Exhibit 783–B: 35 U.S.C. § 103 References for U.S. Patent No. 10,797,783 Claims 1, 2, 3, 6, 13, 14, 15, and 16

To the extent Plaintiff contends that any particular prior art reference charted by Samsung lacks any feature, a person of ordinary skill in the art as of the '783 patent's purported invention date would, at a minimum, have been motivated to modify the reference to include the allegedly missing feature, or to combine it with other references that include that feature (as demonstrated in (a) Defendants' invalidity charts for other prior art references and/or (b) the chart below), as discussed in the cover document of Defendants' invalidity contentions.

The analysis in this chart is based on the Court's claim constructions and the apparent interpretations that Plaintiff has advanced to allege infringement of the asserted claims of the '783 patent, and Samsung's current understanding of the scope of the asserted claims associated therewith. Nothing in this chart should be interpreted as Samsung conceding that Plaintiff's interpretations are correct or supported by intrinsic or extrinsic evidence.

Further, as set forth in the cover document of Samsung's invalidity contentions, many of the claim terms in the asserted claims suffer from 35 U.S.C. § 112 issues, such as lack of written description, lack of enablement, and/or indefiniteness. Nothing in this chart should be taken as an admission or suggestion that the asserted claims meet the statutory requirements of 35 U.S.C. § 112.

Additionally, as set forth in the cover document of Samsung's invalidity contentions, many of the claim terms in the asserted claims suffer from 35 U.S.C. § 101 issues because they are not directed to patent-eligible subject matter. Nothing in this chart should be taken as an admission or suggestion that the asserted claims meet the statutory requirements of 35 U.S.C. § 101. For example, where Samsung has identified prior art disclosures any claims directed to patent ineligible subject matter, Samsung's disclosure is made based on Samsung's understanding of Plaintiff's apparent interpretation of the claims, despite the claims being directed to an abstract idea and lacking an inventive concept to transform that abstract idea into patent eligible subject matter.

To the extent Plaintiff submits new infringement theories and/or identifies additional limitations of the asserted claims that they contend are not disclosed by the prior art references charted by Samsung, either alone or in combination with Samsung's other cited prior art, Samsung expressly reserves the right to rebut any such contention. The chart below provides representative examples of where additional prior art references disclose elements of the asserted claims, under Samsung's present understanding of those claims and/or under the apparent application of the claims that Plaintiff applied in its infringement contentions. The cited evidence is merely illustrative, and Samsung reserves the right to cite alternative or additional evidence. Where the chart below states that any reference "discloses" a limitation, such disclosure may be express or inherent. Samsung also intends to offer expert testimony and opinions establishing the general knowledge of a person of ordinary skill in the art (POSITA), known design objectives, motivations to combine references and elements within the general knowledge of a POSITA, the state-of-the-art, how a POSITA would understand the disclosures of the cited prior art references, and any secondary considerations/objective indicia identified by Plaintiff.

Claims	**Prior Art**
1[pre]. A wireless network device, comprising:	"A wireless network device" was well known at the time of the alleged invention. A person of ordinary skill in the art would have found it obvious to modify an existing device to include the claimed elements as set forth below and in Defendants' other invalidity charts. For example: See, e.g.:

