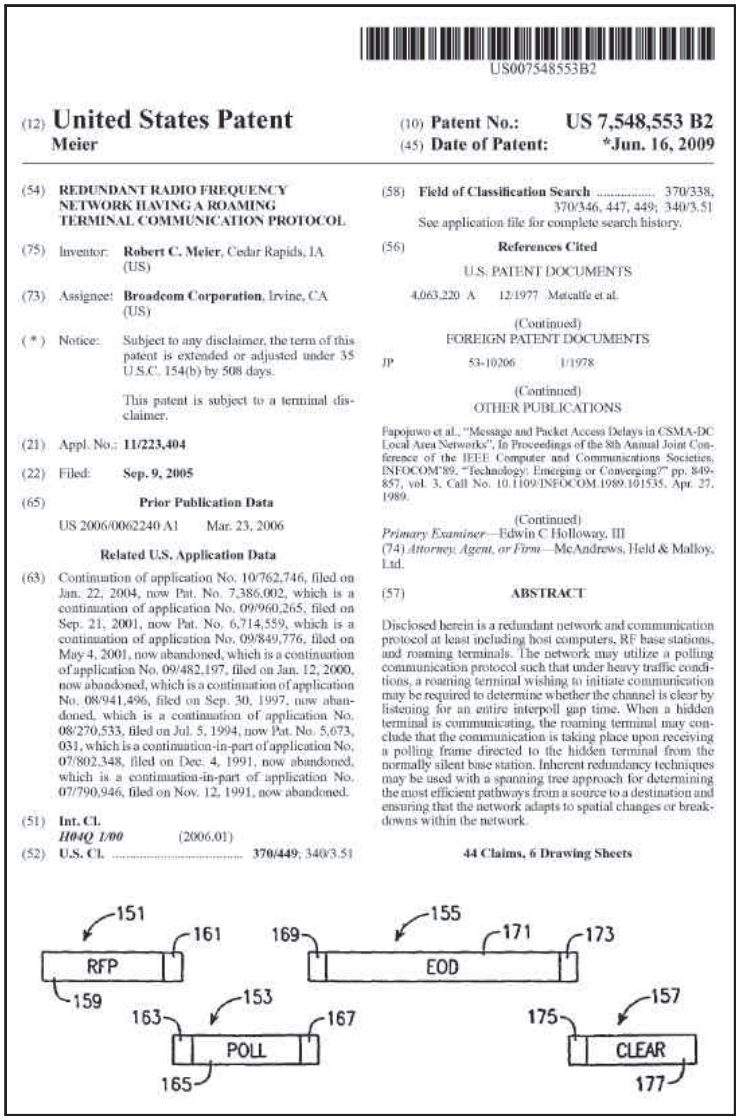
EXHIBIT 14

Exhibit 10

U.S. Patent No. 7,548,553
(Exemplary Infringement Position)



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(12) **United States Patent**
Meier

(10) **Patent No.: US 7,548,553 B2**
(45) **Date of Patent: *Jun. 16, 2009**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 508 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/223,404**

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(65) **Prior Publication Data**

US 2006/0062240 A1 Mar. 23, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/762,746, filed on Jan. 22, 2004, now Pat. No. 7,386,002, which is a continuation of application No. 09/960,265, filed on Sep. 21, 2001, now Pat. No. 6,714,559, which is a continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031, which is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned.

(51) **Int. Cl.**
H04Q 1/00 (2006.01)

(52) **U.S. Cl.** **370/449**; 340/3.51

(58) **Field of Classification Search** 370/338, 370/346, 447, 449; 340/3.51
See application file for complete search history.

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(Continued)

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(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to determine whether the channel is clear by listening for an entire interpoll gap time. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

44 Claims, 6 Drawing Sheets

U.S. Patent No. 7,548,553 and Defendants' 802.11-based Wireless LANs (Block ACK Operation)

7,548,553 For example: Claims 10 and 11, 12, 17, 19 and 20	Primary standards document for the analysis: IEEE 3 Park Avenue New York, NY 10016-5997, USA 12 June 2007 **IEEE Std 802.11™-2007** (Revision of IEEE Std 802.11-1999) **Abstract:** This revision specifies technical corrections and clarifications to IEEE Std 802.11 for wireless local area networks (WLANS) as well as enhancements to the existing medium access control (MAC) and physical layer (PHY) functions. It also incorporates Amendments 1 through 8 including a corrigendum. ("BASE DOC") Many of the amendments (*i.e.*, 1-8) incorporated into the above document were authored during development of later versions of 802.11. For example, 802.11-2007 effectively merges 802.11a, b and g. Regarding 802.11n, see: IEEE 3 Park Avenue New York, NY 10016-5997, USA 29 October 2009 **IEEE Std 802.11n™-2009** (Amendment to IEEE Std 802.11™-2007 as amended by IEEE Std 802.11k™-2008, IEEE Std 802.11r™-2008, IEEE Std 802.11y™-2008, and IEEE Std 802.11w™-2009)

Abstract: This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the IEEE 802.11 medium access control (MAC) sublayer so that modes of operation can be enabled that are capable of much higher throughputs, with a maximum throughput of at least 100 Mb/s, as measured at the MAC data service access point (SAP).
Keywords: high throughput, MAC, medium access control, MIMO, MIMO-OFDM, "multiple input, multiple output," PHY, physical layer, radio, wireless local area network, WLAN

Introduction

This introduction is not part of IEEE Std 802.11n-2009, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 5: Enhancements for Higher Throughput

This amendment specifies enhancements to IEEE 802.11 physical layer (PHY) and medium access control (MAC) sublayer to provide modes of operation with useful data rates substantially higher than those previously available. Significantly higher IEEE 802.11 wireless local area network (WLAN) throughput is expected to improve user experiences for current applications and to enable new applications and market segments.

Thus, the October 2009 approved amendment expresses relationship between the 802.11n amendment and the 2007 version of 802.11.

The following analysis will discuss amendments made to 802.11-2007 by 802.11n-2009, where applicable.

Additionally, in the following discussion, original excerpts from the 802.11 standard will be boxed with added notations thereon highlighted in red. Discussion of such excerpts will be in unboxed plain text.

	The following discussion generally concerns the EDCAF (Enhanced Distributed Channel Access Function) portion of the HCF, in particular operating on the STA. Though the following discussion generally concerns the ECDAF, there is also an infringement position from the perspective from the HCCA operating at the AP (access point) of the BSS (basic service set) performing the coordination function.

10. A method of performing a data exchange over a wireless communication channel between a destination device and a sending device, the method comprising:	In general, a coordination function determines when and how a station (STA) is permitted to transmit data. A Quality-of-Service (or QoS) system will gain access to the wireless medium and transmit data over the wireless medium in accordance with the Hybrid Coordination Function (HCF). For example: **3.26 coordination function:** The logical function that determines when a station (STA) operating within a basic service set (BSS) is permitted to transmit protocol data units (PDUs) via the wireless medium (WM). The coordination function within a BSS may have one hybrid coordination function (HCF), or it may have one HCF and one point coordination function (PCF) and will have one distributed coordination function (DCF). A quality of service (QoS) BSS will have one DCF and one HCF. AND **3.65 hybrid coordination function (HCF):** A coordination function that combines and enhances aspects of the contention-based and contention-free access methods to provide quality of service (QoS) stations (STAs) with prioritized and parameterized QoS access to the wireless medium (WM), while continuing to support non-QoS STAs for best-effort transfer. The HCF includes the functionality provided by both enhanced distributed channel access (EDCA) and HCF controlled channel access (HCCA). The HCF is compatible with the distributed coordination function (DCF) and the point coordination function (PCF). It supports a uniform set of frame formats and exchange sequences that STAs may use during both the contention period (CP) and the contention-free period (CFP). AND

9.1.3 Hybrid coordination function (HCF)

The QoS facility includes an additional coordination function called *HCF* that is only usable in QoS network configurations. The HCF shall be implemented in all QoS STAs. The HCF combines functions from the DCF and PCF with some enhanced, QoS-specific mechanisms and frame subtypes to allow a uniform set of frame exchange sequences to be used for QoS data transfers during both the CP and CFP. The HCF uses both a contention-based channel access method, called the *enhanced distributed channel access* (EDCA) mechanism for contention-based transfer and a controlled channel access, referred to as the *HCF controlled channel access* (HCCA) mechanism, for contention-free transfer.

BASE DOC - no 802.11n-2009 amendment

Thus, communicating data in accordance with the 802.11 HCF is an example of the claimed "performing a data exchange over a wireless communication channel between a destination device and a sending device".

For the following discussion, note that the standard defines a station ("STA") as follows:

> **3.136 station (STA):** Any device that contains an IEEE 802.11-conformant medium access control (MAC) and physical layer (PHY) interface to the wireless medium (WM).

and defines an Access Point Station ("AP-STA" or "AP") as a specific type of STA:

> **3.3 access point (AP):** Any entity that has station (STA) functionality and provides access to the distribution services, via the wireless medium (WM) for associated STAs.

There are also Non-Access Point Stations ("non-AP STA"). For example:

> **3.43 downlink:** A unidirectional link from an access point (AP) to one or more non-AP stations (STAs).

Thus, any general STA requirement that does not specify the type of STA to which it applies, generally applies to both access points and non-access points.

The standard also defines specialized Quality-of-Service (or QoS) APs and non-APs. For example:

> **3.91 non-access point (non-AP) quality of service (QoS) station (STA):** A STA that supports the QoS facility, but is not an access point (AP). A non-AP STA does not have an hybrid coordinator (HC) and uses the QoS AP for the distribution system services (DSSs).

> **3.118 quality of service (QoS) access point (AP):** An AP that supports the QoS facility. The functions of a QoS AP are a superset of the functions of a non-QoS AP, and thus a QoS AP is able to function as a non-QoS AP to non-QoS stations (STAs).

Much of the following discussion will refer to QoS Station (or "QoS STA") operation.

waiting, by the sending device, a period of time that is at least as long as a first predetermined time period and detecting no communication on the wireless communication channel throughout the period of time;	**Regarding "sending device":** An 802.11 Quality-of-Service Station (or "QoS STA") is an example of the claimed "sending device". **Regarding "waiting**, by the sending device, **a period of time that is at least as long as a first predetermined time period and detecting no communication on the wireless communication channel throughout the period of time":** A QoS STA (or "the sending device"), for example, gains access to the wireless medium in accordance with the Hybrid Coordination Function (HCF). In particular, such a QoS STA generally gains access to the wireless medium in accordance with the Enhanced Distributed Channel Access Function (EDCAF) of the HCF. For example: **3.52 enhanced distributed channel access function (EDCAF):** A logical function in a quality of service (QoS) station (STA) that determines, using enhanced distributed channel access (EDCA), when a frame in the transmit queue with the associated access category (AC) is permitted to be transmitted via the wireless medium (WM). There is one EDCAF per AC. AND **3.51 enhanced distributed channel access (EDCA):** The prioritized carrier sense multiple access with collision avoidance (CSMA/CA) access mechanism used by quality of service (QoS) stations (STAs) in a QoS basic service set (BSS). This access mechanism is also used by the QoS access point (AP) and operates concurrently with hybrid coordination function (HCF) controlled channel access (HCCA).

During typical non-QoS operation, which is discussed in another infringement chart, in intervals where medium access is governed by the DCF (Distributed Coordination Function), a STA (station) listens to the channel for at least a DIFS (Distributed [Coordination Function] Interface Space) interval, ensuring such channel is clear, before attempting to begin a new communication. In such operation, the DIFS is an example of a minimum specified idle duration time.

HOWEVER, the EDCAF, utilized for example by a QoS STA, is different from the DCF (*e.g.*, utilizing a minimum specified idle duration time that is selected, based on communication priority, from a set of selectable minimum specified idle duration times). In such operation, a particular type of communication (*e.g.*, a voice communication, a video communication, etc.) corresponds to a particular respective minimum specified idle duration time, or Arbitration InterFrame Space (AIFS). For example:

9.1.3.1 HCF contention-based channel access (EDCA)

The EDCA mechanism provides differentiated, distributed access to the WM for STAs using eight different UPs. The EDCA mechanism defines four access categories (ACs) that provide support for the delivery of traffic with UPs at the STAs. The AC is derived from the UPs as shown in Table 9-1.

For each AC, an enhanced variant of the DCF, called an *enhanced distributed channel access function* (EDCAF), contends for TXOPs using a set of EDCA parameters from the EDCA Parameter Set element or from the default values for the parameters when no EDCA Parameter Set element is received from the AP of the BSS with which the STA is associated, where

a) The parameters used by the EDCAF to control its operation are defined by MIB attribute table dot11QAPEDCATable at the AP and by MIB attribute table dot11EDCATable at the non-AP STA.

b) The minimum specified idle duration time is not the constant value (DIFS) as defined for DCF, but is a distinct value (contained in the MIB attribute table dot11QAPEDCATableAIFSN for an AP and in the MIB table dot11EDCATableAIFSN for a non-AP STA, see 9.9.1) assigned either by a management entity or by an AP.

BASE DOC – no 802.11n-2009 amendment

AND

9.2.3.4 AIFS

The AIFS shall be used by QoS STAs to transmit all data frames (MPDUs), all management frames (MMPDUs), and the following control frames: PS-Poll, RTS, CTS (when not transmitted as a response to the RTS), BlockAckReq, and BlockAck (when not transmitted as a response to the BlockAckReq). A STA using the EDCA shall obtain a TXOP for an AC if the STA's CS mechanism (see 9.2.1) determines that the medium is idle at the AIFS[AC] slot boundary (see 9.9.1.3), after a correctly received frame, and the backoff time for that AC has expired.

BASE DOC – no 802.11n-2009 amendment

AND

9.9.1.3 Obtaining an EDCA TXOP

Each channel access timer shall maintain a backoff function (timer), which has a value measured in backoff slots.

The duration AIFS[AC] is a duration derived from the value AIFSN[AC] by the relation

$$AIFS[AC] = AIFSN[AC] \times aSlotTime + aSIFSTime$$

The value of AIFSN[AC] shall be greater than or equal to 2 for non-AP STAs and is advertised by the AP in the EDCA Parameter Set information element in Beacon and Probe Response frames transmitted by the AP. The value of AIFSN[AC] shall be greater than or equal to 1 for APs. An EDCA TXOP is granted to an EDCAF when the EDCAF determines that it shall initiate the transmission of a frame exchange sequence. Transmission initiation shall be determined according to the following rules:

BASE DOC – no 802.11n-2009 amendment

AND Graphically:

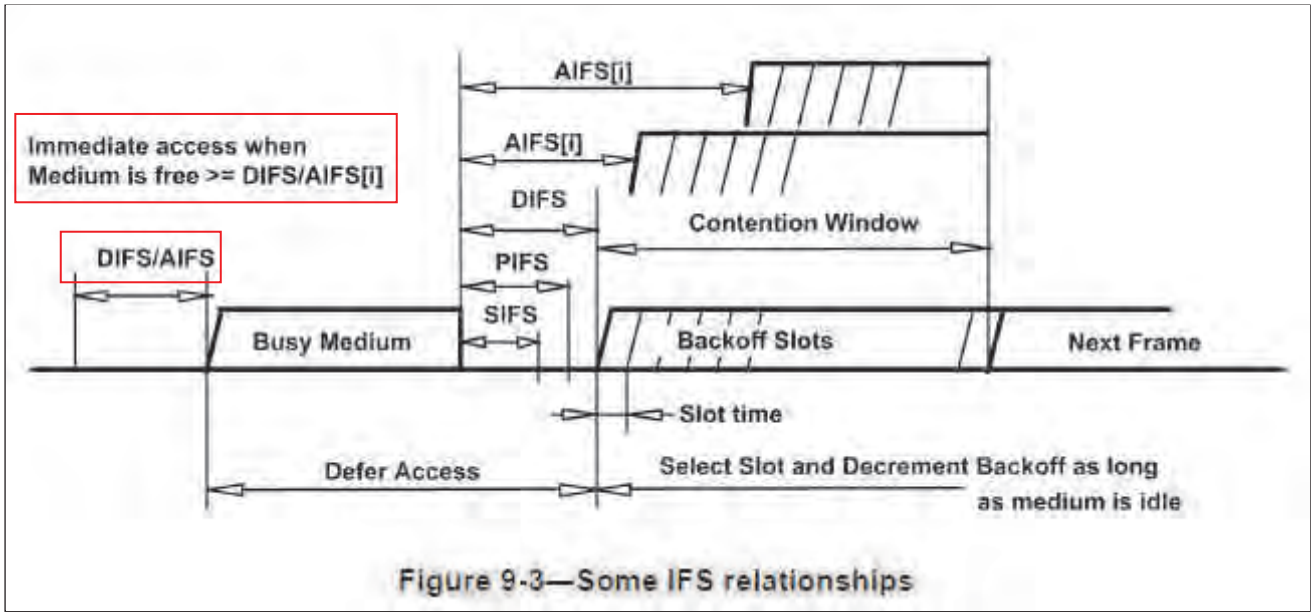


Figure 9-3—Some IFS relationships

BASE DOC – no 802.11n-2009 amendment

Thus, during QoS operation, during which access to and utilization of the communication channel is governed by the EDCAF, there are different predetermined AIFS time periods corresponding to respective different priority levels of information being communicated. Accordingly, for a given data communication, the corresponding AIFS[AC] time period associated with such data communication is an example of the claimed "first predetermined time period".

In the language of the claim, the EDCAF is an example of "waiting, by the sending device [or QoS STA] a period of time that is at least as long as a first predetermined time period [or at least as long as the AIFS] and detecting no communication on the wireless communication channel throughout the period of time".

after said detecting no communication on the wireless communication channel throughout the period of time, attempting, by the sending device, to initiate communication with the destination device;	For example, after the AIFS waiting period discussed above, during which the communication channel must be idle, the QoS STA (or "the sending device") attempts to transmit to another STA (or "the destination device"). Such attempted transmission is an example of the claimed "attempting, by the sending device, to initiate communication with the destination device". For example: **9.9.1.2 EDCA TXOPs** There are two modes of EDCA TXOP defined, the initiation of the EDCA TXOP and the multiple frame transmission within an EDCA TXOP. An initiation of the TXOP occurs when the EDCA rules permit access to the medium. A multiple frame transmission within the TXOP occurs when an EDCAF retains the right to access the medium following the completion of a frame exchange sequence, such as on receipt of an ACK frame. BASE DOC – no 802.11n-2009 amendment AND

On specific slot boundaries, each EDCAF shall make a determination to perform one and only one of the following functions:

— Initiate the transmission of a frame exchange sequence for that access function.

— Decrement the backoff timer for that access function.

— Invoke the backoff procedure due to an internal collision.

— Do nothing for that access function.

The specific slot boundaries at which exactly one of these operations shall be performed are defined as follows, for each EDCAF:

a) Following AIFSN[AC] × aSlotTime – aRxTxTurnaroundTime of idle medium after SIFS (not necessarily idle medium during the SIFS duration) after the last busy medium on the antenna that was the result of a reception of a frame with a correct FCS.

BASE DOC, § 9.9.1.3 – no 802.11n-2009 amendment

AND

At each of the above-described specific slot boundaries, each EDCAF shall initiate a transmission sequence if

— There is a frame available for transmission at that EDCAF, and

— The backoff timer for that EDCAF has a value of zero, and

— Initiation of a transmission sequence is not allowed to commence at this time for an EDCAF of higher UP.

BASE DOC, § 9.9.1.3 – no 802.11n-2009 amendment

As a more specific example, in a Block Acknowledgment (Block ACK) communication in which a STA (or "the sending device") utilizes the Block Acknowledgment functionality provided by the 802.11 standard, the initial request by the QoS STA to set-up the Block ACK communication after winning EDCA contention (*e.g.*, the transmission of an ADDBA Request) is an example of the claimed "attempting … to initiate communication with the destination device". For example:

9.10 Block Acknowledgment (Block Ack)

9.10.1 Introduction

The Block Ack mechanism improves channel efficiency by aggregating several acknowledgments into one frame. There are two types of Block Ack mechanisms: immediate and delayed. Immediate Block Ack is suitable for high-bandwidth, low-latency traffic while the delayed Block Ack is suitable for applications that tolerate moderate latency.[30] In this subclause, the STA with data to send using the Block Ack mechanism is referred to as the *originator*, and the receiver of that data as the *recipient*.

The Block Ack mechanism is initialized by an exchange of ADDBA Request/Response frames. After initialization, blocks of QoS data frames can be transmitted from the originator to the recipient. A block may be started within a polled TXOP or by winning EDCA contention. The number of frames in the block is limited, and the amount of state that is to be kept by the recipient is bounded. The MPDUs within the block of frames are acknowledged by a BlockAck control frame, which is requested by a BlockAckReq control frame.

BASE DOC – no 802.11n-2009 amendment

AND

9.10.2 Setup and modification of the Block Ack parameters

A STA that intends to use the Block Ack mechanism for the transmission of QoS data frames to a peer should first check whether the intended peer STA is capable of participating in Block Ack mechanism by discovering and examining its Delayed Block Ack and Immediate Block Ack capability bits. If the intended peer STA is capable of participating, the originator sends an ADDBA Request frame indicating the TID for which the Block Ack is being set up. The Block Ack Policy and Buffer Size fields in the ADDBA Request frame are advisory and may be changed by the recipient. The receiving STA shall respond by an ADDBA Response frame. The receiving STA, which is the intended peer, has the option of accepting or rejecting the request. When the STA accepts, then a Block Ack agreement exists between the originator and recipient. When the STA accepts, it indicates the type of Block Ack and the number of buffers that it shall allocate for the support of this block. If the receiving STA rejects the request, then the originator shall not use the Block Ack mechanism.

