated future positioning or the estimated future LQ.

8. The method of claim 7, wherein the UE obtains at least a portion of the link quality positioning information from a link partner or wherein the UE communicates the at least the portion of the link quality positioning information to the link partner.

9. The method of claim 1, further comprising allocating a resource to a UE link, wherein the allocation of the resource to the UE link is based on the estimated future LQ.

10. The method of claim 1, further comprising selecting a transmission mode for a UE link, wherein the selecting the transmission mode for the UE link is based on the estimated future LQ.

11. The method of claim 10, wherein the transmission mode comprises one or more of a modulation, a code, a modulation and coding scheme (MCS), a MIMO mode, a beamforming parameter, a transmit power.

12. The method of claim 1, further comprising obtaining at least one future time, and wherein the estimating the at least one future positioning is based on the at least one future time.

13. The method of claim 1, further comprising a second plurality of positionings wherein the second plurality of positionings comprises the at least one future positioning, and further comprising estimating a second plurality of LQs based on the second plurality of positionings.

14. The method of claim 13, further comprising allocating a resource block (RB) to a UE link based on the estimated second plurality of LQs.

15. The method of claim 1, wherein the plurality of positionings is constrained to a physical area.

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16. The method of claim 1, wherein at least one of the plurality of positionings or the estimated at least one future positioning of the UE further comprises at least one of an error, an accuracy, a deformation, a velocity, an acceleration.

17. The method of claim 7, further comprising determining a UE usage information, wherein at least a portion of the link quality positioning information is based on the UE usage information.

18. The method of claim 17, wherein the UE usage information comprises UE information indicating one or more of a user handheld mode, a hands-free mode, a speaker phone mode, a car Bluetooth mode, a headset Bluetooth mode.

19. The method of claim 7, further comprising determining a UE environment information, wherein at least a portion of the link quality positioning information is based on the UE environment information.

20. The method of claim 19, wherein the UE environment information comprises information associated to one or more of a traffic load, a network load, an interference, time of day, whether information, day of year, season.

21. The method of claim 19, wherein the UE environment information comprises information associated with surrounding objects or information associated with a user of the UE.

22. The method of claim 21, wherein the information associated with the user of the UE includes positioning of the user of the UE or positioning of the user of the UE relative to the UE.

23. The method of claim 19, further comprising assisting determining the UE environment information using sensors of the UE.

24. A method, comprising:

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determining a plurality of link qualities (LQs) of a user equipment (UE) for a plurality of positionings of the UE, wherein at least one of the plurality positioning includes at least a location or an orientation of the UE;

storing information associated with the plurality of LQs for the plurality of positionings;

estimating at least a positioning of the UE;

determining at least one neighboring positioning of the positioning of the UE; and

estimating one or more neighboring link qualities (LQs) of the UE at the at least one neighboring positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

25. The method of claim 24, further comprising adjusting or changing a configuration of the UE based on the one or more neighboring LQs.

26. The method of claim 24, further comprising presenting the one or more neighboring LQs of the UE at the at least one neighboring positioning.

27. The method of claim 24, further comprising selecting a candidate positioning from the at least one neighboring positioning based on the one or more neighboring LQs.

28. The method of claim 27, further comprising presenting the selected candidate positioning to a user of the UE.

29. The method of claim 24, wherein a link quality neighboring positioning information includes at least one of the determined plurality of LQs, the stored information, the estimated at least a positioning of the UE, the determined at least one neighboring positioning, or the one or more neighboring LQs.

30. The method of claim 29, further comprising determining a UE environment information, wherein at least a portion of the link quality neighboring positioning information is based on the UE environment information.

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31. The method of claim 30, the UE environment information comprises information associated with a user of the UE.

32. The method of claim 30, further comprising selecting a joint candidate positioning of the UE and a user of the UE, wherein the joint candidate positioning comprises a combination of a UE positioning and a user positioning relative to the UE.

33. A user equipment (UE), the UE comprising:

a transceiver operative to communicate with a link partner device through a communication link, wherein the communication link includes a link quality;

a controller, the controller operative to:

determine a plurality of link qualities (LQs) of the UE for a plurality of positionings of the UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of the UE;

store information associated with the plurality of LQs for the plurality of positionings;

estimate at least one future positioning of the UE; and

estimate a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

34. A method, comprising:

determining a plurality of link qualities (LQs) of one or more user equipment (UE) for a plurality of positionings of the one or more UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of a first UE of the one or more UE;

storing information associated with the plurality of LQs for the plurality of positionings;

estimating at least one future positioning of a second UE; and

estimating a future link quality (LQ) of the second UE at the at least one future positioning of the second UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the one or more UE.

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ABSTRACT OF THE DISCLOSURE

Systems, methods, and apparatuses for estimating a user equipment link quality based on a positioning of user equipment are provided. One method includes determining a plurality of link qualities (LQs) of the user equipment (UE) for a plurality of positionings of the UE, wherein at least one of the plurality of positionings includes at least a location or an orientation of the UE, storing information associated with the plurality of LQs for the plurality of positionings, estimating at least one future positioning of the UE, and estimating a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

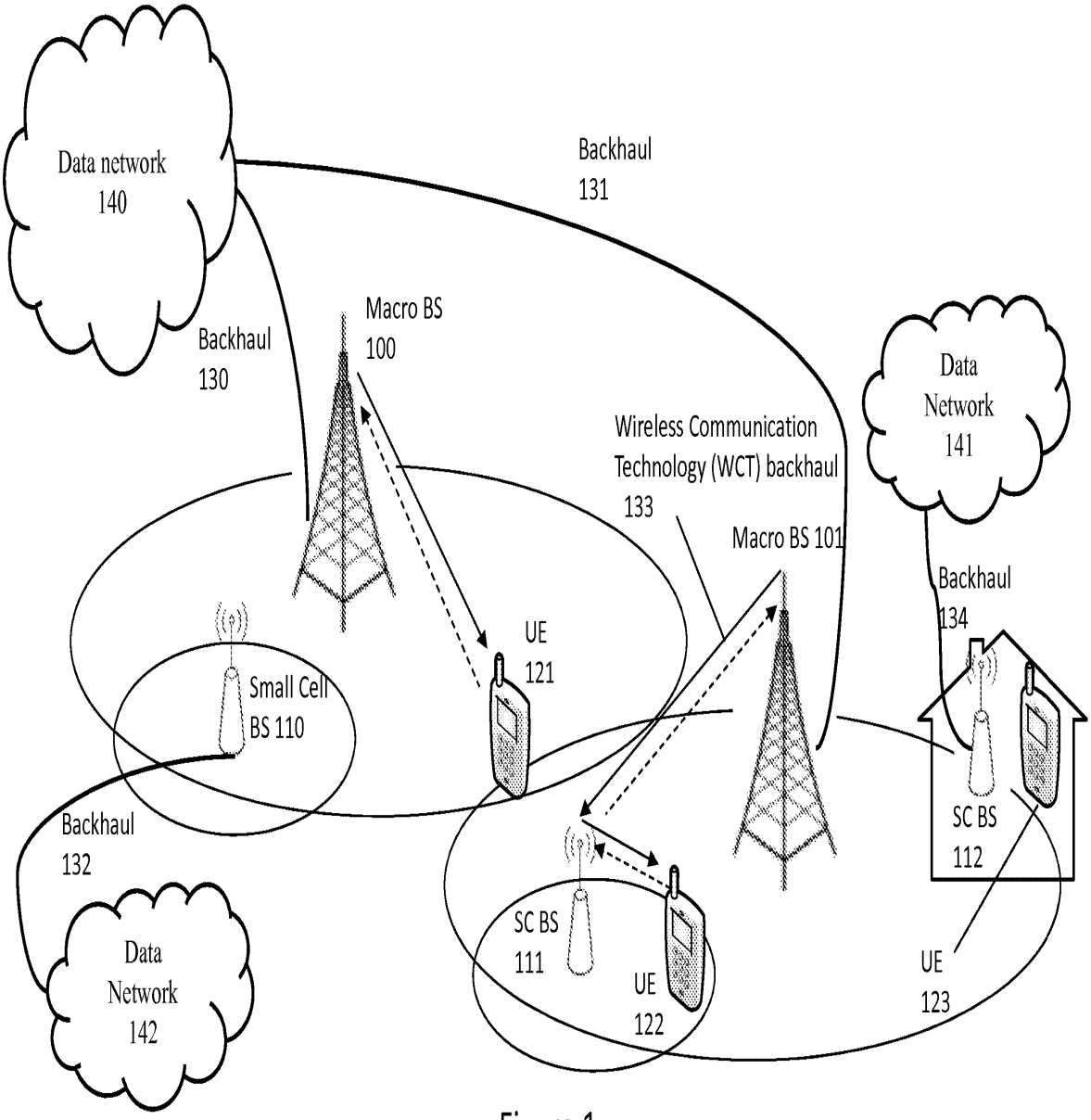

Data network
140
Backhaul
131
Backhaul
130
Macro BS
100
Data
Network
141
Wireless Communication
Technology (WCT) backhaul
133
Macro BS 101
Backhaul
134
UE
121
Small Cell
BS 110
Backhaul
132
SC BS
112
SC BS
111
UE
122
UE
123
Data
Network
142

Figure 1

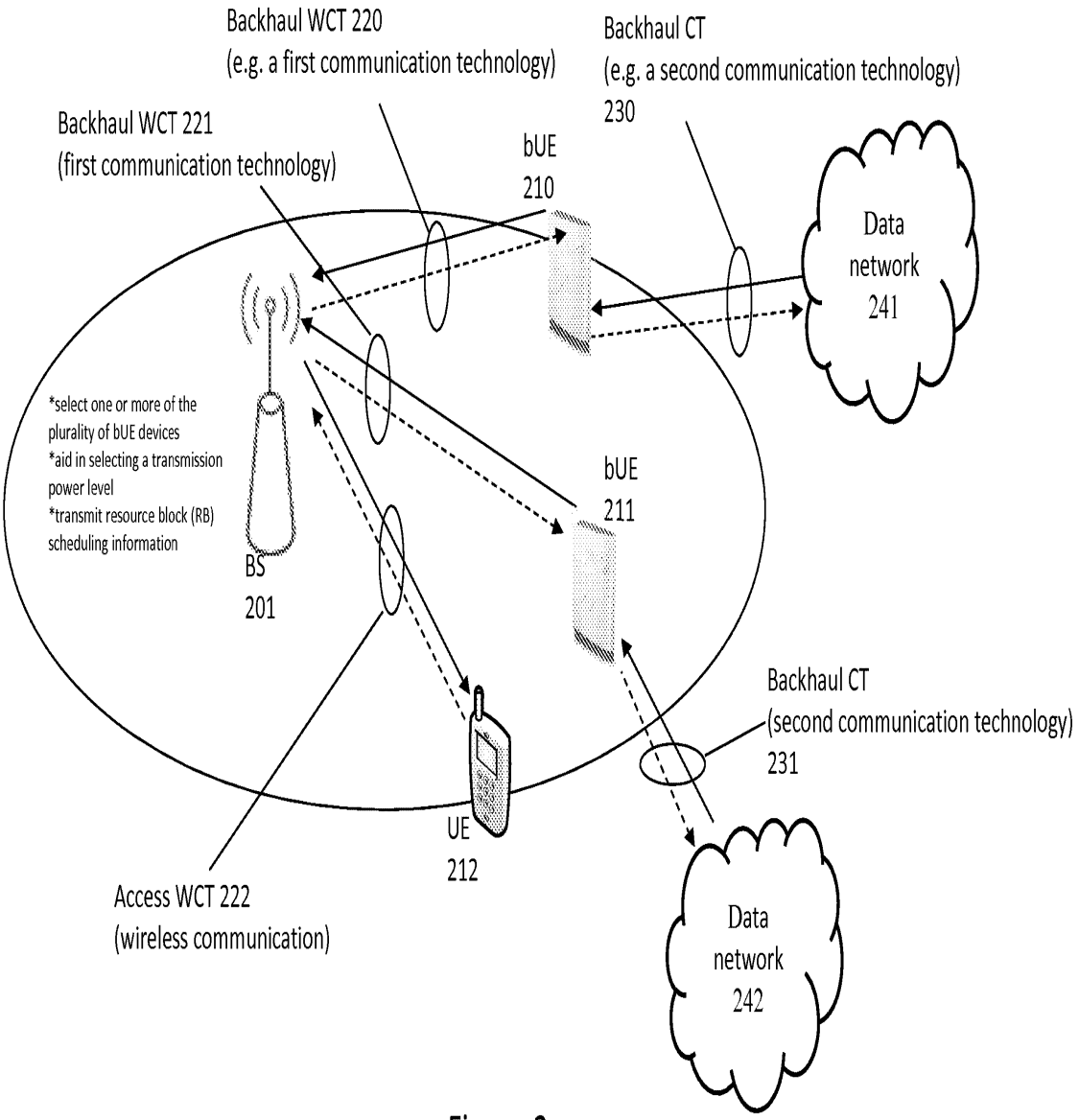

Backhaul WCT 220
(e.g. a first communication technology)
Backhaul CT
(e.g. a second communication technology)
230
Backhaul WCT 221
(first communication technology)
bUE
210
Data
network
241
*select one or more of the plurality of bUE devices
*aid in selecting a transmission power level
*transmit resource block (RB) scheduling information
bUE
211
BS
201
Backhaul CT
(second communication technology)
231
UE
212
Access WCT 222
(wireless communication)
Data
network
242

Figure 2

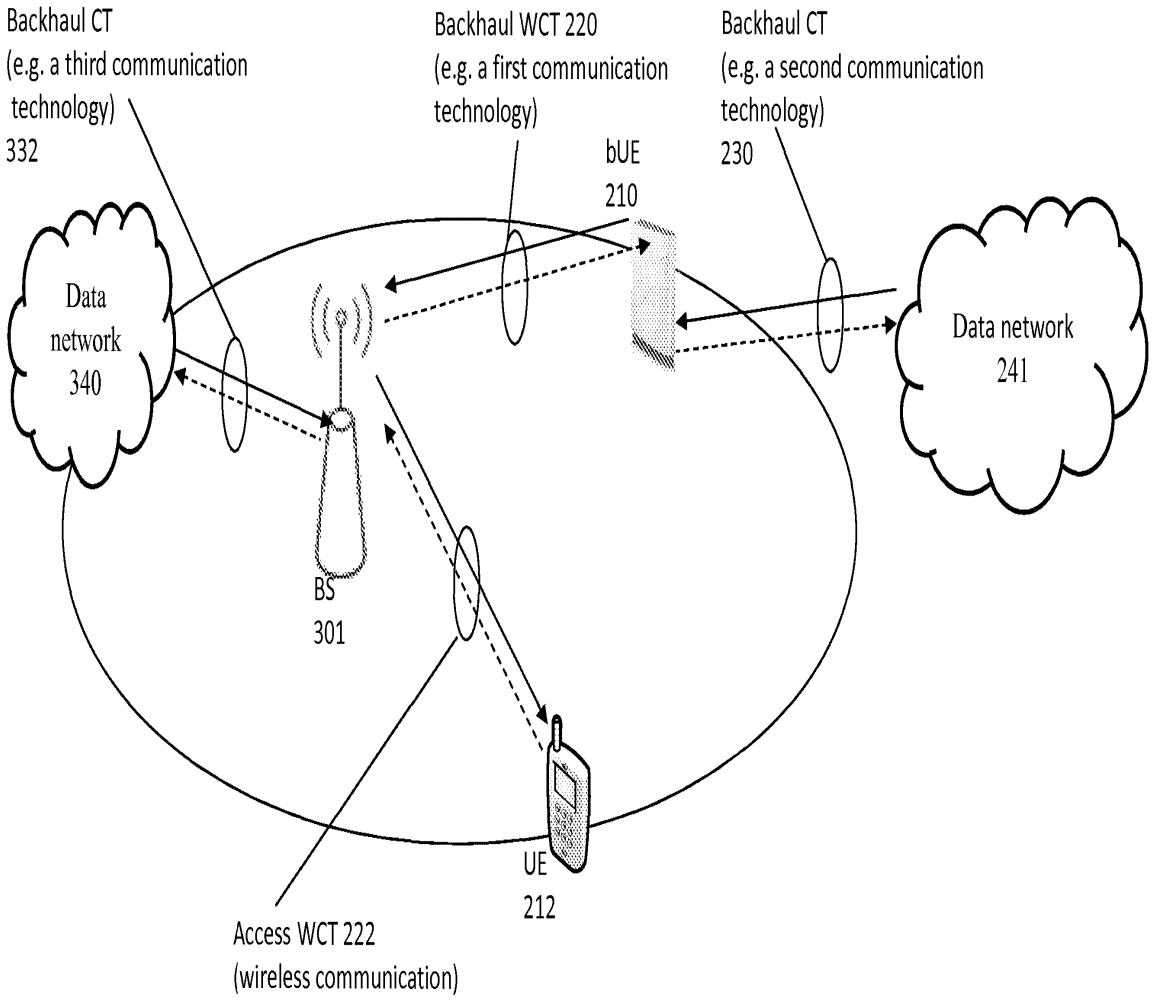

Backhaul CT
(e.g. a third communication technology)
332
Backhaul WCT 220
(e.g. a first communication technology)
bUE
210
Backhaul CT
(e.g. a second communication technology)
230
Data network
340
Data network
241
BS
301
UE
212
Access WCT 222
(wireless communication)

