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(54) **SYSTEM AND METHOD FOR SENDING DATA TO A MOBILE DEVICE IN A WIRELESS NETWORK**

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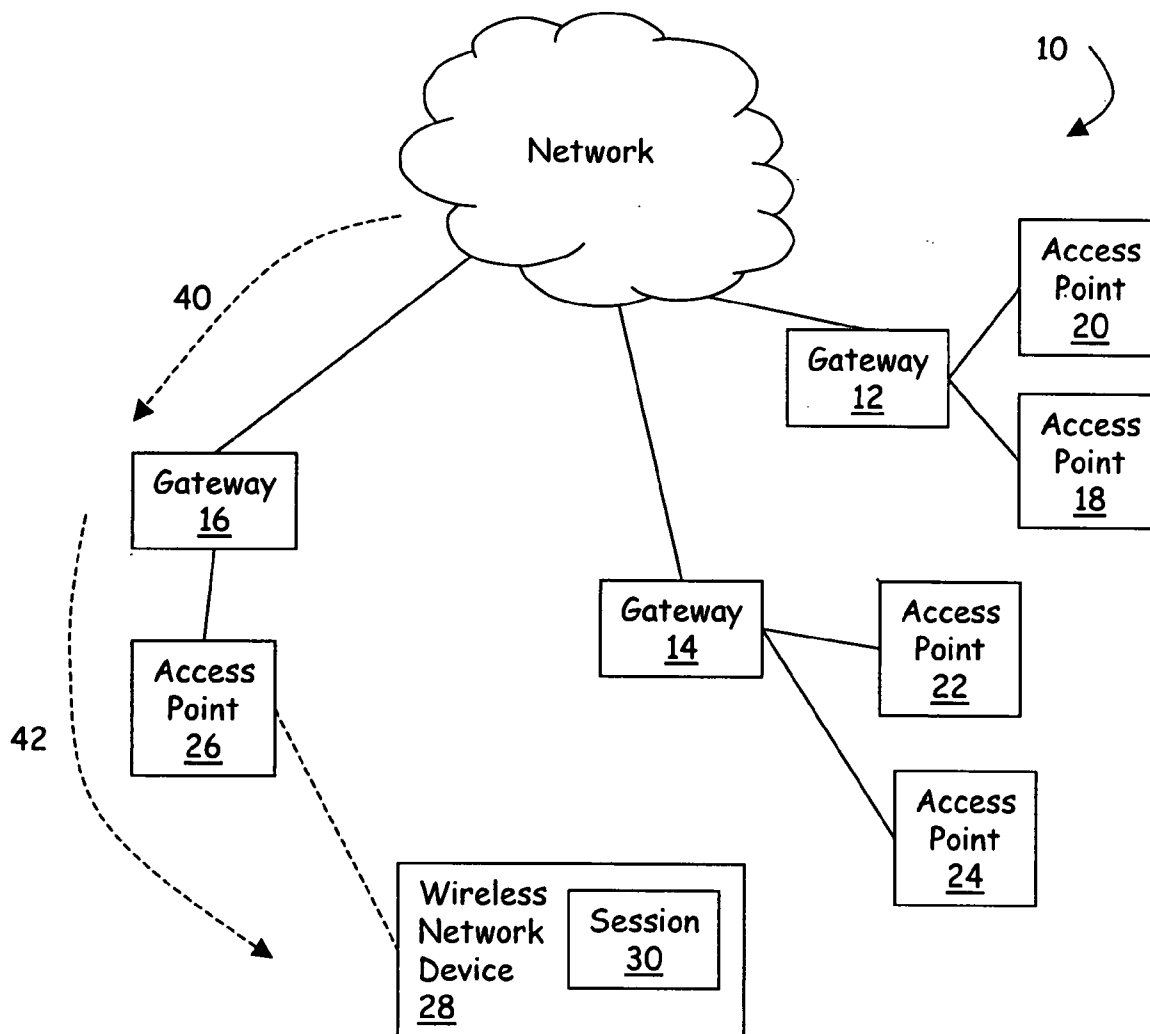
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(57) **ABSTRACT**