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

AND Graphically:

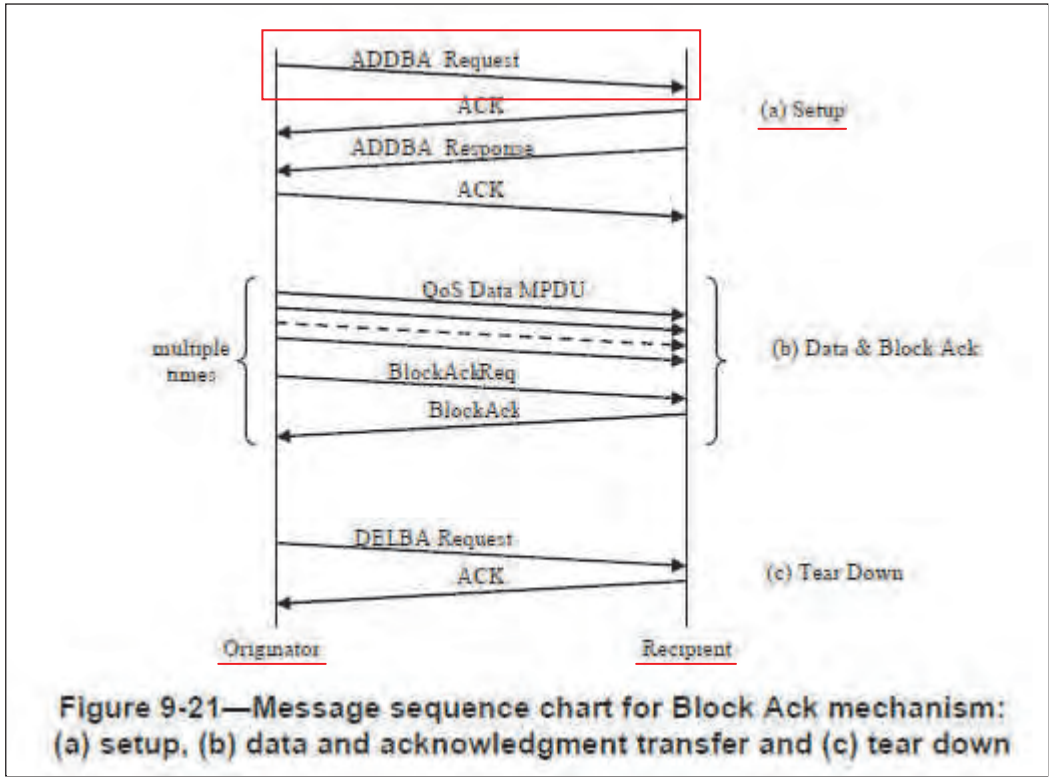


Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down

BASE DOC – no 802.11n-2009 amendment

and if said attempt to initiate communication with the destination device proves successful, then: communicating, between the sending device and the destination device, a series of packets, where said communicating comprises communicating at least one of the series of packets within a second predetermined time period that is less than the first predetermined time period;	**Generally:** If the "attempt to initiate communication" discussed above is successful (*e.g.*, the originator STA has successfully gained access to (and control of) the communication medium, successfully communicated the ADDBA Request message to the recipient STA, and received a positive ADDBA Response message from the recipient STA indicating successful establishment of a Block ACK communication), then a series of packets is communicated between the recipient STA and the originator STA. **Regarding "if said attempt to initiate communication with the destination device proves successful":** The conditional determination of whether the attempt to initiate communication with the destination device proves successful is, for example, satisfied when the originator STA (or "the sending device") receives an ADDBA Response message from the recipient STA (or "the destination device") indicating successful setup of the Block ACK communication desired by the originator STA. For example, see:

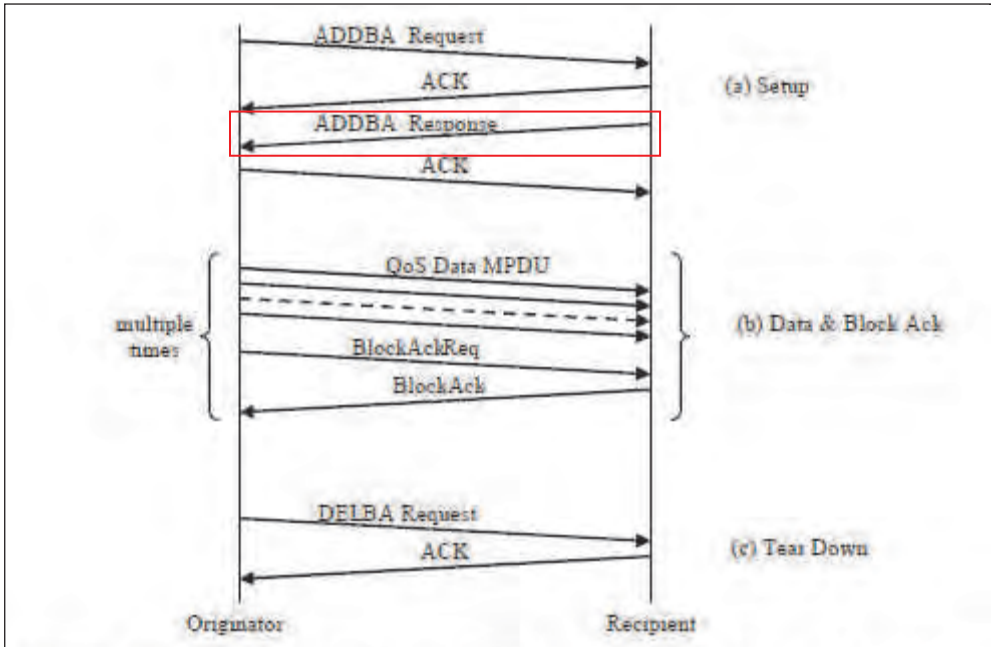


Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down

BASE DOC – no 802.11-2009 amendment

where the ADDBA Response packet from the recipient STA indicates whether the request for a Block ACK communication (*i.e.*, the request corresponding to the ADDBA Request packet discussed above) has been granted by the recipient STA. See, for example:

7.4.4.2 ADDBA Response frame format

The ADDBA Response frame is sent in response to an ADDBA Request frame. The frame body of an ADDBA Response frame contains the information shown in Table 7-56.

Table 7-56—ADDBA Response frame body

Order	Information
1	Category
2	Action
3	Dialog Token
4	Status Code
5	Block Ack Parameter Set
6	Block Ack Timeout Value

BASE DOC – no 802.11n-2009 amendment

where the Status Code field indicates success or failure of the request for a Block ACK communication. See:

7.3.1.9 Status Code field

The Status Code field is used in a response management frame to indicate the success or failure of a requested operation. The length of the Status Code field is 2 octets. The Status Code field is illustrated in Figure 7-27.

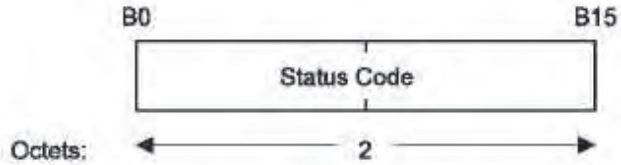


Figure 7-27—Status Code field

BASE DOC – no 802.11-2009 amendment

Thus, the Status Code field of the ADDBA Response frame will indicate success or failure of the request for a Block ACK communication.

Regarding "…, then: communicating, between the sending device and the destination device, a series of packets …":

As illustrated in the message flow diagram in Figure 9-21 below, after successful initiation of the Block ACK communication with the destination device (*e.g.*, as exemplified by successful communication of a positive ADDBA Response message from the recipient STA (or "the destination device") to the originator STA (or "the sending device"), the originator STA and the recipient STA communicate a series of packets between them. Such operation is an example of the claimed "communicating, between the sending device and the destination device, a series of packets". For example:

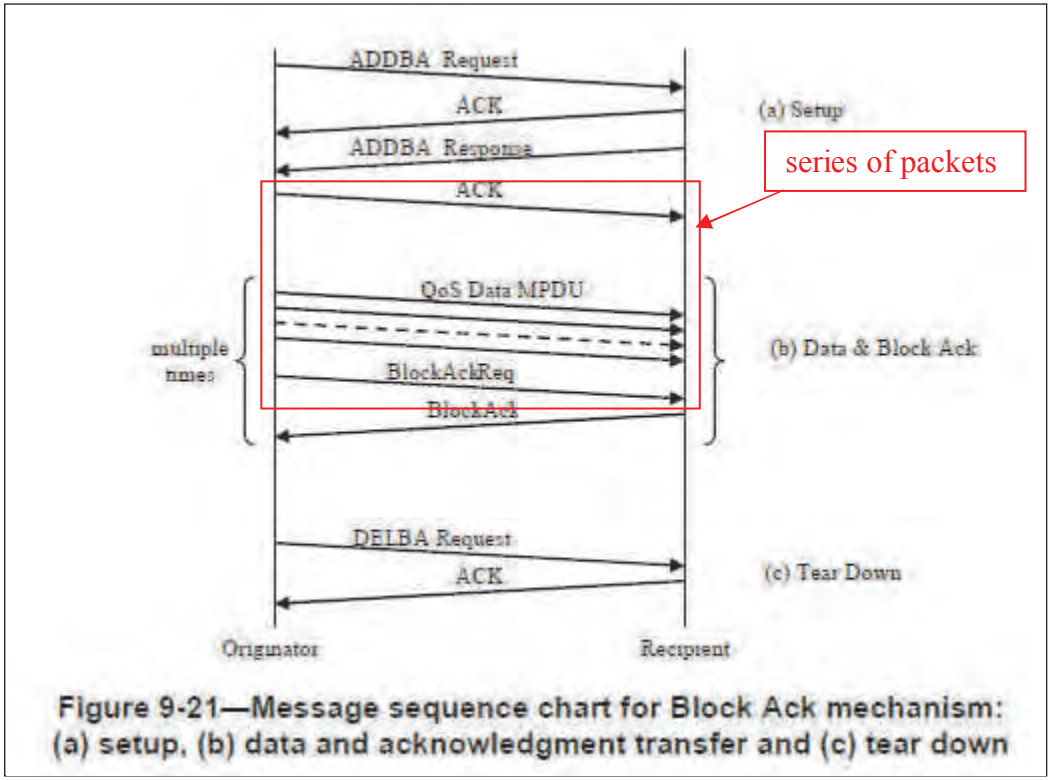


Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down

BASE DOC – no 802.11n-2009 amendment

Such a series of packets, for example, includes the remainder of the packets communicated between the originator and recipient STAs during the "(a) Setup" process (*e.g.*, the ACK from the originator STA), and the QoS data MPDU packets and BlockAckReq packet communicated during the "(b) Data & Block Ack" process. For more information regarding such packets, see, for example:

9.10.2 Setup and modification of the Block Ack parameters

A STA that intends to use the Block Ack mechanism for the transmission of QoS data frames to a peer should first check whether the intended peer STA is capable of participating in Block Ack mechanism by discovering and examining its Delayed Block Ack and Immediate Block Ack capability bits. If the intended peer STA is capable of participating, the originator sends an ADDBA Request frame indicating the TID for which the Block Ack is being set up. The Block Ack Policy and Buffer Size fields in the ADDBA Request frame are advisory and may be changed by the recipient. The receiving STA shall respond by an ADDBA Response frame. The receiving STA, which is the intended peer, has the option of accepting or rejecting the request. When the STA accepts, then a Block Ack agreement exists between the originator and recipient. When the STA accepts, it indicates the type of Block Ack and the number of buffers that it shall allocate for the support of this block. If the receiving STA rejects the request, then the originator shall not use the Block Ack mechanism.

If the Block Ack mechanism is being set up for a TS, bandwidth negotiation (using ADDTS Request and Response frames) should precede the setup of the Block Ack mechanism.

Once the Block Ack exchange has been set up, data and ACK frames are transferred using the procedure described in 9.10.3.

BASE DOC – 802.11n-2009 amendment (no substantial impact)

AND

9.10.3 Data and acknowledgment transfer

After setting up for the Block exchange following the procedure in 9.10.2, the originator may transmit a block of QoS data frames separated by SIFS period, with the total number of frames not exceeding the Buffer Size subfield value in the associated ADDBA Response frame. Each of the frames shall have the Ack Policy subfield in the QoS Control field set to Block Ack. The RA field of the frames shall be the recipient's *unicast* address. The originator requests acknowledgment of outstanding QoS data frames by sending a BlockAckReq frame. The recipient shall maintain a Block Ack record for the block.

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

Regarding "where said communicating comprises communicating at least one of the series of packets within a second predetermined time period":

There are multiple infringement positions with regard to such clause, two examples of which will now be presented.

First exemplary infringement position:

The first exemplary infringement position focuses on communication of the first packet of the exemplary "series of packets", which is the ACK packet transmitted by the originator STA (or "the sending device") following receipt of the ADDBA Response packet by the originator STA.

In such case, the maximum allowable 802.11 Short Interframe Space (SIFS) interval specified by the 802.11 standard is an example of the claimed "second predetermined time period".

	In general, when a STA (or "the sending device") gains control over the medium for a communication (*e.g.*, for a frame exchange sequence), the STA and the second STA with which the STA is communicating (or "the destination device") maintain control over the medium using the SIFS interval between transmissions. More specifically, during a Block ACK communication, after the successful set-up of the Block ACK communication (indicated by a positive ADDBA Response packet, as discussed above), the originator STA (or "the sending device") responds to the ADDBA Response packet from the recipient STA (or "the destination device") with an ACK packet followed by a block of data (or QoS Data MPDU) packets, followed by a Block ACK Request (or BlockAckReq) packet. As discussed above, such a series of packets is an example of the claimed "series of packets", the first packet of which being the ACK packet following the ADDBA Response packet. For example, graphically:

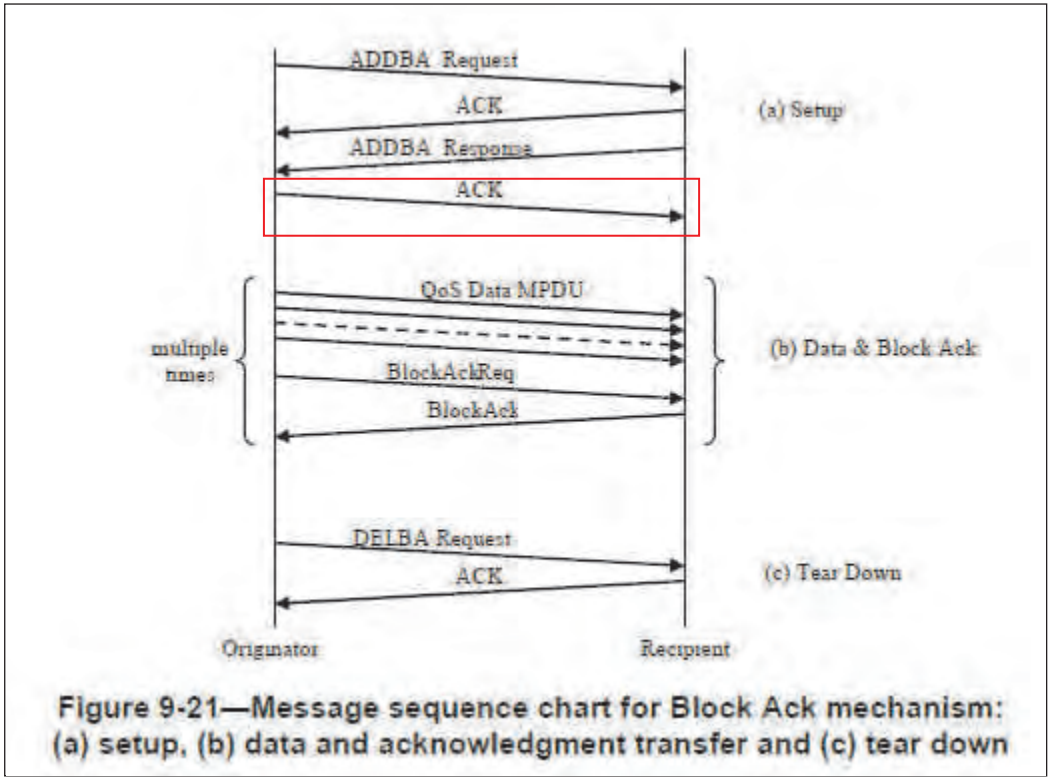


Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down

BASE DOC – no 802.11n-2009 amendment

Communicating such ACK packet by the originator STA (or "the sending device") to the recipient STA (or "the destination device") must begin at a Short InterFrame Space (SIFS) interval after the ADDBA Response packet. For example:

9.2.3.1 SIFS

The SIFS shall be used prior to transmission of an ACK frame, a CTS frame, the second or subsequent MPDU of a fragment burst, and by a STA responding to any polling by the PCF. The SIFS may also be used by a PC for any types of frames during the CFP (see 9.3). The SIFS is the time from the end of the last symbol of the previous frame to the beginning of the first symbol of the preamble of the subsequent frame as seen at the air interface. The valid cases where the SIFS may or shall be used are listed in the frame exchange sequences in 9.12.

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

AND

9.2.8 ACK procedure

An ACK frame shall be generated as shown in the frame exchange sequences listed in 9.12.

Upon successful reception of a frame of a type that requires acknowledgment with the To DS field set, an AP shall generate an ACK frame. An ACK frame shall be transmitted by the destination STA that is not an AP, when it successfully receives a unicast frame of a type that requires acknowledgment, but not if it receives a broadcast or multicast frame of such type. After a successful reception of a frame requiring acknowledgment, transmission of the ACK frame shall commence after a SIFS period, without regard to the busy/idle state of the medium. (See Figure 9-11.)

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

The SIFS interval, while having a nominal value, also has a maximum allowable value that is specified by the 802.11 standard. For example:

9.2.3.1 SIFS

The SIFS shall be used prior to transmission of an ACK frame, a CTS frame, the second or subsequent MPDU of a fragment burst, and by a STA responding to any polling by the PCF. The SIFS may also be used by a PC for any types of frames during the CFP (see 9.3). The SIFS is the time from the end of the last symbol of the previous frame to the beginning of the first symbol of the preamble of the subsequent frame as seen at the air interface. The valid cases where the SIFS may or shall be used are listed in the frame exchange sequences in 9.12.

The SIFS timing shall be achieved when the transmission of the subsequent frame is started at the TxSIFS Slot boundary as specified in 9.2.10. An IEEE 802.11 implementation shall not allow the space between frames that are defined to be separated by a SIFS time, as measured on the medium, to vary from the nominal SIFS value by more than ±10% of aSlotTime for the PHY in use.

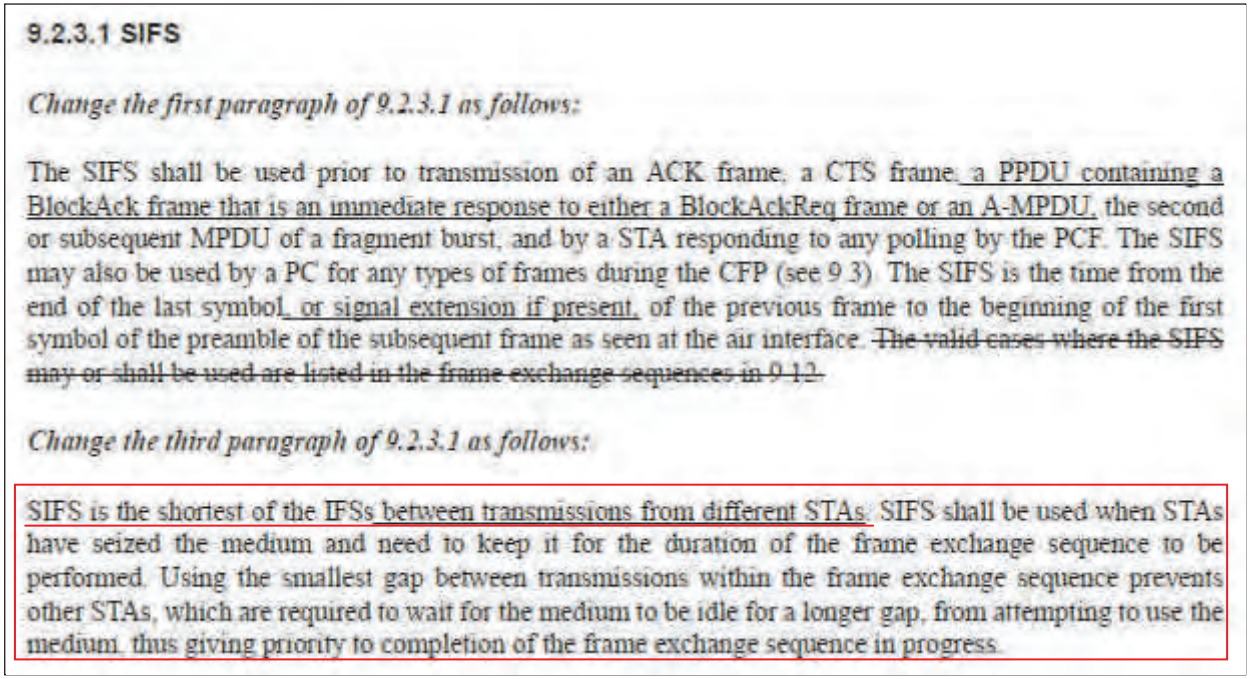
SIFS is the shortest of the IFSs. SIFS shall be used when STAs have seized the medium and need to keep it for the duration of the frame exchange sequence to be performed. Using the smallest gap between transmissions within the frame exchange sequence prevents other STAs, which are required to wait for the medium to be idle for a longer gap, from attempting to use the medium, thus giving priority to completion of the frame exchange sequence in progress.

BASE DOC, § 9.2.3.1 – 802.11n-2009 amendment below

Such maximum allowable value for the SIFS (*i.e.*, the nominal SIFS value plus 10% of a slot time) is an example of the claimed "second predetermined time period", within which communicating the ACK packet must be occurring.

Thus, in the language of the claim, "where said communicating comprises communicating at least one of the series of packets [communicating the ACK packet following the ADDBA Response packet] within a second predetermined time period [within the maximum allowable SIFS interval]".

	Second exemplary infringement position: The second exemplary infringement position focuses on communication of the block of QoS data packets of the claimed "series of packets" (which themselves are examples of the claimed "series of packets"), each two consecutive packets of which must be separated by either the SIFS interval or the shorter RIFS interval added by 802.11n. In such case, the maximum allowable 802.11 Short Interframe Space (SIFS) interval specified by the 802.11 standard is an example of the claimed "second predetermined time period". More specifically, when a STA (or "the sending device") gains control over the medium for a communication (*e.g.*, for a frame exchange sequence), the STA and the second STA with which the STA is communicating (or "the destination device") maintain control over the medium using the SIFS interval. For example:



9.2.3.1 SIFS

Change the first paragraph of 9.2.3.1 as follows:

The SIFS shall be used prior to transmission of an ACK frame, a CTS frame, a PPDU containing a BlockAck frame that is an immediate response to either a BlockAckReq frame or an A-MPDU, the second or subsequent MPDU of a fragment burst, and by a STA responding to any polling by the PCF. The SIFS may also be used by a PC for any types of frames during the CFP (see 9.3). The SIFS is the time from the end of the last symbol, or signal extension if present, of the previous frame to the beginning of the first symbol of the preamble of the subsequent frame as seen at the air interface. ~~The valid cases where the SIFS may or shall be used are listed in the frame exchange sequences in 9.12.~~

Change the third paragraph of 9.2.3.1 as follows:

SIFS is the shortest of the IFSs between transmissions from different STAs. SIFS shall be used when STAs have seized the medium and need to keep it for the duration of the frame exchange sequence to be performed. Using the smallest gap between transmissions within the frame exchange sequence prevents other STAs, which are required to wait for the medium to be idle for a longer gap, from attempting to use the medium, thus giving priority to completion of the frame exchange sequence in progress.

802.11n-2009 amendment

During Block ACK communication, the QoS data frames (*e.g.*, "at least one of the series of packets") will be either separated by such SIFS interval or the recently introduced RIFS interval (smaller than the SIFS interval), which was added by the 802.11n-2009 amendment.

Regarding the SIFS interval, for example:

9.10.3 Data and acknowledgment transfer

After setting up for the Block exchange following the procedure in 9.10.2, the originator may transmit a block of QoS data frames separated by SIFS period, with the total number of frames not exceeding the Buffer Size subfield value in the associated ADDBA Response frame. Each of the frames shall have the Ack Policy subfield in the QoS Control field set to Block Ack. The RA field of the frames shall be the recipient's *unicast* address. The originator requests acknowledgment of outstanding QoS data frames by sending a BlockAckReq frame. The recipient shall maintain a Block Ack record for the block.