MASSIVELY BROADBAND, IPR2025-01605, Ex. 2073, Page 1 of 111

Claims	Prior Art
	783-A01 U.S. Pat. No. 6,584,080 (“Ganz ’080”) 783-A02 U.S. Pat. Pub. No. 2002/0028655(“Rosener ’655”) 783-A03 U.S. Pat. Pub. No. 2004/0160928 (“Perlman ’928”) 783-A04 U.S. Pat. No. 6,188,496 (“Krishna ’496”) 783-A05 U.S. Pat. No. 7,209,523 (“Larrick ’523”) 783-A06 U.S. Pat. No. 4,056,780 (“Faulkner ’780”) 783-A07 U.S. Pat. No. 6,497,656 (“Evans ’656”) 783-A08 U.S. Pat. Pub. No. 2003/0120809 (“Bellur ’809”) 783-A09 U.S. Pat. No. 8,125,940 (“Perlman ’940”) 783-A10 U.S. Pat. Pub. No. 2005/0201326 (“Lakkis ’326”) 783-A11 U.S. Pat. Pub. No. 2004/0048574 (“Walker ’574”) 786–A12 XtremeSpectrum Trinity Chipset Soomro ’456 at [0008] To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide, for use in an independent basic service set (IBSS) network, a dynamic frequency selection (DFS) process enabled by a DFS element within beacon and probe response frames defining a DFS owner, a DFS interval specifying the time until channel switch in beacon intervals, a DFS count specifying a time in beacon intervals until the dynamic frequency selection owner initiates selection of the next operating channel frequency from the supported channel set, and a DFS recovery interval specifying a time after the end of the DFS interval when recovery procedures are initiated if no channel switch information was received during the past DFS interval. Channel switch information is presented in beacons following the end of the channel selection process, and within beacons during the DFS recovery interval. Bareis ’373 at Abstract Broadband multi-drop local network, interface and method for multimedia access. A local network architecture include a wired bus coupleable directly to an external data network terminal and configured for carrying broadband packetized data traffic over a frequency spectrum uninterrupted by other defined data channels or services; and one or a plurality of network transceivers operable individually for coupling

Claims	Prior Art
	an addressable network device processing a defined class of information to the bus wherein each network appliance is configured for and further operable for providing communication interfacing of the class of information of each addressable network appliance with the packetized IP data traffic on the wired bus. Mandke 2003A at 5 TG3a has set out to develop a flexible standard which will enable high data rate WPAN (110 Mbps at 10m, 200 Mbps at 4m, and 480 Mbps at an unspecified distance) over a cost effective architecture. This new standard will enable a broad range of applications including the wireless transmission of images and video. The goal of this paper is to explore the unique design issues specific to UWB, engineering trade-offs faced by standards developers, and the current state of IEEE 802.15.3a. Section 2 will discuss the unique aspects of indoor UWB channels and the four of the proposed TG3a channel models. Section 3 compares a traditional impulse radio approach to UWB with a more recent multibanded approach (which has been employed in many TG3a proposals). Section 4 details the requirements and specifications set forth by IEEE 802.15.3a, and categorize the proposals being considered in order to form a clear picture of the current state of UWB technology as it relates to WPANs. Mandke 2003A at Page 24 **Company** | **Texas Instruments** Spectrum Allocation: # of bands | 3 (additional bands can be added in the future) Bandwidths | 503.25 MHz Frequency ranges | 3.168 GHz – 4.752 GHz Modulation Scheme | TFI-OFDM, QPSK Coexistence method | null band for WLAN (~5 GHz) Multiple access method | not available # of simultaneous piconets | not available Error correction codes | Convolutional code Code rates | 11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps Link margin | 5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps Symbol period | 312.5 ns OFDM symbol Multipath mitigation method | 1-tap (robust to 60.6 ns delay spread) A. Batra, et. al. "TI Physical Layer Proposal for IEEE 802.15 Task Group 3a," IEEE P802.15-03/142r0. March 3, 2003.

Claims	Prior Art
	Mandke 2003A at Page 24

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Ternary CDMA
# of simultaneous piconets	4 piconets/band
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