A device for wirelessly transmitting data under a wireless protocol is contemplated. A remote wireless network device initiates a session with a network. In this manner, information is sent to a gateway associated with the access point that couples the remote wireless network device to the network. When the remote wireless network device moves, data is tunneled between the succeeding gateway and the original gateway, but for those sessions opened at the original gateway. Any sessions associated with the remote wireless network device at the new gateway are processed and maintained by the new gateway without tunneling the data.
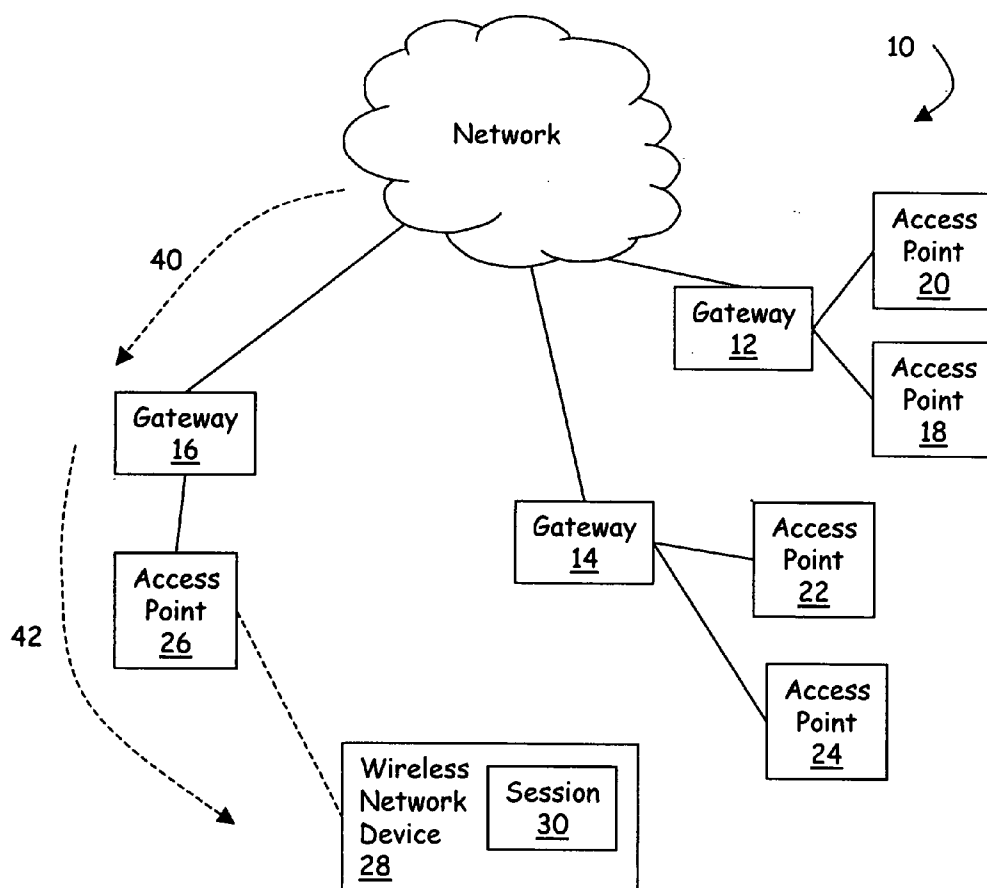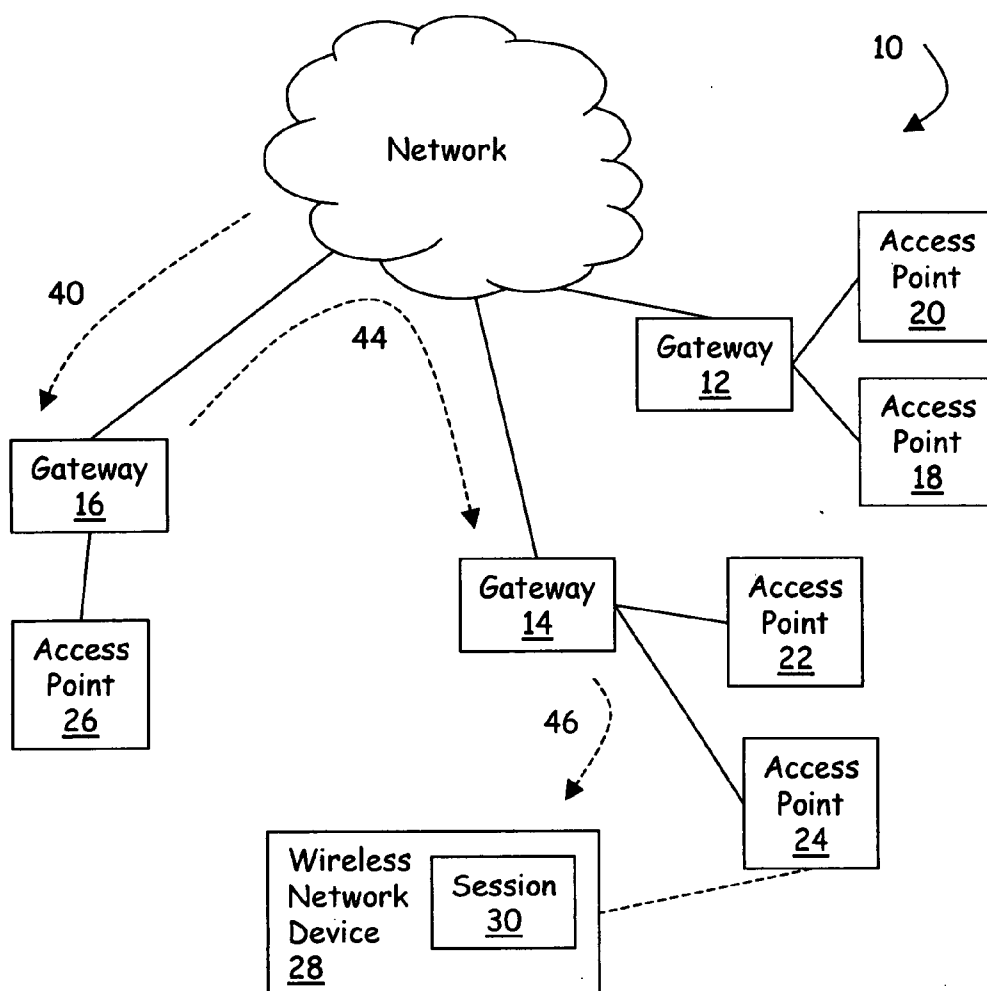
Network