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

AND graphically:

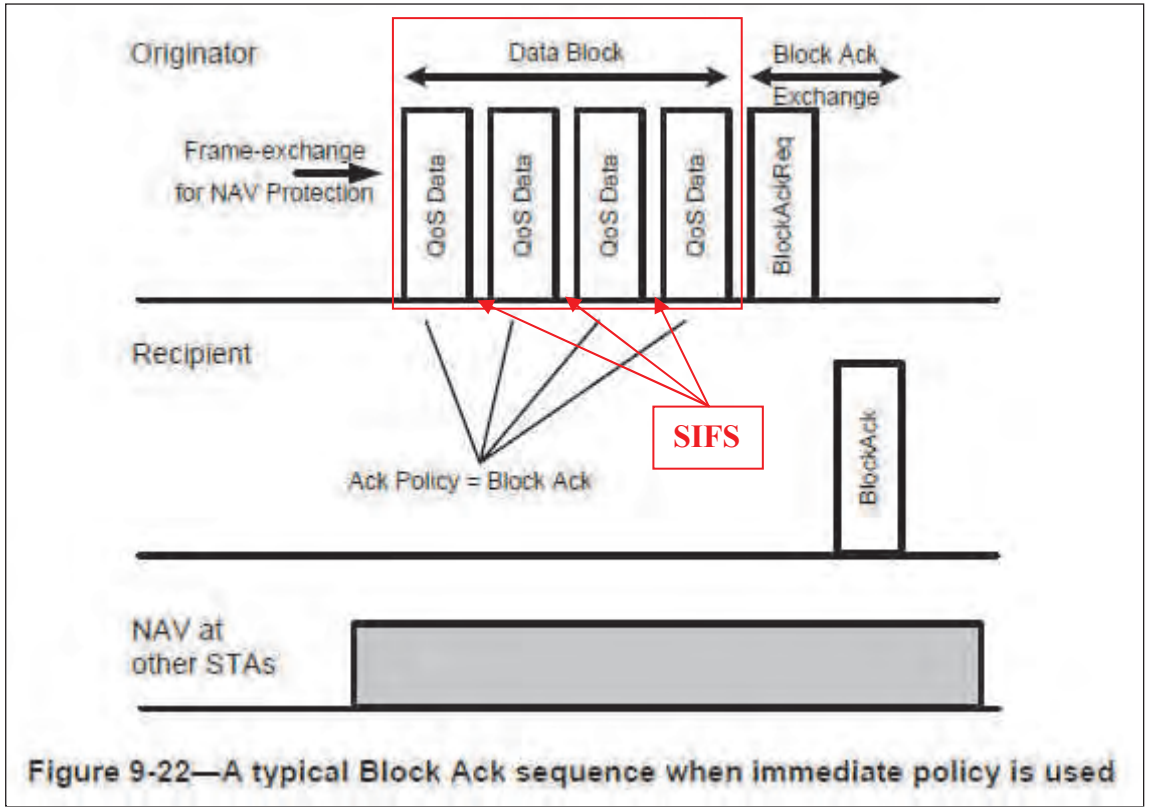


Figure 9-22—A typical Block Ack sequence when immediate policy is used

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

Thus, when operating in accordance with 802.11-2007 (without the 802.11-2009 amendments), the consecutive packets transmitted by the sending device during a Block ACK communication are separated by the SIFS interval.

Regarding the RIFS interval, for example:

The 802.11n-2009 amendment to the standard introduced a new interframe spacing (*i.e.*, the RIFS, Reduced InterFrame Space) that is smaller than the SIFS, where the RIFS may optionally be utilized between transmissions from a single station (*e.g.*, during a data block transmission). For example:

9.2.3.0a Overview

Change the first paragraph of the new 9.2.3.0a as follows:

The time interval between frames is called the IFS. A STA shall determine that the medium is idle through the use of the CS function for the interval specified. ~~Five~~Six different IFSs are defined to provide priority levels for access to the wireless media. Figure 9-3 shows some of these relationships. All timings are referenced from PHY interface signals PHY-TXEND.confirm, PHY-TXSTART.confirm, PHY-RXSTART.indication, and PHY-RXEND.indication.

a)	RIFS	reduced interframe space
b)	~~a)~~ SIFS	short interframe space
c)	~~b)~~ PIFS	PCF interframe space
d)	~~c)~~ DIFS	DCF interframe space
e)	~~d)~~ AIFS	arbitration interframe space (used by the QoS facility)
f)	~~e)~~ EIFS	extended interframe space

802.11n-2009 amendment

AND

9.2.3.0b RIFS

RIFS is a means of reducing overhead and thereby increasing network efficiency.

RIFS may be used in place of SIFS to separate multiple transmissions from a single transmitter, when no SIFS-separated response transmission is expected. RIFS shall not be used between frames with different RA values. The duration of RIFS is defined by the aRIFS PHY characteristic (see Table 20-24). The RIFS is the time from the end of the last symbol of the previous frame to the beginning of the first symbol of the preamble of the subsequent frame as seen at the air interface. A STA shall not allow the space between frames that are defined to be separated by a RIFS time, as measured on the medium, to vary from the nominal RIFS value (aRIFSTime) by more than ± 10% of aRIFSTime. Two frames separated by a RIFS shall both be HT PPDUs.

There are additional restrictions regarding when RIFS may be employed as defined in 9.15 and 9.16. See also 9.13.3.3.

802.11n-2009 amendment

where Table 20-24 reads, in relevant part:

Characteristics	Value
aRIFSTime	2 µs
aSlotTime	When operating in the 2.4 GHz band: long = 20 µs, short = 9 µs When operating in the 5 GHz band: 9 µs
aSIFSTime	10 µs when operating in the 2.4 GHz band 16 µs when operating in the 5 GHz bands

802.11n-2009 amendment

So transmissions from a single transmitter *may* be separated by the RIFS instead of the SIFS. During a Block-ACK communication, a single transmitter (*e.g.*, the claimed "sending device") must separate consecutive non-ACK'd packets by either the RIFS interval or the SIFS interval.

Graphically:

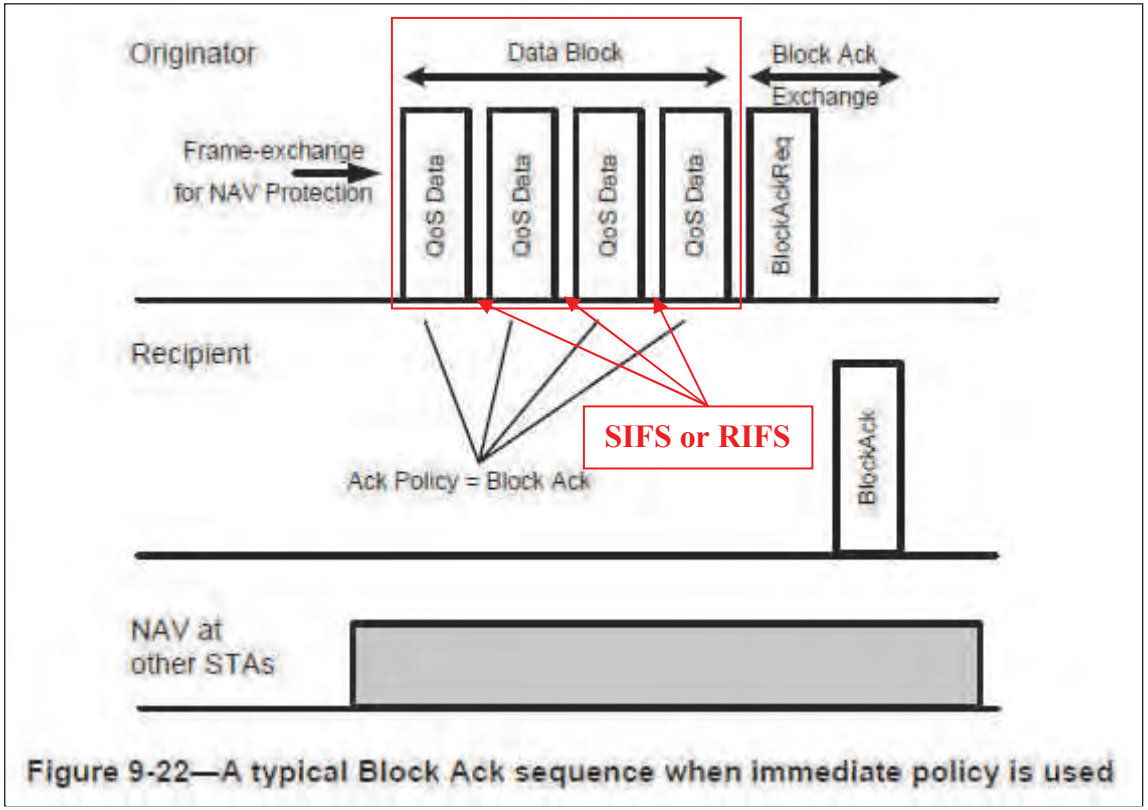


Figure 9-22—A typical Block Ack sequence when immediate policy is used

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

	Thus, in 802.11n operation, the consecutive data packets transmitted by the sending device during a Block ACK communication may be separated by either of the SIFS interval or the RIFS interval (which is shorter than the SIFS interval). As discussed above in detail, the SIFS interval, while having a nominal value, also has a maximum allowable value that is specified by the 802.11 standard. Such maximum allowable value for the SIFS (*i.e.*, the nominal SIFS value plus 10% of a slot time) is an example of the claimed "second predetermined time period", within which consecutive data packets of the Block ACK communication must occur. Thus, in the language of the claim, "where said communicating comprises communicating at least one of the series of packets [the QoS data packets of the block of data packets] within a second predetermined time period [within the maximum allowable SIFS interval]". **Summarizing:** In either of the two exemplary infringement positions discussed above, the maximum specified SIFS interval is an example of the claimed "second predetermined time period".

Regarding "within a second predetermined time period **that is less than the first predetermined time period":**

As discussed above, the specified maximum allowable SIFS interval (*e.g.*, the nominal SIFS value plus 10% of a slot time) is an example of the claimed "second predetermined time period", and the AIFS interval (*e.g.*, any of the AIFS[AC] intervals) is an example of the claimed "first predetermined time interval".

The following discussion will explain that the maximum allowable SIFS interval (*e.g.*, the claimed "second predetermined time period") is less than any of the AIFS[AC] intervals discussed above (*e.g.*, the claimed "first predetermined time period").

Regarding the relationship between the AIFS intervals and the SIFS interval, see:

9.9.1.3 Obtaining an EDCA TXOP

Each channel access timer shall maintain a backoff function (timer), which has a value measured in backoff slots.

The duration AIFS[AC] is a duration derived from the value AIFSN[AC] by the relation

AIFS[AC] = AIFSN[AC] × aSlotTime + aSIFSTime.

The value of AIFSN[AC] shall be greater than or equal to 2 for non-AP STAs and is advertised by the AP in the EDCA Parameter Set information element in Beacon and Probe Response frames transmitted by the AP. The value of AIFSN[AC] shall be greater than or equal to 1 for APs. An EDCA TXOP is granted to an EDCAF when the EDCAF determines that it shall initiate the transmission of a frame exchange sequence. Transmission initiation shall be determined according to the following rules:

BASE DOC – no 802.11n-2009 amendment

Since AIFSN[AC] is always at least 1, according to the above formula, AIFS[AC] is always at least SIFS plus 1 slot time. Also, as discussed above, the maximum allowable SIFS interval is the nominal SIFS value plus 10% of the slot time. Thus, the maximum value of the SIFS (*e.g.*, the claimed "the second predetermined time period") is always less than the AIFS[AC] (*e.g.*, the claimed "predetermined time period"). Graphically:

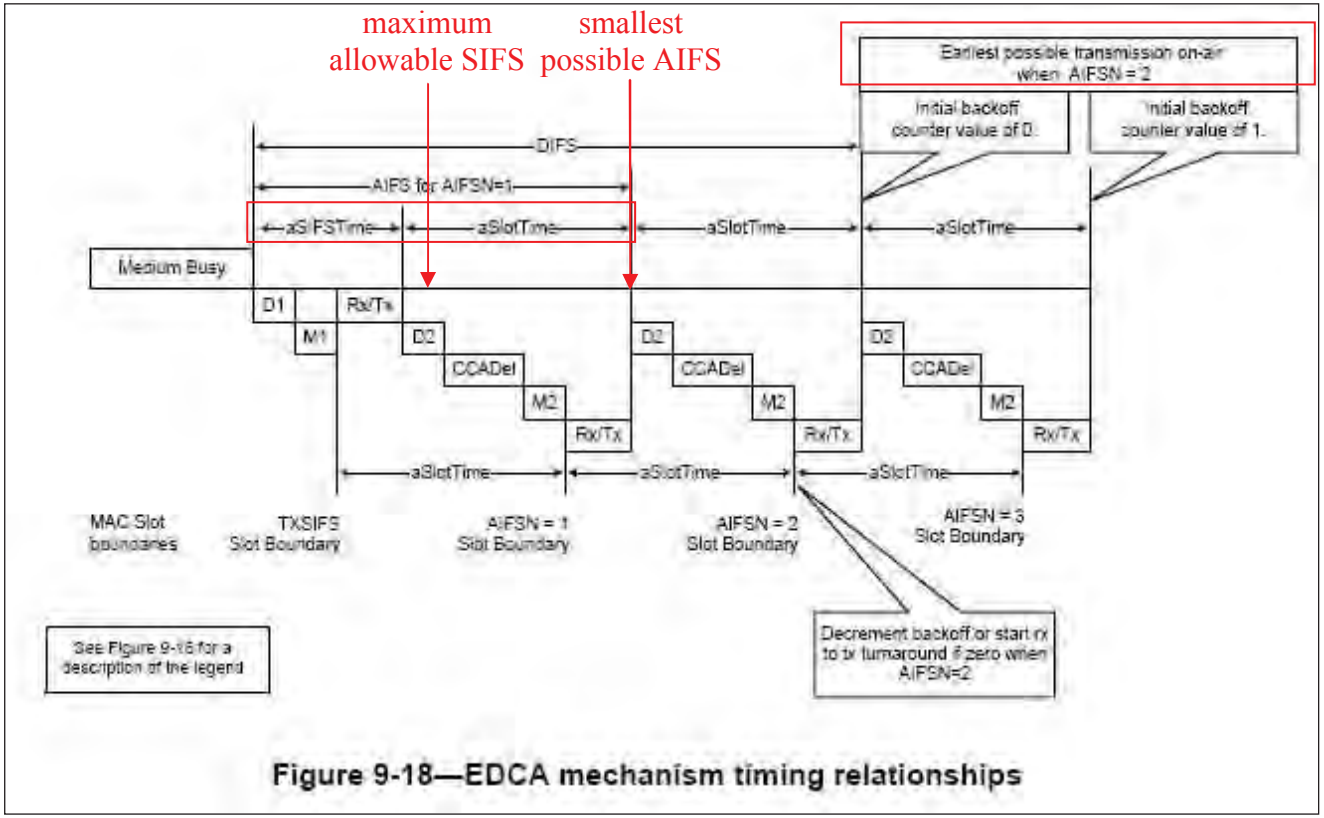


Figure 9-18—EDCA mechanism timing relationships

BASE DOC – no 802.11n-2009 amendment

AND

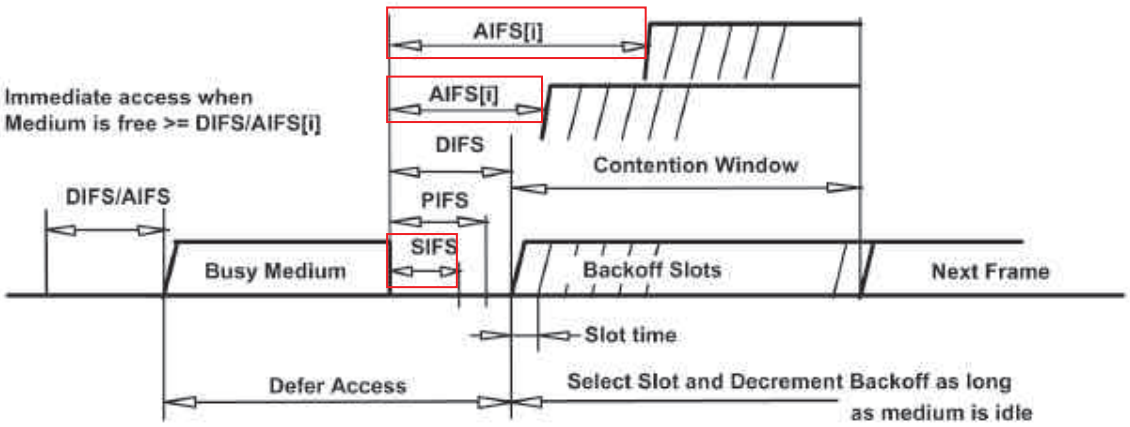


Figure 9-3—Some IFS relationships

9.2.3.1 SIFS

BASE DOC – no 802.11n-2009 amendment

after said communicating the series of packets, communicating, between the sending device and the destination device, a packet that indicates successful communication of the series of packets.	As mentioned above, the series of packets ending with the Block ACK Request (or BlockAckReq) packet is an example of the claimed "series of packets". Following the BlockAckReq packet, the recipient STA (or "the destination device") communicates a BlockAck packet to the originator STA (or "the sending device"). The BlockAck packet, in turn, "indicates successful communication of the series of packets". For example:

Change the sixth through ninth paragraphs of 9.10.3 as follows:

If the immediate Block Ack policy is used, the recipient shall respond to a Basic BlockAckReq frame with a Basic BlockAck frame. If the recipient sends the Basic BlockAck frame, the originator updates its own record and retries any frames that are not acknowledged in the Basic BlockAck frame, either in another block or individually.

If the delayed Block Ack policy is used, the recipient shall respond to a Basic BlockAckReq frame with an ACK frame. The recipient shall then send its Basic BlockAck ~~Block Ack~~ response in a subsequently obtained TXOP. Once the contents of the Basic BlockAck frame have been prepared, the recipient shall send this frame in the earliest possible TXOP using the highest priority AC. The originator shall respond with an ACK frame upon receipt of the Basic BlockAck frame. If delayed Block Ack policy is used and if the HC is the recipient, then the HC may respond with a +CF-Ack frame if the Basic BlockAckReq frame is the final frame of the polled TXOP's frame exchange. If delayed Block Ack policy is used and if the HC is the originator, then the HC may respond with a +CF-Ack frame if the Basic BlockAck frame is the final frame of the TXOP's frame exchange.

The Basic BlockAck frame contains acknowledgments for the MPDUs of up to 64 previous MSDUs. In the Basic BlockAck frame, the STA acknowledges only the MPDUs starting from the starting sequence control until the MPDU with the highest sequence number ~~(modulo 2^{12})~~ that has been received, and the STA shall set bits in the Block Ack bitmap corresponding to all other MPDUs to 0. The status of MPDUs that are considered "old" and prior to the sequence number range for which the receiver maintains status shall be reported as successfully received (i.e., the corresponding bit in the bitmap shall be set to 1). ~~The sequence number space is considered divided into two parts, one of which is "old" and one of which is "new" by means of a boundary created by adding half the sequence number range to the current start of receive window (modulo 2^{12}).~~ If the Basic BlockAck frame indicates that an MPDU was not received correctly, the originator shall retry that MPDU subject to that MPDU's appropriate lifetime limit.

A typical Block Ack ~~BlockAck~~ frame exchange sequence using the immediate Block Ack for a single TID is shown in Figure 9-22.

802.11n-2009 amendment

AND Graphically:

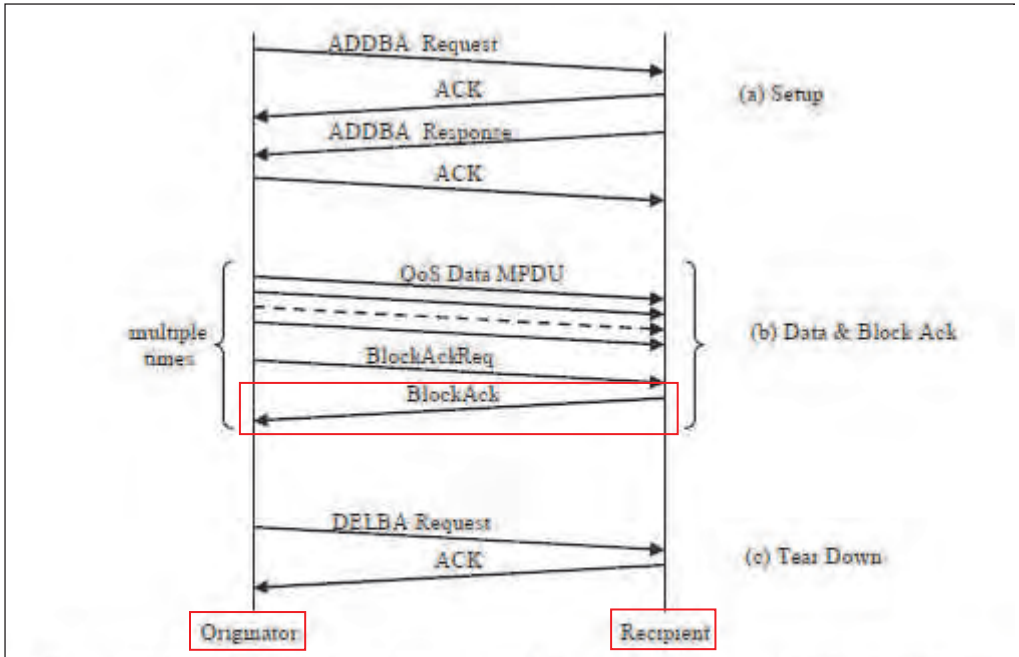


Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down

BASE DOC – no 802.11n-2009 amendment

AND

A typical BlockAck frame exchange sequence using the immediate Block Ack for a single TID is shown in Figure 9-22.