Figure 3

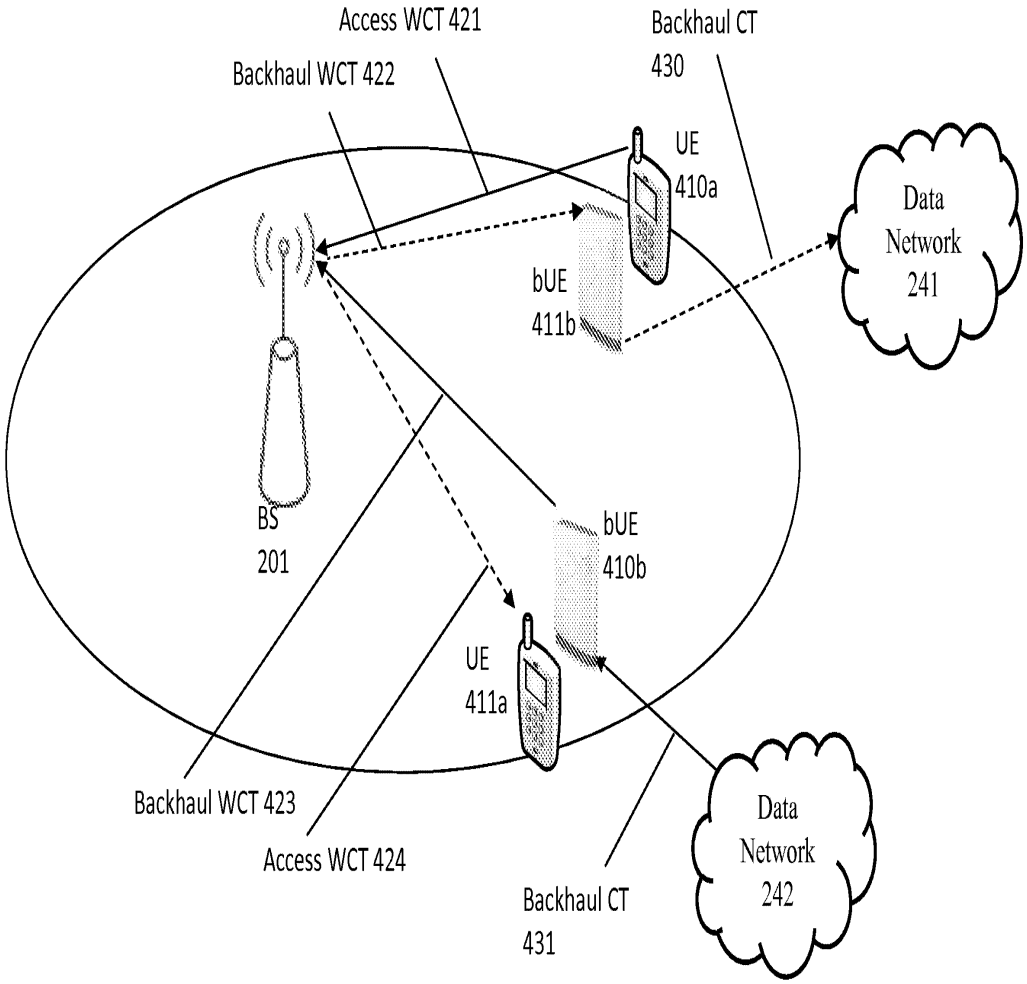

Access WCT 421
Backhaul WCT 422
Backhaul CT
430
UE
410a
Data
Network
241
bUE
411b
BS
201
bUE
410b
UE
411a
Backhaul WCT 423
Access WCT 424
Backhaul CT
431
Data
Network
242

Figure 4

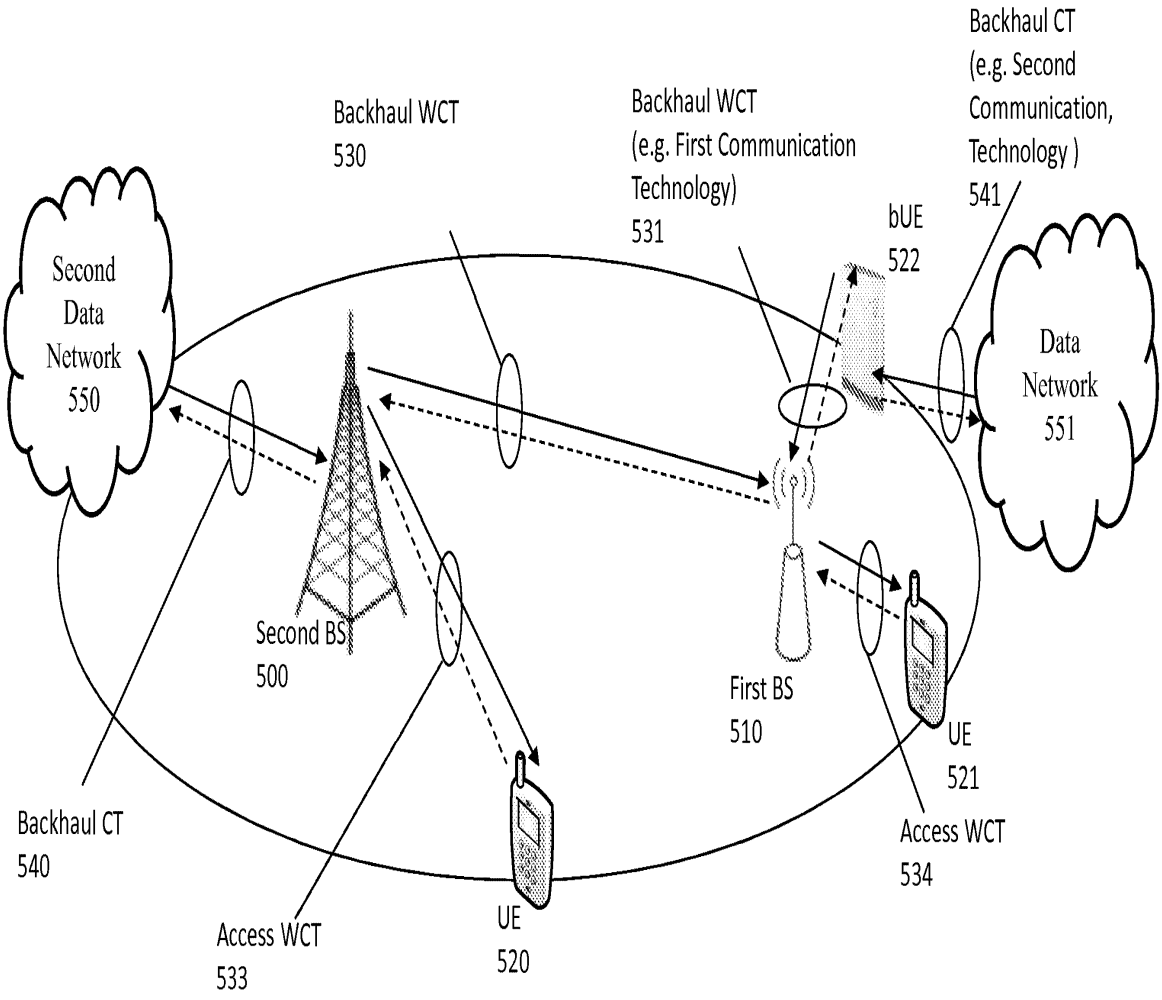

Backhaul CT
(e.g. Second
Communication,
Technology)
541
Backhaul WCT
530
Backhaul WCT
(e.g. First Communication
Technology)
531
bUE
522
Second
Data
Network
550
Data
Network
551
Second BS
500
First BS
510
UE
521
Backhaul CT
540
Access WCT
534
Access WCT
533
UE
520

Figure 5

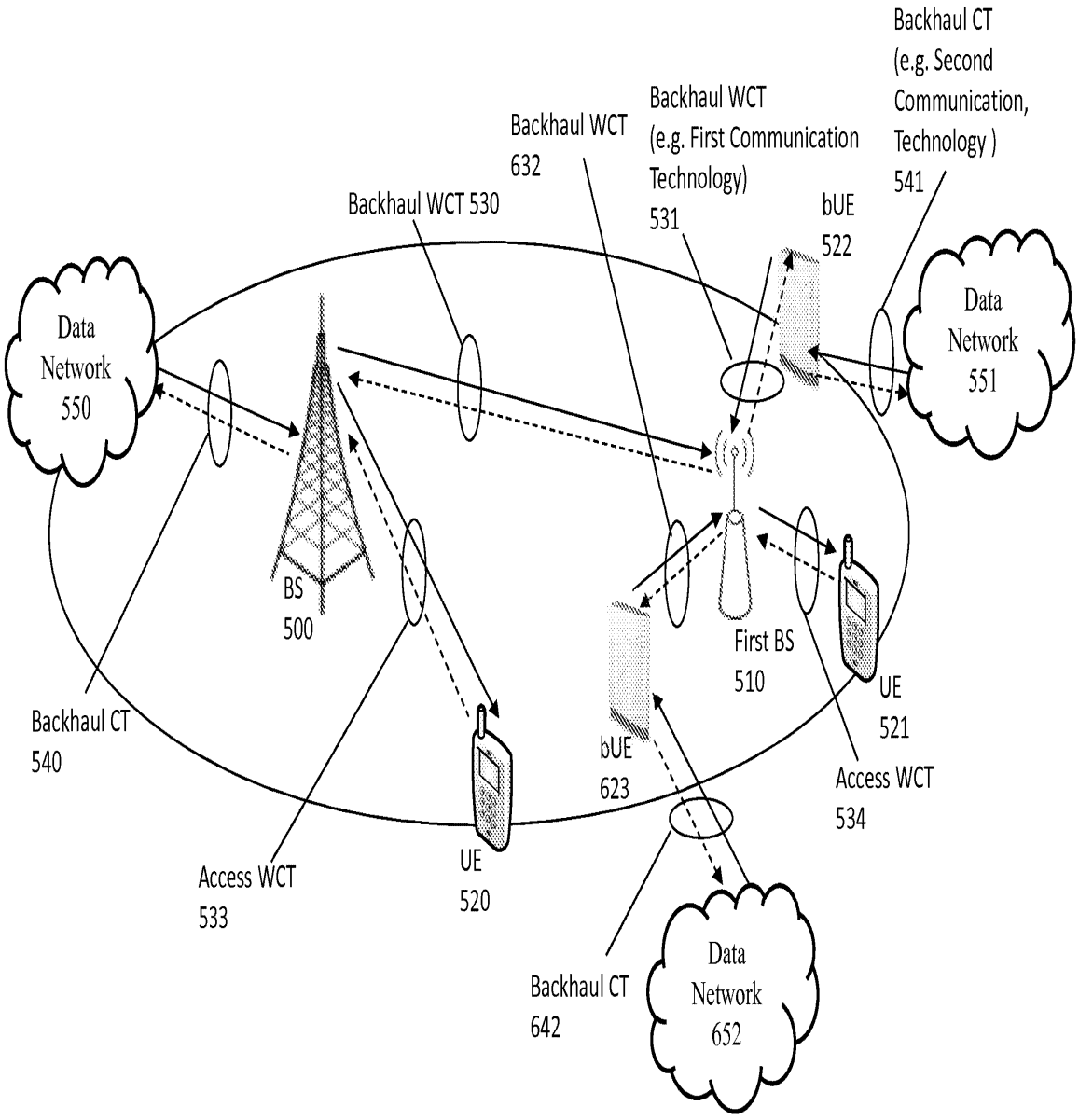

Backhaul CT
(e.g. Second
Communication,
Technology)
541
Backhaul WCT
(e.g. First Communication
Technology)
531
Backhaul WCT
632
Backhaul WCT 530
bUE
522
Data
Network
550
Data
Network
551
BS
500
First BS
510
Backhaul CT
540
bUE
623
UE
521
Access WCT
534
Access WCT
533
UE
520
Backhaul CT
642
Data
Network
652

Figure 6

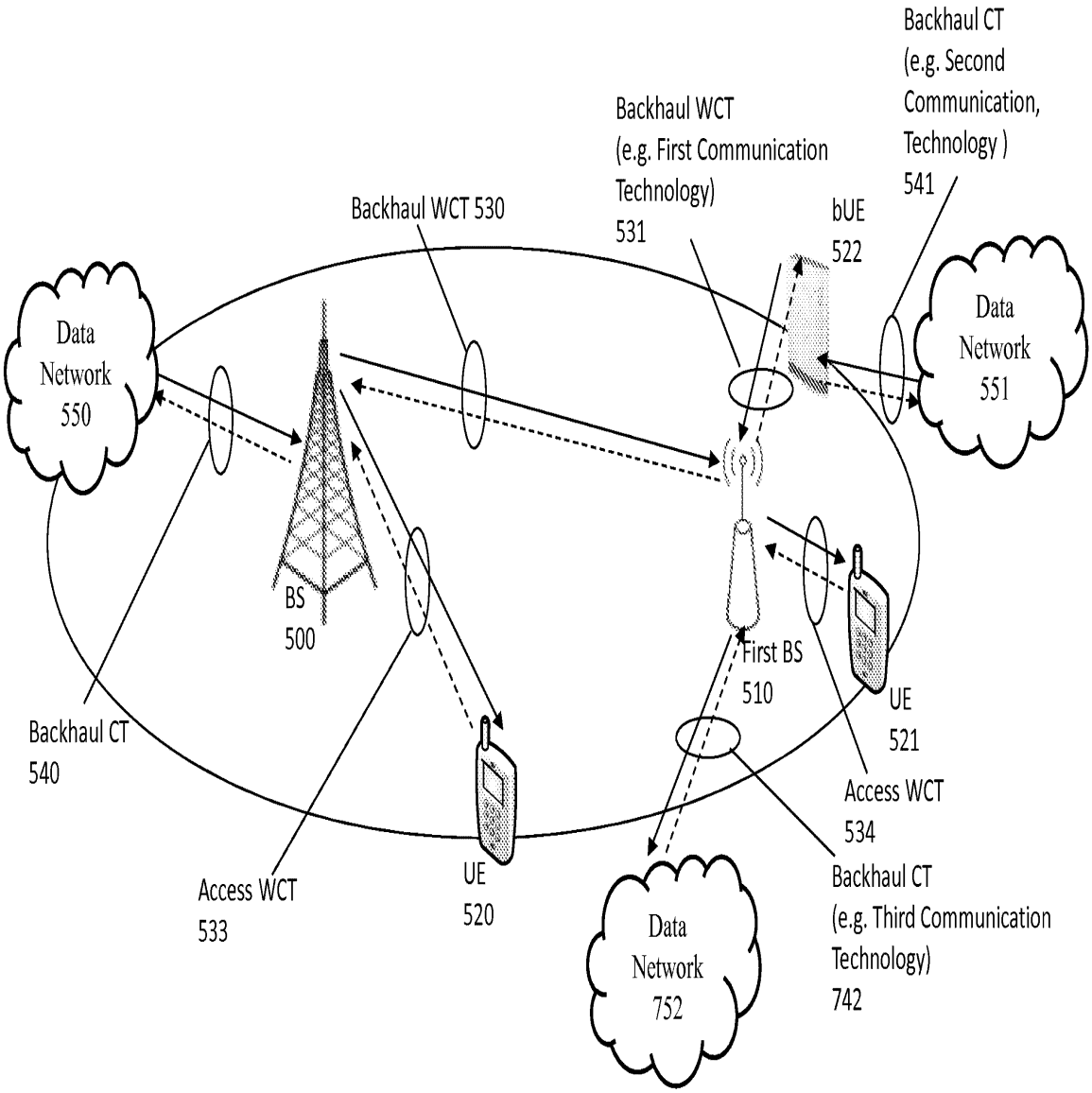

Backhaul CT
(e.g. Second
Communication,
Technology)
541
Backhaul WCT
(e.g. First Communication
Technology)
531
Backhaul WCT 530
bUE
522
Data
Network
550
Data
Network
551
BS
500
First BS
510
UE
521
Backhaul CT
540
Access WCT
534
Backhaul CT
(e.g. Third Communication
Technology)
742
Access WCT
533
UE
520
Data
Network
752

Figure 7a

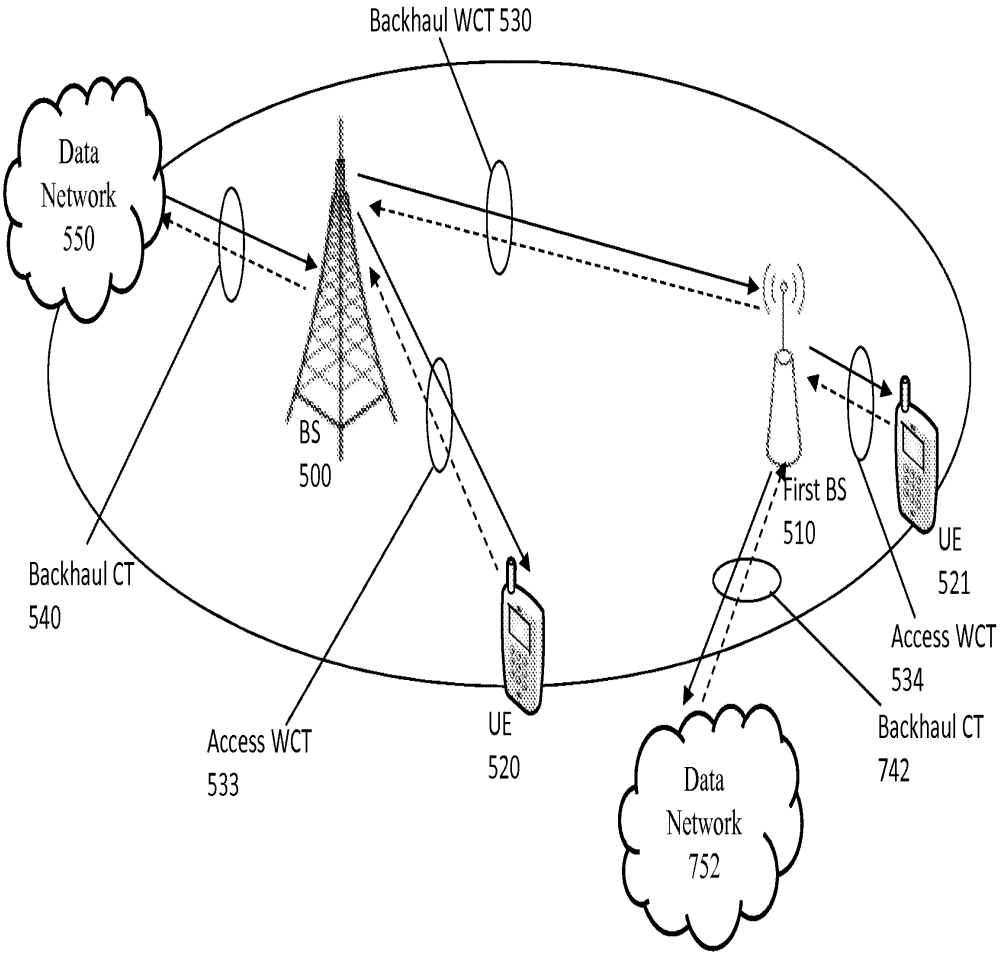

Backhaul WCT 530
Data Network 550
BS 500
First BS 510
Backhaul CT 540
Access WCT 533
UE 520
UE 521
Access WCT 534
Backhaul CT 742
Data Network 752