10

40

Access
Point
20

Gateway
12

Access
Point
18

Gateway
16

42

Access
Point
26

Gateway
14

Access
Point
22

Access
Point
24

Wireless
Network
Device
28

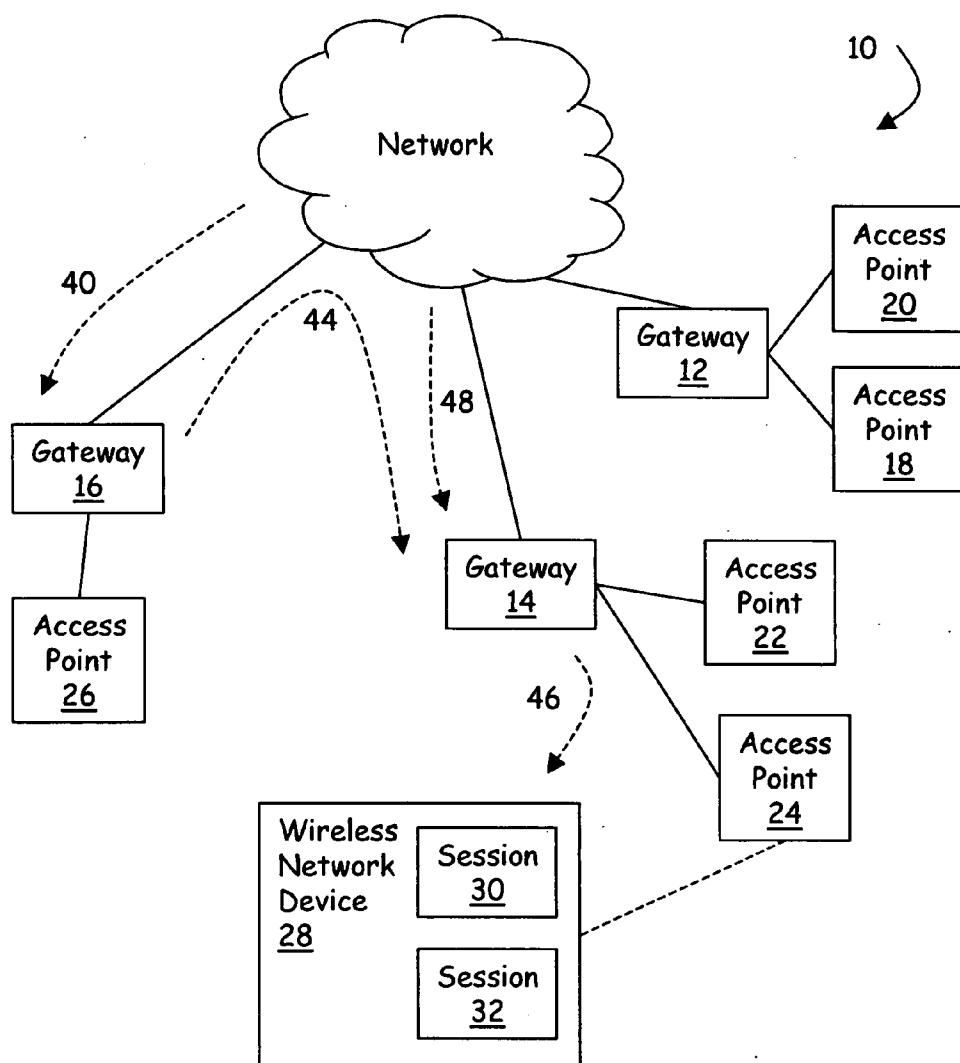Session
30

Figure 1

Figure 2

Figure 3

SYSTEM AND METHOD FOR SENDING DATA TO A MOBILE DEVICE IN A WIRELESS NETWORK

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority based on provisional application Ser. No. 60/443,114, entitled "System and Method for Sending Data to a Mobile Device in a Wireless Network" by Hilton Hung filed on Jan. 27, 2003.

FIELD OF THE INVENTION

[0002] The present invention relates to a wireless communication system. More particularly, the present invention is related to sending data to a non-static device coupled to a wireless network.

BACKGROUND

[0003] In some wireless networks, an access point (AP) can be coupled to a variety of wireless network devices. Typically, a wireless network can allow a mobile device to send and receive data as it moves through coverage zones of the individual access points. Sometimes, the wireless network device will initiate a session with a particular gateway. The data that is transferred to the wireless network device is sent to the gateway, which then relays the data to the wireless network device. Relatedly, the data emanating form the wireless network device is sent to the initial gateway, from where it is relayed to the ultimate destination.

[0004] When the wireless network device is mobile, the wireless network device can leave the coverage zone of a particular access point, or associated gateway. The wireless network device reinitiates contact with an access point that services the new location where the wireless network device is now located. In this manner, a new gateway may be used for the communication of information to and from the wireless network device.

[0005] In many cases, a link between the old gateway and the new gateway is established. Data traffic to the wireless network device is received by the old gateway, encapsulated by the old gateway, and relayed to the new gateway. At the new gateway, the data is decapsulated, and sent to the wireless network device.

[0006] Data traffic from the wireless network device is handled in much the same way. Data from the wireless network device is relayed from the wireless network device to the current gateway. The current gateway encapsulates the data and relays it to the original gateway. At this point, the original gateway decapsulates the data and relays it to the ultimate destination.