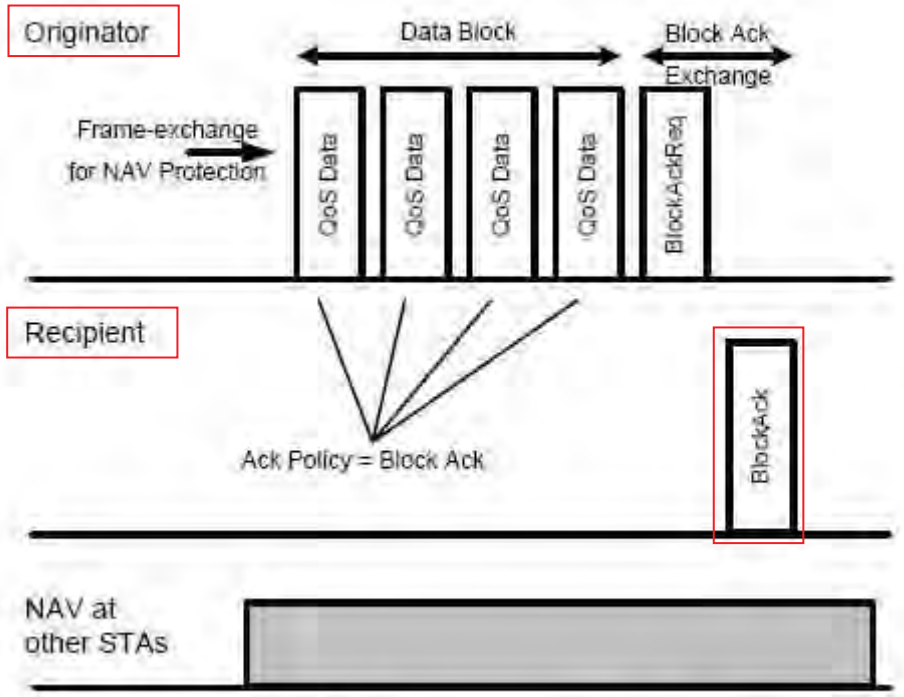
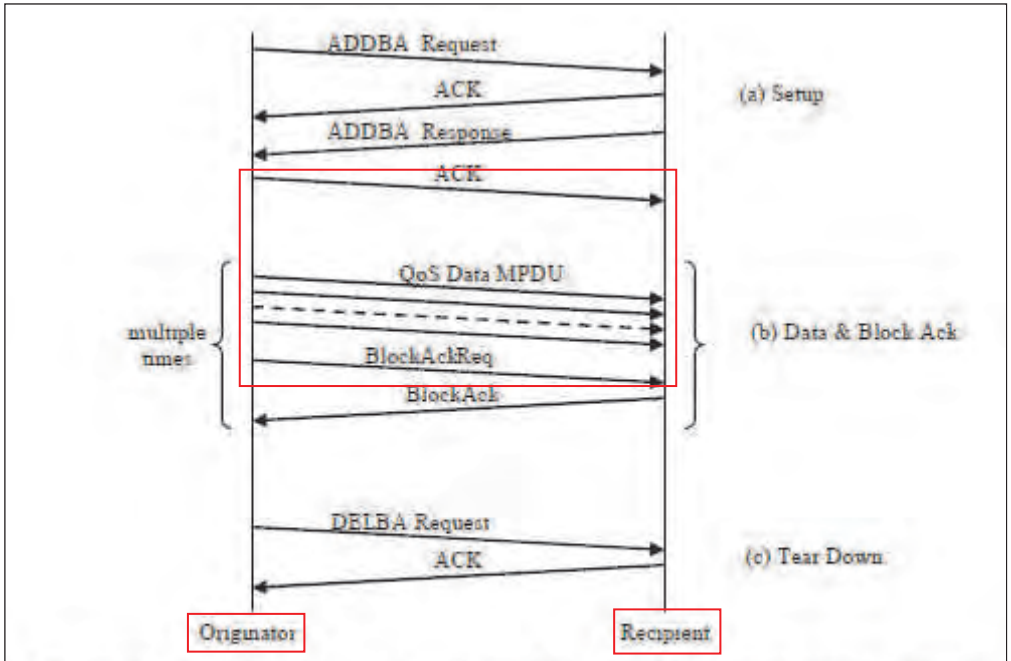


Figure 9-22—A typical Block Ack sequence when immediate policy is used

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

	Thus, in 802.11 Block Acknowledgment operation, the communication of the BlockAck frame from the recipient STA to the originator STA is an example of the claimed "communicating, between the sending device and the destination device", and the BlockAck frame is an example of the claimed "a packet that indicates successful communication of the series of packets".

11. The method of claim 10, wherein communicating the series of packets between the sending device and the destination device comprises transmitting each of the series of packets from the sending device to the destination device.	As explained above in the discussion of claim 10, in one example, the series of packets including: the ACK packet following the ADDBA Response packet, the series of QoS Data MPDU packets, and the BlockAckReq packet, is an example of the claimed "series of packets". Each of such exemplary series of packets is transmitted by the originator STA (or "the sending device") to the recipient STA (or "the destination device"). For example:  Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down BASE DOC – no 802.11n-2009 amendment

AND

A typical BlockAck frame exchange sequence using the immediate Block Ack for a single TID is shown in Figure 9-22.

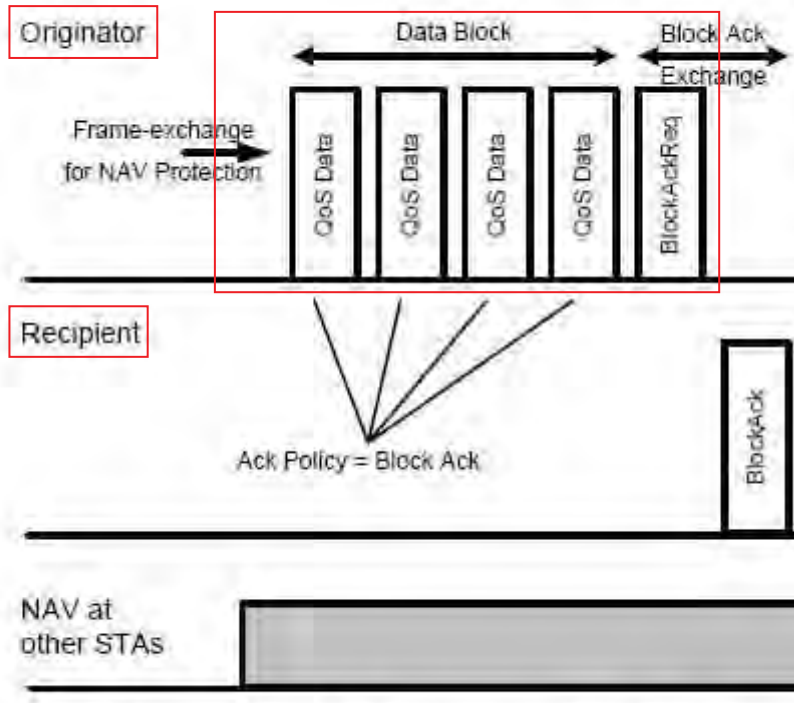
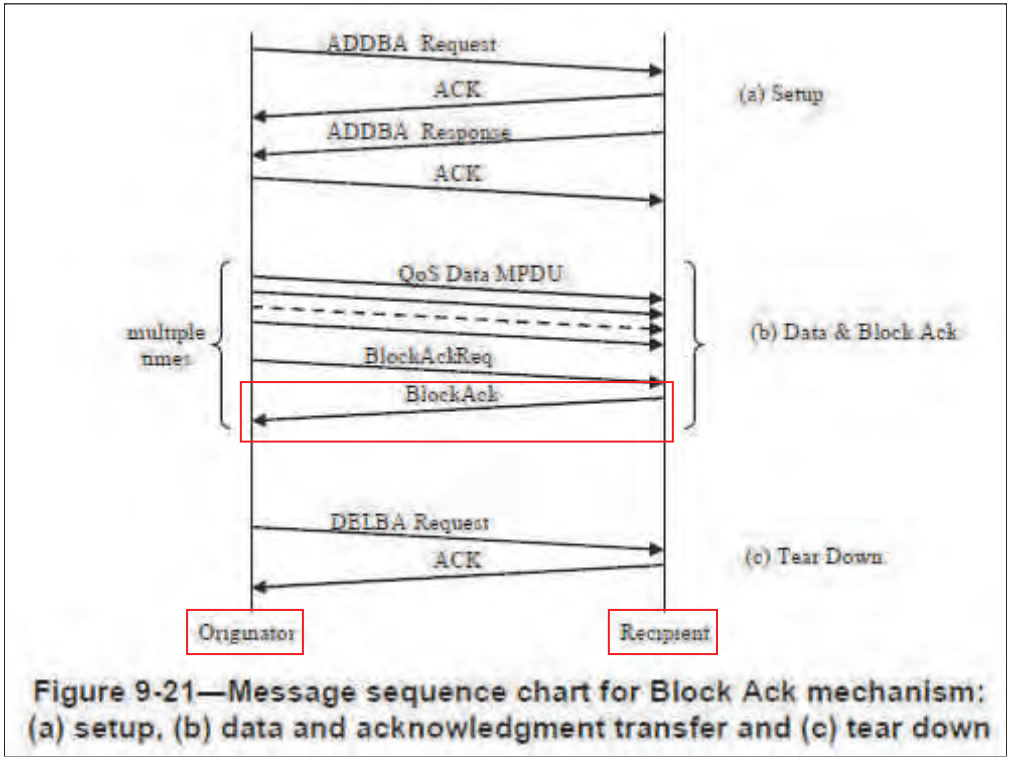


Figure 9-22—A typical Block Ack sequence when immediate policy is used

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

12. The method of claim 11, wherein communicating the packet that indicates successful communication of the series of packets comprises receiving, at the sending device, the packet that indicates successful communication of the series of packets.	As mentioned above in the discussion of claim 10, the recipient of the data block (or "the destination device") transmits the Block ACK (or "the packet that indicates successful communication of the series of packets") to the originator of the data block (or "the sending device"), which then receives such packet. For example:  **Figure 9-21—Message sequence chart for Block Ack mechanism: (a) setup, (b) data and acknowledgment transfer and (c) tear down** BASE DOC – no 802.11n-2009 amendment

AND

A typical BlockAck frame exchange sequence using the immediate Block Ack for a single TID is shown in Figure 9-22.

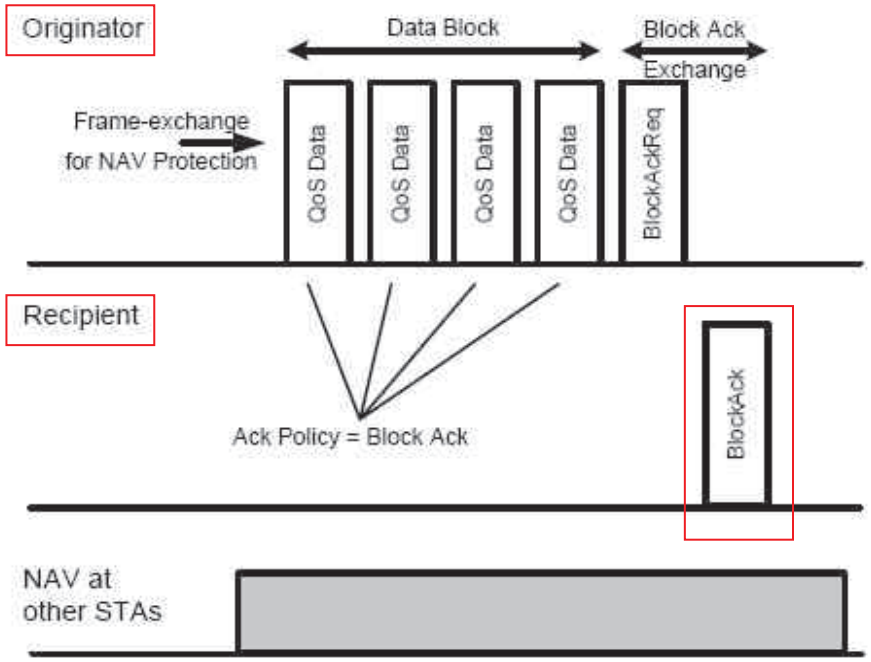
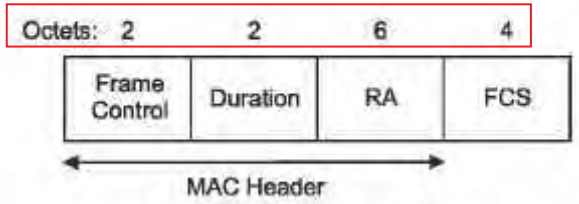


Figure 9-22—A typical Block Ack sequence when immediate policy is used

BASE DOC – minor 802.11n-2009 amendment (no substantial impact)

17. The method of claim 10, wherein each of the series of packets has a predetermined maximum length.	As explained above in the discussion of claim 10, in one example, the series of packets including: the ACK packet following the ADDBA Response packet, the series of QoS Data MPDU packets, and the BlockAckReq packet, is an example of the claimed "series of packets". Each of such packets has a predetermined maximum length. For example: <u>With regard to the ACK packet:</u> **7.2.1.3 ACK frame format** The frame format for the ACK frame is as defined in Figure 7-8.  **Figure 7-8—ACK frame** BASE DOC – no 802.11n-2009 amendment Thus, the ACK packet has a predetermined maximum length of 14 octets.

	With regard to the data packets: The fragments transmitted by the STA (or "the sending device") are examples of "data packets of the series of packets that are sent by the sending device". Additionally, the length of the fragments of the multiple-fragment MSDU is limited by the fragmentation threshold parameter (expanded by IV and ICV when Wired Equivalent Privacy (WEP) is invoked) and thus "have a predetermined maximum length". For example:

9.4 Fragmentation

The MAC may fragment and reassemble individually addressed MSDUs or MMPDUs. The fragmentation and defragmentation mechanisms allow for fragment retransmission.

The length of each fragment shall be an equal number of octets for all fragments except the last, which may be smaller. The length of each fragment shall always be an even number of octets, except for the last fragment of an MSDU or MMPDU, which may be either an even or an odd number of octets. The length of a fragment shall never be larger than dot11FragmentationThreshold unless WEP is invoked for the MPDU. If WEP is active for the MPDU, then the MPDU shall be expanded by IV and ICV (see 8.2.1); this may result in a fragment larger than dot11FragmentationThreshold.

A fragment is an MPDU, the payload of which carries all or a portion of an MSDU or MMPDU. When data are to be transmitted, the number of octets in the fragment (before processing by the security mechanism) shall be determined by dot11FragmentationThreshold and the number of octets in the MPDU that have yet to be assigned to a fragment at the instant the fragment is constructed for the first time. Once a fragment is transmitted for the first time, its frame body content and length shall be fixed until it is successfully delivered to the immediate receiving STA. A STA shall be capable of receiving fragments of arbitrary length.

If a fragment requires retransmission, its frame body content and length shall remain fixed for the lifetime of the MSDU or MMPDU at that STA. After a fragment is transmitted once, contents and length of that fragment are not allowed to fluctuate to accommodate the dwell time boundaries. Each fragment shall contain a Sequence Control field, which is comprised of a sequence number and fragment number. When a STA is transmitting an MSDU or MMPDU, the sequence number shall remain the same for all fragments of that MSDU or MMPDU. The fragments shall be sent in order of lowest fragment number to highest fragment number, where the fragment number value starts at zero, and increases by one for each successive fragment. The Frame Control field also contains a bit, the More Fragments bit, that is equal to zero to indicate the last (or only) fragment of the MSDU or MMPDU.

The source STA shall maintain a transmit MSDU timer for each MSDU being transmitted. The attribute dot11MaxTransmitMSDULifetime specifies the maximum amount of time allowed to transmit an MSDU. The timer starts on the initial attempt to transmit the first fragment of the MSDU. If the timer exceeds dot11MaxTransmitMSDULifetime, then all remaining fragments are discarded by the source STA and no attempt is made to complete transmission of the MSDU.

BASE DOC, § 9.4, page 279 – minor 11n amendment (no substantial impact)

AND

8.2.1.2 WEP MPDU format

Figure 8-1 depicts the encrypted frame body as constructed by the WEP algorithm.

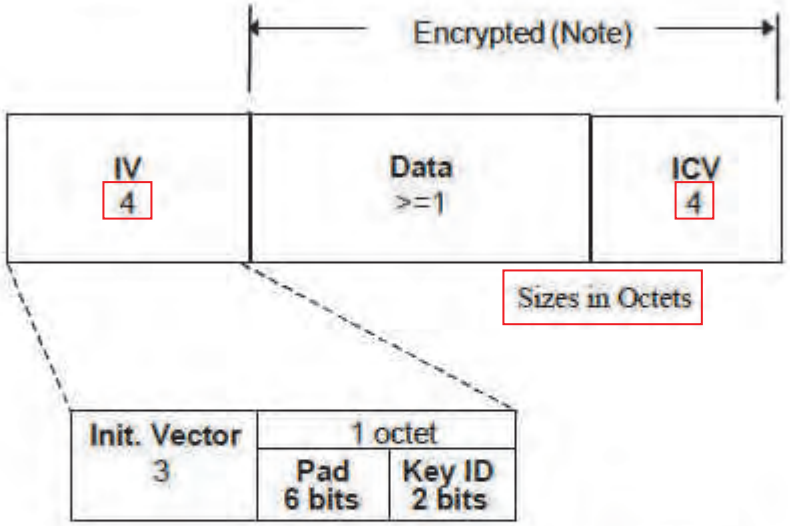


Figure 8-1—Construction of expanded WEP MPDU

The WEP ICV field shall be 32 bits in length. The expanded frame body shall start with a 32-bit IV field. This field shall contain three subfields: a 3-octet subfield that contains the IV, a 2-bit Key ID subfield, and a 6-bit Pad subfield. The ordering conventions defined in 7.1.1 apply to the IV field and its subfields and to the ICV field. The Key ID subfield contents select one of four possible secret key values for use in decrypting this frame body. When key-mapping keys are used, the Key ID field value is ignored.

BASE DOC – no 802.11n-2009 amendment

With regard to the BlockAckReq packet:

Prior to the 802.11n-2009 amendment, there was only a single variant of the Block ACK Request packet. For example:

7.2.1.7 Block Ack Request (BlockAckReq) frame format

The frame format of the BlockAckReq frame is defined in Figure 7-12.

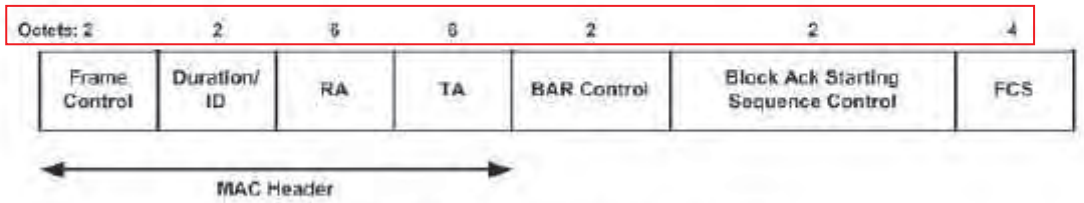


Figure 7-12—BlockAckReq frame

BASE DOC – 802.11n-2009 amendment below

Thus, in 802.11-2007 operation (without the 802.11n-2009 amendment), the Block ACK Request packet has a predetermined maximum length of 24 octets.

The 802.11n-2009 amendment specifies multiple variants of the Block ACK Request frame, each with a specific size, depending on the particular communication being performed. For example:

Replace Figure 7-12 with the following figure:

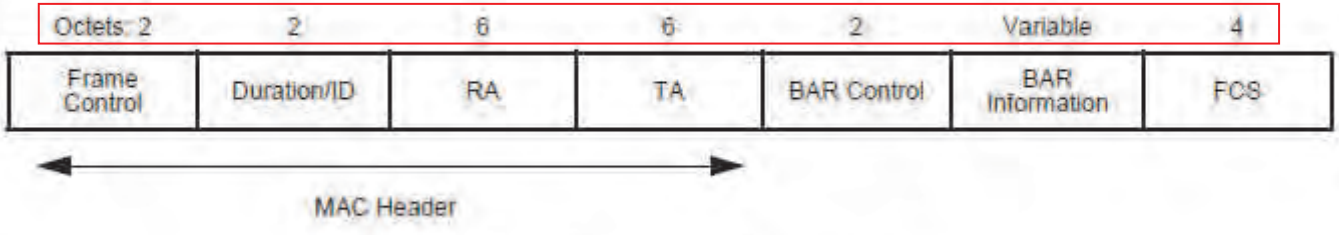


Figure 7-12—BlockAckReq frame

802.11n-2009 amendment

where the "BAR Information" field can be either:

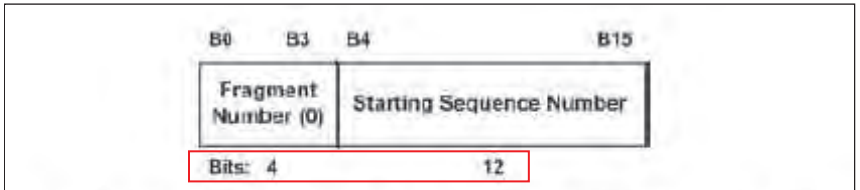


Figure 7-14—Block Ack Starting Sequence Control field

BASE DOC

or

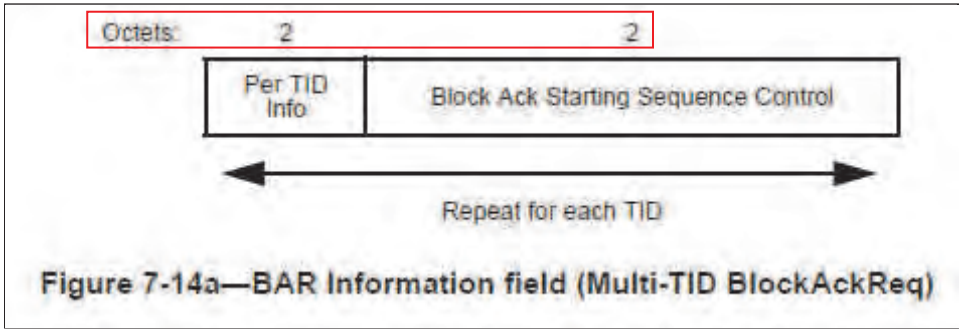


Figure 7-14a—BAR Information field (Multi-TID BlockAckReq)

802.11n-2009 amendment

Thus, for a particular communication in 802.11n-2009 operation, the BlockAckReq packet can be either 24 or 26 octets in size.

Accordingly, the BlockAckReq packet in 802.11n operation has a predetermined maximum size of 26 octets.

Summarizing, each of the ACK packet, QoS data packets, and BlockAckReq packets has a predetermined maximum size.

19. The method of claim 10, wherein the destination device is a polling device.	There are multiple infringement positions with regard to claim 19. **First exemplary infringement position:** An 802.11 access point station (AP STA, or AP) is an example of the claimed "sending device", and an 802.11 non-access point station (non-AP STA) is an example of the claimed "destination device". In such a scenario, the 802.11 non-AP STA (or "destination device"), for example, polls the AP STA with a PS-Poll to retrieve messages stored at the AP STA, and thus "the destination device is a polling device". For example: **Table 11-1—Power Management modes** Active mode or AM: STA may receive frames at any time. In Active mode, a STA shall be in the Awake state. A STA on the polling list of a PCF shall be in Active mode for the duration of the CFP PS: STA listens to selected Beacon frames (based upon the ListenInterval parameter of the MLME-ASSOCIATE.request primitive) and sends PS-Poll frames to the AP if the TIM element in the most recent Beacon frame indicates a directed MSDU buffered for that STA. The AP shall transmit buffered directed MSDUs to a PS STA only in response to a PS-Poll from that STA, or during the CFP in the case of a CF-Pollable PS STA. In PS mode, a STA shall be in the Doze state and shall enter the Awake state to receive selected Beacon frames, to receive broadcast and multicast transmissions following certain received Beacon frames, to transmit, and to await responses to transmitted PS-Poll frames or (for CF-Pollable STAs) to receive CF transmissions of buffered MSDUs BASE DOC – minor 802.11n-2009 amendment (no substantial impact) AND

In a BSS operating under the DCF, or during the CP of a BSS using the PCF, upon determining that an MSDU is currently buffered in the AP, a STA operating in the *PS mode* shall transmit a short PS-Poll frame to the AP, which shall respond with the corresponding buffered MSDU immediately, or acknowledge the PS-Poll and respond with the corresponding MSDU at a later time. If the TIM indicating the buffered

BASE DOC, § 11.2.1 – minor 802.11n-2009 amendment (no substantial impact)

AND

7.2.1.4 PS-Poll frame format

The frame format for the PS-Poll frame is as defined in Figure 7-9.