Figure 7b

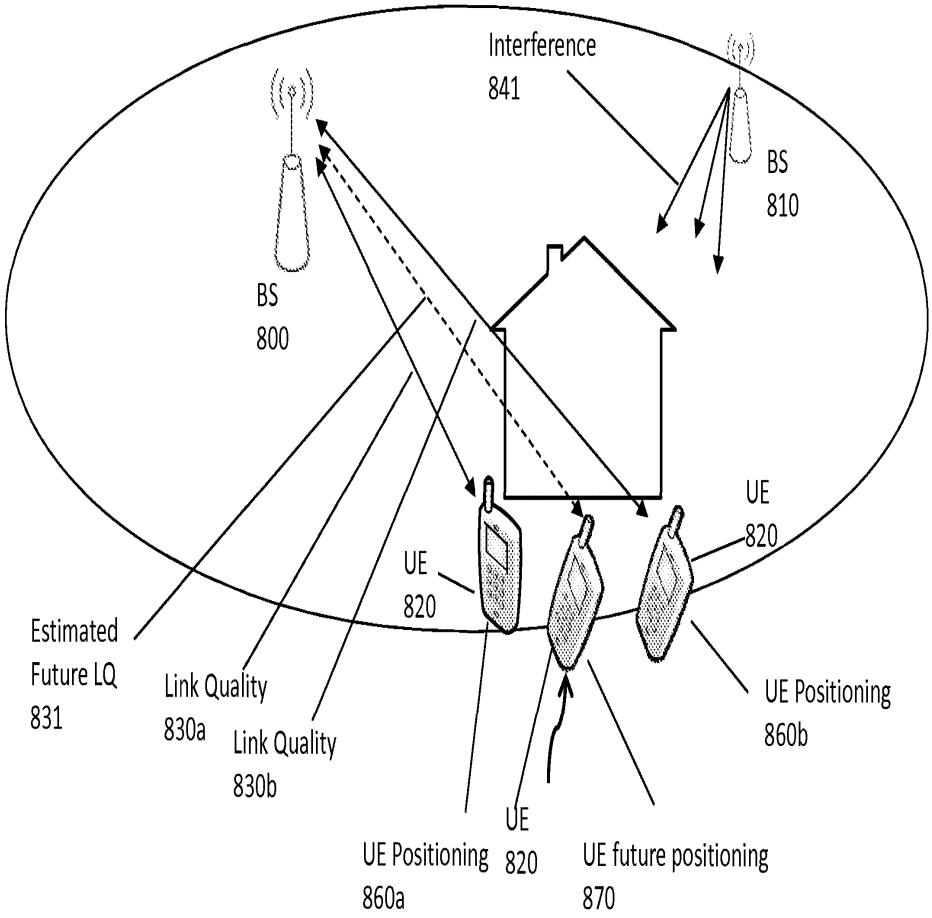

Interference
841
BS
810
BS
800
UE
820
UE
820
Estimated
Future LQ
831
Link Quality
830a
Link Quality
830b
UE Positioning
860b
UE Positioning
860a
UE
820
UE future positioning
870

Figure 8

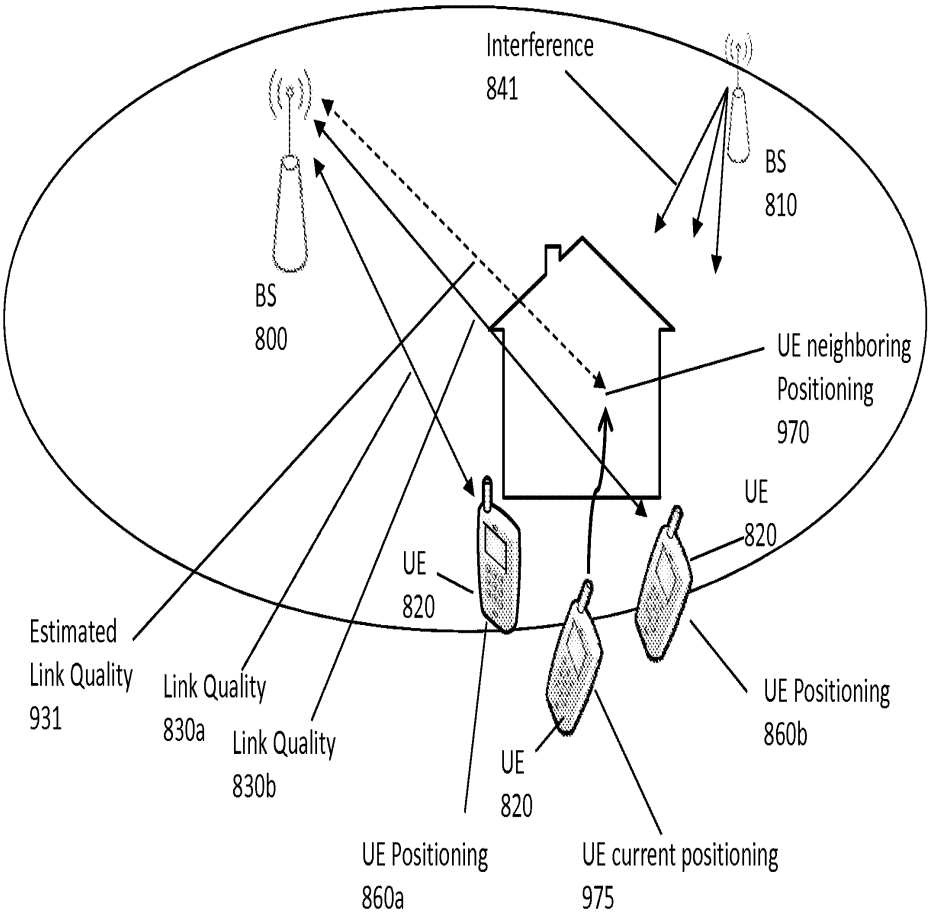

Interference
841
BS
810
BS
800
UE neighboring
Positioning
970
UE
820
UE
820
Estimated
Link Quality
931
Link Quality
830a
Link Quality
830b
UE Positioning
860b
UE
820
UE Positioning
860a
UE current positioning
975

Figure 9

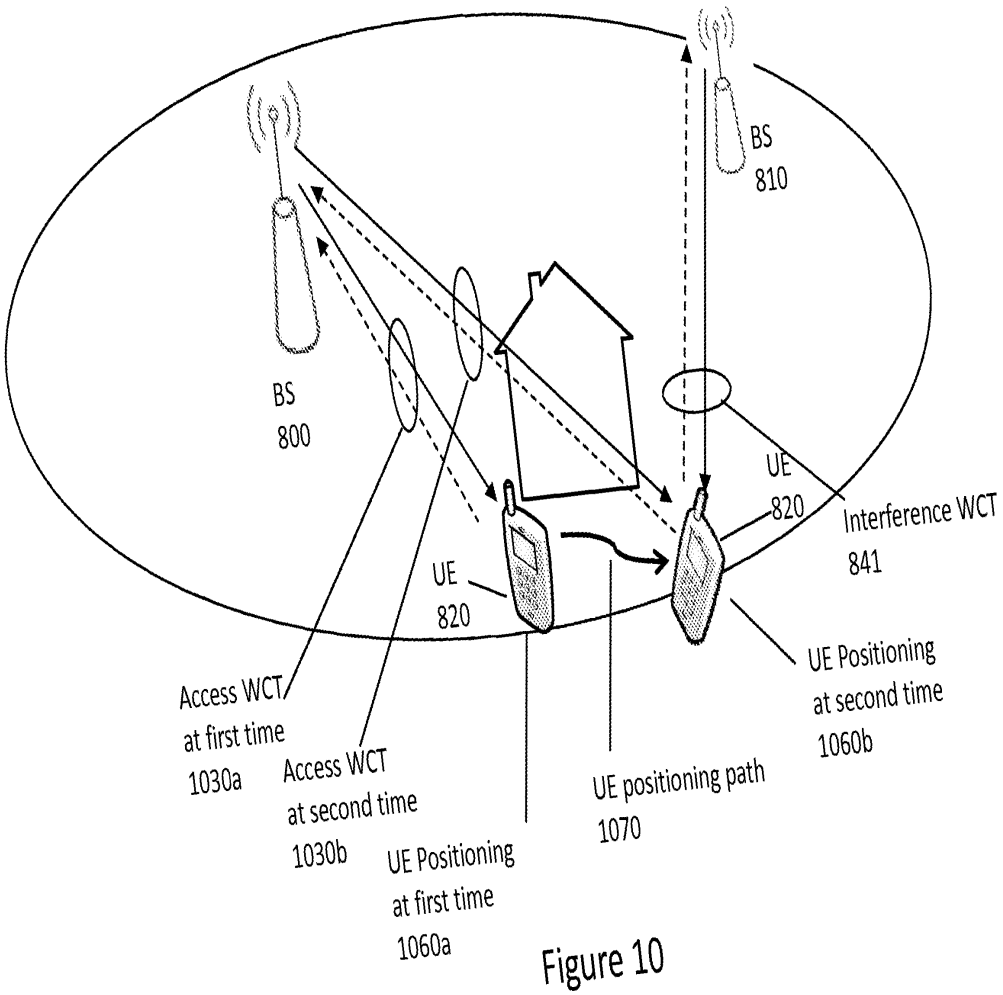

BS
810
BS
800
UE
820
Interference WCT
841
UE
820
UE Positioning
at second time
1060b
Access WCT
at first time
1030a
Access WCT
at second time
1030b
UE positioning path
1070
UE Positioning
at first time
1060a

Figure 10

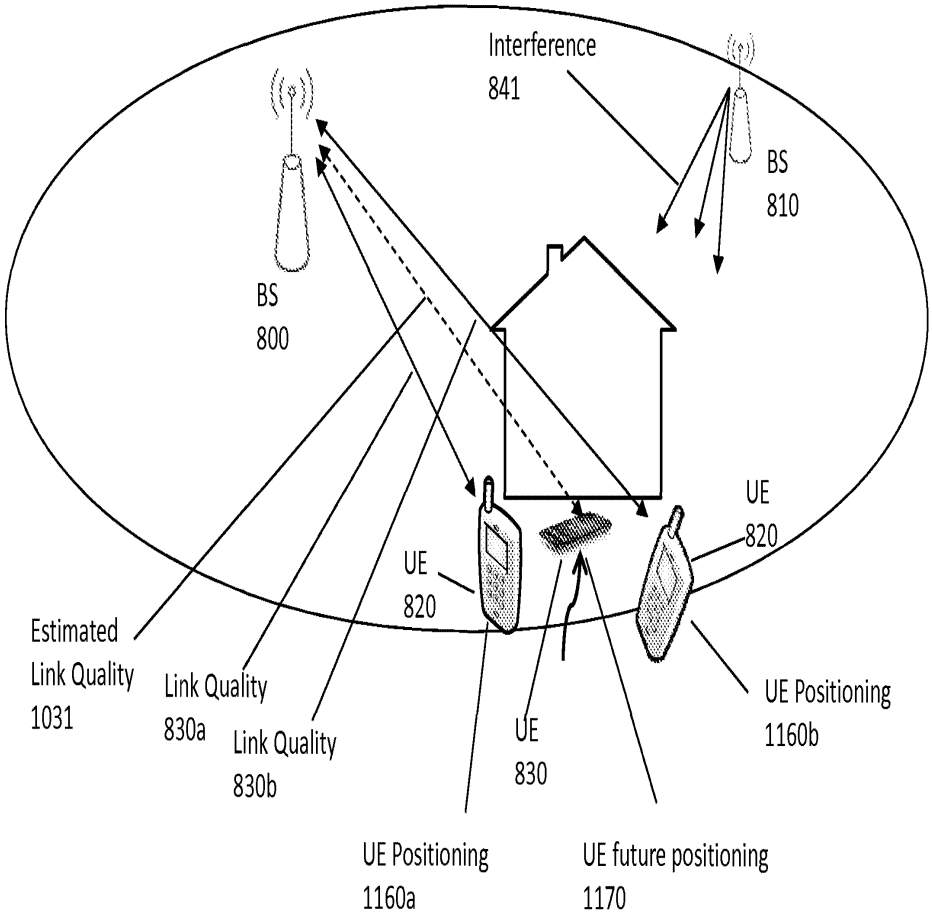

Interference
841
BS
810
BS
800
UE
820
UE
820
Estimated
Link Quality
1031
Link Quality
830a
Link Quality
830b
UE
830
UE Positioning
1160b
UE Positioning
1160a
UE future positioning
1170

Figure 11

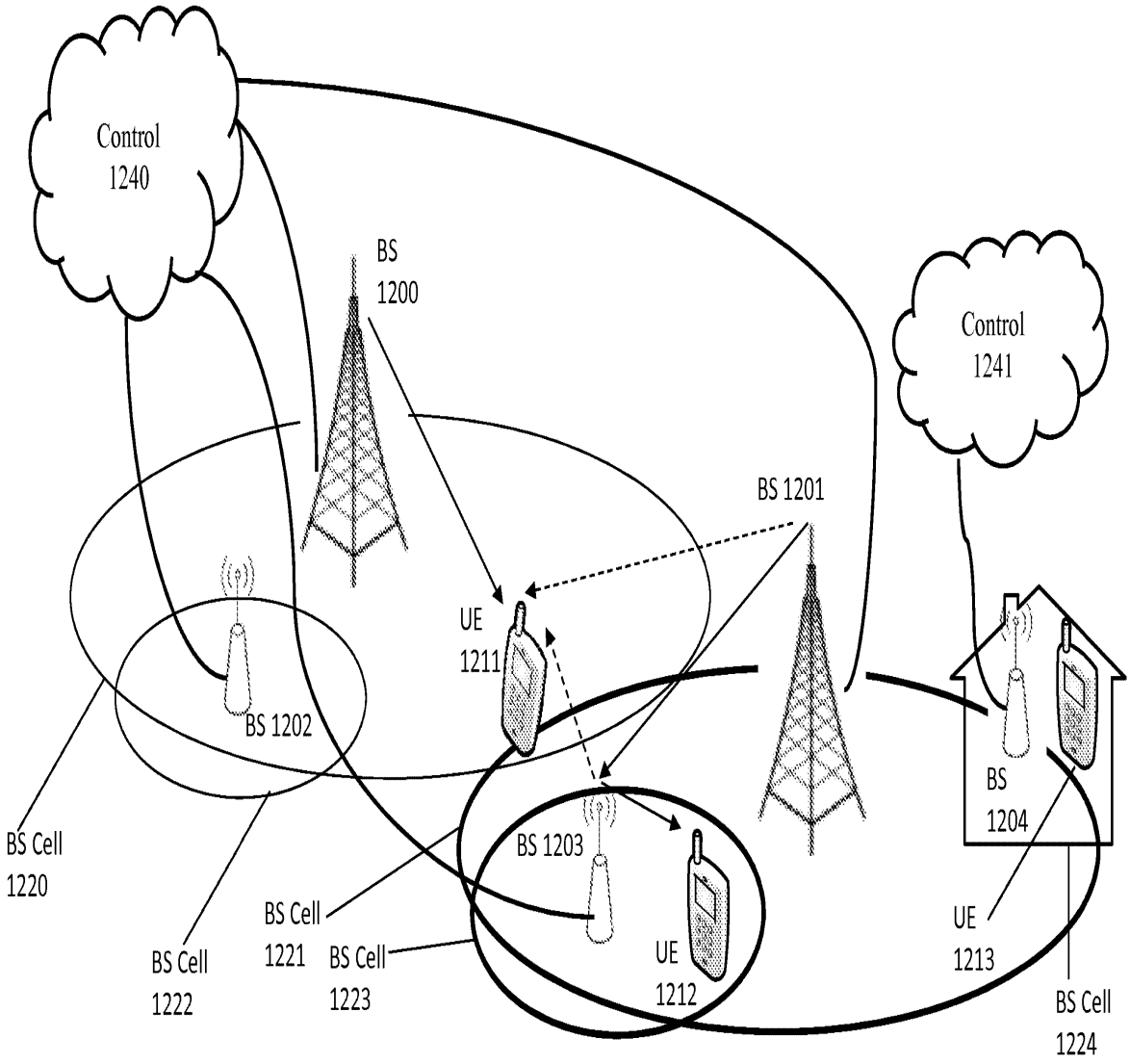

Control
1240
BS
1200
Control
1241
BS 1201
UE
1211
BS 1202
BS Cell
1220
BS Cell
1222
BS Cell
1221
BS Cell
1223
BS 1203
UE
1212
BS
1204
UE
1213
BS Cell
1224