R. Roberts, "XtremeSpectrum CFP Document," IEEE P802.15-03/154r1. March 3, 2003.

Mandke 2003A at Page 27

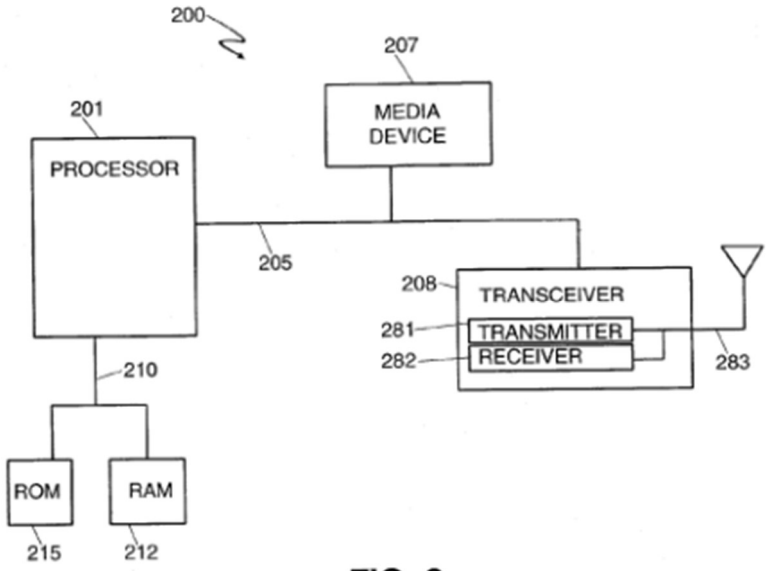
Company	Discrete Time
Spectrum Allocation:	
# of bands	15 bands
Bandwidths	500 MHz
Frequency ranges	3.1 GHz – 10.6 GHz,
Modulation Scheme	QPSK, FH
Coexistence method	sacrifice 2 band for WLAN coexistence (5 GHz)
Multiple access method	FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	½ @ 110 Mbps
Link margin	15.1 dB @ 4m @ 110 Mbps, 12 dB @ 4 m @ 220 Mbps, 11.1 dB @ 4 m @ 480 Mbps
Symbol period	8.9 ns @ 110 Mbps, 4.5 ns @ 200 Mbps, 2.1 ns @ 480 Mbps
Multipath mitigation method	not available

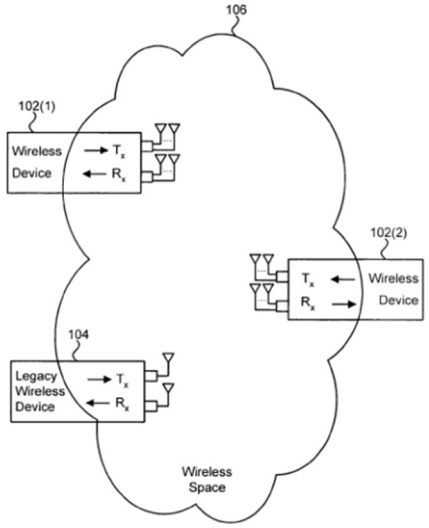
Roberto Aiello, "Discrete Time PHY Proposal for TG3a," IEEE 802.15-03/099r1. March 2003.

Claims	Prior Art
	Fontana at 2 UWB APPLICATIONS Figure 1 illustrates an ultra wideband, handheld transceiver that was designed for full duplex voice and data transmission at rates of up to 128 kb/s (CVSD) and 115.2 kb/s (RS232). The radio has an operational center frequency in L-band (1.5 GHz) with an instantaneous bandwidth of 400 MHz (27% fractional BW). Peak power output from the UWB transceiver was measured at 2.0 Watts, with a resultant average power (worst case) of 640 µW. This results in a worst case power density of 1.6 pW/Hz. These units have a range of approximately 1 to 2 km (with small antennas shown and line-of-sight), and an extended range of 10 to 20 miles with small gain antennas. Fontana at Figure 1 **Figure 1.** Full Duplex UWB Handheld Transceivers. Fontana at 3 As in the above example, this radio was capable of both digital voice and data transmission to 128 kb/s and had an operational range over water of approximately 10 miles using a standard SINCGARS (30-88 MHz) VHF military antenna. Operational range over land depended upon terrain, but was observed to be from 1 to 5 miles with intervening foliage, buildings and hills. [Note that multipath cancellation is a serious problem over water, even with UWB impulse technology, because of the typically low grazing angles (resulting in small differential delays between direct and reflected paths) and strong, out-of-phase reflection from the water surface. Thus, both higher frequency UWB systems as well as more conventional narrowband VHF/UHF radios were unable to provide the requisite performance.] Also unique to the receiver design was the addition of anti-jam circuitry to prevent loss of sensitivity due to strong, in-band interferers commonly observed in this frequency range. The units could also be operated in a "digipeater" mode in which packet store-and-forward techniques were used to transmit data from one radio to another via an intermediate repeater link.