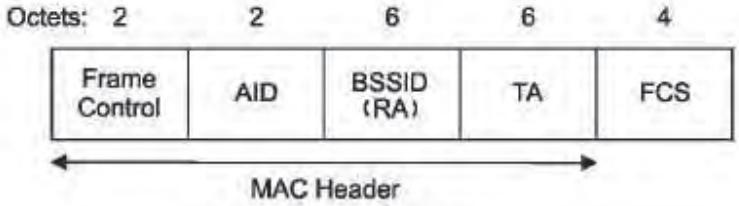


Figure 7-9—PS-Poll frame

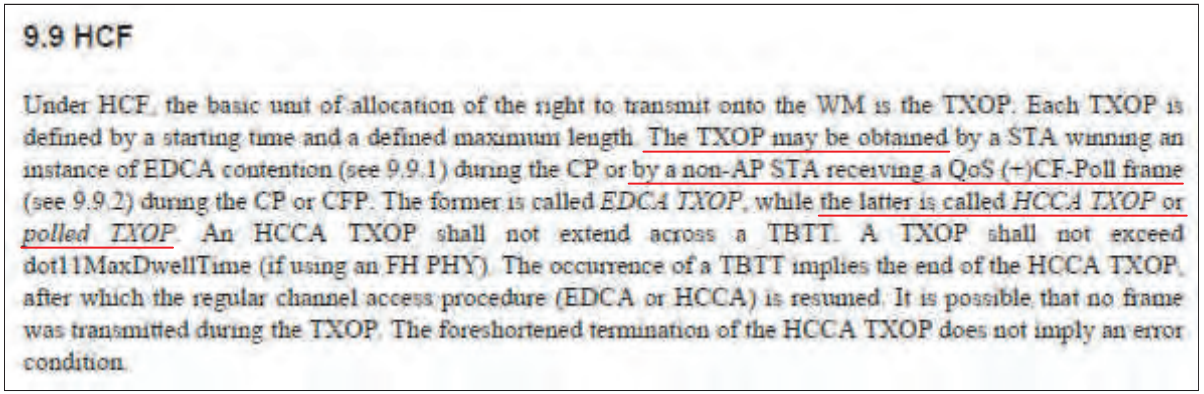
BASE DOC – no 802.11n-2009 amendment

Reasonable opportunity for further investigation or discovery will likely show that Defendants' wireless communication networks include a destination device that operates in accordance with the 802.11 power-save (PS) mode and thus is a polling device.

Second exemplary infringement position:

An 802.11 non-AP STA is an example of the claimed "sending device", and an 802.11 AP STA is an example of the claimed "destination device".

In such a scenario, the 802.11 AP (or "destination device"), for example, polls the non-AP STA with a CF-Poll, and thus, "the destination device is a polling device". For example:



9.9 HCF

Under HCF, the basic unit of allocation of the right to transmit onto the WM is the TXOP. Each TXOP is defined by a starting time and a defined maximum length. The TXOP may be obtained by a STA winning an instance of EDCA contention (see 9.9.1) during the CP or by a non-AP STA receiving a QoS (+)CF-Poll frame (see 9.9.2) during the CP or CFP. The former is called *EDCA TXOP*, while the latter is called *HCCA TXOP* or *polled TXOP*. An HCCA TXOP shall not extend across a TBTT. A TXOP shall not exceed dot11MaxDwellTime (if using an FH PHY). The occurrence of a TBTT implies the end of the HCCA TXOP, after which the regular channel access procedure (EDCA or HCCA) is resumed. It is possible that no frame was transmitted during the TXOP. The foreshortened termination of the HCCA TXOP does not imply an error condition.

BASE DOC, page 286 – no 11n amendment

Thus, in such a scenario, the AP (*e.g.*, the claimed "destination device") is a polling device.

Reasonable opportunity for further investigation or discovery will likely show that Defendants' wireless communication networks include a destination device that operates in accordance with the HCCA of the Hybrid Coordination Function (HCF) and thus is a polling device.

20. The method of claim 10, further comprising if the beginning of the period of time through which no communication is detected coincides with the end of a detected transmission, then attempting to avoid collisions by delaying a random period before attempting to initiate communication between the sending device and the destination device.	See, for example: **9.9.1.5 EDCA backoff procedure** Each EDCAF shall maintain a state variable CW[AC], which shall be initialized to the value of the parameter CWmin[AC]. If a frame is successfully transmitted by a specific EDCAF, indicated by the successful reception of a CTS in response to an RTS, the successful reception of an ACK frame in response to a unicast MPDU or BlockAck, the successful reception of a BlockAck or ACK frame in response to a BlockAckReq frame, or the transmission of a multicast frame or a frame with No Ack policy, CW[AC] shall be reset to CWmin[AC]. The backoff procedure shall be invoked for an EDCAF when any of the following events occurs: — A frame with that AC is requested to be transmitted, the medium is busy as indicated by either physical or virtual CS, and the backoff timer has a value of zero for that AC. — The final transmission by the TXOP holder initiated during the TXOP for that AC was successful. — The transmission of a frame of that AC fails, indicated by a failure to receive a CTS in response to an RTS, a failure to receive an ACK frame that was expected in response to a unicast MPDU, or a failure to receive a BlockAck or ACK frame in response to a BlockAckReq frame. — The transmission attempt collides internally with another EDCAF of an AC that has higher priority, that is, two or more EDCAFs in the same STA are granted a TXOP at the same time. If the backoff procedure is invoked for reason a) above, the value of CW[AC] shall be left unchanged. If the backoff procedure is invoked because of reason b) above, the value of CW[AC] shall be reset to CWmin[AC]. If the backoff procedure is invoked because of a failure event [either reason c) or d) above], the value of CW[AC] shall be updated as follows before invoking the backoff procedure: (continued on next page)

a) If the QSRC[AC] or the QLRC[AC] for the QoS STA has reached dot11ShortRetryLimit or dot11LongRetryLimit respectively, CW[AC] shall be reset to CWmin[AC].

b) Otherwise,

1) If CW[AC] is less than CWmax[AC], CW[AC] shall be set to the value (CW[AC] + 1)*2 – 1.

2) If CW[AC] is equal to CWmax[AC], CW[AC] shall remain unchanged for the remainder of any retries.

The backoff timer is set to an integer value chosen randomly with a uniform distribution taking values in the range [0,CW[AC]] inclusive.

All backoff slots occur following an AIFS[AC] period during which the medium is determined to be idle for the duration of the AIFS[AC] period, or following an EIFS – DIFS + AIFS[AC] period during which the medium is determined to be idle for the duration of the EIFS – DIFS + AIFS[AC] period, as appropriate (see 9.2.3).

BASE DOC, pages 290-291 – no 802.11n-2009 amendment to the highlighted portion

EXHIBIT 15

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Federal Rules of Civil Procedure, Rules and Commentary
Database updated January 2011

Steven S. Gensler

Appendix A

Rule 19. Required Joinder of Parties

Advisory Committee Notes

1937 Adoption

Note to Subdivision (a). The **first sentence** with **verbal differences** (e.g., "united" interest for "joint" interest) **is** to be **found** in [**former**] **Equity Rule 37** (Parties Generally—Intervention). Such compulsory joinder provisions are common. Compare Alaska Comp.Laws (1933) § 3392 (containing in same sentence a "class suit" provision); Wyo.Rev.Stat.Ann. (Courtright, 1931) § 89-515 (immediately followed by "class suit" provisions, § 89-516). See also former Equity Rule 42 (Joint and Several Demands). For example of a proper case for involuntary plaintiff, see Independent Wireless Telegraph Co. v. Radio Corp. of America, 269 U.S. 459, 46 S.Ct. 166, 70 L.Ed. 357 (1926).

The joinder provisions of this rule are subject to Rule 82 (Jurisdiction and Venue Unaffected).

Note to Subdivision (b). For the substance of this rule see [former] Equity Rule 39 (Absence of Persons Who Would be Proper Parties) and U.S.C., Title 28, § 111 [now § 1391] (When part of several defendants cannot be served); Camp v. Gress, 250 U.S. 308, 39 S.Ct. 478, 63 L.Ed. 997 (1919). See also the second and third sentences of [former] Equity Rule 37 (Parties Generally— Intervention).

Note to Subdivision (c). For the substance of this rule see the fourth subdivision of [former] Equity Rule 25 (Bill of Complaint—Contents).

1966 Amendment

General ConsiderationsWhenever feasible, the persons materially interested in the subject of an action—see the more detailed description of these persons in the discussion of new subdivision (a) below—should be joined as parties so that they may be heard and a complete disposition made. When this comprehensive joinder cannot be accomplished—a situation which may be encountered in Federal courts because of limitations on service of process, subject matter jurisdiction, and venue— the case should be examined pragmatically and a choice made between the alternatives of proceeding with the action in the absence of particular interested persons, and dismissing the action.

Even if the court is mistaken in its decision to proceed in the absence of an interested person, it does not by that token deprive itself of the power to adjudicate as between the parties already before it through proper service of process. But the court can make a legally binding adjudication only between the parties actually joined in the action. It is true that an adjudication between the parties before the court may on occasion adversely affect the absent person as a practical matter, or leave a party exposed to a later inconsistent recovery by the absent person. These are factors which should be considered in deciding whether the action should proceed, or should rather be dismissed; but they do not themselves negate the court's power to adjudicate as between the parties who have been joined.

Defects in the Original RuleThe foregoing propositions were well understood in the older equity practice, see Hazard, Indispensable Party: The Historical Origin of a Procedural Phantom, 61 Colum.L.Rev. 1254 (1961),

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and Rule 19 could be and often was applied in consonance with them. But experience showed that the rule was defective in its phrasing and did not point clearly to the proper basis of decision.

Textual defects.—(1) The expression "persons … who ought to be parties if complete relief is to be accorded between those already parties," appearing in original subdivision (b), was apparently intended as a description of the persons whom it would be desirable to join in the action, all questions of feasibility of joinder being put to one side; but it was not adequately descriptive of those persons.

(2) The word "indispensable," appearing in original subdivision (b), was apparently intended as an inclusive reference to the interested persons in whose absence it would be advisable, all factors having been considered, to dismiss the action. Yet the sentence implied that there might be interested persons, not "indispensable," in whose absence the action ought also to be dismissed. Further, it seemed at least superficially plausible to equate the word "indispensable" with the expression "having a joint interest," appearing in subdivision (a). See United States v. Washington Inst. of Tech., Inc., 138 F.2d 25, 26 (3d Cir. 1943); cf. Chidester v. City of Newark, 162 F.2d 598 (3d Cir. 1947). But persons holding an interest technically "joint" are not always so related to an action that it would be unwise to proceed without joining all of them, whereas persons holding an interest not technically "joint" may have this relation to an action. See Reed, Compulsory Joinder of Parties in Civil Actions, 55 Mich.L.Rev. 327, 356 ff., 483 (1957).

(3) The use of "indispensable" and "joint interest" in the context of original Rule 19 directed attention to the technical or abstract character of the rights or obligations of the persons whose joinder was in question, and correspondingly distracted attention from the pragmatic considerations which should be controlling.

(4) The original rule, in dealing with the feasibility of joining a person as a party to the action, besides referring to whether the person was "subject to the jurisdiction of the court as to both service of process and venue," spoke of whether the person could be made a party "without depriving the court of jurisdiction of the parties before it." The second quoted expression used "jurisdiction" in the sense of the competence of the court over the subject matter of the action, and in this sense the expression was apt. However, by a familiar confusion, the expression seems to have suggested to some that the absence from the lawsuit of a person who was "indispensable" or "who ought to be [a] part[y]" itself deprived the court of the power to adjudicate as between the parties already joined. See Samuel Goldwyn, Inc. v. United Artists Corp., 113 F.2d 703, 707 (3d Cir. 1940); McArthur v. Rosenbaum Co. of Pittsburgh, 180 F.2d 617, 621 (3d Cir. 1949); cf. Calcote v. Texas Pac. Coal & Oil Co., 157 F.2d 216 (5th Cir. 1946), cert. denied, 329 U.S. 782 (1946), noted in 56 Yale L.J. 1088 (1947); Reed, supra, 55 Mich.L.Rev. at 332–34.

Failure to point to correct basis of decision. The original rule did not state affirmatively what factors were relevant in deciding whether the action should proceed or be dismissed when joinder of interested persons was infeasible. In some instances courts did not undertake the relevant inquiry or were misled by the "jurisdiction" fallacy. In other instances there was undue preoccupation with abstract classifications of rights or obligations, as against consideration of the particular consequences of proceeding with the action and the ways by which these consequences might be ameliorated by the shaping of final relief or other precautions.

Although these difficulties cannot be said to have been general analysis of the cases showed that there was good reason for attempting to strengthen the rule. The literature also indicated how the rule should be reformed. See Reed, supra (discussion of the important case of *Shields v. Barrow*, 17 How. (58 U.S.) 130 (1854), appears at 55 Mich.L.Rev., p. 340 ff.); Hazard, supra; N.Y. Temporary Comm. on Courts, First Preliminary Report, Legis.Doc.1957, No. 6(b), pp. 28, 233; N.Y. Judicial Council, Twelfth Ann.Rep., Legis.Doc.1946, No. 17, p. 163; Joint Comm. on Michigan Procedural Revision, Final Report, Pt. III, p. 69 (1960); Note, Indispensable Parties in the Federal Courts, 65 Harv.L.Rev. 1050 (1952); Developments in the Law—Multiparty Litigation in the Federal Courts, 71 Harv.L.Rev. 874, 879 (1958); Mich.Gen.Court Rules, R. 205 (effective Jan. 1, 1963); N.Y.Civ.Prac.Law & Rules, § 1001 (effective Sept. 1, 1963).

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The Amended RuleNew subdivision (a) defines the persons whose joinder in the action is desirable. Clause (1) stresses the desirability of joining those persons in whose absence the court would be obliged to grant partial or "hollow" rather than complete relief to the parties before the court. The interests that are being furthered here are not only those of the parties, but also that of the public in avoiding repeated lawsuits on the same essential subject matter. Clause (2)(i) recognizes the importance of protecting the person whose joinder is in question against the practical prejudice to him which may arise through a disposition of the action in his absence. Clause (2)(ii) recognizes the need for considering whether a party may be left, after the adjudication, in a position where a person not joined can subject him to a double or otherwise inconsistent liability. See Reed, supra, 55 Mich.L.Rev. at 330, 338; Note, supra, 65 Harv.L.Rev. at 1052–57; Developments in the Law, supra, 71 Harv.L.Rev. at 881–85.

The subdivision (a) definition of persons to be joined is not couched in terms of the abstract nature of their interests—"joint," "united," "separable," or the like. See N.Y. Temporary Comm. on Courts, First Preliminary Report, supra; Developments in the Law, supra, at 880. It should be noted particularly, however, that the description is not at variance with the settled authorities holding that a tortfeasor with the usual "joint-and-several" liability is merely a permissive party to an action against another with like liability. See 3 Moore's Federal Practice 2153 (2d ed. 1963); 2 Barron & Holtzoff, Federal Practice & Procedure § 513.8 (Wright ed. 1961). Joinder of these tortfeasors continues to be regulated by Rule 20; compare Rule 14 on third-party practice.

If a person as described in subdivision (a)(1)(2) is amenable to service of process and his joinder would not deprive the court of jurisdiction in the sense of competence over the action, he should be joined as a party; and if he has not been joined, the court should order him to be brought into the action. If a party joined has a valid objection to the venue and chooses to assert it, he will be dismissed from the action.

Subdivision (b).—When a person as described in subdivision (a)(1)-(2) cannot be made a party, the court is to determine whether in equity and good conscience the action should proceed among the parties already before it, or should be dismissed. That this decision is to be made in the light of pragmatic considerations has often been acknowledged by the courts. See Roos v. Texas Co., 23 F.2d 171 (2d Cir. 1927), cert. denied 277 U.S. 587 (1928); Niles-Bement-Pond Co. v. Iron Moulders' Union, 254 U.S. 77, 80 (1920). The subdivision sets out four relevant considerations drawn from the experience revealed in the decided cases. The factors are to a certain extent overlapping, and they are not intended to exclude other considerations which may be applicable in particular situations.

The first factor brings in a consideration of what a judgment in the action would mean to the absentee. Would the absentee be adversely affected in a practical sense, and if so, would the prejudice be immediate and serious, or remote and minor? The possible collateral consequences of the judgment upon the parties already joined are also to be appraised. Would any party be exposed to a fresh action by the absentee, and if so, how serious is the threat? See the elaborate discussion in Reed, supra; cf. A. L. Smith Iron Co. v. Dickson, 141 F.2d 3 (2d Cir. 1944); Caldwell Mfg. Co. v. Unique Balance Co., 18 F.R.D. 258 (S.D.N.Y.1955).

The second factor calls attention to the measures by which prejudice may be averted or lessened. The "shaping of relief" is a familiar expedient to this end. See, e.g., the award of money damages in lieu of specific relief where the latter might affect an absentee adversely. Ward v. Deavers, 203 F.2d 72 (D.C.Cir.1953); Miller & Lux, Inc. v. Nickel, 141 F.Supp. 41 (N.D.Calif.1956). On the use of "protective provisions," see Roos v. Texas Co., supra; Atwood v. Rhode Island Hosp. Trust Co., 275 Fed. 513, 519 (1st Cir. 1921), cert. denied, 257 U.S. 661 (1922); cf. Stumpf v. Fidelity Gas Co., 294 F.2d 886 (9th Cir. 1961); and the general statement in National Licorice Co. v. Labor Board, 309 U.S. 350, 363 (1940).

Sometimes the party is himself able to take measures to avoid prejudice. Thus a defendant faced with a prospect of a second suit by an absentee may be in a position to bring the latter into the action by defensive interpleader. See Hudson v. Newell, 172 F.2d 848, 852 mod., 176 F.2d 546 (5th Cir. 1949); Gauss v. Kirk, 198 F.2d

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83, 86 (D.C.Cir. 1952); Abel v. Brayton Flying Service, Inc., 248 F.2d 713, 716 (5th Cir. 1957) (suggestion of possibility of counter-claim under Rule 13(h)); cf. Parker Rust-Proof Co. v. Western Union Tel. Co., 105 F.2d 976 (2d Cir. 1939), cert. denied, 308 U.S. 597 (1939). So also the absentee may sometimes be able to avert prejudice to himself by voluntarily appearing in the action or intervening on an ancillary basis. See Developments in the Law, supra, 71 Harv.L.Rev. at 882; Annot., Intervention or Subsequent Joinder of Parties as Affecting Jurisdiction of Federal Court Based on Diversity of Citizenship, 134 A.L.R. 335 (1941); Johnson v. Middleton, 175 F.2d 535 (7th Cir. 1949); Kentucky Nat. Gas Corp. v. Duggins, 165 F.2d 1011 (6th Cir. 1948); McComb v. McCormack, 159 F.2d 219 (5th Cir. 1947). The court should consider whether this, in turn, would impose undue hardship on the absentee. (For the possibility of the court's informing an absentee of the pendency of the action, see comment under subdivision (c) below.)

The third factor—whether an "adequate" judgment can be rendered in the absence of a given person—calls attention to the extent of the relief that can be accorded among the parties joined. It meshes with the other factors, especially the "shaping of relief" mentioned under the second factor. Cf. Kroese v. General Steel Castings Corp., 179 F.2d 760 (3d Cir. 1949), cert. denied, 339 U.S. 983 (1950).

The fourth factor, looking to the practical effects of a dismissal, indicates that the court should consider whether there is any assurance that the plaintiff, if dismissed, could sue effectively in another forum where better joinder would be possible. See Fitzgerald v. Haynes, 241 F.2d 417, 420 (3d Cir. 1957); Fouke v. Schenewerk, 197 F.2d 234, 236 (5th Cir. 1952); cf. Warfield v. Marks, 190 F.2d 178 (5th Cir. 1951).

The subdivision uses the word "indispensable" only in a conclusory sense, that is, a person is "regarded as indispensable" when he cannot be made a party and, upon consideration of the factors above mentioned, it is determined that in his absence it would be preferable to dismiss the action, rather than to retain it.

A person may be added as a party at any stage of the action on motion or on the court's initiative (see Rule 21); and a motion to dismiss, on the ground that a person has not been joined and justice requires that the action should not proceed in his absence, may be made as late as the trial on the merits (see Rule 12(h)(2), as amended; cf. Rule 12(b)(7), as amended). However, when the moving party is seeking dismissal in order to protect himself against a later suit by the absent person (subdivision (a)(2)(ii)), and is not seeking vicariously to protect the absent person against a prejudicial judgment (subdivision (a)(2)(i)), his undue delay in making the motion can properly be counted against him as a reason for denying the motion. A joinder question should be decided with reasonable promptness, but decision may properly be deferred if adequate information is not available at the time. Thus the relationship of an absent person to the action, and the practical effects of an adjudication upon him and others, may not be sufficiently revealed at the pleading stage; in such a case it would be appropriate to defer decision until the action was further advanced. Cf. Rule 12(d).

The amended rule makes no special provision for the problem arising in suits against subordinate Federal officials where it has often been set up as a defense that some superior officer must be joined. Frequently this defense has been accompanied by or intermingled with defenses of sovereign community or lack of consent of the United States to suit. So far as the issue of joinder can be isolated from the rest, the new subdivision seems better adapted to handle it than the predecessor provision. See the discussion in Johnson v. Kirkland, 290 F.2d 440, 446–47 (5th Cir. 1961) (stressing the practical orientation of the decisions); Shaughnessy v. Pedreiro, 349 U.S. 48, 54 (1955). Recent legislation, P.L. 87-748, 76 Stat. 744, approved October 5, 1962, adding §§ 1361, 1391(e) to Title 28, U.S.C., vests original jurisdiction in the District Courts over actions in the nature of mandamus to compel officials of the United States to perform their legal duties, and extends the range of service of process and liberalizes venue in these actions. If, then, it is found that a particular official should be joined in the action, the legislation will make it easy to bring him in.

Subdivision (c) parallels the predecessor subdivision (c) of Rule 19. In some situations it may be desirable to advise a person who has not been joined of the fact that the action is pending, and in particular cases the court

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in its discretion may itself convey this information by directing a letter or other informal notice to the absentee.

Subdivision (d) repeats the exception contained in the first clause of the predecessor subdivision (a).

1987 AmendmentThe amendments are technical. No substantive change is intended.

2007 AmendmentThe language of Rule 19 has been amended as part of the general restyling of the Civil Rules to make them more easily understood and to make style and terminology consistent throughout the rules. These changes are intended to be stylistic only.

Former Rule 19(b) described the conclusion that an action should be dismissed for inability to join a Rule 19(a) party by carrying forward traditional terminology: “the absent person being thus regarded as indispensable.” “Indispensable” was used only to express a conclusion reached by applying the tests of Rule 19(b). It has been discarded as redundant.

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FRCP-RC APP A RULE 19

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EXHIBIT 16

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

STORED VALUE SOLUTIONS INC,	:	
	:	
Plaintiff,	:	
	:	
v.	:	Civil Action No. 09-495-JJF
	:	
CARD ACTIVATION TECHNOLOGIES INC.,	:	
	:	
Defendant.	:	

Alan M. Fisch, Esquire, Jason F. Hoffman, Esquire, Coke Morgan Stewart, Esquire, and R. William Sigler, Esquire of Kaye Scholer LLP, Washington, D.C.

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Attorneys for Defendants.

MEMORANDUM OPINION

November 20, 2009
Wilmington, Delaware

Farnan, District Judge.

Pending before the Court is a Motion To Transfer (D.I. 18) to the Northern District of Illinois, filed by Defendant Card Activation Technologies, Inc. Plaintiff, Stored Value Solutions, Inc., opposes the Motion. (D.I. 23.) For the reasons discussed below, the Motion will be denied.

I. THE LEGAL STANDARD FOR CHANGE OF VENUE

A change of venue or "transfer" may be granted by a district court pursuant to 28 U.S.C. § 1404(a) which provides:

> For the convenience of parties and witnesses, in the interest of justice, a district court may transfer any civil action to any other district or division where it might have been brought.