[0007] This paradigm is used for ongoing sessions, as well as new sessions. Thus, when the wireless network device starts a link at the new location, the encapsulation and relaying of the data from the new gateway to the original gateway is undertaken.

[0008] In this manner, a single gateway acts as the central point for all communications to and from a particular wireless network device. The transferring of the data to a new gateway takes additional time and effort, especially when the wireless network device is operating with several open sessions.

[0009] Such a mechanism may be found in the use of Mobile IP, a proposal before the Internet Engineering Taskforce (IETF). Mobile IP involves the use of a "Home Agent", which is the location of the device's known IP address, and a "Foreign Agent", which knows the actual location of the device. All traffic intended for the device is sent to the Home Agent and is then "tunneled" to the Foreign Agent for delivery to the device. This same type of method can be used within a wireless LAN, without the need to use the Mobile IP protocol.

[0010] In a more trivial implementation of a tunneling system to achieve seamless subnet roaming, an administrator could be forced to assign a "Home" Gateway for each wireless user in the network. Each wireless client would then communicate to its currently local access point, which would "tunnel" the packet to the client's "Home" Gateway. However, this implementation has two major inefficiencies. First, it requires the administrator to setup a Home Gateway for each user. Secondly, and more difficult to work around, it is rather inefficient, forcing more traffic to be tunneled than necessary

SUMMARY

[0011] A device for wirelessly transmitting data under a wireless protocol is contemplated. A remote wireless network device initiates a session with a network. In this manner, information is sent to a gateway associated with the access point that couples the remote wireless network device to the network. When the remote wireless network device moves, data is tunneled between the succeeding gateway and the original gateway, but for those sessions opened at the original gateway. Any sessions associated with the remote wireless network device at the new gateway are processed and maintained by the new gateway without tunneling the data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more embodiments of the present invention and, together with the detailed description, serve to explain the principles and implementations of the invention.