Claims	Prior Art
	Fontana at Figure 6 **Figure 6.** UWB *Wireless Intercom Communications System* (WICS). McCorkle '032 at 11:49–12:5 The UWB transceiver of FIG. 1a or 2 may be used to perform a radio transport function for interfacing with different applications as part of a stacked protocol architecture. In such a configuration, the UWB transceiver performs signal creation, transmission and reception functions as a communications service to applications that send data to the transceiver and receive data from the transceiver much like a wired I/O port. Moreover, the UWB transceiver may be used to provide a wireless communications function to any one of a variety of devices that may include interconnection to other devices either by way of wired technology or wireless technology. Thus, the UWB transceiver of FIG. 1a or 2 may be used as part of a local area network (LAN) (connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example. In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention, as will be apparent to those skilled in the microprocessor systems art. Appropriate software can be readily prepared by programmers of ordinary skill based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. McCorkle '032 at 13:66–14:19 The processor system 301 also includes a communication interface 319 coupled to the bus 303. The communications interface 319 provides a two-way UWB data communication coupling to a network link 321 that is connected to a communications network 323 such as a local network (LAN) or personal area network (PAN)323. For example, the communication interface 319 may be a network interface card to attach to any packet switched UWB-enabled personal area network (PAN)323. As another example, the communication interface 319 may be a UWB accessible asymmetrical digital subscriber line (ADSL) card, an integrated services digital network (ISDN) card, or a modem to provide a data communication connection to a corresponding type of communications line. The communications interface 319 may also

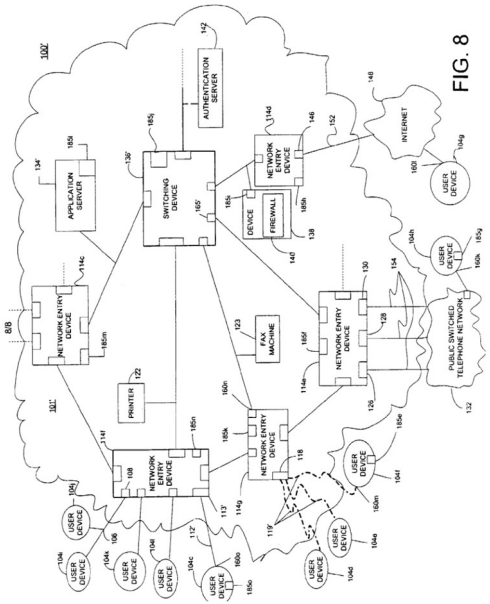
Claims	Prior Art
	include the hardware to provide a two-way wireless communications coupling other than a UWB coupling, or a hardwired coupling to the network link 321. Thus, the communications interface 319 may incorporate the UWB transceiver of FIG. 2 as part of a universal interface that includes hardwired and non-UWB wireless communications coupling to the network link 321. McCorkle '032 at 14:20–39 The network link 321 typically provides data communication through one or more networks to other data devices. For example, the network link 321 may provide a connection through a LAN to a host computer 325 or to data equipment operated by a service provider, which provides data communication services through an IP (Internet Protocol) network 327. Moreover, the network link 321 may provide a connection through a PAN323 to a mobile device 329 such as a personal digital assistant (PDA) laptop computer, or cellular telephone. The LAN/PAN communications network 323 and IP network 327 both use electrical, electromagnetic or optical signals that carry digital data streams. The signals through the various networks and the signals on the network link 321 and through the communication interface 319, which carry the digital data to and from the system 301, are exemplary forms of carrier waves transporting the information. The processor system 301 can transmit notifications and receive data, including program code, through the network(s), the network link 321 and the communication interface 319.