Figure 12

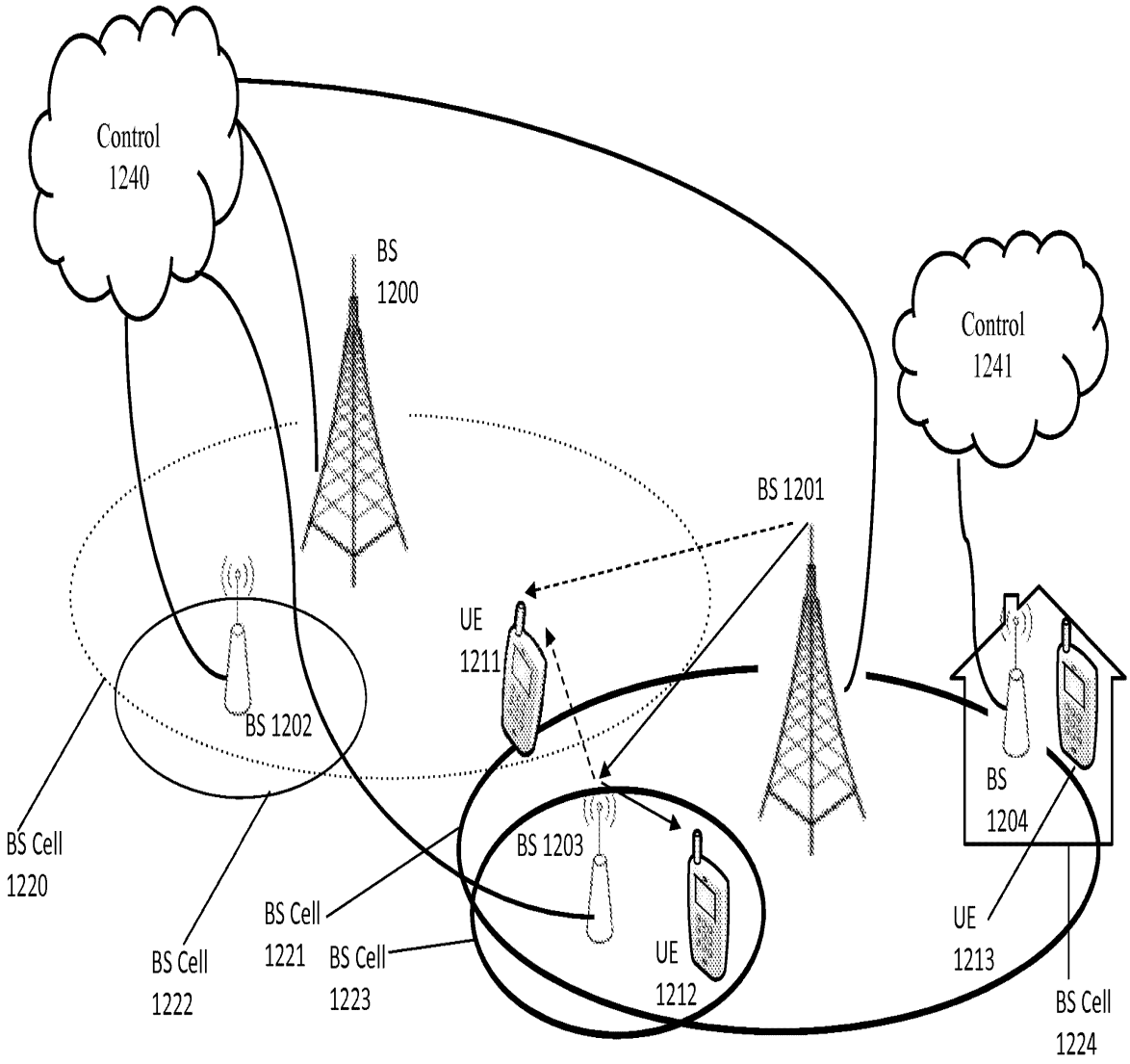

Control
1240
BS
1200
Control
1241
BS 1201
UE
1211
BS 1202
BS
1204
BS 1203
BS Cell
1220
BS Cell
1221
BS Cell
1222
BS Cell
1223
UE
1212
UE
1213
BS Cell
1224

Figure 13

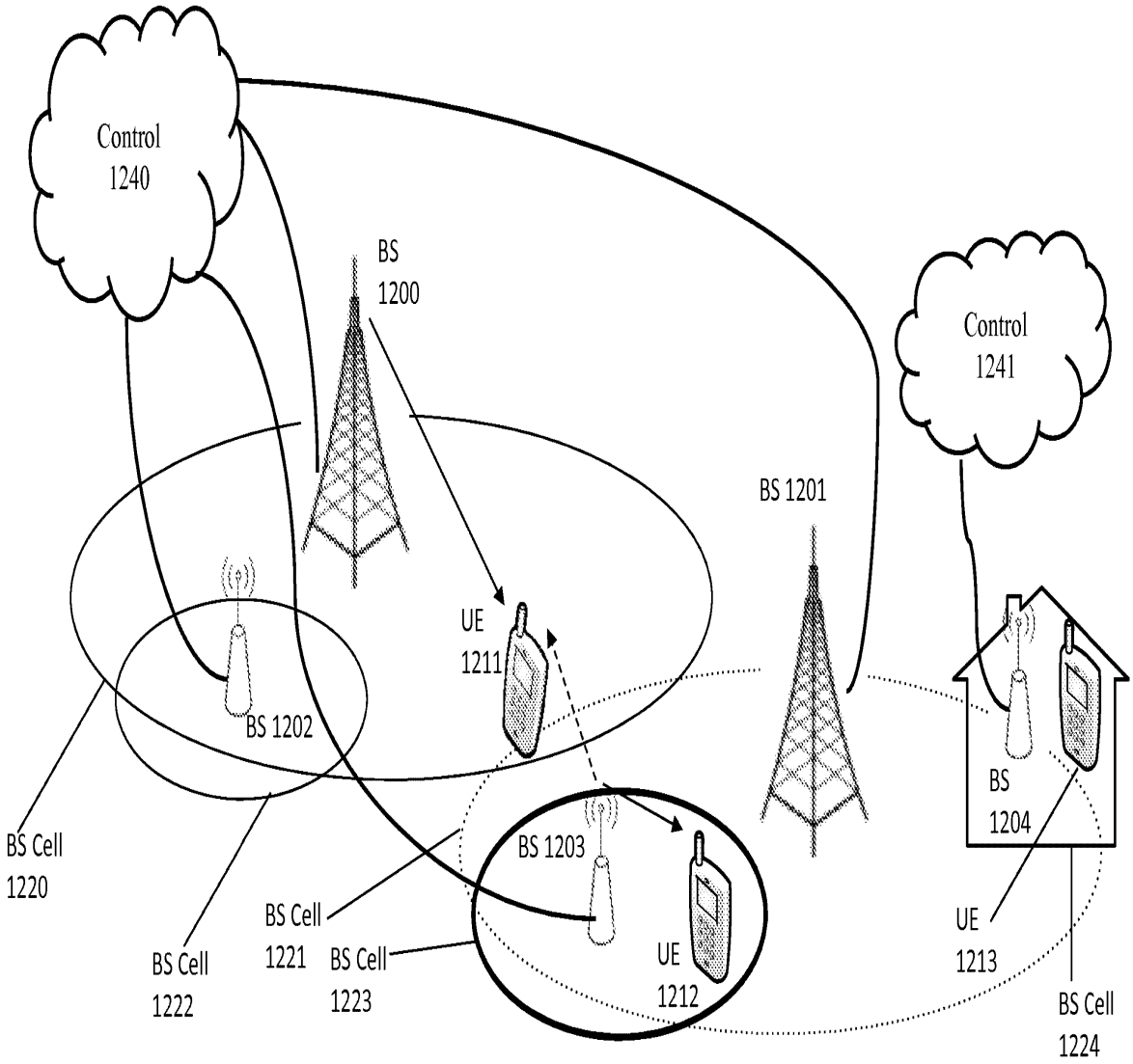

Control
1240
BS
1200
Control
1241
BS 1201
UE
1211
BS 1202
BS Cell
1220
BS Cell
1222
BS Cell
1221
BS Cell
1223
BS 1203
UE
1212
BS
1204
UE
1213
BS Cell
1224

Figure 14

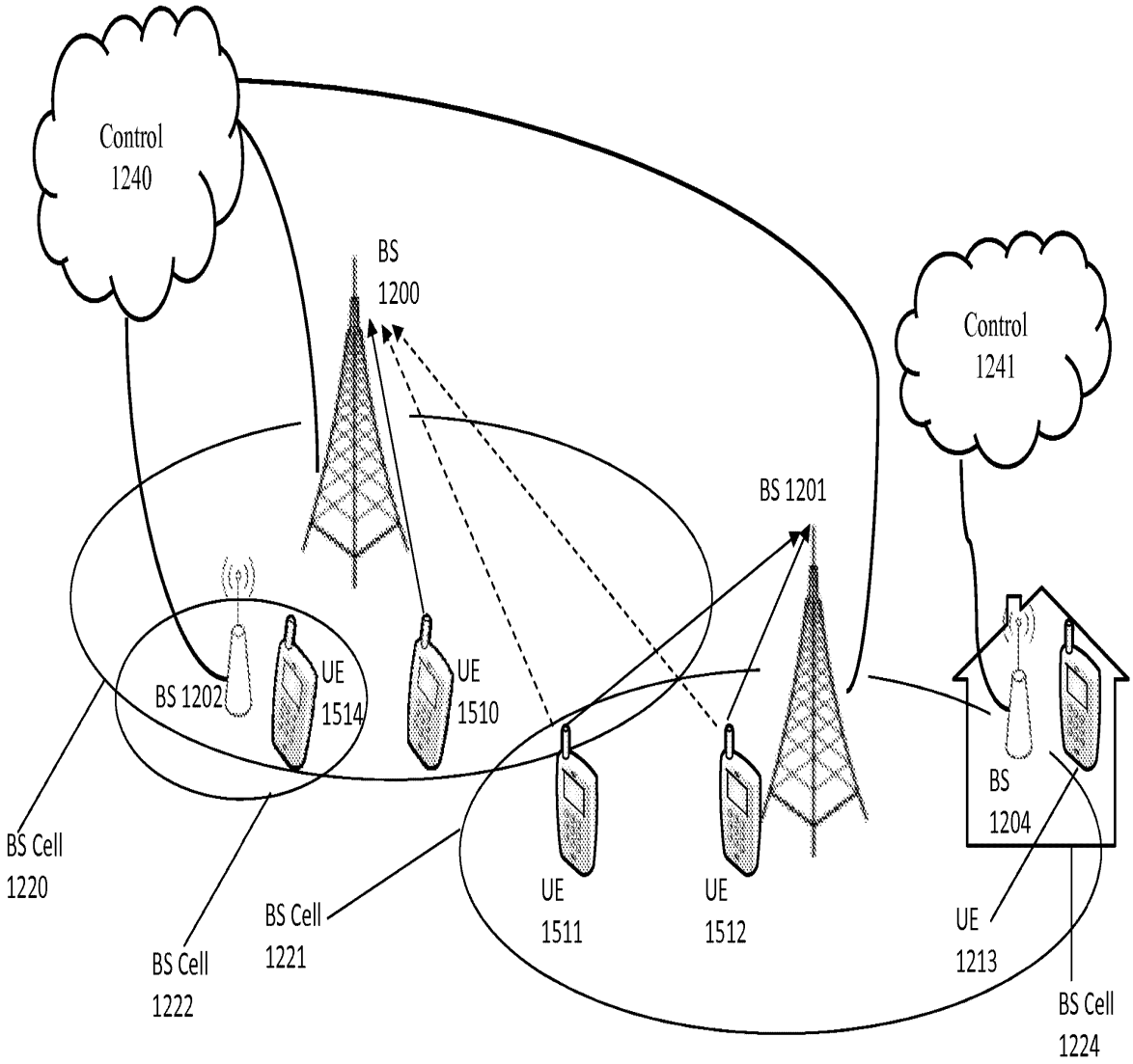

Control
1240
BS
1200
Control
1241
BS 1201
BS 1202
UE
1514
UE
1510
BS
1204
BS Cell
1220
BS Cell
1221
UE
1511
UE
1512
UE
1213
BS Cell
1222
BS Cell
1224

Figure 15

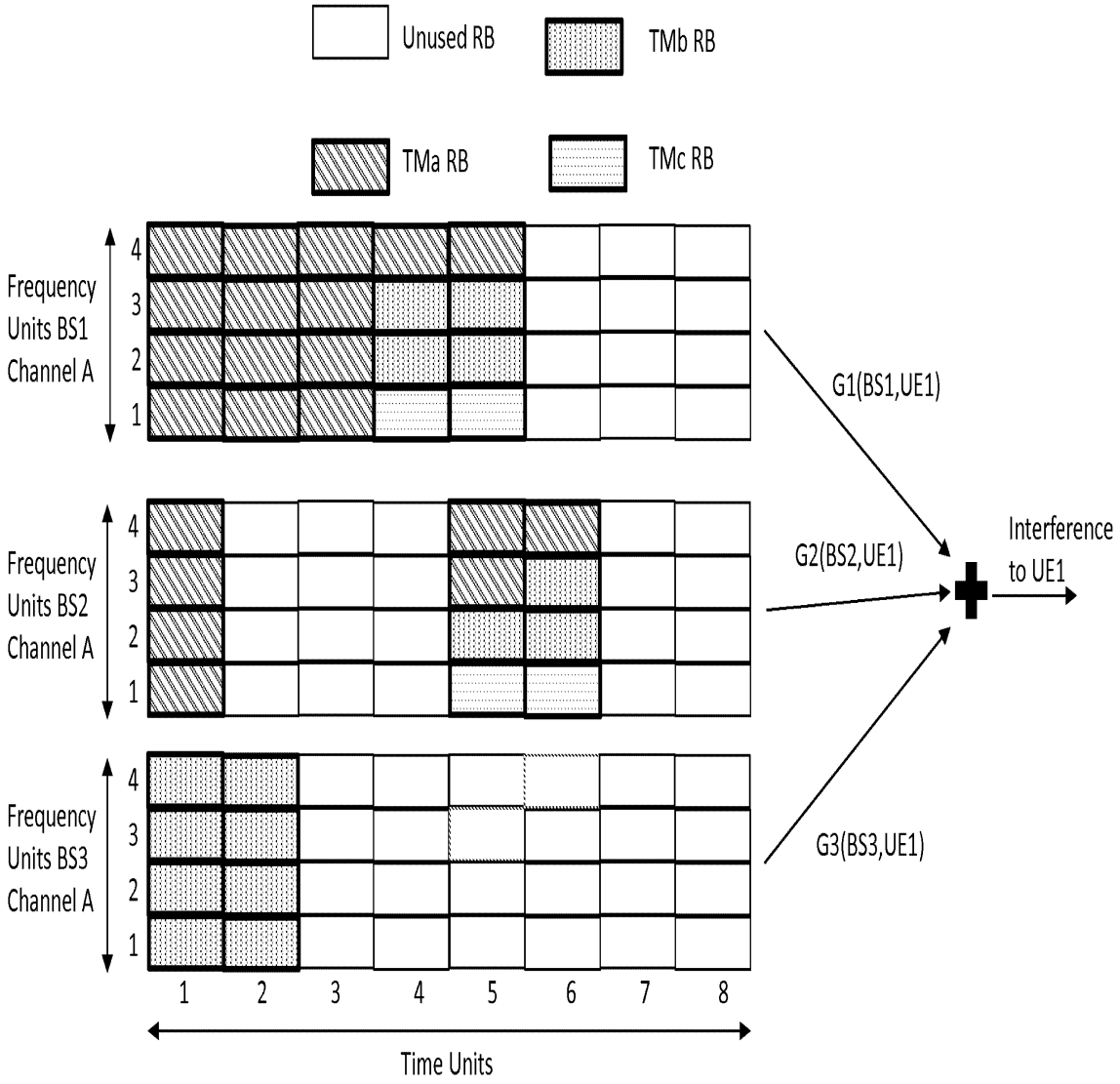

Unused RB
TMb RB
TMa RB
TMc RB
Frequency Units BS1 Channel A
Frequency Units BS2 Channel A
Frequency Units BS3 Channel A
4
3
2
1
G1(BS1,UE1)
G2(BS2,UE1)
G3(BS3,UE1)
Interference to UE1
1
2
3
4
5
6
7
8
Time Units

Figure 16

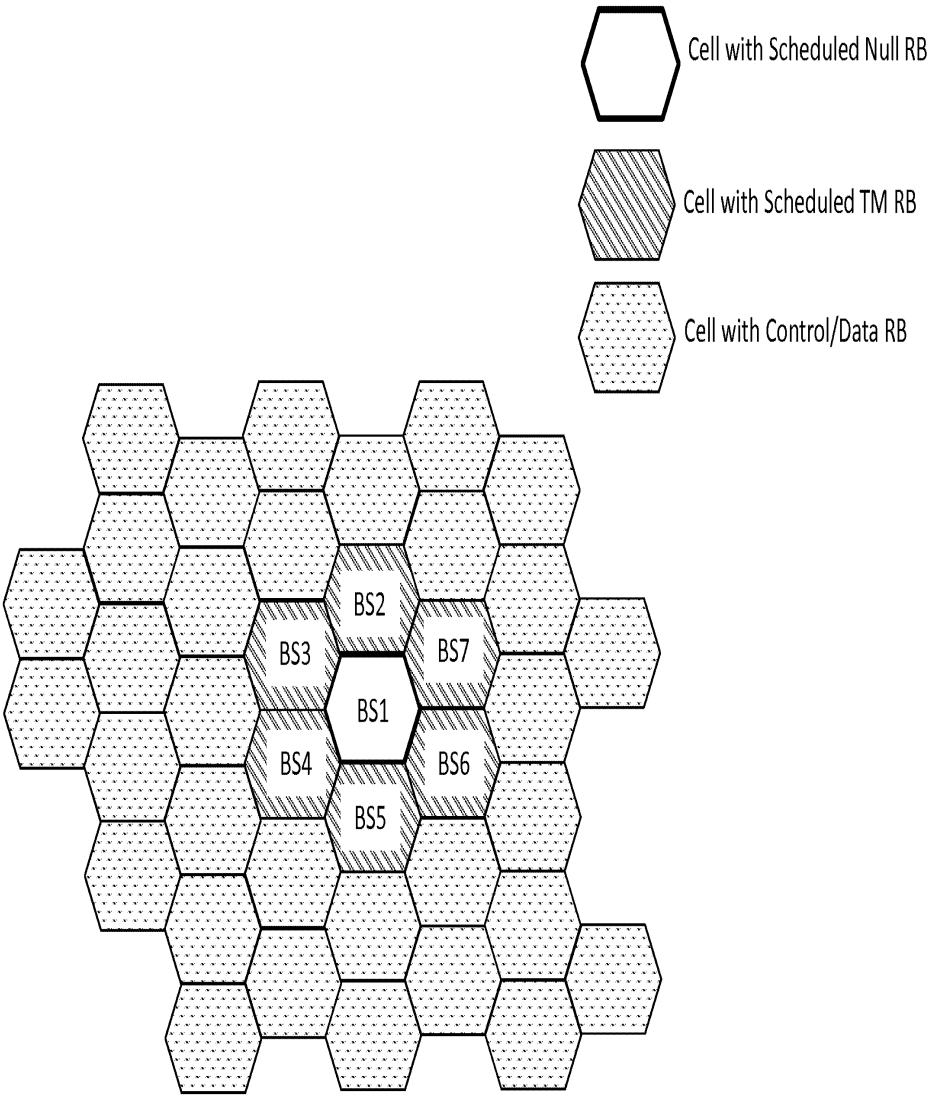

Cell with Scheduled Null RB
Cell with Scheduled TM RB
Cell with Control/Data RB
BS2
BS3
BS7
BS1
BS4
BS6
BS5