[0013] In the drawings:

[0014] **FIGS. 1 through 3** are network diagrams detailing the mechanics a wireless network with a dynamic gateway system, according to the invention.

DETAILED DESCRIPTION

[0015] Embodiments of the present invention are described herein in the context of a System And Method for Sending Data to A Mobile Device in A Wireless Network. Those of ordinary skill in the art will realize that the following detailed description of the present invention is illustrative only and is not intended to be in any way limiting. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure. Reference will now be made in detail to implementations of the present invention as illustrated in the accompanying drawings. The same reference indicators will be used throughout the drawings and the following detailed description to refer to the same or like parts.

[0016] In the interest of clarity, not all of the routine features of the implementations described herein are shown and described. It will, of course, be appreciated that in the development of any such actual implementation, numerous implementation-specific decisions must be made in order to achieve the developer's specific goals, such as compliance with application- and business-related constraints, and that these specific goals will vary from one implementation to another and from one developer to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking of engineering for those of ordinary skill in the art having the benefit of this disclosure.

[0017] In accordance with the present invention, the components, process steps, and/or data structures may be implemented using various types of digital systems, including hardware, software, or any combination thereof. In addition, those of ordinary skill in the art will recognize that devices of a less general purpose nature, such as hardwired devices, field programmable gate arrays (FPGAs), application specific integrated circuits (ASICs), or the like, may also be used without departing from the scope and spirit of the inventive concepts disclosed herein.

[0018] FIGS. 1 through 3 are network diagrams detailing the mechanics a wireless network with a dynamic gateway system, according to the invention. A wireless network 10 contains several functional units. These include gateways 12, 14, and 16. Access points 18 and 20 are coupled to the gateway 12. Access points 22 and 24 are coupled to the gateway 14, and an access point 26 is coupled to the gateway 16.

[0019] Assume that a wireless network device 28 makes contact with the access point 26. After making a network connection, the information for a particular session 30 initiated while in the zone serviced by the access point 26 is sent through the gateway 16. The date flow from the network is indicated by the arrow 40, and the data flow from the gateway 16 to the access point is indicated by the arrow 42.

[0020] In FIG. 2, assume that the wireless network device 28 then moves to the zone serviced by the access point 24. For the information traveling to the first session 30, the gateway 16 encapsulates the data and relays it to the gateway 14. This is indicated by the arrow 44. From there the gateway 16 relays that information to the device 28, denoted by the arrow 46.

[0021] In FIG. 3, assume that the wireless network device 28 initiates a second network session 32. The wireless network device 28 requests the new session 32 through the gateway 14. However, instead of sending the data bound for the session 32 and to the gateway 16, the gateway 14 assigns an address to the session so that the gateway 14 can directly service the second session 32. This is denoted by an arrow 48. Thus, the pathway for information for the second session 32 flows directly through the gateway 14, rather than being sent to the gateway 16, being encapsulated, and then sent to the gateway 14 for final delivery to the session 32.

[0022] In this manner, the gateway that initiates a network session from a network device may be thought of as an agent for the particular session. The gateways that the wireless network device 28 may move to will be the foreign agents for the session. Thus, when the wireless network device 28

moves, the new gateway will not have to encapsulate and deliver every single transmission emanating from the wireless network device 28 to a central gateway responsible for that client. The new gateway can send and deliver data directly to the wireless network device 28 for those sessions the new gateway initiates during the time under its aegis, rather than have another gateway encapsulating and forwarding the data.

[0023] Of course, the flow of data going from the network device 28 to the network can be treated in a similar manner. Thus, instead of the new gateway encapsulating and forwarding data to another gateway, the new gateway can initiate a direct link to the network for those sessions started on the network device 28 while that device is under the aegis of the new gateway.

[0024] In a more detailed example assume that a client device associates with an access point. In this case, it might use address resolution protocol (ARP) and dynamic host communication protocol (DHCP) service to request an internet protocol (IP) address from the network. The initial gateway responds to such a request using a pool of IP addresses it has been assigned (either through prior assignment, or through any other mechanisms.)