Claims	Prior Art
	Aiello ’273 at Fig. 2  FIG. 2 Gardner ’709 at Abstract A modified preamble is used by extended devices that operate at higher rates, MIMO or other extensions relative to strict 802.11a-compliant devices. The extended devices might use multiple antenna techniques (MIMO), where multiple data streams are multiplexed spatially and/or multi-channel techniques, where an extended transmitter transmits using more than one 802.11a channel at a time. Such extensions to IEEE 802.11a can exist in extended devices. The modified preamble is usable for signaling, to legacy devices as well as extended devices, to indicate capabilities and to cause legacy devices or extended devices to defer to other devices such that the common communication channel is not subject to unnecessary interference. The modified preamble. is also usable for obtaining MIMO channel estimates and/or multi-channel estimates. The modified preamble preferably includes properties that facilitate detection of conventional and/or extended modes (“mode detection”) and provides some level of coexistence with legacy IEEE 802.11a devices.

Claims	Prior Art
	Gardner ’709 at FIG. 3  FIG. 3 Gardner ’709 at [0014] FIG. 3 illustrates several devices coupled via a wireless network. Treadaway ’477 at 7:22–30 A router or switch 116 is coupled to the TFU 106, and hence, to the terminal 100, via cables 118 and 120. The cable 118 preferably communicates data in accordance with the 100BASE-TX or T4 Fast Ethernet standard, while the cable 120 preferably communicates data in accordance with the 10BASE-T Ethernet standard. Alternately, the cable 118 can be a fiber-optic cable, in which case, it preferably communicates data in accordance with 100BASE-FX Fast Ethernet standard. Treadaway ’477 at 7:42–68 A wired local area network (LAN) 128, such as an Ethernet LAN located within the building having the terminal 100, can be coupled to the router or switch 116. In addition, a wide area network (WAN) 130, such as a telephone service network which provides access to the world wide web, can be coupled to the LAN 128. Thus, the wireless link 102 can be accessed from one or more personal computers (PCs), data terminals, workstations or other conventional digital devices included in the LAN 128 or WAN 130. A

Claims	Prior Art
	network management system (NMS) 132 is coupled to any one or more of the router or switch 116, the LAN 128 or the WAN 130. The NMS 132 accesses the wireless link 102 and the terminals 100, 100′ for performing network management and link control functions (e.g. collecting data regarding operation of the MAN or changing the manner of data transmission over a particular link or links). If the NMS 132 is coupled to the LAN 128, this access is through the LAN 128. If the NMS 132 is coupled to the WAN 130, however, this access is remote via direct dial-up through a telephone service provider or via access through the world wide web. When network management and link control functions are accessed via the world wide web, a web browser is provided in the NMS 132, while a web server 236 (FIG. 3) is provided in the terminal 100. In the preferred embodiment, the DS 124 and the NMS 132 are each a personal computer, but can be another type of conventional digital device. Treadaway ’477 at 8:38–50 The TFU 106 provides three interfaces to customer equipment, including the router or switch 116 (FIG. 1) and the DS 124 (FIG. 1). These include a full-duplex 100 Mbps interface via the regenerator 200, a half-duplex 10 Mbps interface via the repeater 204 and an RS232 serial port via the converter 206. Though the payload data traffic is generally directed through the 100 Mbps interface while network management and link control traffic is generally directed through the 10 Mbps interface, a user of the terminal 100 can combine network management and link control signals with the payload data traffic in the 100 Mbps interface depending upon the particular capabilities of the router or switch 116 (FIG. 1). Engels ’850 at Abstract An indoor to outdoor unit is described for placement outside of a building and adjacent to a structural part of the building. The unit has first antenna means (12) for communication with at least one indoor antenna (13) placed inside said building, the first antenna means having a reflector for reflecting radio signals towards the inside of the building. For instance, the first antenna means may be adapted to be located with respect to a wall of the building in such a way that a part of the wall is situated in the near-field region of the first antenna means. The first antenna means may be adapted for connection to a cable network. Alternatively; the unit may also have a second antenna means (10) for communication with at least one outdoor antenna (9) located outside the building. The first and second antenna means are adapted for attachment to or located in a housing. In operation some signals received by the second antenna means (10) from the one outdoor antenna (9) are transmitted to the first antenna means (12) and some signals transmitted from the second antenna means (10) to the one outdoor antenna (9) are received from the first antenna means (12) so that the unit acts as a repeater.