Figure 17

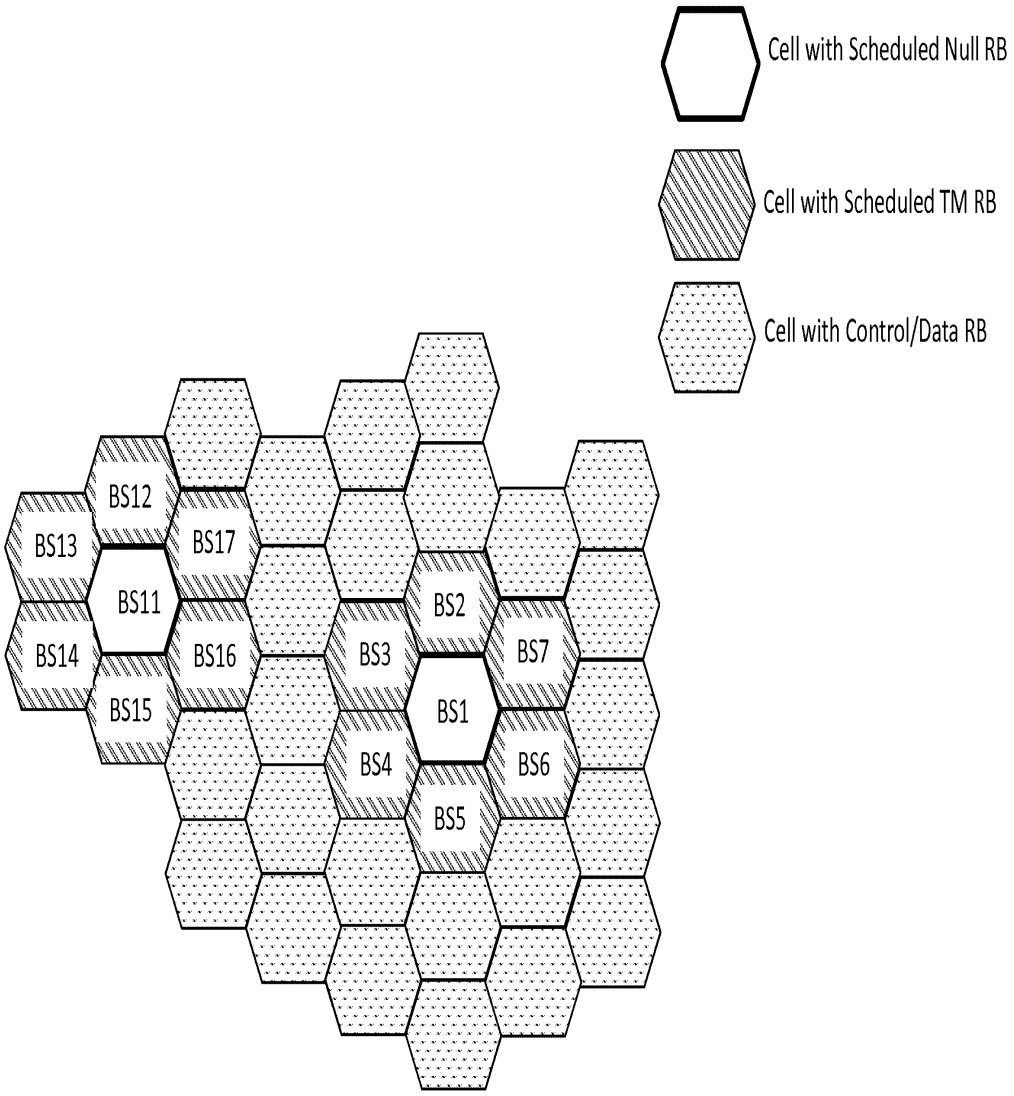

Cell with Scheduled Null RB
Cell with Scheduled TM RB
Cell with Control/Data RB
BS12
BS13
BS17
BS11
BS2
BS14
BS16
BS3
BS7
BS15
BS1
BS4
BS6
BS5

Figure 18

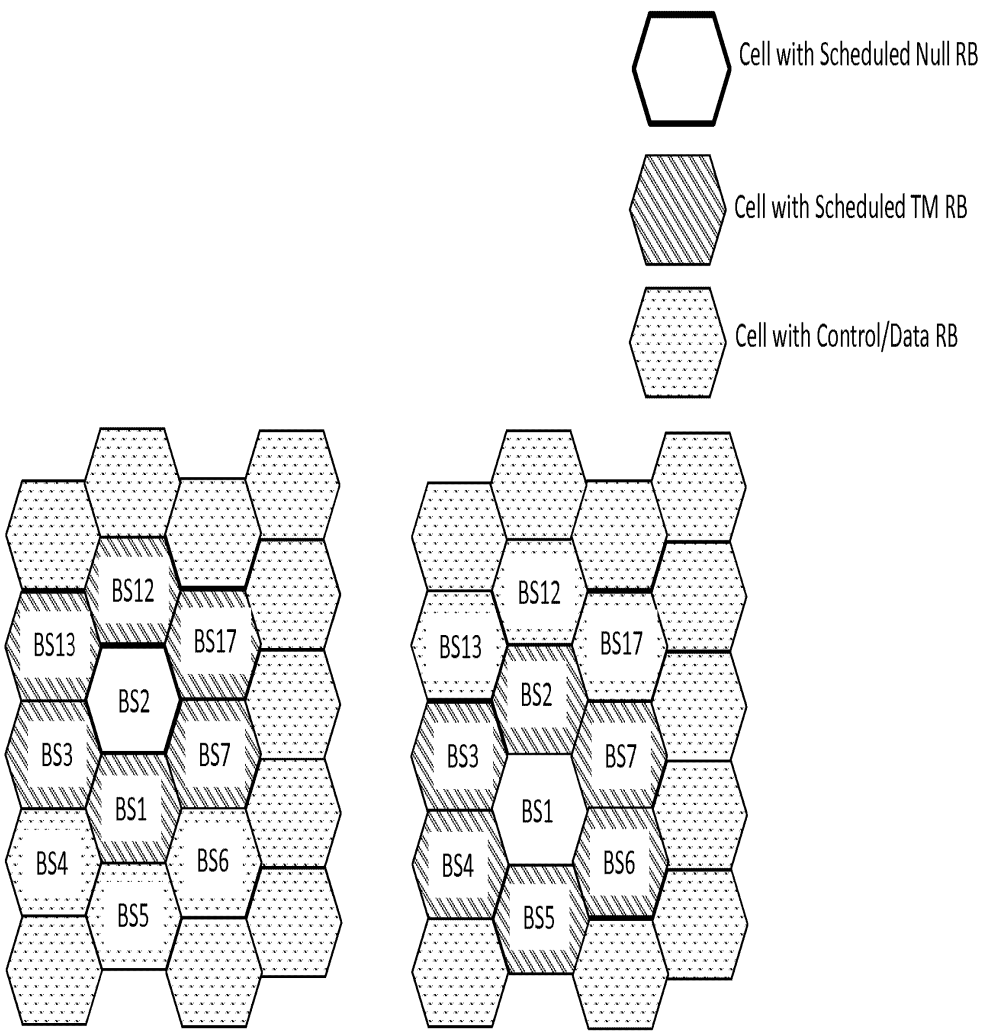


Figure 19a

Figure 19b

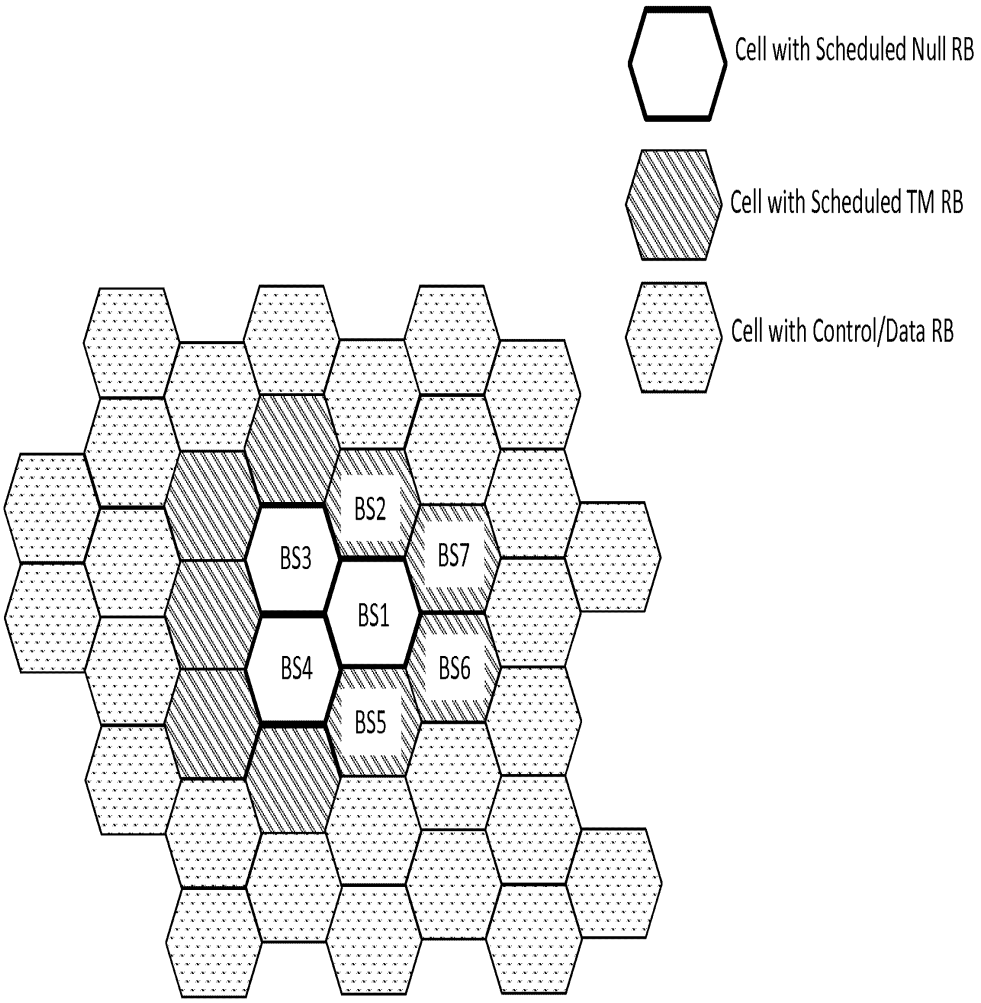

Cell with Scheduled Null RB
Cell with Scheduled TM RB
Cell with Control/Data RB
BS2
BS3
BS7
BS1
BS4
BS6
BS5

Figure 20

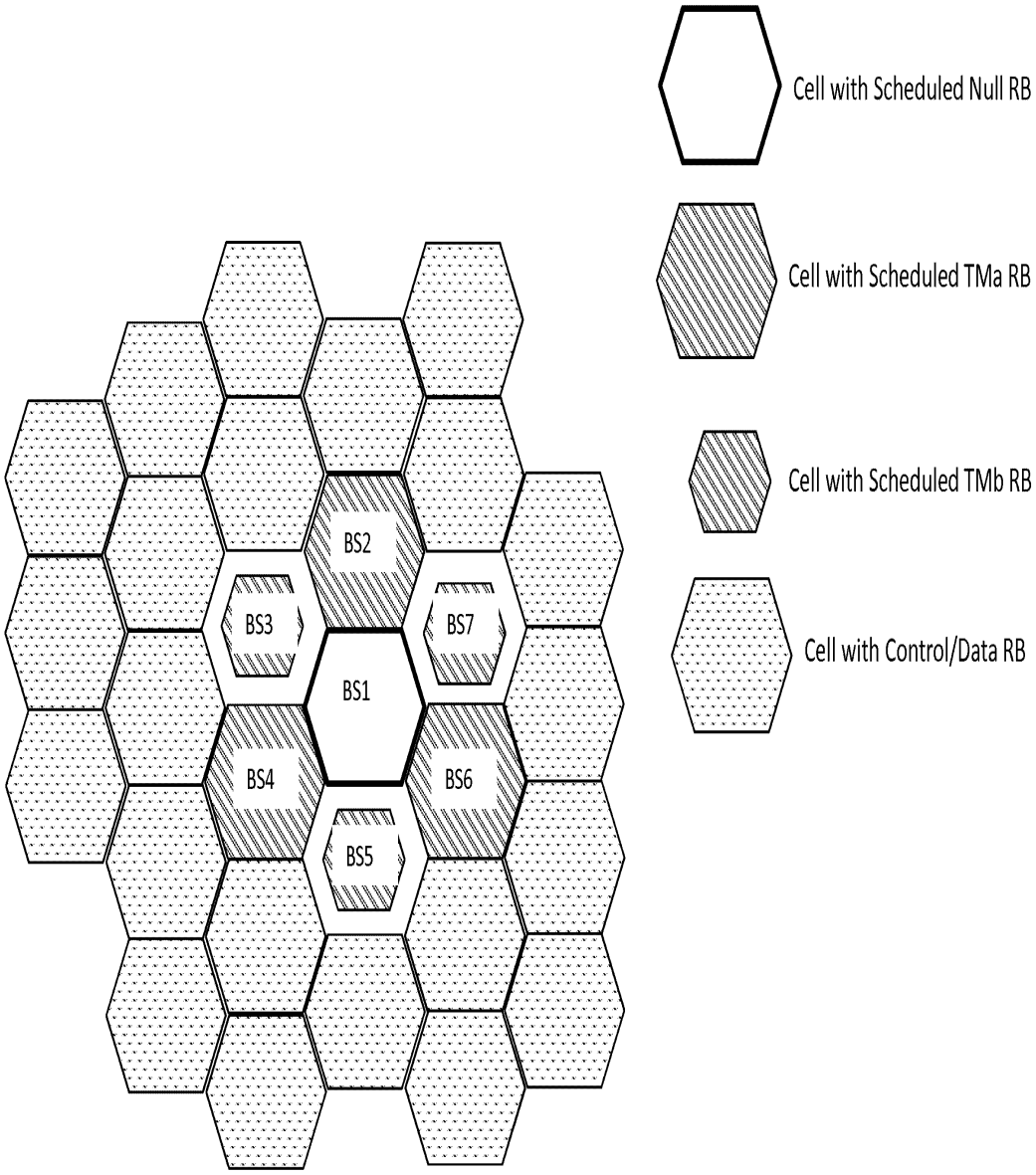

Cell with Scheduled Null RB
Cell with Scheduled TMa RB
Cell with Scheduled TMb RB
Cell with Control/Data RB
BS1
BS2
BS3
BS4
BS5
BS6
BS7

Figure 21

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Filer:	Brian R. Short
Attorney Docket Number:	HWPII-1004-3
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Pages:				
Claims:				
Claims in excess of 20	2202	14	40	560
Independent Claims in Excess of 3	2201	1	210	210
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1500**

Electronic Acknowledgement Receipt	
EFS ID:	17122961
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	Brian R. Short
Filer Authorized By:	
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	14-OCT-2013
Filing Date:	
Time Stamp:	22:43:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1500
RAM confirmation Number	16663
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Application Data Sheet	HWPII-1004-3-DataSheet.pdf	1505406 46bfd030870a876667799d79ec513ec6c13519de	no	7
Warnings:					
Information:					
2	Oath or Declaration filed	1004-3-Dec-Jose-Signed.pdf	326448 bf9ef2865b20ec2150d45737b818c5fd27800aa5	no	1
Warnings:					
Information:					
3	Oath or Declaration filed	1004-3-Dec-Gregory-Signed.pdf	324376 102fa84ead9da291fa72b9084a87c3de1e8b95dd	no	1
Warnings:					
Information:					
4		HWPII-1004-3-Specification.pdf	267030 ac3a0b0d52937f5b3e3ce97285f4d6540299de90	yes	78
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Specification		1	72	
	Claims		73	77	
	Abstract		78	78	
Warnings:					
Information:					
5	Drawings-only black and white line drawings	HWPII-1004-3-Figs.pdf	970684 bf0e49ed2ab7387d8fed25412988f0980b1b0faf	no	22
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	37982 38f4c206f83e83c49003f1ad8acb714a7da98b85	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3431926		

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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.

DocCode - SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 14053574 Document Date: 10/14/2013

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.