[0025] When the client has an IP address, it can then begin an application that requires a high layer connection, such as, for example, a transport control protocol (TCP) application. Such an application might be those like an email application, a file sharing application, or a web browsing application, just to name a few.

[0026] If the client device moves to any of the other access points connected to the original gateway, only a reassociation process need take place. Other network information (like IP address, default gateway, etc.) is still valid for this access point.

[0027] When the client device roams from an access point attached to the first gateway to an access point attached to a different gateway, it is preferable to accomplish this without breaking the higher layer (e.g. TCP) connection. The gateways can inform each other that the move has occurred.

[0028] In addition to simple notification, gateways in adjacent physical locations can be kept appraised of the clients currently attached to each other. In this way, roaming can be anticipated, and the transfer of information between the gateways expedited.

[0029] In the current implementation, data from the network intended for the client continues to be routed to the original gateway. Upon receipt of the data, the original gateway forwards them to gateway that the client is now attached to. This second gateway then prepares the data for final delivery to the client.

[0030] When a client moves to a new subnet, or to a portion of network that is controlled by a different gateway, the network traffic operates for the ongoing sessions in the above-mentioned manner. Thus, when a user establishes a TCP session and then roams to a new subnet, the traffic is tunneled, in both directions between the original gateway and the new gateway.

[0031] However, in the context of the current specification, such tunneling is only carried out on an as-needed basis. The current specification offers routing optimization

for mobile networking. This optimization is achieved since only the traffic from particular sessions is tunneled between gateways.

[0032] In this context, assume that the client device associates with the original gateway and starts a network application session. The client then moves to an access point attached to another gateway. When the client device moves to the new access point, it cannot receive a new IP address without breaking its ongoing application session. Thus, the gateways establish a tunnel for the traffic associated with this application session.

[0033] Assume that, when attached to the new access point, the client device starts a second network application session. The data associated with this new network application session is allowed to pass directly out to the network.

[0034] In one embodiment, the gateways map the original IP address of the client device to a new IP address on a per-session basis. That is, traffic from one session, using the original IP address, is tunneled back to the gateway. However, traffic from the new session, using a new IP address, can be routed directly to and from the network.

1. A device for sending data to one or more wireless devices in a wireless network, the data being time constant digital data, the device comprising:

a first circuit for alerting the wireless devices that the time constant digital data is to be sent;

a second circuit for defining a frame in which the time constant digital data is to be sent; and

a third circuit for sending the digital data to the one or more wireless devices.

2. A device for sending data to a plurality of wireless devices in a wireless network, the data being time constant digital data, the device comprising:

a first circuit for alerting the wireless devices that the time constant digital data is to be sent;

a second circuit for defining a frame in which the time constant digital data is to be sent; and

a third circuit for sending the digital data as a single data block to the plurality of wireless devices within the frame.

3. A device for receiving data at one of a plurality of wireless devices in a wireless network, the data being time constant digital data, the device comprising:

a first circuit for receiving an alert that the time constant digital data is to be sent;

a second circuit for receiving parameters regarding a frame in which the time constant digital data is to be sent;

a third circuit for receiving the digital data as a single data block to the plurality of wireless devices within the frame; and

a fourth circuit for extracting the digital data bound for the one of a plurality of wireless devices from the single block of data.

4. A device for receiving data from one or more wireless devices in a wireless network, the data being time constant digital data, the device comprising:

a first circuit for alerting the wireless devices that the time constant digital data is to be sent;

a second circuit for defining a frame in which the time constant digital data is to be sent;

a third circuit for polling the particular wireless device to initiate the sending of the digital data; and

a fourth circuit for receiving the data sent from each particular polled wireless device.

5. A method for receiving digital data from a wireless device in a wireless network, the method comprising:

alerting the wireless device to send the time constant data;

polling the wireless device to send the time constant data; and

receiving a sent packet of time constant data from the particular wireless device.

6. A method for sending digital data from a wireless device in a wireless network, the method comprising:

awaiting an Alert to send the time constant data;

subsequent to the alert, awaiting a Poll to send the time constant data;

sending a sent packet of time constant data from the particular wireless device.

7. A method for sending digital data to a plurality of wireless devices in a wireless network, the method comprising:

alerting the plurality of wireless devices to receive the time constant data; and

sending one block of data, the one block of data comprising all of the data destined for the plurality of wireless devices.

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