Claims	Prior Art
	Engels ’850 at 2:13–22 A known solution to this problem is the insertion of a repeater in the radio link, as depicted in Fig. 3: the information is first transmitted from the transmitting antenna (1) to an auxiliary receiving antenna (4) associated with the repeater. In a second step, the repeater amplifies the received signal and re-transmits it from an auxiliary transmitting antenna (5) associated with the repeater, to the receiving antenna (2). The resulting capacity of the link is then given by expression 3: [Equation 3] where gain is the signal gain of the repeater, and Attenuation I and Attenuation 2 are the signal attenuations over the two radio links, respectively. Engels ’850 at 5:29 Fig. 3 shows a radio communications channel with repeater in side view. Engels ’850 at 7:17–30 A first aspect of the present invention provides a solution for indoor coverage for a wireless radio communications network by placing an indoor to outdoor coupling unit (10, 12) outside a structural part of a building such as the outer wall of the building, as shown in Fig. 5. To place the unit it is preferably portable, e.g. has a housing to which the antennas are attached or wherein they are included, as well as any electronics placed within the housing in a suitable sealed compartment required to control the environment inside the unit. The portable unit may be brought to site as a kit of parts that are there assembled and installed at the appropriate location. The unit may be battery powered or may have a suitable power connection, e.g. for connection to the mains or an optional solar cell battery charging system for keeping the batteries charged up. The indoor-outdoor device is preferably in the form of a self-contained unit that does not require an opening in the wall of the building, i.e. does not have two parts: an indoor antenna and an outdoor antenna with a connection there between which must pass through the wall. Engels ’850 at 13:27–14:2 Such an indoor-outdoor unit could, for instance, be used for transmitting digital data information between an outdoor antenna (e.g. a base station or an outdoor cell extending repeater) and one or more in-door computers. Alternatively, the indoor-outdoor coupling unit could be used for transmitting digital voice information between an outdoor antenna (e.g. a base station or an outdoor cell extending repeater) and an in-door telephony device or telephony network. Alternatively, the indoor-outdoor coupling unit could be used to communicate other forms of speech information, e.g. VOIP, or video information, such as e.g.

Claims	Prior Art
	Video-on-Demand or to provide connection to the Internet. Roese ’556 at Abstract A method for location discovery in a data network includes receiving, at a first device, connection information from a neighboring network device and determining a physical location of the first device based on the connection information. The method can include receiving, at the first device, the physical location transmitted from the neighboring network device. The method can further include associating a level of trust with the physical location based on the neighboring network device. The first device be one of a variety of devices, such as a router, a switch, a network entry device, a firewall device, or a gateway. Roese ’556 at FIG. 8  FIG. 8 Roese ’556 at 31:31–48 Network entry devices 114 and end user devices 104 can come in a wide array of configurations. For example, user devices 104 can include individual computers, printers, servers, cellular phones, laptops, handheld electronic devices, telephones, Internet Protocol (IP)-configured telephones, switch devices, and the like. Network entry devices 114 can include, for example, switches, routers, hubs, bridges, repeaters, wireless access points, data communications equipment, server computers, modems, multiplexers, Private