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Form Revision Date: September 30, 2013

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/053,574

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	34 minus 20 =	* 14	x 40 =	560	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1	x 210 =	210			
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	1500		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	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))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	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))									
	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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United States Patent and Trademark Office
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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
14/053,574	10/14/2013	2414	1500	HWPII-1004-3	34	4

CONFIRMATION NO. 8913

86125
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

FILING RECEIPT

OC000000064673278

Date Mailed: 10/31/2013

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)

Jose Tellado, Mountain View, CA;
Gregory G. Raleigh, Woodside, CA;

Applicant(s)

Headwater Partners II LLC, Redwood Shores, CA

Assignment For Published Patent Application

Headwater Partners II LLC, Redwood Shores, CA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/714,151 10/15/2012

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.

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/053,574**
Projected Publication Date: 04/17/2014
Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

Preliminary Class

370

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

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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).

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 86125

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 86125

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: Headwater Partners II LLC
350 Marine Parkway, Suite 300
Redwood Shores, CA 94065

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	3/8/2013
Name	David R. Johnson	Telephone	650-517-2782
Title	Chief Financial Officer		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 minutes 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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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Jose Tellado, Gregory G. Raleigh

Application No./Patent No.: 14/053,574 Filed/Issue Date: 10/14/2013

Titled: USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

Headwater Partners II LLC, a limited liability company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 031450, Frame 0105, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). 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 1.11 and 1.14. This collection is estimated to take 12 minutes 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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STATEMENT UNDER 37 CFR 3.73(c)

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature	2013-10-28 Date
Krista S. Jacobsen Printed or Typed Name	59374 Title or Registration Number

Doc Code: TRAN.LET
Document Description: Transmittal Letter

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Total Number of Pages in This Submission

Application Number	14/053,574
Filing Date	10/14/2013
First Named Inventor	Jose Tellado
Art Unit	
Examiner Name	
Attorney Docket Number	HWPII-1004-3

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
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- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):
  *Statement under 37CFR3.73(c)

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Law Office of Brian Short		
Signature	Brian Short		
Printed name	Brian Short		
Date	10/29/2013	Reg. No.	41,309

CERTIFICATE OF TRANSMISSION/MAILING

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Signature	Brian Short		
Typed or printed name	Brian Short	Date	10/29/2013

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3

CONFIRMATION NO. 8913

86125
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

POA ACCEPTANCE LETTER

OC000000064903086

Date Mailed: 11/13/2013

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/04/2013.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/tnnguyen/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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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	6295285		2001-09-25	Whitehead	
	2	6687503		2004-02-03	Porter et al.	
	3	6947748		2005-09-20	Li et al.	
	4	7280814		2007-10-09	Austin et al.	
	5	7321571		2008-01-22	Schnack et al.	
	6	7567543		2009-07-28	Cao et al.	
	7	7593729		2009-09-22	Barak et al.	
	8	7688835		2010-03-30	Kotzin et al.	

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	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	9	7756482		2010-07-13	Lin et al.	
	10	7818018		2010-10-19	Nanda et al.	
	11	7853264		2010-12-14	Oh	
	12	7917149		2011-03-29	Chen et al.	
	13	7962145		2011-06-14	Gale et al.	
	14	8009562		2011-08-30	Rayment et al.	
	15	8098590		2012-01-17	Catovic et al.	
	16	8103280		2012-01-24	Austin et al.	
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	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	1	20020077151		2002-06-20	Matthews et al.	
	2	20070110005		2007-05-17	Jin et al.	
	3	20080248822		2008-10-09	Jarvinen et al.	
	4	20090047971		2009-02-19	Fu	
	5	20090059851		2009-03-05	Weil et al.	
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	10	20090257380		2009-10-15	Meier	
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	12	20090310527		2009-12-17	Rao et al.	
	13	20090316585		2009-12-24	Srinivasan et al.	
	14	20090323621		2009-12-31	Touboul et al.	
	15	20100099428		2010-04-22	Bhushan et al.	
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	17	20100182906		2010-07-22	Cheng et al.	
	18	20100238845		2010-09-23	Love et al.	
	19	20100261482		2010-10-14	Guey	
	20	20100261493		2010-10-14	Guey et al.	
	21	20100317355		2010-12-16	Zangi et al.	
	22	20100322171		2010-12-23	Dekorsy et al.	

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	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	23	20110058479		2011-03-10	Chowdhury	
	24	20110086610		2011-04-14	Baldwin et al.	
	25	20110103296		2011-05-05	Ji et al.	
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	27	20110243060		2011-10-06	Mildh et al.	
	28	20110256861		2011-10-20	Yoo et al.	
	29	20110275378		2011-11-10	Kwon et al.	
	30	20120014333		2012-01-19	Ji et al.	
	31	20120063383		2012-03-15	Barbieri et al.	
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	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	1	"Performance of Uplink Fractional Power Control in UTRAN LTE", May 2008, VTC, Castellanos, C. U. et al	☐
	2	"Performance of Decentralized Interference Coordination in the LTE Uplink", Sep. 2009, VTC, Ellenbeck, J. et al	☐
	3	"Downlink Scheduling for Multiclass Traffic in LTE", Nov. 2009, EURASIP Journal on Wireless Commun and Networking, Sadiq, B. et al	☐
	4	"Relays in HSPA+: Power Control and Mobility", Dec. 2011, GLOBECOM, Hunzinger, J. F. et al	☐
	5	"Cell Association and Interference Coordination in Heterogeneous LTE-A Cellular Networks", Dec. 2010, IEEE Journal on Selected Areas in Communications, Madan, R. et al	☐
	6	"Enhanced Inter-cell Interference Coordination for Heterogeneous Networks in LTE-Advanced: A Survey", Dec 2011, Lindbom, L. et al	☐
	7	7. "Intercell Interference Coordination in OFDMA Networks and in the 3GPP Long Term Evolution System", Aug. 2009, Journal of Communications, Fodor, G. et al	☐

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	First Named Inventor	Jose Tellado
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	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	8	8. "A Survey of Scheduling and interference mitigation in LTE", May 2010, Journal of Electrical and Computer Engineering, Kwan, R. et al	☐
	9	9. "Belief Propagation Methods for Intercell Interference Coordination in Femtocell Networks", Apr. 2012, IEEE Journal on Selected Areas in Communications, Rangan, S. et al	☐
	10	10. "On Interference Coordination in Metropolitan Area Relay Networks", circa 2008, Doppler, K. et al	☐
	11	11. "LTE: The Evolution of Mobile Broadband", Apr. 2009, IEEE Communications Magazine, Astely, D. et al	☐
	12	12. "Using Carrier Ethernet to Backhaul LTE", Feb. 2011, Infonetics Research White Paper, Howard, M.	☐
	13	13. "Relay networks specific resource management features", May 2011, Advanced Radio Interface Technologies for 4G Systems, Braun, V. et al	☐
	14	14. "Flexible interference control-concepts", Oct 2011, Advanced Radio Interface Technologies for 4G Systems, Berberana, I. et al	☐
	15	15. "Relay configurations", Jul. 2011, Advanced Radio Interface Technologies for 4G Systems, Aronsson, D. et al	☐
	16	16. "Capacity Benefits of Relays with In-band Backhauling in Cellular Networks", 2008, ICC Proceedings, Balachandran, K. et al	☐
	17	17. "Interference Mitigation Using Coordinated Backhaul Timing Allocation for LTE-Advanced Relay Systems", Jun. 2011, ICC Proceedings, Yuda, Y. et al	☐
	18	18. "Centralized Scheduling for Joint Transmission Coordinated Multi-Point in LTE-Advanced", 2010, International ITG Workshop on Smart Antennas, Brueck, S. et al	☐

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	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	19	19. "Effect of Relaying on Coverage in 3GPP LTE-Advanced", Apr. 2009, VTC, Beniero, T. et al	☐
	20	20. "Analysis of 3GPP LTE-Advanced Cell Spectral Efficiency", Sep. 2010, PIMRC, Bultmann, D. et al	☐
	21	21. "Application of Coordinated Beam Selection in Heterogeneous LTE-Advanced Networks", Nov. 2011, ISWCS, Giese, J. et al	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*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.

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	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	/Brian Short/	Date (YYYY-MM-DD)	2014-01-14
Name/Print	Brian Short	Registration Number	41309

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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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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

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 record s.

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.

Electronic Acknowledgement Receipt	
EFS ID:	17904720
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	Brian R. Short
Filer Authorized By:	
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	14-JAN-2014
Filing Date:	14-OCT-2013
Time Stamp:	11:21:35
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)	HWPII-1004-3-ids.pdf	615074 b6dd7c3cb7949f29ca546c0a8c58bbe682eb1466	no	10
Warnings:					
Information:					

2	Non Patent Literature	HWPII-1004-NPL1.pdf	245718 17fa5a39c4b94388f12c58757d4c520b60332a08	no	5
Warnings:					
Information:					
3	Non Patent Literature	HWPII-1004-NPL2.pdf	295274 eb69cc8f0516d04fb56869610683 98d625d8d9df	no	5
Warnings:					
Information:					
4	Non Patent Literature	HWPII-1004-NPL3.pdf	239850 29a1753d1548454e2d3d00acd7a0dcf7d4c41eee	no	18
Warnings:					
Information:					
5	Non Patent Literature	HWPII-1004-NPL4-1.pdf	231662 59e13a27d3fb01bf28aa4fae2924987e5403d3b5	no	5
Warnings:					
Information:					
6	Non Patent Literature	HWPII-1004-NPL5.pdf	1063390 26b6a8750581578a1fc188aecc3db97f9e6a8a7b	no	11
Warnings:					
Information:					
7	Non Patent Literature	HWPII-1004-NPL6.pdf	170513 00992fd28fc1b39616f9a639547a396078156dab	no	18
Warnings:					
Information:					
8	Non Patent Literature	HWPII-1004-NPL7.pdf	654321 38fb51fcbda432e534d058c7e9d176e2b2010906	no	9
Warnings:					
Information:					
9	Non Patent Literature	HWPII-1004-NPL8.pdf	131839 f6ef7f1a25360077d50c35a35872e9337d39988f	no	10
Warnings:					
Information:					
10	Non Patent Literature	HWPII-1004-NPL9-1.pdf	191003 fb1ce6cbf36d6b3b3db35d71d35d27b4bc0cb212	no	10
Warnings:					
Information:					

11	Non Patent Literature	HWPII-1004-NPL10-1.pdf	182991 3944b3950d0c4e9f580ea54a75dba0d1ec2a0195	no	8
Warnings:					
Information:					
12	Non Patent Literature	HWPII-1004-NPL11.pdf	140705 a50b2dd31bd2cebfe055aab42ebdf9e2dd87f70a	no	8
Warnings:					
Information:					
13	Non Patent Literature	HWPII-1004-NPL12-3.pdf	7936336 c4840adf48f2a1105fcf5551e15f43c6beb79cb2	no	18
Warnings:					
Information:					
14	Non Patent Literature	HWPII-1004-NPL13-4.pdf	4425858 d1e128916fabf924db34cbac374b1534192841f0	no	87
Warnings:					
Information:					
15	Non Patent Literature	HWPII-1004-NPL14.pdf	2049361 58f21a67cf760772b799b66e2c241f9e95827a39	no	51
Warnings:					
Information:					
16	Non Patent Literature	HWPII-1004-NPL15.pdf	2537680 b9ae23b8644dbe83aa90d23f57c7df8ebcacbfb4	no	104
Warnings:					
Information:					
17	Non Patent Literature	HWPII-1004-NPL16.pdf	234299 f3f81f1587d15c47fc34e8a0541979c6b4cc9c14	no	7
Warnings:					
Information:					
18	Non Patent Literature	HWPII-1004-NPL17.pdf	319733 7c26a1f7609972b08e15c813f070ebcf84fc3fb9	no	5
Warnings:					
Information:					
19	Non Patent Literature	HWPII-1004-NPL18.pdf	1372252 896e66d85daa3964984ff93351c20a1e9c4bc4b	no	8
Warnings:					
Information:					

20	Non Patent Literature	HWPII-1004-NPL19.pdf	382491 b87b6dbe882dc3189014f1791653d0d28dcdd0e5	no	5
Warnings:					
Information:					
21	Non Patent Literature	HWPII-1004-NPL20-1.pdf	153519 57deed42953201b0dd76b4b6f541997009e970dc	no	6
Warnings:					
Information:					
22	Non Patent Literature	HWPII-1004-NPL21-3.pdf	2664916 63f4ad9c69b704bbe05e2cfa22737c93b3049122	no	5
Warnings:					
Information:					
		Total Files Size (in bytes):	26238785		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14053574
	Filing Date	2013-10-13
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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
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U.S.PATENT APPLICATION PUBLICATIONS						Remove
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	20130322322		2013-12-05	Redana et al.	
	2	20130034070		2013-02-07	Seo et al.	
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐
If you wish to add additional Foreign Patent Document citation information please click the Add button								Add

NON-PATENT LITERATURE DOCUMENTS	Remove

EFS Web 2.1.17

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574
	Filing Date	2013-10-13
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	Notification of Transmittal of the International Search Report and Written Opinion of the International Searching Authority, or the Declaration, International Application No. PCT/US2013/065096, 10 Feb. 2014	☐
	2	Pantech & Curitel: "Discussion on access/backhaul link bandwidth allocation in LTE-A Relay Network", 3GPP Draft; R1-091909, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre; 650, Route Des Luciolides; F-06921 Sophia-Antipolis Cedex; France, San Francisco, USA, 20090502, 2 May 2009	☐
	3	Samsung: "Resource Partitioning via Bandwidth Reduction for Co-channel Deployments", 3GPP Draft; R1-104628 Non-CA Based Control ICIC-Final, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre; 650, Route Des Luciolides; F-06921 Sophia-Antipolis Cedex; France, Vol. RAN WG1, no. Madrid, Spain; 20100823, 18 August 2010 (2010-08-18)	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*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	14053574
	Filing Date	2013-10-13
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	/Brian Short/	Date (YYYY-MM-DD)	2014-02-17
Name/Print	Brian Short	Registration Number	41309

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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 record s.

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.

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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.

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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.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

To:
Jacobsen, Krista S.
Headwater Partners II LLC
350 Marine Parkway, Suite 300
Redwood City, California 94065
ETATS-UNIS D'AMERIQUE

Date of mailing *(day/month/year)*: 10 February 2014 (10-02-2014)

Applicant's or agent's file reference: HWPII-1004-1-PCT

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.: PCT/US2013/065096

International filing date *(day/month/year)*: 15 October 2013 (15-10-2013)

Applicant: HEADWATER PARTNERS II LLC

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Fascimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. Following the expiration of 30 months from the priority date, these comments will also be made available to the public.

Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

Name and mailing address of the International Searching Authority:
European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040
Fax: (+31-70) 340-3016

Authorized officer:
REICHERT, Jacques
Tel: +49 (0)89 2399-5951

Form PCT/ISA/220 (July 2010)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
HWPII-1004-1-PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2013/065096	15 October 2013 (15-10-2013)	15 October 2012 (15-10-2012)
Applicant		
HEADWATER PARTNERS II LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 2
      [ ] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [X] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/065096

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W72/12
ADD. H04W72/04 H04W72/08

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PANTECH & CURITEL: "Discussion on access/backhaul link bandwidth allocation in LTE-A Relay Network", 3GPP DRAFT; R1-091909, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. San Francisco, USA; 20090502, 2 May 2009 (2009-05-02), XP050339398, [retrieved on 2009-05-02] the whole document ----- -/--	1-46

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2014	10/02/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lastoria, Gianluca

2

Form PCT/ISA/210 (second sheet) (April 2005)

Petitioners Exhibit 1002
Page 145

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/065096

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/132988 A2 (LG ELECTRONICS INC [KR]; SEO HAN BYUL [KR]; KIM HAK SEONG [KR]; KIM KI) 27 October 2011 (2011-10-27) page 1, line 12 - page 2, line 24; figure 1 page 3, line 14 - line 29 page 11, line 3 - page 12, line 10 page 29, line 1 - page 30, line 30 page 35, line 5 - page 43, line 31	1-46
A	SAMSUNG: "Resource Partitioning via Bandwidth Reduction for Co-channel Deployments", 3GPP DRAFT; R1-104628 NON-CA BASED CONTROL ICIC-FINAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Madrid, Spain; 20100823, 18 August 2010 (2010-08-18), XP050450108, [retrieved on 2010-08-18] the whole document	1-46
A	WO 2012/089269 A1 (NOKIA SIEMENS NETWORKS OY [FI]; REDANA SIMONE [DE]; BULAKCI OMER [DE];) 5 July 2012 (2012-07-05) page 11, line 18 - page 13, line 26; figure 2 page 23, line 31 - page 27, line 2; figures 5A-5D	1-46

2

Petitioners Exhibit 1002
Page 146

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/065096

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011132988 A2	27-10-2011	CN 102859900 A	02-01-2013
		EP 2561629 A2	27-02-2013
		US 2013034070 A1	07-02-2013
		WO 2011132988 A2	27-10-2011
WO 2012089269 A1	05-07-2012	EP 2659704 A1	06-11-2013
		US 2013322322 A1	05-12-2013
		WO 2012089269 A1	05-07-2012

Form PCT/ISA/210 (patent family annex) (April 2005)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2013/065096	15.10.2013	15.10.2012

International Patent Classification (IPC) or both national classification and IPC
INV. H04W72/12 ADD. H04W72/04 H04W72/08

Applicant
HEADWATER PARTNERS II LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Lastoria, Gianluca Telephone No. +49 89 2399-7339

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-46
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-46
Industrial applicability (IA)	Yes:	Claims	1-46
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

&

Item VIII

Certain observations on the international application

1 Reference is made to the following documents:

D1 PANTECH & CURITEL: "Discussion on access/backhaul link bandwidth allocation in LTE-A Relay Network", 3GPP DRAFT; R1-091909, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. San Francisco, USA; 20090502, 2 May 2009 (2009-05-02), XP050339398, [retrieved on 2009-05-02]

D2 WO 2011/132988 A2 (LG ELECTRONICS INC [KR]; SEO HAN BYUL [KR]; KIM HAK SEONG [KR]; KIM KI) 27 October 2011 (2011-10-27)

D3 SAMSUNG: "Resource Partitioning via Bandwidth Reduction for Co-channel Deployments", 3GPP DRAFT; R1-104628 NON-CA BASED CONTROL ICIC-FINAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Madrid, Spain; 20100823, 18 August 2010 (2010-08-18), XP050450108, [retrieved on 2010-08-18]

D4 WO 2012/089269 A1 (NOKIA SIEMENS NETWORKS OY [FI]; REDANA SIMONE [DE]; BULAKCI OMER [DE];) 5 July 2012 (2012-07-05)

2 The claims do, for the following reasons, not meet the requirements of Article 6 PCT in respect of clarity:

2.1 Although **claims 1, 28, 30, 31 and 40** have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only in some additional features of the subject-matter for which protection is sought. The aforementioned claims, therefore, lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of protection.