Id. Section 1404(a) is not complicated. It instructs a district court that it may transfer a case if:

> 1) the case could have been filed initially in the district the court is considering transferring the case to;
>
> 2) the parties and witnesses for both sides of the case would find it more convenient to litigate in the district under consideration by the court; and
>
> 3) the transfer to another court for the convenience of the parties and witnesses is in the interest of justice, or to state another way, it is fair and reasonable to send the parties and witnesses to another federal district for convenience purposes.

From these simple, straightforward principles, a legend of case law has developed concerning the transfer of venue for the convenience of the parties and witnesses. In the Third Circuit district courts are required to analyze and weigh a set of eleven

(11) private/public factors. Those factors are best set forth in Jumara v. State Farm Ins. Co., 55 F.3d 873 (3d Cir. 1995):

The Private Factors:

1) The plaintiff's forum preference as manifested in the original choice;

2) the defendant's preference;

3) whether the claim arose elsewhere;

4) the convenience of the parties;

5) the convenience of the witnesses, but only to the extent that the witnesses may actually be unavailable for trial in one of the fora; and

6) the location of books and records, but only to the extent that they may actually be unavailable for trial in one of the fora.

The Public Factors:

1) The enforceability of the judgment;

2) practical considerations that could make the trial easy, expeditious, or inexpensive;

3) the relative administrative difficulty in the two fora resulting from court congestion;

4) the local interest; and

5) the public policies of the fora.

II. THE PARTIES' CONTENTIONS

The parties' contentions concerning these private and public

factors are:

Private Factors - Parties' Contentions		
	Plaintiff	Defendant
1. Plaintiff's preference as manifested by its choice of forum	Plaintiff's choice of forum is due great deference under Third Circuit precedent. Additionally, the "home turf" argument is not applicable because Plaintiff is incorporated in Delaware.	Plaintiff's choice of forum should receive considerably less deference because Plaintiff is not physically located in Delaware and thus it is not Plaintiff's "home turf."
2. The defendant's preference	No argument made.	Defendant prefers transfer.
3. Whether the plaintiff's claim arose elsewhere	No argument made.	No argument made.
4. The convenience of the parties	The Delaware Court is at least as convenient as the Illinois Court. Additionally, Defendant's incorporation in Delaware makes it impossible for Defendant to argue that it is not convenient to litigate in its home state, Delaware.	The convenience of the parties weighs in favor of transfer because of the extensive litigation that has already taken place in the Illinois Court.
5. The convenience of the witnesses, but only to the extent that the witnesses may actually be unavailable for trial in one of the fora	There is no evidence that any witnesses are unable or unwilling to come to Delaware and traveling to Delaware is not more difficult than traveling to Illinois.	The ease of travel to Chicago will make travel easier for any out of town witnesses in traveling to Illinois as opposed to Delaware.

6. The location of books and records, but only to the extent that they may actually be unavailable for trial in one of the fora	Defendant does not contend that records could not be produced in Delaware or to Plaintiff's counsel.	One of Defendant's counsel is located in Illinois and has physical custody of the files.

Public Factors - Parties' Positions		
	Plaintiff	Defendant
1. The enforceability of the judgment	No argument made.	No argument made.
2. Practical considerations that could make the trial easy, expeditious, or inexpensive	The Delaware Court is on a faster track than the Illinois Court in deciding the related matters.	Judicial economy dictates a transfer so that multiple cases stemming from the same transaction are before the same court.
3. The relative administrative difficulty in the two fora resulting from court congestion	One of the reasons Plaintiff filed this case in the Delaware Court was the Court's lighter, more efficient docket.	The Delaware Court's docket is not more efficient than the Illinois Court's docket because the cases in Illinois are on similar time lines to this case.
4. The local interest	There is no local interest in the Illinois Court because the relevant cases are before a number of different judges meaning the court does not have increased efficiency because the cases have not been heard	The Illinois Court has a greater interest in this case because the cases pending before that court relating to the same parties and patent.

	by a single judge.	
5. The public policies of the fora	No argument made.	No argument made.

When viewed outside the scope of the factors, Defendant's main contention is that the case should be transferred so that it is heard by the same court that has heard the other cases stemming from the alleged patent infringement at issue in this case. Plaintiff counters that efficiency may be found when a single judge presides over similar cases, not when a single court, but multiple judges in that court (Illinois) preside over the cases, which is the situation here.

III. DISCUSSION OF THE RELEVANT FACTORS

With regard to the parties' positions, the following are the Court's findings on each factor.

Private Factors - Court's Findings	
	Court's Finding
1. Plaintiff's forum preference as manifested in the original choice	A plaintiff's choice of venue is given great deference, and the Court will give such deference to Plaintiff because it filed this case in this Court for legitimate reasons. Accordingly, this factor weighs against transfer.
2. The defendant's preference	Defendant clearly prefers a transfer, and thus, this factor favors transfer.
3. Whether the claim arose elsewhere	This factor is not relevant in this case.
4. The convenience	Although Defendant may find it more

of the parties	convenient to litigate in Illinois, Plaintiff chose to litigate in Delaware because it believed this Court was more convenient for it. Thus, this factor is neutral with regard to transfer.
5. The convenience of the witnesses, but only to the extent that the witnesses may actually be unavailable for trial in one of the fora	Defendant did not establish that witnesses would refuse or be physically unable to attend trial in Delaware nor that the ease of travel to Illinois is substantially different than travel to Delaware. Accordingly, the Court finds that this factor weighs against transfer.
6. The location of books and records, but only to the extent that they may actually be unavailable for trial in one of the fora	Defendant has not shown that there would be any difficulty in producing records in Delaware. Thus, the Court finds that this factor weighs against transfer.

Public Factors - Court's Findings	
	Court's Findings
1. The enforceability of the judgment	This factor is not an issue in this case, thus, the Court finds that this factor is neutral with regard to transfer.
2. Practical considerations that could make the trial easy, expeditious, or inexpensive	Although the Illinois Court does have multiple cases pending relating to the same materials, these cases are before multiple judges. With multiple judges presiding, any efficiency that is gained by similar cases being in the same court is lost. The existence of a proposed Markman decision does not change the Court's view on this argument. Thus, the Court finds that this factor weighs against transfer.

3. The relative administrative difficulty in the two fora resulting from court congestion	The efficiency of the dockets of the two courts is not dramatically different. Accordingly, the Court finds that this factor is neutral with regard to transfer.
4. The local interest	For the same reasons as explained in Public Factor 2, the Court finds that this factor weighs against transfer.
5. The public policies of the fora	This factor is not an issue in this case, thus, the Court finds that this factor is neutral with regard to transfer.

IV. DECISION

In sum, after considering the private and public factors the Court finds that this case could have been filed in the District of Northern Illinois. However, Plaintiff chose to file the case in Delaware because both Plaintiff and Defendant are incorporated in and thus, residents of Delaware.

Defendant's principal argument for transfer is that the case should be transferred for judicial efficiency because several cases are pending in the Northern District of Illinois regarding actions brought by Defendant against Plaintiff's customers. While judicial efficiency is an important concern, the cases are presently distributed among five different judges. In order for efficiency to be achieved, the cases would have to be before a single judge. The result is that transferring this case to Illinois would not increase efficiency over what it is currently. The proposed claim construction from the Illinois Court does not

change the Court's opinion because the construction was not adopted and related to different parties.

Accordingly, the Court finds that Defendant has not established that a transfer of venue to the Northern District of Illinois would be more convenient than the District of Delaware for the parties nor that it is needed to promote the interests of justice.

V. Conclusion

For the reasons discussed, the Motion to Transfer Venue (D.I. 18) to the Northern District of Illinois will be denied.

An appropriate order will be entered.

EXHIBIT 17

PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
Broadcom Corporation	02/28/2011

RECEIVING PARTY DATA

Name:	Innovatio IP Ventures
Street Address:	6 Clawon Street
City:	Ladera Ranch
State/Country:	CALIFORNIA
Postal Code:	92694

PROPERTY NUMBERS Total: 31

Property Type	Number
Application Number:	12323036
Application Number:	12121536
Patent Number:	5740366
Patent Number:	5940771
Patent Number:	6374311
Patent Number:	7457646
Patent Number:	7536167
Patent Number:	7552246
Patent Number:	7558557
Patent Number:	7826818
Patent Number:	7873343
Patent Number:	5673031
Patent Number:	6714559
Patent Number:	7386002
Patent Number:	7535921

CH $1240.00 12323036

Patent Number:	7548553
Patent Number:	5546397
Patent Number:	5844893
Patent Number:	6665536
Patent Number:	6697415
Patent Number:	7013138
Patent Number:	7107052
Patent Number:	7710907
Patent Number:	7710935
Patent Number:	7856003
Patent Number:	5295154
Patent Number:	5428636
Patent Number:	5504746
Patent Number:	6046992
Patent Number:	6826165
Patent Number:	7483397

CORRESPONDENCE DATA

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ATTORNEY DOCKET NUMBER:	INNOVATIO IP VENTURES
NAME OF SUBMITTER:	Hannah Martin

Total Attachments: 3
source=InnovationIPassignment#page1.tif
source=InnovationIPassignment#page2.tif
source=InnovationIPassignment#page3.tif

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

ASSIGNMENT

WHEREAS, Broadcom Corporation, located at 5300 California Avenue, Irvine, CA 92617 ("**ASSIGNOR**") and Innovatio IP Ventures, LLC, a Delaware limited liability company, with a place of business at 6 Clawson, Ladera Ranch, CA 92694 ("**ASSIGNEE**") have entered into an agreement assigning all of ASSIGNOR's right, title and interest in and to certain patents listed in Appendix A attached hereto and incorporated herein by reference (the "**PATENTS**") from ASSIGNOR to ASSIGNEE;

NOW, THEREFORE, in consideration of the sum of One Dollar ($1.00) and other good and valuable consideration, the receipt and sufficiency of which hereby is acknowledged, ASSIGNOR does hereby sell, assign, transfer and convey unto ASSIGNEE its entire right, title and interest in and to the PATENTS listed in Appendix A to this Assignment attached hereto. Such property and rights assigned by ASSIGNOR include its rights to (i) maintain, enforce and sue on the Patents; (ii) collect damages and obtain other remedies for any past, present and future infringement of the Patents; and (iii) grant licenses under the Patents. ASSIGNEE acknowledges and agrees that the PATENTS remain subject to a certain non-exclusive license to ASSIGNOR and certain other non-exclusive licenses and covenants granted or required to be granted under the PATENTS prior to the date hereof, which shall remain in effect notwithstanding assignment of such PATENTS.

ASSIGNOR hereby authorizes the respective patent office or governmental agency to record the Patents and any reissues or reexaminations thereof in the name of ASSIGNEE, as the assignee of the entire interest therein.

This Assignment does not sell, assign, transfer or convey any right, title or interest in or to any patents or patent applications other than those expressly listed in Appendix A to this Assignment.

IN WITNESS WHEREOF, ASSIGNOR has caused this Assignment to be duly executed by an authorized officer on this 28th day of February, 2011.

By: _____

Name: JEYHAN KARAOGUZ

Title: VP, INTELLECTUAL PROPERTY & STANDARDS

Attachment A

United States Patent No.	Title
5,740,366	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
5,940,771	Network supporting roaming, sleeping terminals
6,374,311	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
7,457,646	Radio frequency local area network
7,536,167	Network supporting roaming, sleeping terminals
7,552,246	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
7,558,557	Low-power messaging in a network supporting roaming terminals
7,826,818	Network supporting roaming, sleeping terminals
7,873,343	Communication network terminal with sleep capability
5,673,031	Redundant radio frequency network having a roaming terminal communication protocol
6,714,559	Redundant radio frequency network having a roaming terminal communication protocol
7,386,002	Redundant radio frequency network having a roaming terminal communication protocol
7,535,921	Redundant radio frequency network having a roaming terminal communication protocol
7,548,553	Redundant radio frequency network having a roaming terminal communication protocol
5,546,397	High reliability access point for wireless local area network
5,844,893	System for coupling host computer means with base transceiver units on a local area network
6,665,536	Local area network having multiple channel wireless access
6,697,415	Spread spectrum transceiver module utilizing multiple mode transmission
7,013,138	Local area network having multiple channel wireless access
7,107,052	Local area network having multiple channel wireless access
7,710,907	Local area network having multiple channel wireless access
7,710,935	Local area network having multiple channel wireless access
7,856,003	Local area network having multiple channel wireless access
5,295,154	Radio frequency local area network
5,428,636	Radio frequency local area network
5,504,746	Radio frequency local area network
6,046,992	Radio frequency local area network
6,826,165	Radio frequency local area network
7,483,397	Radio frequency local area network

Appendix A
Patents

[redacted]	
5,740,366	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
5,940,771	Network supporting roaming, sleeping terminals
6,374,311	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
7,457,646	Radio frequency local area network
7,536,167	Network supporting roaming, sleeping terminals
7,552,246	Communication network having a plurality of bridging nodes which transmit a beacon to terminal nodes in power saving state that it has messages awaiting delivery
7,558,557	Low-power messaging in a network supporting roaming terminals
7,826,818	Network supporting roaming, sleeping terminals
7,873,343	Communication network terminal with sleep capability
12/323,036*	Radio frequency local area network
5,673,031	Redundant radio frequency network having a roaming terminal communication protocol
6,714,559	Redundant radio frequency network having a roaming terminal communication protocol
7,386,002	Redundant radio frequency network having a roaming terminal communication protocol
7,535,921	Redundant radio frequency network having a roaming terminal communication protocol
7,548,553	Redundant radio frequency network having a roaming terminal communication protocol
12/121,536*	Redundant radio frequency network having a roaming terminal communication protocol
5,546,397	High reliability access point for wireless local area network
5,844,893	System for coupling host computer means with base transceiver units on a local area network
6,665,536	Local area network having multiple channel wireless access
6,697,415	Spread spectrum transceiver module utilizing multiple mode transmission
7,013,138	Local area network having multiple channel wireless access
7,107,052	Local area network having multiple channel wireless access
7,710,907	Local area network having multiple channel wireless access
7,710,935	Local area network having multiple channel wireless access
7,856,003	Local area network having multiple channel wireless access
5,295,154	Radio frequency local area network
5,428,636 *	Radio frequency local area network
5,504,746	Radio frequency local area network
6,046,992	Radio frequency local area network
6,826,165	Radio frequency local area network
7,483,397	Radio frequency local area network

916171 v8/HN

EXHIBIT 18

US005546397A

United States Patent [19]

Mahany

[11] Patent Number: 5,546,397

[45] Date of Patent: Aug. 13, 1996

[54] **HIGH RELIABILITY ACCESS POINT FOR WIRELESS LOCAL AREA NETWORK**

[75] Inventor: **Ronald L. Mahany**, Cedar Rapids, Iowa

[73] Assignee: **Norand Corporation**, Cedar Rapids, Iowa

[21] Appl. No.: **238,180**

[22] Filed: **May 4, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 197,392, Feb. 16, 1994, abandoned, which is a continuation-in-part of Ser. No. 170,121, Dec. 20, 1993, abandoned.

[51] **Int. Cl.**[6] **H04B 7/04**

[52] **U.S. Cl.** **370/85.1**; 375/347; 455/52.1; 455/101; 455/133; 455/272

[58] **Field of Search** 455/52.1, 52.2, 455/53.1, 54.1, 56.1, 101, 103, 132, 133, 271, 277.1, 277.2; 370/18, 26, 37, 85.1, 85.3, 95.1, 95.3; 371/68.2; 375/260, 285, 347; 359/113, 152, 164, 167

[56] **References Cited**

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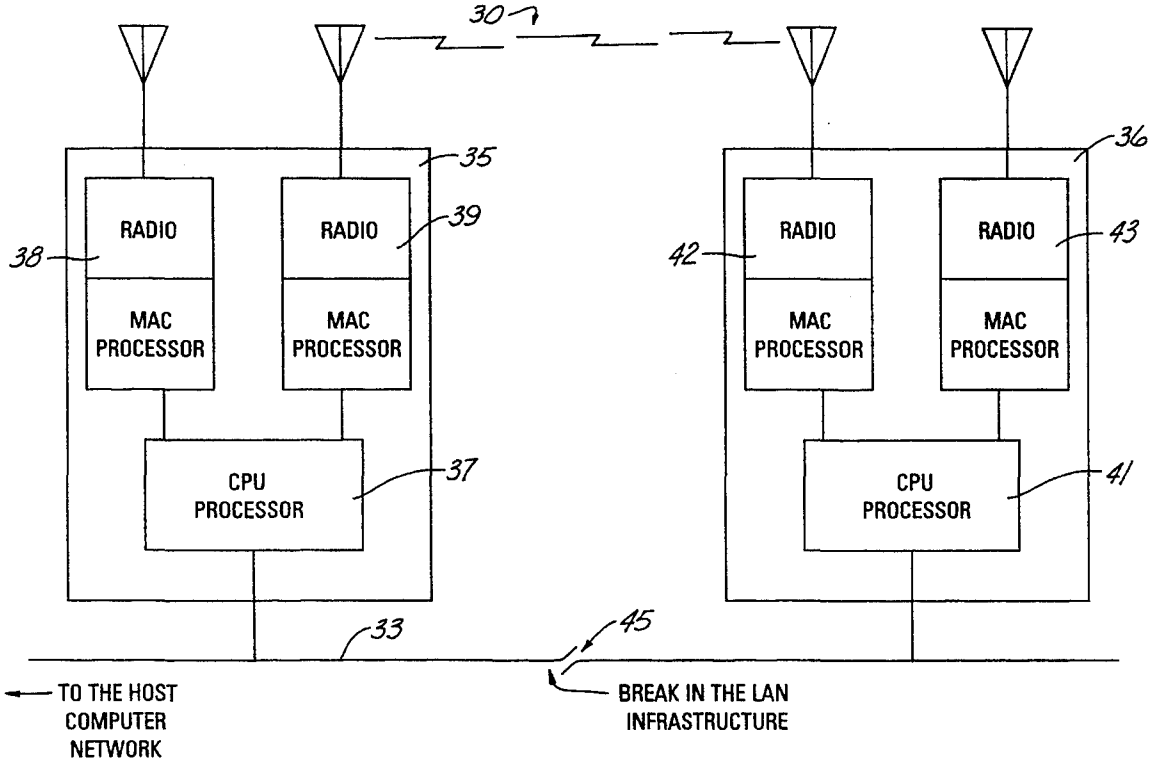
5,465,392	11/1995	Baptist et al.	455/55.2

Primary Examiner—Benedict V. Safourek
Attorney, Agent, or Firm—Henderson & Sturm

[57] **ABSTRACT**

A high reliability access point for RF communications in a wireless local area network. The high reliability access point includes a central processing unit (CPU) for handling high level protocol functions and for interfacing with the infrastructure of the local area network. The high reliability access point also includes at least two wireless adapters. Each wireless adapter includes a radio, a media access control (MAC) processor for handling low level protocol functions, and at least one antenna. The multiple wireless adapters allow the access point to perform self monitoring, reduce the effects of multipath interference, reduce some occurrences of collisions at the access point and provide infrastructure backup in the event of an infrastructure failure. The access points also allow for wireless network infrastructure communication for connection of one or more remote access points to the infrastructure. A backup power supply for the access point is also shown.

21 Claims, 5 Drawing Sheets



US005740366A

United States Patent [19]

Mahany et al.

[11] Patent Number: 5,740,366

[45] Date of Patent: Apr. 14, 1998

[54] **COMMUNICATION NETWORK HAVING A PLURALITY OF BRIDGING NODES WHICH TRANSMIT A BEACON TO TERMINAL NODES IN POWER SAVING STATE THAT IT HAS MESSAGES AWAITING DELIVERY**

[75] Inventors: **Ronald L. Mahany**; **Robert C. Meier**, both of Cedar Rapids; **Ronald E. Luse**, Marion, all of Iowa

[73] Assignee: **Norand Corporation**, Cedar Rapids, Iowa

[21] Appl. No.: **395,555**

[22] Filed: **Feb. 28, 1995**

Related U.S. Application Data

[63] Continuation of Ser. No. 255,848, Jun. 8, 1994, Pat. No. 5,394,436, which is a continuation of Ser. No. 970,411, Nov. 2, 1992, abandoned, which is a continuation-in-part of Ser. No. 968,990, Oct. 30, 1992, abandoned, which is a continuation-in-part of Ser. No. 769,425, Oct. 1, 1991, abandoned, and a continuation-in-part of PCT/US92/08610, Oct. 1, 1992.

[51] **Int. Cl.**[6] **G06F 13/00**

[52] **U.S. Cl.** **395/20.12**; 395/684; 395/750; 395/838; 395/866; 340/825.47; 455/49.1; 455/53.1; 455/54.2

[58] **Field of Search** 340/825.47; 379/74, 379/88, 84, 33, 67; 367/77; 455/54.2

[56] **References Cited**

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5,276,680	1/1994	Messenger	370/85.1
5,280,650	1/1994	Sobti	370/343
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5,291,479	3/1994	Vaziri et al.	370/58.2
5,425,051	6/1995	Mahany	375/202

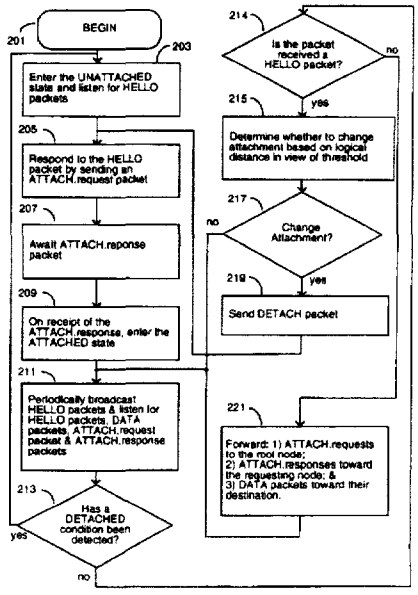
Primary Examiner—Thomas C. Lee
Assistant Examiner—Po C. Huang
Attorney, Agent, or Firm—Stanford & Bennett,L.L.P.

[57] **ABSTRACT**

An apparatus and a method for routing data in a radio data communication system having one or more host computers, one or more intermediate base stations, and one or more RF terminals organizes the intermediate base stations into an optimal spanning-tree network to control the routing of data to and from the RF terminals and the host computer efficiently and dynamically. Communication between the host computer and the RF terminals is achieved by using the network of intermediate base stations to transmit the data.

32 Claims, 2 Drawing Sheets

Microfiche Appendix Included
(10 Microfiche, 602 Pages)



US005844893A

United States Patent [19]

Gollnick et al.

[11] Patent Number: 5,844,893

[45] Date of Patent: Dec. 1, 1998

[54] **SYSTEM FOR COUPLING HOST COMPUTER MEANSWITH BASE TRANSCEIVER UNITS ON A LOCAL AREA NETWORK**

[75] Inventors: **Charles D. Gollnick**, Cedar Rapids; **Ronald E. Luse**, Marion; **John G. Pavek**; **Marvin L. Sojka**, both of Cedar Rapids; **James D. Cnossen**, Marion; **Robert G. Geers**, Cedar Rapids; **Arvin D. Danielson**, Solon; **Mary L. Detweiler**, Parnell; **Gary N. Spiess**, Lisbon; **Guy J. West**, Cedar Rapids; **Amos D. Young**, Cedar Rapids; **Keith K. Cargin, Jr.**, Cedar Rapids; **Richard C. Arensdorf**, Cedar Rapids; **Ronald L. Mahany**, Cedar Rapids, all of Iowa

[73] Assignee: **Norand Corporation**, Cedar Rapids, Iowa

[21] Appl. No.: **486,083**

[22] Filed: **Jun. 7, 1995**

Related U.S. Application Data

[63] Continuation of Ser. No. 277,944, Jun. 29, 1994, which is a continuation of Ser. No. 57,218, May 4, 1993, abandoned, which is a continuation of Ser. No. 700,704, May 14, 1991, abandoned.