Claims	Prior Art
	Branch Exchanges (PBXs), virtually any devices used to interconnect data equipment or end devices, and the like. The discreet boundaries of infrastructure 101′ are for illustration only. For example, system 100′ may include a server outside of the illustrated boundary while remaining logically part of infrastructure 101′. In another example, there may be a portion of network infrastructure 101′ connected to system 100′ located in a remote network, such as Internet 148. 802-15-3a at PAR Form, Page 2 The intent of this project is to provide a standard for a low complexity, low cost, low power consumption alternate PHY for 802.15.3 (comparable to the goals for 802.15.3). The data rate will be high enough, 110 Mb/s or more (see 18a), to satisfy an evolutionary set of consumer multi-media industry needs for WPAN communications. The project will address the requirements to support multimedia data types in multiple compliant co-located systems and also coexistence (18b). **14. Intellectual Property:** **Sponsor has reviewed the IEEE patent policy with the working group?** Yes **Sponsor is aware of copyrights relevant to this project?** No **Sponsor is aware of trademarks relevant to this project?** No **Sponsor is aware of possible registration of objects or numbers due to this project?** No **15. Are you aware of other standards or projects with a similar scope?** No **Similar Scope Project Information:** **16. Is there potential for this standard (in part or in whole) to be submitted to an international organization for review/adoption?:** Do not Know **If yes, please answer the following questions:** **Which International Organization/Committee?** **International Contact Information?** **17. Will this project focus on Health, Safety or Environmental Issues?** No **18. Additional Explanatory Notes: (Item Number and Explanation)** 18a] The CFAs responses collected by study group 802.15.SG3a over the past several months indicate an evolutionary market developing for a group of applications that will not be addressed by 802.15.3. For example, high data rates, at least 110 Mb/s, will be required for simultaneous time dependent applications such as multiple HDTV video streams without sacrificing the requirements for low complexity, low cost, and low power consumption. In addition to at least 110 Mbps data rate, additional data rates, both lower and higher, may be supported. 18b] It is in the best interest of users and the industry to strive for a level of coexistence with other wireless systems, especially those in similar market spaces. Coexistence requirements will be established in SG3a selection criteria against which the proposals will be evaluated.
[1a] a wireless transmitter that tramsits wireless data throught electromagnetic signales that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless transmitter that tramsits wireless data throught electromagnetic signales that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless transmitter that tramsits wireless data throught electromagnetic signales that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless transmitter that tramsits wireless data throught electromagnetic signales that have a bandwidth greater than or equal to 100 MHz and less than or equal to

Claims	Prior Art
	500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. Soomro '456 at [0008] To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide, for use in an independent basic service set (IBSS) network, a dynamic frequency selection (DFS) process enabled by a DFS element within beacon and probe response frames defining a DFS owner, a DFS interval specifying the time until channel switch in beacon intervals, a DFS count specifying a time in beacon intervals until the dynamic frequency selection owner initiates selection of the next operating channel frequency from the supported channel set, and a DFS recovery interval specifying a time after the end of the DFS interval when recovery procedures are initiated if no channel switch information was received during the past DFS interval. Channel switch information is presented in beacons following the end of the channel selection process, and within beacons during the DFS recovery interval. Mandke 2003A at 2 IEEE 802.15.3 would not be able to provide the data rates necessary to support many of these applications. In November 2001, an additional task group within IEEE 802.15, Task Group 3a, was formed to identify a higher speed physical layer alternative that could support data rates between 110 Mbps and 480 Mbps over short ranges of less than 10 meters. The February 2002 FCC approval of ultra wideband (UWB) devices prompted many companies to consider UWB radio when proposing physical layers to IEEE 802.15.3a. Mandke 2003A at 3 In February of 2002, the FCC amended their Part 15 rules (concerning unlicensed radio devices) to include the operation of UWB devices without a license. The FCC defines UWB signals as having a fractional bandwidth of greater than 0.20 or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [2]. Mandke 2003A at 5 TG3a has set out to develop a flexible standard which will enable high data rate WPAN (110 Mbps at 10m, 200 Mbps at 4m, and 480 Mbps at an unspecified distance) over a cost effective architecture. This new standard will enable a broad range of applications including the wireless transmission of images and