Hence, said claims do not meet the requirements of Article 6 PCT.

In particular it should be noted that, despite being formulated as independent claims, **claims 28 and 30** are basically dependent on **claim 1**, as they comprise the same feature combination of **claim 1** plus the additional feature of having interfaces using different technologies.

Furthermore, **claim 1** is actually dependent either on **claim 31** or on **claim 40**, as **claim 1** contains all the feature of the base station/backhaul User Equipment [bUE] claimed in **claim 31/40** plus the additional features of the bUE/ base station of **claims 40/31**.

In order to overcome this objection, it would appear appropriate to file an amended set of claims defining the relevant subject matter in terms of a **single** independent claim for a base station, a **single** independent claim for a bUE (*by taking into account the clarity objections raised below*) followed by dependent claims covering features which are merely optional, including a **dependent system claim**, and a single independent method claim, as currently on file.

2.2 If the applicant wishes, the objections raised above notwithstanding, to keep a plurality of independent claims, he should, however note that the **independent claims** of the present application are **not** defined with corresponding features, thus introducing doubt as to which features the Applicant considers to be essential to the definition of the invention and resulting in the lack of clarity (Article 6 PCT) regarding the desired scope of protection.

2.3 Furthermore, the term "*backhaul user equipment [bUE]*" used in the **claims** is **vague** and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

The term is **not** a well known term in the field of wireless communication, as confirmed by a search in Google for "*backhaul user equipment*", which returns zero relevant results.

2.4 Finally, **claim 40** do not meet the requirements of Article 6 PCT in that the matter of which protection is sought is not defined. The claims attempt to define the subject-mater in terms of the result to be achieved ("*the bUE further operative to be selected from the plurality of bUE devices...*"). Such a definition is only allowable under the conditions elaborated in the PCT Guidelines, Chapter 5, 5.35. In this instance, however, such a formulation is not allowable because it appears possible to define the subject-matter in more concrete terms, viz. in terms of how the effect is to be achieved.

2.5 **Claim 40** is further not clear as it refers to the vague bUE but it also includes features related to a base station, which is **not** part of the claimed entity. This leads to doubts as to the scope of the protection of said claims (*see PCT-Guidelines, 5.37*).

3 In so far as the present text can be understood, the present application does not meet the requirements of Article 33 (1) and (3) PCT because the subject-matter of the claims does not involve an inventive step:

3.1 Document **D1** (*see in particular the passages cited in the International Search Report*) discloses, according to the main features of **claim 1**, a system comprising:

- a base station (*see the MeNB in figure 1*);
- a plurality of backhaul user equipment [bUE] devices (*see the CGS HeNB in figure 1; while only one HeNB is depicted in figure 1, a plurality thereof are normally deployed in a LTE network*), each of the plurality of bUE devices operable to wirelessly communicate with the BS through at least a first communication technology, and the plurality of bUE devices each operable to communicate with at least one data network through at least a second communication technology (*HeNB communicates wirelessly with the MeNB and are normally wired connected to the wired network of the user deploying the HeNB*);
- the BS operative to:
- select one or more plurality of bUE (*this is described e.g. in page 2, point 2) or page 3, poinr 2), wherein the selection is made by the MeNB based on the communication received by the HeNB*);
- wirelessly communicate with one or more user equipment [UE] devices (*see connection between MeNB and MUE in figure 1*), and network connect the one or more UE devices to the at least one data network through one or more of the plurality of bUE devices (*as already mentioned before, MeNB and HeNB are wired/wirelessly connected, as to transfer ICIC information, as shown in page 2, point 2*);
- transmit resource block [RB] scheduling information for the BH traffic of at least one of the plurality of UE devices and the access traffic of at least one of the one or more UE devices (*see e.g. paragraph "2.2 Dynamic resource partitioning"*).

The subject-matter of **claim 1** differs from the disclosure of document **D1** in that:

(a) the backhaul traffic comprises access traffic associated with the one or more UE devices; and that

(b) the BS is further operative to aid in selecting a transmission power level of at least one of the plurality of bUE devices, or at least one of the one or more UE devices.

The technical effects provided by the distinguishing features are:

(a') reliability in communication with the UE; and

(d) minimisation of interference by choosing the right transmission power level.

Since there is no common technical effect achieved by all the distinguishing features, the objective technical problem must be regarded as an aggregation of a plurality of partial technical problems.

The two partial technical problems to be solved by the present invention may be regarded as to:

(a") reliably transmit access information to the UE; and

(b") minimise interference.

In consulting the prior art in the general field of mobile communication, the skilled person, wishing to find a solution to overcome the above mentioned problems and bearing in mind the disclosure of document **D1**, which also disclose that the HeNB could work as range expansion (*see figure 3*), would come across document **D2** (*see in particular paragraph the passages cited in the International Search Report*), which discloses that

(a) the backhaul traffic comprises access traffic associated with the one or more UE devices (*see figure 1*); and that
(b) the BS is further operative to aid in selecting a transmission power level of at least one of the plurality of bUE devices, or at least one of the one or more UE devices (*see pages 40 and 41, chapter "Backhaul link power allocation"*).

For the skilled person, therefore, starting from the system described in document **D1** and being aware both of the above mentioned problems and of the principle of the solution described in document **D2**, it would be obvious to apply said principle of document **D2** to the system of document **D1** in order to arrive at a system wherein the above problem has been overcome.

The skilled person would thus arrive, without the exercise of inventive skill, at the mobile device corresponding to the subject-matter of **claim 1**.

The subject-matter of **claim 1** therefore does not involve an inventive step, Article 33(1), (3) PCT.

3.2 Due to the objections raised in point 2.1 above, the same considerations as made regarding the lack of inventive step of **claim 1** also apply to **independent claims 28, 30, 31 and 40**.

The subject-matter of **claims 28, 30, 31 and 40** therefore does not involve an inventive step, Article 33(1), (3) PCT.

3.3 Furthermore, The same considerations as made above in paragraph 3.1 regarding the system of **claim 1** are in essence also valid for **independent claim 43**, since said claim is based on the same essential feature combination as claim 1 in terms of a method.

The subject-matter of **claim 43** therefore does not involve an inventive step, Article 33(1), (3) PCT.

4 **Dependent claims 2 to 27** do not contain any additional features which, in combination with the features of the claims to which they respectively refer, meet the requirement of the PCT with respect to inventive step for the reason that the subject-matter of said claims is either in principle derivable from the disclosure of document **D1** (*for **claim 5** see figure 1; for **claim 6** see pages 2 and 3; for **claim 9 to 12 and 19 to 21** see page 3, points a) to f); for **claims 14 and 15** see figure 4*) or document **D2** (*for **claim 2** see page 11; for **claim 3** see figure 1; for **claims 16** see MIMO, starting on page 15; for **claims 21 to 23** see CoMP on page 29; for **claims 24 to 27** see page 36 on frequency reuse*) or represents simple design details which are generally known to the person skilled in the art.

As **dependent claims 29, 32 to 39, 41, 42 and 44 to 46** comprise the same subject-matter of claims 2 to 27, the objections made above still apply, *mutatis mutandis*.

Due to the above reasons, **dependent claims 2 to 27, 29, 32 to 39, 41, 42 and 44 to 46** do not meet the requirement of Article 33 PCT.

Item VII

Certain defects in the international application

5 The following requirements should have been taken into consideration:

5.1 The ultimately adopted main claims should have been drafted in the proper two-part "characterised" form recommended by Rule 6.3 (b),(i),(ii) PCT, having a preamble that correctly reflects the nearest prior art, presumably that represented by the above noted document **D1**.

5.2 The opening part of the description should have been brought into agreement with any independent claims (see Rule 5.1 (a) PCT).

5.3 To meet the requirements of Rule 5.1 (a) (ii) PCT, the most relevant prior art, i.e. documents **D1 to D4**, should have been acknowledged by reference and briefly discussed in the introductory part of the description, preferably in such a way that the inventive merit of what is claimed can be readily understood.

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XS CPRTENFRDE

BNSDOCID: <XS_____2006100103CF_I_>

Electronic Acknowledgement Receipt	
EFS ID:	18215382
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	Brian R. Short
Filer Authorized By:	
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	17-FEB-2014
Filing Date:	14-OCT-2013
Time Stamp:	09:46:13
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)	HWPII-1004-3-IDS-PCT.pdf	612759 91c5dd28690f28620ac29e287bdadc48934df3f0	no	4

Warnings:
Information:

2	Non Patent Literature	HWPII-1004-1-PCT-ISR.pdf	3979188 66cfcb78446989d13f1b466de857cbb39ed84453	no	16
Warnings:					
Information:					
3	Non Patent Literature	HWPII-1004-1-PCT-NPL1.pdf	1734209 fdf15e0c2d7a34be226eaee77f229346c9f590b1	no	5
Warnings:					
Information:					
4	Non Patent Literature	HWPII-1004-1-PCT-NPL2.pdf	674092 27cd315377e6d44a83aaea4d76f2887c8c4f9c50	no	3
Warnings:					
Information:					
		Total Files Size (in bytes):	7000248		

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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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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3

CONFIRMATION NO. 8913

86125
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

PUBLICATION NOTICE

OC000000067849904

Title:USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

Publication No.US-2014-0105046-A1
Publication Date:04/17/2014

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/053,574	Filing Date 10/14/2013	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ 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).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	03/19/2015	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 34	Minus	** 34	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						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 number found in the appropriate box in column 1.

LIE
/DONNA 1. SMALLS LOGAN/

This collection of information is required by 37 CFR 1.16. 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 12 minutes 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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NOTICE OF ALLOWANCE AND FEE(S) DUE

86125 7590 04/01/2015

Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

EXAMINER
ROBERTS, BRIAN S

ART UNIT	PAPER NUMBER
2466	

DATE MAILED: 04/01/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3	8913

TITLE OF INVENTION: USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	07/01/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

86125 7590 04/01/2015
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3	8913

TITLE OF INVENTION: USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	07/01/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ROBERTS, BRIAN S	2466	370-252000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status.
  NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Petitioners Exhibit 1002
Page 164

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3	8913

86125 7590 04/01/2015

Law Office of Brian Short
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San Jose, CA 95164-1867

EXAMINER	
ROBERTS, BRIAN S	
ART UNIT	PAPER NUMBER
2466	

DATE MAILED: 04/01/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 12 minutes 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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

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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

Notice of Allowability	Application No. 14/053,574	Applicant(s) TELLADO ET AL.	
	Examiner BRIAN ROBERTS	Art Unit 2466	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the application dated 10/14/2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-34*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☒ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BRIAN ROBERTS/
Primary Examiner, Art Unit 2466

The present application is being examined under the pre-AIA first to invent provisions.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

Claim 2 line 2 "path loss (PL), S, I, SNR, SINR, SIR, CQI, CSI, PER." has been amended to --path loss (PL), shadowing (S), interference (I), signal to noise ratio (SNR), signal to interference and noise ratio (SINR), signal to interference ratio (SIR), channel quality indicator (CQI), channel state information (CQI), packet error rate (PER).--

Claim 11 line 2 "a MIMO mode," has been amended to --a multiple input multiple output (MIMO) mode,--

Examiner's Statement of Reasons for Allowance

Claims 1-34 are allowed.

The following is an examiner's statement of reasons for allowance:

The primary reason independent claim 1 is allowable is because the closest prior art of record, US 2011/0310865 by Kennedy et al., fails to teach or fairly suggest either alone or in combination with the prior art of record a method that includes estimating a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

The primary reason independent claim 24 is allowable is because the closest prior art of record, US 2011/0310865 by Kennedy et al., fails to teach or fairly suggest either alone or in combination with the prior art of record a method that includes estimating one or more neighboring link qualities (LQs) of the UE at the at least one neighboring positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

The primary reason independent claim 33 is allowable is because the closest prior art of record, US 2011/0310865 by Kennedy et al., fails to teach or fairly suggest either alone or in combination with the prior art of record a user equipment (UE) comprising a controller operative to: estimate a future link quality (LQ) of the UE at the at least one future positioning of the UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the UE.

The primary reason independent claim 34 is allowable is because the closest prior art of record, US 2011/0310865 by Kennedy et al., fails to teach or fairly suggest either alone or in combination with the prior art of record a method that includes estimating a future link quality (LQ) of the second UE at the at least one future positioning of the second UE based on the stored information associated with the plurality of LQs at the plurality of positionings of the one or more UE.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure are:

- US 2011/0310865
- US 2012/0164950
- US 8135397
- US 2013/0053054
- US 2013/0308470
- US 2014/0066117

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRIAN ROBERTS whose telephone number is (571)272-3095. The examiner can normally be reached on M-F 10:00-6:30.

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.

/BRIAN ROBERTS/
Primary Examiner, Art Unit 2466
03/19/2015

Notice of References Cited	Application/Control No. 14/053,574	Applicant(s)/Patent Under Reexamination TELLADO ET AL.	
	Examiner BRIAN ROBERTS	Art Unit 2466	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2011/0310865	12-2011	Kennedy et al.	370/338
*	B	US-2012/0164950	06-2012	Nentwig, Markus	455/63.1
*	C	US-8,135,397	03-2012	Lall et al.	455/425
*	D	US-2013/0053054	02-2013	Lovitt et al.	455/456.1
*	E	US-2013/0308470	11-2013	Bevan et al.	370/252
*	F	US-2014/0066117	03-2014	Egner et al.	455/513
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14053574	TELLADO ET AL.
	Examiner	Art Unit
	BRIAN ROBERTS	2466

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
PALM inventor search	3/19/2015	BSR
Search focused on: H04W4/02,021,022,023,025,026,028,04,046 H04W64/00,003,006 H04W68/00,04 H04W80/08,085 H04W24/00,08 H04L5/0064,0066 Y02B60/50	3/19/2015	BSR
EAST text search: see search history printout	3/19/2015	BSR

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
Interference search	See earch history printout	3/19/2015	BSR

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	6295285		2001-09-25	Whitehead	
	2	6687503		2004-02-03	Porter et al.	
	3	6947748		2005-09-20	Li et al.	
	4	7280814		2007-10-09	Austin et al.	
	5	7321571		2008-01-22	Schnack et al.	
	6	7567543		2009-07-28	Cao et al.	
	7	7593729		2009-09-22	Barak et al.	
	8	7688835		2010-03-30	Kotzin et al.	

EFS Web 2.1.17

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	9	7756482		2010-07-13	Lin et al.	
	10	7818018		2010-10-19	Nanda et al.	
	11	7853264		2010-12-14	Oh	
	12	7917149		2011-03-29	Chen et al.	
	13	7962145		2011-06-14	Gale et al.	
	14	8009562		2011-08-30	Rayment et al.	
	15	8098590		2012-01-17	Catovic et al.	
	16	8103280		2012-01-24	Austin et al.	
	17	8155659		2012-04-10	Kazmi et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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

EFS Web 2.1.17 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	1	20020077151		2002-06-20	Matthews et al.	
	2	20070110005		2007-05-17	Jin et al.	
	3	20080248822		2008-10-09	Jarvinen et al.	
	4	20090047971		2009-02-19	Fu	
	5	20090059851		2009-03-05	Weil et al.	
	6	20090092059		2009-04-09	Fu	
	7	20090103492		2009-04-23	Altshuller et al.	
	8	20090196174		2009-08-06	Ji	
	9	20090203310		2009-08-13	Lozano et al.	
	10	20090257380		2009-10-15	Meier	
	11	20090280819		2009-11-12	Brisebois et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	12	20090310527		2009-12-17	Rao et al.	
	13	20090316585		2009-12-24	Srinivasan et al.	
	14	20090323621		2009-12-31	Touboul et al.	
	15	20100099428		2010-04-22	Bhushan et al.	
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	19	20100261482		2010-10-14	Guey	
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	21	20100317355		2010-12-16	Zangi et al.	
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	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	23	20110058479		2011-03-10	Chowdhury	
	24	20110086610		2011-04-14	Baldwin et al.	
	25	20110103296		2011-05-05	Ji et al.	
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	27	20110243060		2011-10-06	Mildh et al.	
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	31	20120063383		2012-03-15	Barbieri et al.	
	32	20120127941		2012-05-24	Li et al.	