[51] **Int. Cl.**[6] **H04Q 7/00**; H04Q 7/24

[52] **U.S. Cl.** **370/329**; 370/331; 370/338; 370/328; 375/202

[58] **Field of Search** 370/95.1, 95.2, 370/95.3, 85.7, 84, 94.2, 85.2, 422, 431, 474, 414, 417, 346, 345, 349, 352, 331, 329, 338; 375/200, 202, 216; 379/61, 58; 455/17, 34.1, 33.1, 54.1, 54.2, 33.4, 38.1

[56] **References Cited**

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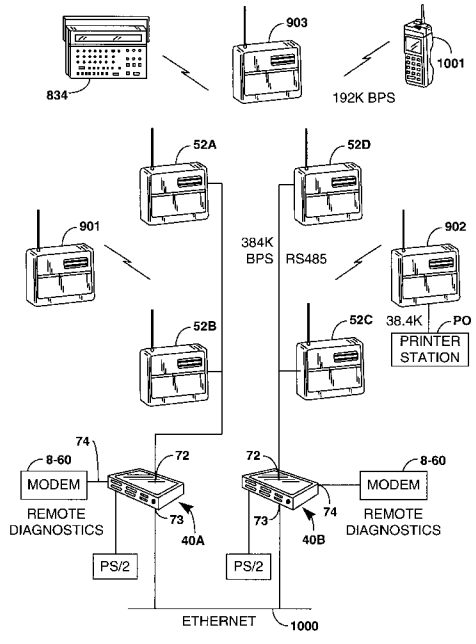
5,297,144	3/1994	Gilbert et al.	370/346

Primary Examiner—Wellington Chin
Assistant Examiner—Melissa Kay Carman
Attorney, Agent, or Firm—Akin, Gump, Strauss, Hauer & Feld, LLP

[57] **ABSTRACT**

Improved apparatus for a radio communication system having a multiplicity of mobile transceiver units selectively in communication with a plurality of base transceiver units which communicate with one or two host computers for storage and manipulation of data collected by bar code scanners or other collection means associated with the mobile transceiver units. A network controller provides selective interface means to be employed between the host computers and the base transceivers whereby low data rate base transceivers may be utilized with the network controller while spread spectrum or high data rate networked base transceivers may be also utilized. The network controller may allow selection of interface means for three of its ports from its front panel with use of three input keys. The network controller is entirely external to the host computer or computers, and can couple to a variety of commonly encountered host ports. Most preferable one- or two-network controller ports can each be software configured to match any needed host port, so that the host computer(s) need not be adapted to a radio network protocol accommodating the multiple base transceiver units.

14 Claims, 13 Drawing Sheets



US005940771A

United States Patent [19]

Gollnick et al.

[11] Patent Number: 5,940,771

[45] Date of Patent: *Aug. 17, 1999

[54] **NETWORK SUPPORTING ROAMING, SLEEPING TERMINALS**

[75] Inventors: **Charles D. Gollnick**, Cedar Rapids; **Ronald E. Luse**, Marion; **John G. Pavek**; **Marvin L. Sojka**, both of Cedar Rapids; **James D. Cnossen**, Marion; **Arvin D. Danielson**; **Ronald L. Mahany**, both of Cedar Rapids; **Mary L. Detweiler**, Parnell; **Gary N. Spiess**, Lisbon; **Guy J. West**, Cedar Rapids; **Amos D. Young**, Cedar Rapids; **Robert C. Meier**, Cedar Rapids; **Keith K. Cargin, Jr.**, Cedar Rapids; **Richard C. Arensdorf**, Ely; **Robert G. Geers**, Cedar Rapids, all of Iowa

[73] Assignee: **Norand Corporation**, Iowa

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/545,108**

[22] Filed: **Oct. 19, 1995**

Related U.S. Application Data

[63] Continuation of application No. 07/947,102, Sep. 14, 1992, abandoned, and a continuation of application No. 07/907,927, Jun. 30, 1992, abandoned, which is a continuation-in-part of application No. 07/857,603, Mar. 30, 1992, abandoned, which is a continuation-in-part of application No. 07/700,704, May 14, 1991, abandoned, which is a continuation-in-part of application No. 07/699,818, May 13, 1991, abandoned.

[51] **Int. Cl.**[6] **H04B 7/26**

[52] **U.S. Cl.** **455/517**; 455/524; 455/343; 370/311

[58] **Field of Search** 455/38.1, 38.3, 455/50.1, 54.1, 56.1, 63, 343, 517, 501, 524, 574, 575; 370/95.1, 280, 311, 338

[56] **References Cited**

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(List continued on next page.)

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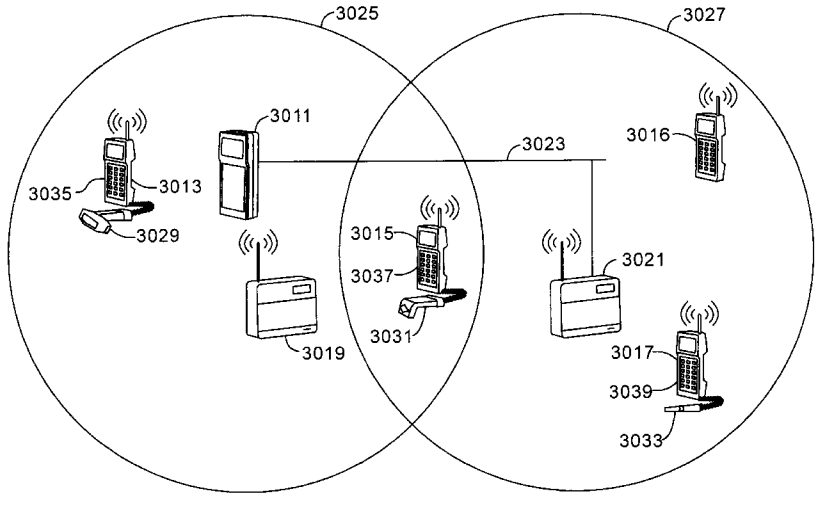
Primary Examiner—Edward F. Urban
Attorney, Agent, or Firm—Akin, Gump, Strauss, Hauer & Feld, L.L.P.

[57] **ABSTRACT**

A data collection network supports roaming terminals which may enter and exit a sleep mode to conserve power. A plurality of base stations each periodically transmit pending message indications to those roaming data collection terminals in range. Instead of requiring the transceiver within each terminal to always be active, the receiver is activated in synchrony with the transmissions of pending message indications from at least one of the base stations. Otherwise, the terminal may deactivate the transceiver, i.e., place it in a sleep state. The terminal may also sleep through pluralities of transmissions of pending message indications, and, thereafter, awake in synchrony to receive subsequent pending message indications. To minimize noise, the terminal may operate using a lower frequency system clock when not collecting data. When collecting data, especially where processing time proves more critical, the system clock frequency is increased.

17 Claims, 26 Drawing Sheets



US006374311B1

(12) **United States Patent**
Mahany et al.

(10) **Patent No.: US 6,374,311 B1**
(45) **Date of Patent: *Apr. 16, 2002**

(54) **COMMUNICATION NETWORK HAVING A PLURALITY OF BRIDGING NODES WHICH TRANSMIT A BEACON TO TERMINAL NODES IN POWER SAVING STATE THAT IT HAS MESSAGES AWAITING DELIVERY**

(75) Inventors: **Ronald L. Mahany**; **Robert C. Meier**, both of Cedar Rapids; **Ronald E. Luse**, Marion, all of IA (US)

(73) Assignee: **Intermec IP Corp.**, Woodland Hills, CA (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/060,287**

(22) Filed: **Apr. 14, 1998**

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/545,108, filed on Oct. 19, 1995, now Pat. No. 5,940,771, which is a continuation of application No. 07/947,102, filed on Sep. 14, 1992, now abandoned, which is a continuation-in-part of application No. 07/907,927, filed on Jun. 30, 1992, now abandoned, which is a continuation-in-part of application No. PCT/US92/03982, filed on May 13, 1992, now abandoned, and a continuation-in-part of application No. 07/857,603, filed on Mar. 30, 1992, now abandoned, and a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned.

(51) **Int. Cl.**[7] **G06F 13/372**

(52) **U.S. Cl.** **710/18**; 710/46; 709/227; 709/304; 713/320; 713/321; 713/323; 713/324; 455/343; 455/524; 455/517; 375/132; 375/202; 375/220; 370/329; 370/351

(58) **Field of Search** 710/18, 46; 713/320, 713/323, 324; 709/227, 304; 455/343, 524; 340/825.47; 370/311

(56) **References Cited**

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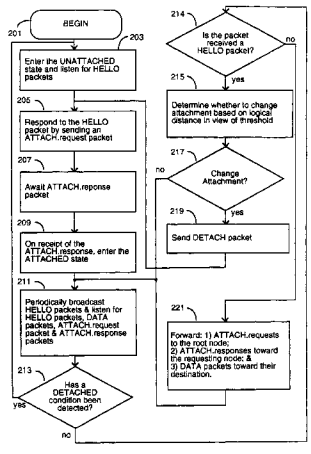
Primary Examiner—Thomas Lee
Assistant Examiner—Tammara Peyton
(74) *Attorney, Agent, or Firm*—Akin, Gump, Strauss, Hauer & Feld, L.L.P.; Gregory K. Goshorn

(57) **ABSTRACT**

An apparatus and a method for routing data in a radio data communication system having one or more host computers, one or more intermediate base stations, and one or more RF terminals organizes the intermediate base stations into an optimal spanning-tree network to control the routing of data to and from the RF terminals and the host computer efficiently and dynamically. Communication between the host computer and the RF terminals is achieved by using the network of intermediate base stations to transmit the data.

31 Claims, 2 Drawing Sheets



US006665536B1

(12) **United States Patent**
Mahany

(10) **Patent No.: US 6,665,536 B1**
(45) **Date of Patent: Dec. 16, 2003**

(54) **LOCAL AREA NETWORK HAVING MULTIPLE CHANNEL WIRELESS ACCESS**

(75) Inventor: **Ronald L. Mahany**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/357,429**

(22) Filed: **Jul. 20, 1999**

Related U.S. Application Data

(63) Continuation of application No. 08/878,357, filed on Jun. 27, 1997, now Pat. No. 5,960,344, which is a continuation-in-part of application No. 08/772,895, filed on Dec. 24, 1996, now abandoned, which is a continuation-in-part of application No. 08/696,086, filed on Aug. 13, 1996, now abandoned, which is a continuation of application No. 08/238,180, filed on May 4, 1994, now Pat. No. 5,546,397, which is a continuation-in-part of application No. 08/197,392, filed on Feb. 16, 1994, now abandoned, which is a continuation-in-part of application No. 08/170,121, filed on Dec. 20, 1993, now abandoned.

(30) **Foreign Application Priority Data**

Jun. 3, 1996 (WO) PCT/US96/09474

(51) **Int. Cl.**[7] **H04Q 7/00**

(52) **U.S. Cl.** **455/432**; 455/434; 455/435

(58) **Field of Search** 455/432, 434, 455/436, 338, 500, 444, 524, 456, 422, 466, 507, 515, 454, 554, 552; 375/131, 132, 147, 130; 370/350, 389

(56) **References Cited**

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News Release "Norand Introduces Enhanced Wireless LAN Capabilities", May 16, 1995, by Norand Corporation, Cedar Rapids, Iowa, pp. 1–4.

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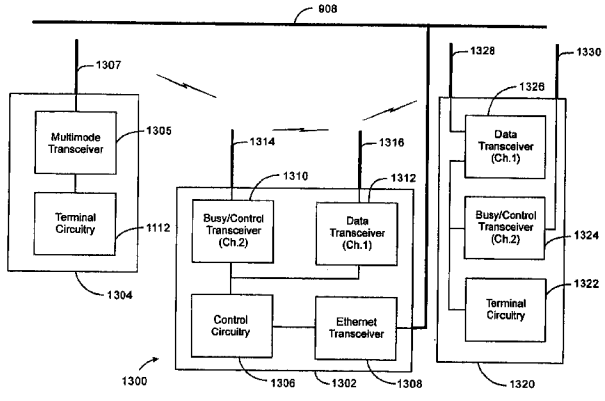
Primary Examiner—Salvatore Cangialosi
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A communication network having at least one access point supports wireless communication among a plurality of wireless roaming devices via a first and a second wireless channel. The access point comprises a first and a second transceiver. The first and second transceivers operate on the first and second wireless channels, respectively. Each of the plurality of wireless roaming devices are capable of communicating on the first and second wireless channel. In one embodiment, the first wireless channel is used to exchange data, while the second channel is used to manage such exchanges as well as access to the first channel. In an alternate embodiment, both channels are used to support communication flow, however the first channel supports a protocol that is more deterministic than that of the second channel. Allocation of ones of the plurality of wireless roaming devices from one channel to the next may occur per direction from the access point. It may also result from decisions made by each of the wireless roaming devices made independent of the access point. For example, a decision may be made based on the data type being transferred or based on the current channel load. Such factors may also be used by the access point for allocation determinations. In addition, allocation may be based on the type of roaming device involved, such as allocating peripherals to a slower channel.

55 Claims, 17 Drawing Sheets



US006697415B1

(12) **United States Patent**
Mahany

(10) **Patent No.: US 6,697,415 B1**
(45) **Date of Patent: Feb. 24, 2004**

(54) **SPREAD SPECTRUM TRANSCEIVER MODULE UTILIZING MULTIPLE MODE TRANSMISSION**

(75) Inventor: **Ronald L. Mahany**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/973,195**

(22) PCT Filed: **Jun. 3, 1996**

(86) PCT No.: **PCT/US96/09474**

§ 371 (c)(1), (2), (4) Date: **Mar. 6, 2000**

(87) PCT Pub. No.: **WO96/38925**

PCT Pub. Date: **Dec. 5, 1996**

(51) **Int. Cl.**[7] **H04B 1/44**; H04B 1/69

(52) **U.S. Cl.** **375/130**; 375/219; 455/88

(58) **Field of Search** 375/130, 144, 375/146, 219, 222, 259, 377; 455/434, 73, 88

(56) **References Cited**

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PCMCIA (IC) Cards, vol. 13, No. 8.

(List continued on next page.)

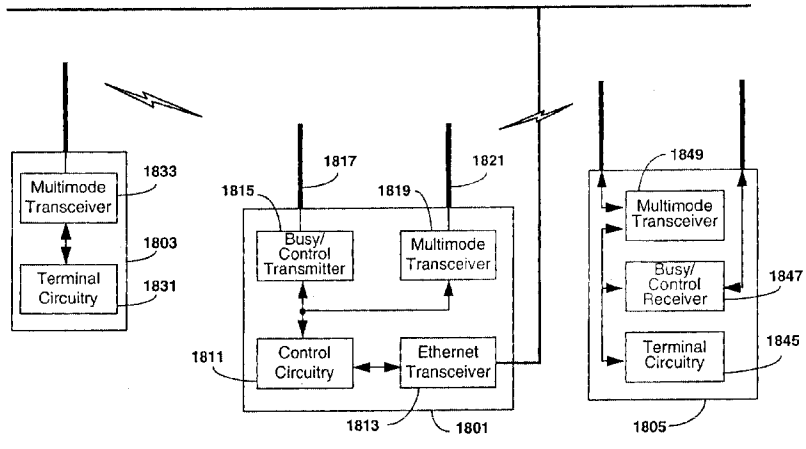
Primary Examiner—Young T. Tse

(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A data transceiver module for digital data communications in a portable hand-held data terminal has multiple data spread spectrum modes which include direct sequence and frequency function modulation algorithms. The transceiver module has multiple user or program configurable data rates, modulation, channelization and process gain in order to maximize the performance of radio data transmissions and to maximize interference immunity. Various module housings, which may be PCMCIA type, are able to be mated with a suitably designed data terminal. Media access control protocols and interfaces of multiple nominal operational frequencies are utilized. Wireless access devices in a cell based network each consider a variety of factors when choosing one of a plurality of modes of wireless operation and associated operating parameters. Such selection defines a communication channel to support wireless data, message and communication exchanges. In further embodiments, the wireless access devices also support a second channel, a busy/control channel, for managing communication on the main communication channel and to overcome roaming and hidden terminal problems. Roaming terminal devices are also configured to support the dual channel design. Such configuration in both circumstances may involve the use of a multimode radio that is timeshared between the two channels or two radios, one dedicated to each channel.

18 Claims, 36 Drawing Sheets



US006714559B1

(12) **United States Patent**
Meier

(10) **Patent No.: US 6,714,559 B1**
(45) **Date of Patent: Mar. 30, 2004**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

(75) Inventor: **Robert C. Meier**, Cuyahoga Falls, OH (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 173 days.

(21) Appl. No.: **09/960,265**

(22) Filed: **Sep. 21, 2001**

Related U.S. Application Data

(63) Continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031, which is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned.

(51) **Int. Cl.**[7] **H04Q 1/00**
(52) **U.S. Cl.** **370/449**; 340/3.51
(58) **Field of Search** 370/449, 445, 370/346, 447; 340/3.51

(56) **References Cited**

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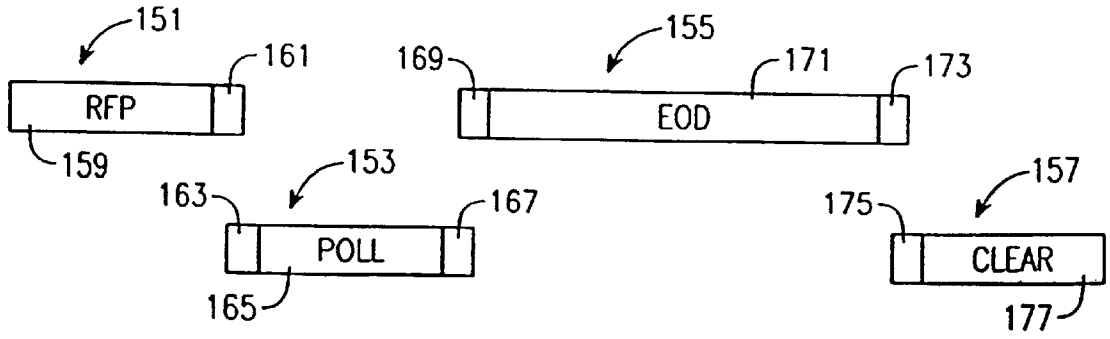
Primary Examiner—Brian Zimmerman
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy Ltd.

(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to determine whether the channel is clear by listening for an entire interpoll gap time. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

20 Claims, 6 Drawing Sheets



US007013138B2

(12) **United States Patent**
Mahany

(10) **Patent No.: US 7,013,138 B2**
(45) **Date of Patent: *Mar. 14, 2006**

(54) **LOCAL AREA NETWORK HAVING MULTIPLE CHANNEL WIRELESS ACCESS**

(75) Inventor: **Ronald L. Mahany**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 251 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/648,726**

(22) Filed: **Aug. 26, 2003**

(65) **Prior Publication Data**

US 2004/0042421 A1 Mar. 4, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/357,429, filed on Jul. 20, 1999, now Pat. No. 6,665,536, which is a continuation of application No. 08/878,357, filed on Jun. 27, 1997, now Pat. No. 5,960,344, which is a continuation-in-part of application No. 08/772,895, filed on Dec. 24, 1996, now abandoned, which is a continuation-in-part of application No. 08/696,086, filed on Aug. 13, 1996, now abandoned, which is a continuation of application No. 08/238,180, filed on May 4, 1994, now Pat. No. 5,546,397, which is a continuation-in-part of application No. 08/197,392, filed on Feb. 16, 1994, now abandoned, which is a continuation-in-part of application No. 08/170,121, filed on Dec. 20, 1993, now abandoned.

(30) **Foreign Application Priority Data**

Jun. 3, 1996 (WO) PCT/US96/09474

(51) **Int. Cl.**
H04Q 7/00 (2006.01)

(52) **U.S. Cl.** **455/432**; 455/434; 455/435

(58) **Field of Classification Search** 375/131, 375/147, 132, 130; 455/434, 432, 435, 436, 455/338, 500, 444, 524, 456, 422, 466, 507, 455/515, 454; 370/350, 389

See application file for complete search history.

(56) **References Cited**

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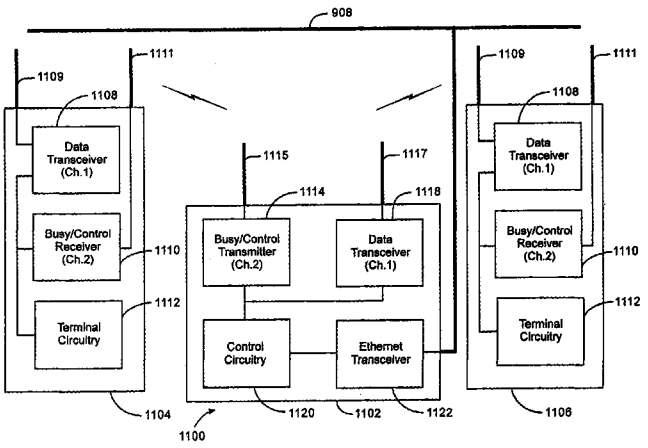
Primary Examiner—Salvatore Cangialosi
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A communication network having at least one access point supports wireless communication among a plurality of wireless roaming devices via a first and a second wireless channel. The access point comprises a first and a second transceiver. The first and second transceivers operate on the first and second wireless channels, respectively. Each of the plurality of wireless roaming devices are capable of communicating on the first and second wireless channel. In one embodiment, the first wireless channel is used to exchange data, while the second channel is used to manage such exchanges as well as access to the first channel. In an alternate embodiment, both channels are used to support communication flow, however the first channel supports a protocol that is more deterministic than that of the second channel. Allocation of ones of the plurality of wireless roaming devices from one channel to the next may occur per direction from the access point. It may also result from decisions made by each of the wireless roaming devices made independent of the access point. For example, a decision may be made based on the data type being transferred or based on the current channel load. Such factors may also be used by the access point for allocation determinations. In addition, allocation may be based on the type of roaming device involved, such as allocating peripherals to a slower channel.

40 Claims, 17 Drawing Sheets



US007386002B2

(12) **United States Patent**
Meier

(10) **Patent No.: US 7,386,002 B2**
(45) **Date of Patent: *Jun. 10, 2008**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

(75) Inventor: **Robert C. Meier**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 16 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/762,746**

(22) Filed: **Jan. 22, 2004**

(65) **Prior Publication Data**

US 2004/0169583 A1 Sep. 2, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/960,265, filed on Sep. 21, 2001, now Pat. No. 6,714,559, which is a continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031, said application No. 08/270,553 is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned, said application No. 08/270,553 is a continuation-in-part of application No. 07/910,865, filed on Jul. 6, 1992, now abandoned, which is a continuation-in-part of application No. 07/883,854, filed on May 13, 1992, now abandoned, which is a continuation-in-part of application No. 07/857,603, filed on Mar. 30, 1992, now abandoned, which is a continuation-in-part of application No. 07/700,704, filed on May 14, 1991, now abandoned, which is a continuation-in-part of application No. 07/699,815, filed on May 13, 1991, now abandoned.