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	1	"Performance of Uplink Fractional Power Control in UTRAN LTE", May 2008, VTC, Castellanos, C. U. et al	☐
	2	"Performance of Decentralized Interference Coordination in the LTE Uplink", Sep. 2009, VTC, Ellenbeck, J. et al	☐
	3	"Downlink Scheduling for Multiclass Traffic in LTE", Nov. 2009, EURASIP Journal on Wireless Commun and Networking, Sadiq, B. et al	☐
	4	"Relays in HSPA+: Power Control and Mobility", Dec. 2011, GLOBECOM, Hunzinger, J. F. et al	☐
	5	"Cell Association and Interference Coordination in Heterogeneous LTE-A Cellular Networks", Dec. 2010, IEEE Journal on Selected Areas in Communications, Madan, R. et al	☐
	6	"Enhanced Inter-cell Interference Coordination for Heterogeneous Networks in LTE-Advanced: A Survey", Dec 2011, Lindbom, L. et al	☐
	7	7. "Intercell Interference Coordination in OFDMA Networks and in the 3GPP Long Term Evolution System", Aug. 2009, Journal of Communications, Fodor, G. et al	☐

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	Attorney Docket Number	HWPII-1004-3

	8	8. "A Survey of Scheduling and interference mitigation in LTE", May 2010, Journal of Electrical and Computer Engineering, Kwan, R. et al	☐
	9	9. "Belief Propagation Methods for Intercell Interference Coordination in Femtocell Networks", Apr. 2012, IEEE Journal on Selected Areas in Communications, Rangan, S. et al	☐
	10	10. "On Interference Coordination in Metropolitan Area Relay Networks", circa 2008, Doppler, K. et al	☐
	11	11. "LTE: The Evolution of Mobile Broadband", Apr. 2009, IEEE Communications Magazine, Astely, D. et al	☐
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	16	16. "Capacity Benefits of Relays with In-band Backhauling in Cellular Networks", 2008, ICC Proceedings, Balachandran, K. et al	☐
	17	17. "Interference Mitigation Using Coordinated Backhaul Timing Allocation for LTE-Advanced Relay Systems", Jun. 2011, ICC Proceedings, Yuda, Y. et al	☐
	18	18. "Centralized Scheduling for Joint Transmission Coordinated Multi-Point in LTE-Advanced", 2010, International ITG Workshop on Smart Antennas, Brueck, S. et al	☐

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	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

	19	19. "Effect of Relaying on Coverage in 3GPP LTE-Advanced", Apr. 2009, VTC, Beniero, T. et al	☐
	20	20. "Analysis of 3GPP LTE-Advanced Cell Spectral Efficiency", Sep. 2010, PIMRC, Bultmann, D. et al	☐
	21	21. "Application of Coordinated Beam Selection in Heterogeneous LTE-Advanced Networks", Nov. 2011, ISWCS, Giese, J. et al	☐

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EXAMINER SIGNATURE

Examiner Signature	/Brian Roberts/ (03/19/2015)	Date Considered	03/19/2015

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	/Brian Short/	Date (YYYY-MM-DD)	2014-01-14
Name/Print	Brian Short	Registration Number	41309

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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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	205	estimat$4 with future with interference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 17:26
S2	133	estimat$4 with future with interference and (location or position$4 or coordinace or orientation)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 17:27
S3	460	estimat$4 with predict$4 with interference and (location or position$4 or coordinace or orientation)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 17:41
S4	3599	H04W24/08.cpc. and (location or position$4 or coordinace or orientation)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 19:19
S5	667	H04W24/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 19:22
S6	681	H04W24/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 19:23
S7	151	H04W24/08.cpc. and (estimat$4 or predict$5) with (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2015/03/17 19:24

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S8	681	H04W24/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 19:25
S9	26817	(estimat$4 or predict$5) with (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/17 19:26
S10	681	H04W24/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 09:55
S11	112	H04W72/10.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 12:44
S12	233	H04W72/00.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 12:51
S13	56	H04L5/0066.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:13
S14	287	H04L5/0064.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with	US-PGPUB; USPAT; USOCR;	OR	ON	2015/03/18 13:37

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S15	3964707	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:52
S16	14684	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS) and schedul$4 with bandwidth	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:53
S17	57860	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS) and (schedul$4 or allocat$4 or reserv$4) with bandwidth	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:53
S18	14815	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS) and (schedul$4 or allocat$4 or reserv$4) with bandwidth and start$4 with time	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:58
S19	9160	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS) and (schedul$4 or allocat$4 or reserv$4) with bandwidth and start$4 near2 time	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:58
S20	3589	((Multimedia near2 Broadcast$3 Multicast$3 Service$2) or MBMS) and (schedul$4 or allocat$4 or reserv$4) with bandwidth and start$4 near2 time and end$3 near2 time	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 13:59
S21	851	H04W16/14.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 14:04
S22	3	"20130104173".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2015/03/18 14:04

			JPO; DERWENT; IBM_TDB			
S23	3	"20100111103".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 14:13
S24	1890	H04L5/0007.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 15:30
S25	956	Y02B60/50.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/18 15:46
S26	360	H04W4/02.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 12:24
S27	28	H04W4/021.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 12:58
S28	1	H04W4/022.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 13:05
S29	64	H04W4/023.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 13:15

		state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))				
S30	30	H04W4/025.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 13:28
S31	26	H04W4/026.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 13:35
S32	71	H04W4/028.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 13:37
S33	3	"20140066117".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:06
S34	17	"7013145".pn. "20120057569".pn. "20100202376".pn. "20060268849".pn. "20050215290".pn. "20050041696".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:09
S35	49	H04W4/04.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:11
S36	15	H04W4/046.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:15

S37	793	H04W64/00.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:17
S38	2	"20100208658".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:32
S39	2	"7286507".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:50
S40	99	H04W64/003.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 14:52
S41	108	H04W64/006.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 15:13
S42	76	H04W68/00.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 15:23
S43	3	"20140105046".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 15:25
S44	15	H04W68/04.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2015/03/19 15:47

		PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	DERWENT; IBM_TDB			
S45	3	H04W80/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 16:43
S46	0	H04W80/085.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 16:49
S47	1112	H04W24/00.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:01
S48	683	H04W24/08.cpc. and (location or position$4 or coordinace or orientation) and (estimat$4 or predict$5) with ((path near2 loss) or SNR or Interference or SIR or CQI or CSI or PER or (channel near2 quality) or (channel near2 state) or (link near2 state) or (packet near2 error near2 rate) or (link near2 quality) or (LQ))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:05
S49	5	"20130322322".pn. "20130034070".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:49
S50	17	"6295285".pn. "6687503".pn. "6947748".pn. "7280814".pn. "7321571".pn. "7567543".pn. "7593729".pn. "7688835".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:50
S51	13	"7756482".pn. "7818018".pn. "7853264".pn. "7917149".pn. "7962145".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:52

S52	23	"8009562".pn. "8098590".pn. "8103280".pn. "8155659".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:53
S53	28	"20020077151".pn. "20070110005".pn. "20080248822".pn. "20090047971".pn. "20090059851".pn. "20090092059".pn. "20090103492".pn. "20090196174".pn. "20090203310".pn. "20090257380".pn. "20090280819".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:54
S54	24	"20090310527".pn. "20090316585".pn. "20090323621".pn. "20100099428".pn. "20100136998".pn. "20100182906".pn. "20100238845".pn. "20100261482".pn. "20100261493".pn. "20100317355".pn. "20100322171".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 17:58
S55	26	"20110058479".pn. "20110086610".pn. "20110103296".pn. "20110222506".pn. "20110243060".pn. "20110256861".pn. "20110275378".pn. "20120014333".pn. "20120063383".pn. "20120127941".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/19 18:00

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S56	0	future near2 link near2 quality.clm. with (orientation or location) with future near2 position$4.clm.	USPAT; UPAD	OR	ON	2015/03/19 18:10
S57	3	future near2 link near2 quality.clm.	USPAT; UPAD	OR	ON	2015/03/19 18:10
S58	3	future near2 link near2 qualit$4.clm.	USPAT; UPAD	OR	ON	2015/03/19 18:10
S59	37	(orientation or location) with future near2 position$4.clm.	USPAT; UPAD	OR	ON	2015/03/19 18:10
S60	6	estimat$4 with neighbor$5 with link near2 qualit$4.clm.	USPAT; UPAD	OR	ON	2015/03/19 18:11

3/19/2015 6:12:36 PM
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CONFIRMATION NO. 8913

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/053,574	10/14/2013 RULE	370	2466	HWPII-1004-3

APPLICANTS
Headwater Partners II LLC, Redwood Shores, CA, Assignee (with 37 CFR 1.172 Interest);

INVENTORS
Jose Tellado, Mountain View, CA;
Gregory G. Raleigh, Woodside, CA;

**** CONTINUING DATA ***************************
This appln claims benefit of 61/714,151 10/15/2012

**** FOREIGN APPLICATIONS ***************************

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Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged		STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ Yes ☑ No	☐ Yes ☑ No	/BRIAN S ROBERTS/ Examiner's Signature	☐ Met after Allowance BSR Initials	CA	22	34	4

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San Jose, CA 95164-1867
UNITED STATES

TITLE
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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14053574	TELLADO ET AL.
	Examiner	**Art Unit**
	BRIAN ROBERTS	2466

CPC						
Symbol					**Type**	**Version**
H04W		24	/	08	F	2013-01-01
H04W		4	/	028	A	2013-01-01
Y02B		60	/	50	A	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
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NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	34	
/BRIAN ROBERTS/ Primary Examiner.Art Unit 2466	03/19/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	8

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
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CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
		H	0	4	W	24 / 08 (2009.01.01)						

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	34	
/BRIAN ROBERTS/ Primary Examiner.Art Unit 2466	03/19/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	8

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14053574	TELLADO ET AL.
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	BRIAN ROBERTS	2466

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	9	17	33	33										
2	2	10	18	34	34										
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18	11	27	27												
19	12	28	28												
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21	14	30	30												
22	15	31	31												
23	16	32	32												

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 34	
/BRIAN ROBERTS/ Primary Examiner.Art Unit 2466 (Primary Examiner)	03/19/2015 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 8

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14053574
	Filing Date	2013-10-13
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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	First Named Inventor	Jose Tellado
	Art Unit	
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	Attorney Docket Number	HWPII-1004-3

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	1	Notification of Transmittal of the International Search Report and Written Opinion of the International Searching Authority, or the Declaration, International Application No. PCT/US2013/065096, 10 Feb. 2014	☐
	2	Pantech & Curitel: "Discussion on access/backhaul link bandwidth allocation in LTE-A Relay Network", 3GPP Draft; R1-091909, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre; 650, Route Des Lucioldes; F-06921 Sophia-Antipolis Cedex; France, San Francisco, USA, 20090502, 2 May 2009	☐
	3	Samsung: "Resource Partitioning via Bandwidth Reduction for Co-channel Deployments", 3GPP Draft; R1-104628 Non-CA Based Control ICIC-Final, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre; 650, Route Des Lucioldes; F-06921 Sophia-Antipolis Cedex; France, Vol. RAN WG1, no. Madrid, Spain; 20100823, 18 August 2010 (2010-08-18)	☐

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Examiner Signature	/Brian Roberts/ (03/19/2015)	Date Considered	03/19/2015

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-13
	First Named Inventor	Jose Tellado
	Art Unit	
	Examiner Name	
	Attorney Docket Number	HWPII-1004-3

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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	/Brian Short/	Date (YYYY-MM-DD)	2014-02-17
Name/Print	Brian Short	Registration Number	41309

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	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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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	20070133427		2007-06-14	Taylor et al.	
	2	20090059851		2009-03-05	Weil et al.	
	3	20090180428		2009-07-16	Viswanath, Pramod	
	4	20100329134		2010-12-30	Doppler et al.	
	5	20110003598		2011-01-06	Ma et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

	6	20130034070		2013-02-07	Seo et al.	
	7	20130142055		2013-06-06	Bao et al.	
	8	20130322322		2013-12-05	Redana et al.	
	9	20130260712		2013-10-03	Deb et al.	
	10	20130182583		2013-07-18	Siomina et al.	
	11	20120120888		2012-05-17	Miao et al.	
	12	20100040000		2010-02-18	Jang et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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		☐

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Examiner Signature		Date Considered	

*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	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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	/Brian Short/	Date (YYYY-MM-DD)	2015-06-16
Name/Print	Brian Short	Registration Number	41309

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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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

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 record s.

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.

Electronic Patent Application Fee Transmittal	
Application Number:	14053574
Filing Date:	14-Oct-2013
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Filer:	Brian R. Short
Attorney Docket Number:	HWPII-1004-3
Filed as Small 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($)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
		Total in USD ($)		**90**

Electronic Acknowledgement Receipt	
EFS ID:	22649178
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	Brian R. Short
Filer Authorized By:	
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	16-JUN-2015
Filing Date:	14-OCT-2013
Time Stamp:	16:54:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$90
RAM confirmation Number	4018
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

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)	HWPII-1004-3-ids-supplemental.pdf	612921 3b25eafdfbe46790ad5125ea145c74a0ea494b60	no	5
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30738 3bccc2c08b1d558694798c11adc8ecd222d49b55	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	643659		

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New Applications Under 35 U.S.C. 111
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.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

86125 7590 04/01/2015
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Brian Short	(Depositor's name)
Brian Short	(Signature)
06/17/2015	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3	8913

TITLE OF INVENTION: USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	07/01/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ROBERTS, BRIAN S	2466	370-252000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Brian A. Short
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Headwater Partners II LLC
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Redwood City CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies .....

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
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5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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Authorized Signature Brian Short Date 06/17/2015
Typed or printed name Brian Short Registration No. 41,309

PTOL-85 Part B (10-13) Approved for use through 10/31/2013 OMB 0651-0033 U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal

Application Number:	14053574
Filing Date:	14-Oct-2013
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Filer:	Brian R. Short
Attorney Docket Number:	HWPII-1004-3

Filed as Small 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:				
Utility Appl Issue Fee	2501	1	480	480

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**480**

Electronic Acknowledgement Receipt	
EFS ID:	22653779
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	Brian R. Short
Filer Authorized By:	
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	17-JUN-2015
Filing Date:	14-OCT-2013
Time Stamp:	10:15:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$480
RAM confirmation Number	9054
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	HWPII-1004-3-IssueFee.pdf	1250474 30c9abbc6072a33d5b9400015ebcd79a155f5d4c	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30529 8790a254ca43a3e5c7f27aba4effe49389e21849	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1281003		

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New Applications Under 35 U.S.C. 111
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
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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3	8913

86125 7590 06/25/2015

Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

EXAMINER	
ROBERTS, BRIAN S	

ART UNIT	PAPER NUMBER
2466	

MAIL DATE	DELIVERY MODE
06/25/2015	PAPER

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

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U.S. Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
14/053,574	14 October, 2013	TELLADO ET AL.	HWPII-1004-3

		EXAMINER	
Law Office of Brian Short P.O. Box 641867 San Jose, CA 95164-1867		BRIAN ROBERTS	
		ART UNIT	PAPER
		2466	20150622

DATE MAILED:

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

Commissioner for Patents

The IDS filed on 06/16/2015 has been considered.
/BRIAN ROBERTS/ Primary Examiner, Art Unit 2466

PTO-90C (Rev.04-03)

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	14053574
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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	6687503		2004-02-03	Porter et al.	
If you wish to add additional U.S. Patent citation information please click the Add button.						Add

U.S.PATENT APPLICATION PUBLICATIONS						Remove
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	20070133427		2007-06-14	Taylor et al.	
	2	20090059851		2009-03-05	Weil et al.	
	3	20090180428		2009-07-16	Viswanath, Pramod	
	4	20100329134		2010-12-30	Doppler et al.	
	5	20110003598		2011-01-06	Ma et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

	6	20130034070		2013-02-07	Seo et al.	
	7	20130142055		2013-06-06	Bao et al.	
	8	20130322322		2013-12-05	Redana et al.	
	9	20130260712		2013-10-03	Deb et al.	
	10	20130182583		2013-07-18	Siomina et al.	
	11	20120120888		2012-05-17	Miao et al.	
	12	20100040000		2010-02-18	Jang et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14053574 14053574 - GAU: 2466
	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/Brian Roberts/ (06/22/2015)	Date Considered	06/22/2015

*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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2013-10-14
	First Named Inventor	Jose Tellado
	Art Unit	2466
	Examiner Name	Roberts, Brian S
	Attorney Docket Number	HWPII-1004-3

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	/Brian Short/	Date (YYYY-MM-DD)	2015-06-16
Name/Print	Brian Short	Registration Number	41309

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.**

EFS Web 2.1.17 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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

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 record s.

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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.R./

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/053,574	07/28/2015	9094868	HWPII-1004-3	8913

86125 7590 07/08/2015

Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 98 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Headwater Partners II LLC, Redwood Shores, CA;
Jose Tellado, Mountain View, CA;
Gregory G. Raleigh, Woodside, CA;

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 USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 106964

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 106964

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: Headwater Partners II LLC
1011 Pruitt Place
Tyler, TX 75703 (USA)

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	March 10, 2016
Name	David R. Johnson	Telephone	650-517-2782
Title	Chief Executive Officer		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 minutes 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

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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).
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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.

Electronic Acknowledgement Receipt	
EFS ID:	28942521
Application Number:	14053574
International Application Number:	
Confirmation Number:	8913
Title of Invention:	USER EQUIPMENT LINK QUALITY ESTIMATION BASED ON POSITIONING
First Named Inventor/Applicant Name:	Jose Tellado
Customer Number:	86125
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	HWPII-1004-3
Receipt Date:	17-APR-2017
Filing Date:	14-OCT-2013
Time Stamp:	14:28:30
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	Power of Attorney	HWPII_POA.pdf	388629 56d11b940357b20da2fad0f6f2ce9c37ef81cd6d	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	388629

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3

CONFIRMATION NO. 8913

106964
Headwater Partners II LLC
1011 Pruitt Place
Tyler, TX 75703

POA ACCEPTANCE LETTER

OC000000090773899

Date Mailed: 04/21/2017

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/17/2017.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

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**.

/ytdemisse/

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/053,574	10/14/2013	Jose Tellado	HWPII-1004-3

CONFIRMATION NO. 8913

POWER OF ATTORNEY NOTICE

86125
Law Office of Brian Short
P.O. Box 641867
San Jose, CA 95164-1867

OC000000090773870

Date Mailed: 04/21/2017

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/17/2017.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

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**.

/ytdemisse/