(51) **Int. Cl.**
H04Q 1/00 (2006.01)

(52) **U.S. Cl.** **370/449**; 340/3.51

(58) **Field of Classification Search** 370/338, 370/346, 447, 449; 340/3.51
See application file for complete search history.

(56) **References Cited**

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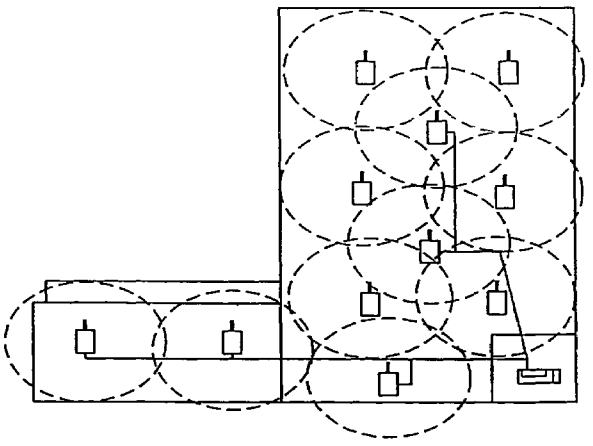
Primary Examiner—Edwin C. Holloway, III
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to determine whether the channel is clear by listening for an entire interpoll gap time. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

20 Claims, 6 Drawing Sheets



US007457646B2

(12) **United States Patent**
Mahany et al.

(10) **Patent No.: US 7,457,646 B2**
(45) **Date of Patent: *Nov. 25, 2008**

(54) **RADIO FREQUENCY LOCAL AREA NETWORK**

(75) Inventors: **Ronald L. Mahany**, Cedar Rapids, IA (US); **Robert C. Meier**, Cedar Rapids, IA (US); **Ronald E. Luse**, Marion, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 270 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/631,071**

(22) Filed: **Jul. 31, 2003**

(65) **Prior Publication Data**

US 2004/0023617 A1 Feb. 5, 2004

Related U.S. Application Data

(63) Continuation of application No. 10/123,873, filed on Apr. 16, 2002, now Pat. No. 6,895,450, which is a continuation of application No. 09/060,287, filed on Apr. 14, 1998, now Pat. No. 6,374,311, which is a continuation of application No. 08/545,108, filed on Oct. 19, 1995, now Pat. No. 5,940,771, which is a continuation of application No. 08/395,555, filed on Feb. 28, 1995, now Pat. No. 5,740,366, which is a continuation of application No. 08/255,848, filed on Jun. 8, 1994, now Pat. No. 5,394,436, which is a continuation of application No. 07/970,411, filed on Nov. 12, 1992, now abandoned, which is a continuation-in-part of application No. 07/968,990, filed on Oct. 30, 1992, now abandoned, which is a continuation-in-part of application No. PCT/US92/08610, filed on Oct. 1, 1992, now abandoned, which is a continuation of application No. 07/947,102, filed on Sep. 14, 1992, now abandoned, which is a continuation of application No. 07/907,927, filed on Jun. 30, 1992, now abandoned, which is a continuation-in-part of application No. PCT/US92/03982, filed on May 13, 1992, now abandoned, which is a continuation-in-part of application No. 07/857,603, filed on Mar. 30, 1992, now abandoned, which is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned, which is a continuation-in-part of application No. 07/769,425, filed on Oct. 1, 1991, now abandoned, which is a continuation-in-part of application No. 07/700,704, filed on May 14, 1991, now abandoned, which is a continuation-in-part of application No. 07/699,818, filed on May 13, 1991, now abandoned.

(51) **Int. Cl.**
H04B 1/38 (2006.01)
H04L 12/58 (2006.01)
G08C 17/00 (2006.01)

(52) **U.S. Cl.** **455/574**; 455/412.1; 370/311

(58) **Field of Classification Search** 455/574, 455/412.1; 370/311
See application file for complete search history.

(56) **References Cited**

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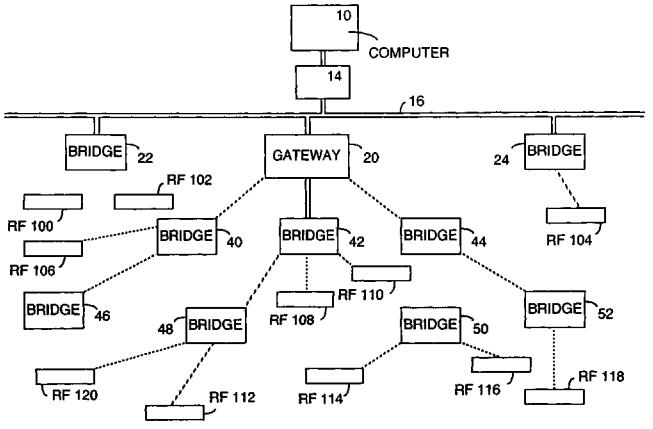

US007535921B2

(12) **United States Patent**
Meier

(10) **Patent No.: US 7,535,921 B2**
(45) **Date of Patent: *May 19, 2009**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

(75) Inventor: **Robert C. Meier**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 508 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/222,915**

(22) Filed: **Sep. 9, 2005**

(65) **Prior Publication Data**

US 2006/0007951 A1 Jan. 12, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/762,746, filed on Jan. 22, 2004, now Pat. No. 7,386,002, which is a continuation of application No. 09/960,265, filed on Sep. 21, 2001, now Pat. No. 6,714,559, which is a continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031, which is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned.

(51) **Int. Cl.**
H04Q 1/00 (2006.01)

(52) **U.S. Cl.** **370/449**; 340/3.51

(58) **Field of Classification Search** 370/338, 370/346, 447, 449; 340/3.51
See application file for complete search history.

(56) **References Cited**

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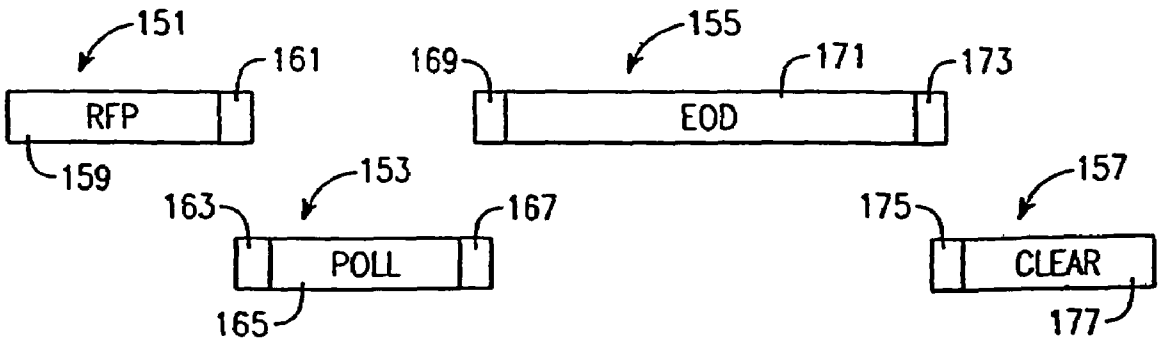
Primary Examiner—Edwin C Holloway, III
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to determine whether the channel is clear by listening for an entire interpoll gap time. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

31 Claims, 6 Drawing Sheets



US007536167B2

(12) **United States Patent**
Gollnick et al.

(10) **Patent No.: US 7,536,167 B2**
(45) **Date of Patent: *May 19, 2009**

(54) **NETWORK SUPPORTING ROAMING, SLEEPING TERMINALS**

(75) Inventors: **Charles D. Gollnick**, Cedar Rapids, IA (US); **Ronald E. Luse**, Marion, IA (US); **John G. Pavek**, Cedar Rapids, IA (US); **Marvin L. Sojka**, Cedar Rapids, IA (US); **James D. Cnossen**, Marion, IA (US); **Arvin D. Danielson**, Cedar Rapids, IA (US); **Ronald L. Mahany**, Cedar Rapids, IA (US); **Mary L. Detweiler**, Parnell, IA (US); **Gary N. Spiess**, Lisbon, IA (US); **Guy J. West**, Cedar Rapids, IA (US); **Amos D. Young**, Cedar Rapids, IA (US); **Robert C. Meier**, Cedar Rapids, IA (US); **Keith K. Cargin, Jr.**, Cedar Rapids, IA (US); **Richard C. Arensdorf**, Ely, IA (US); **Robert G. Geers**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 279 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/630,138**

(22) Filed: **Jul. 29, 2003**

(65) **Prior Publication Data**

US 2004/0023651 A1 Feb. 5, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/318,668, filed on May 25, 1999, which is a continuation of application No. 08/545,108, filed on Oct. 19, 1995, now Pat. No. 5,940,771, which is a continuation of application No. 07/947,102, filed on Sep. 14, 1992, now abandoned, and a continuation of application No. 07/907,927, filed on Jun. 30, 1992, now abandoned, said application No. 07/947,102 and a continuation-in-part of application No. 07/857,603, filed on Mar. 30, 1992, now abandoned, is a continuation-in-part of application No. 07/700,704, filed on May 14, 1991, now abandoned, which is a continuation-in-part of application No. 07/699,818, filed on May 13, 1991, now abandoned, said application No. 07/907,927 and a continuation-in-part of application No. PCT/US92/03982, filed on May 13, 1992, and a continuation-in-part of application No. 07/769,425, filed on Oct. 1, 1991, now abandoned, and a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned.

(51) **Int. Cl.**
H04W 52/44 (2006.01)
H04W 52/28 (2006.01)

(52) **U.S. Cl.** **455/343.4**; 455/412.2; 455/517; 455/574

(58) **Field of Classification Search** 455/343.1–6, 455/517, 561, 412.2, 574
See application file for complete search history.

(56) **References Cited**

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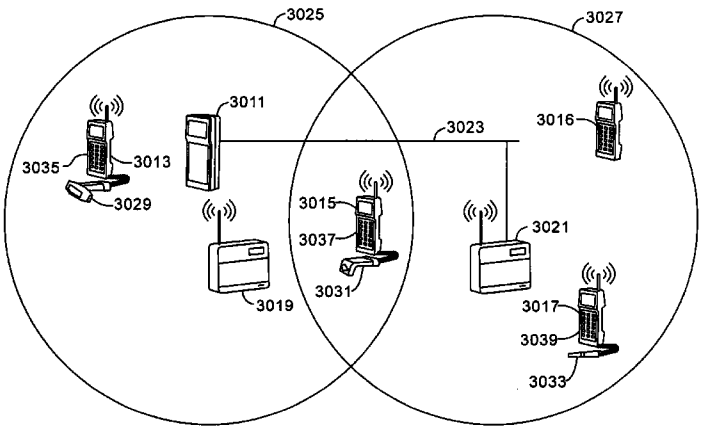

US007548553B2

(12) **United States Patent**
Meier

(10) **Patent No.: US 7,548,553 B2**
(45) **Date of Patent: *Jun. 16, 2009**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

(75) Inventor: **Robert C. Meier**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 508 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/223,404**

(22) Filed: **Sep. 9, 2005**

(65) **Prior Publication Data**

US 2006/0062240 A1 Mar. 23, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/762,746, filed on Jan. 22, 2004, now Pat. No. 7,386,002, which is a continuation of application No. 09/960,265, filed on Sep. 21, 2001, now Pat. No. 6,714,559, which is a continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031, which is a continuation-in-part of application No. 07/802,348, filed on Dec. 4, 1991, now abandoned, which is a continuation-in-part of application No. 07/790,946, filed on Nov. 12, 1991, now abandoned.

(51) **Int. Cl.**
H04Q 1/00 (2006.01)

(52) **U.S. Cl.** **370/449**; 340/3.51

(58) **Field of Classification Search** 370/338, 370/346, 447, 449; 340/3.51
See application file for complete search history.

(56) **References Cited**

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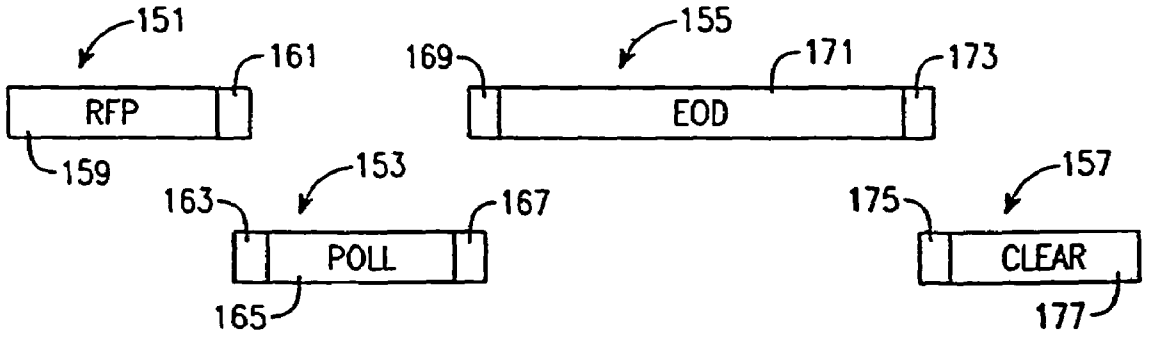
Primary Examiner—Edwin C Holloway, III
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to determine whether the channel is clear by listening for an entire interpoll gap time. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

44 Claims, 6 Drawing Sheets



US007710907B2

(12) United States Patent
Mahany

(10) **Patent No.: US 7,710,907 B2**
(45) **Date of Patent: *May 4, 2010**

(54) **LOCAL AREA NETWORK HAVING MULTIPLE CHANNEL WIRELESS ACCESS**

(75) Inventor: **Ronald L. Mahany**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 766 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/496,950**

(22) Filed: **Aug. 1, 2006**

(65) **Prior Publication Data**

US 2006/0270338 A1 Nov. 30, 2006

Related U.S. Application Data

(60) Division of application No. 10/648,707, filed on Aug. 26, 2003, now Pat. No. 7,107,052, which is a continuation of application No. 09/357,429, filed on Jul. 20, 1999, now Pat. No. 6,665,536, which is a continuation of application No. 08/878,357, filed on Jun. 27, 1997, now Pat. No. 5,960,344, which is a continuation-in-part of application No. 08/772,895, filed on Dec. 24, 1996, now abandoned, which is a continuation-in-part of application No. 08/696,086, filed on Aug. 13, 1996, now abandoned, which is a continuation of application No. 08/238,180, filed on May 4, 1994, now Pat. No. 5,546,397, which is a continuation-in-part of application No. 08/197,392, filed on Feb. 16, 1994, now abandoned, which is a continuation-in-part of application No. 08/170,121, filed on Dec. 20, 1993, now abandoned.

(30) **Foreign Application Priority Data**

Jun. 3, 1996 (WO) PCT/US96/09474

(51) **Int. Cl.**
H04B 7/00 (2006.01)

(52) **U.S. Cl.** **370/310.2**; 370/328; 370/338; 370/401; 455/41.2; 455/432.1

(58) **Field of Classification Search** 370/310.1, 370/338, 401, 466; 455/3.01, 41.2, 432.1, 455/517; 375/240

See application file for complete search history.

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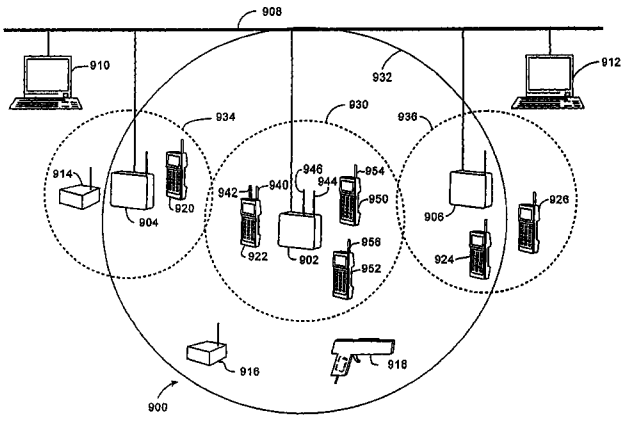
Primary Examiner—Sharad Rampuria
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

A communication network having at least one access point supports wireless communication among a plurality of wireless roaming devices via a first and a second wireless channel. The access point comprises a first and a second transceiver. The first and second transceivers operate on the first and second wireless channels, respectively. Each of the plurality of wireless roaming devices are capable of communicating on the first and second wireless channel. In one embodiment, the first wireless channel is used to exchange data, while the second channel is used to manage such exchanges as well as access to the first channel. In an alternate embodiment, both channels are used to support communication flow, however the first channel supports a protocol that is more deterministic than that of the second channel. Allocation of ones of the plurality of wireless roaming devices from one channel to the next may occur per direction from the access point. It may also result from decisions made by each of the wireless roaming devices made independent of the access point. For example, a decision may be made based on the data type being transferred or based on the current channel load. Such factors may also be used by the access point for allocation determinations. In addition, allocation may be based on the type of roaming device involved, such as allocating peripherals to a slower channel.

50 Claims, 17 Drawing Sheets



US007873343B2

(12) **United States Patent**
Gollnick et al.

(10) **Patent No.: US 7,873,343 B2**
(45) **Date of Patent: *Jan. 18, 2011**

(54) **COMMUNICATION NETWORK TERMINAL WITH SLEEP CAPABILITY**

(75) Inventors: **Charles D. Gollnick**, Cedar Rapids, IA (US); **Ronald E. Luse**, Marion, IA (US); **John G. Pavek**, Cedar Rapids, IA (US); **Marvin L. Sojka**, Cedar Rapids, IA (US); **James D. Cnossen**, Marion, IA (US); **Arvin D. Danielson**, Cedar Rapids, IA (US); **Ronald L. Mahany**, Cedar Rapids, IA (US); **Mary L. Detweiler**, Parnell, IA (US); **Gary N. Spiess**, Lisbon, IA (US); **Guy J. West**, Cedar Rapids, IA (US); **Amos D. Young**, Cedar Rapids, IA (US); **Robert C. Meier**, Cedar Rapids, IA (US); **Keith K. Cargin, Jr.**, Cedar Rapids, IA (US); **Richard C. Arensdorf**, Ely, IA (US); **Robert G. Geers**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/468,698**

(22) Filed: **May 19, 2009**

(65) **Prior Publication Data**

US 2009/0247241 A1 Oct. 1, 2009

Related U.S. Application Data

(63) Continuation of application No. 10/630,138, filed on Jul. 29, 2003, now Pat. No. 7,536,167, which is a continuation of application No. 09/318,668, filed on May 25, 1999, now Pat. No. 7,558,557, which is a continuation of application No. 08/545,108, filed on

(51) **Int. Cl.** (Continued)
H04W 52/44 (2009.01)
H04W 52/28 (2009.01)

(52) **U.S. Cl.** **455/343.3**; 455/412.2; 455/517; 455/574

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

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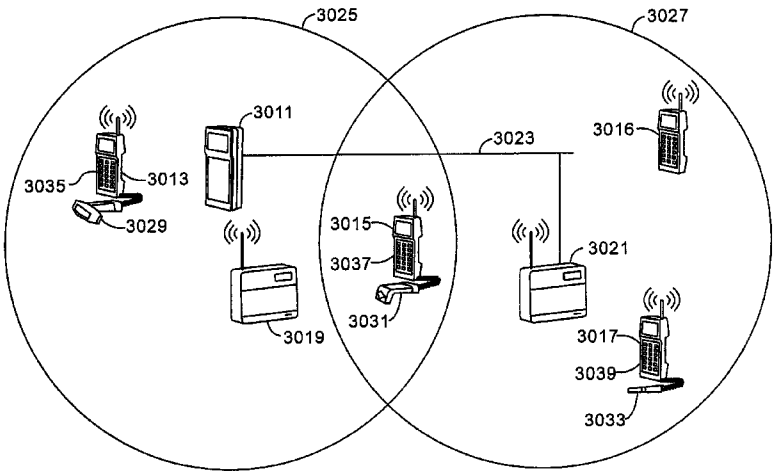
Primary Examiner—Philip J Sobutka
(74) *Attorney, Agent, or Firm*—McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

Improved apparatus for a radio communication system having a multiplicity of mobile transceiver units selectively in communication with a plurality of base transceiver units which, in turn, communicate with one or more host computers for storage and manipulation of data collected by bar code scanners or other collection means associated with the mobile transceiver units. A network controller and an adapter which has a simulcast and sequential mode provide selective interface between host computers and base transceivers. A scheme for routing data through the communication system is also disclosed wherein the intermediate base stations are organized into an optimal spanning-tree network to control the routing of data to and from the RF terminals and the host computer efficiently and dynamically. Additionally, redundant network and communication protocol is disclosed wherein the network utilizes a polling communication protocol which, under heavy loaded conditions, requires that a roaming terminal wishing to initiate communication must first determine that the channel is truly clear by listing for an entire interpoll gap time. In a further embodiment, a criterion used by the roaming terminals for attaching to a given base station reduces conflicts in the overlapping RF regions of adjacent base stations.

60 Claims, 26 Drawing Sheets



US007916747B2

(12) **United States Patent**
Meier

(10) **Patent No.: US 7,916,747 B2**
(45) **Date of Patent: *Mar. 29, 2011**

(54) **REDUNDANT RADIO FREQUENCY NETWORK HAVING A ROAMING TERMINAL COMMUNICATION PROTOCOL**

(75) Inventor: **Robert C. Meier**, Cedar Rapids, IA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 12 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/121,536**

(22) Filed: **May 15, 2008**

(65) **Prior Publication Data**

US 2008/0285489 A1 Nov. 20, 2008

Related U.S. Application Data

(63) Continuation of application No. 10/762,746, filed on Jan. 22, 2004, now Pat. No. 7,386,002, which is a continuation of application No. 09/960,265, filed on Sep. 21, 2001, now Pat. No. 6,714,559, which is a continuation of application No. 09/849,776, filed on May 4, 2001, now abandoned, which is a continuation of application No. 09/482,197, filed on Jan. 12, 2000, now abandoned, which is a continuation of application No. 08/941,496, filed on Sep. 30, 1997, now abandoned, which is a continuation of application No. 08/270,533, filed on Jul. 5, 1994, now Pat. No. 5,673,031.

(51) **Int. Cl.**
H04Q 1/00 (2006.01)

(52) **U.S. Cl.** **370/449**; 340/3.51

(58) **Field of Classification Search** 370/280, 370/256, 338, 346, 447, 449; 340/3.51
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Edwin C Holloway, III
(74) *Attorney, Agent, or Firm* — McAndrews, Held & Malloy, Ltd.

(57) **ABSTRACT**

Disclosed herein is a redundant network and communication protocol at least including host computers, RF base stations, and roaming terminals. The network may utilize a polling communication protocol such that under heavy traffic conditions, a roaming terminal wishing to initiate communication may be required to wait for at least a predetermined period and determine whether the channel is available for communication. When a hidden terminal is communicating, the roaming terminal may conclude that the communication is taking place upon receiving a polling frame directed to the hidden terminal from the normally silent base station. Inherent redundancy techniques may be used with a spanning tree approach for determining the most efficient pathways from a source to a destination and ensuring that the network adapts to spatial changes or breakdowns within the network.

25 Claims, 6 Drawing Sheets