Claims	Prior Art
	video. The goal of this paper is to explore the unique design issues specific to UWB, engineering trade-offs faced by standards developers, and the current state of IEEE 802.15.3a. Section 2 will discuss the unique aspects of indoor UWB channels and the four of the proposed TG3a channel models. Section 3 compares a traditional impulse radio approach to UWB with a more recent multibanded approach (which has been employed in many TG3a proposals). Section 4 details the requirements and specifications set forth by IEEE 802.15.3a, and categorize the proposals being considered in order to form a clear picture of the current state of UWB technology as it relates to WPANs. Mandke 2003A at Table 4 **Company** | **Texas Instruments** Spectrum Allocation: # of bands | 3 (additional bands can be added in the future) Bandwidths | 503.25 MHz Frequency ranges | 3.168 GHz – 4.752 GHz Modulation Scheme | TFI-OFDM, QPSK 13

Claims	Prior Art
	Mandke 2003A at Table 5

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Avoidance
# of simultaneous piconets	Ternary CDMA
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

Table 5: Overview of the XtremeSpectrum CFP Document [23].

Mandke 2003A at Table 6

Company	Intel
Spectrum Allocation:	
# of bands	7 (+ optional 6 bands for future use)
Bandwidths	550 MHz
Frequency ranges	3.6 GHz – 6.9 GHz, (7.45 GHz – 10.2 GHz optional)
Modulation Scheme	M-ary Bi-orthogonal Keying, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	DS/FH CDMA, optional FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	6/32 @ 110 Mbps, 5/16 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	6.3 dB @ 10 m @ 108 Mbps, 8.0 dB @ 4 m @ 288 Mbps, 4.0 dB @ 4 m @ 577 Mbps
Symbol period	3 ns
Multipath mitigation method	frequency interleaving of MBOK chips; time frequency codes; feed forward filter

Table 6: Overview of the Intel CFP Presentation for a UWB PHY [24].

Claims	Prior Art
	Mandke 2003A at Page 24

Company	Texas Instruments
Spectrum Allocation:	
# of bands	3 (additional bands can be added in the future)
Bandwidths	503.25 MHz
Frequency ranges	3.168 GHz – 4.752 GHz
Modulation Scheme	TFI-OFDM, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	not available
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

A. Batra, et. al. "TI Physical Layer Proposal for IEEE 802.15 Task Group 3a," IEEE P802.15-03/142r0. March 3, 2003.

Mandke 2003A at Page 24

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Ternary CDMA
# of simultaneous piconets	4 piconets/band
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

R. Roberts, "XtremeSpectrum CFP Document," IEEE P802.15-03/154r1. March 3, 2003.

Claims	Prior Art
	Mandke 2003A at Page 27

Company	Discrete Time
Spectrum Allocation:	
# of bands	15 bands
Bandwidths	500 MHz
Frequency ranges	3.1 GHz – 10.6 GHz,
Modulation Scheme	QPSK, FH
Coexistence method	sacrifice 2 band for WLAN coexistence (5 GHz)
Multiple access method	FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	½ @ 110 Mbps
Link margin	15.1 dB @ 4m @ 110 Mbps, 12 dB @ 4 m @ 220 Mbps, 11.1 dB @ 4 m @ 480 Mbps
Symbol period	8.9 ns @ 110 Mbps, 4.5 ns @ 200 Mbps, 2.1 ns @ 480 Mbps
Multipath mitigation method	not available

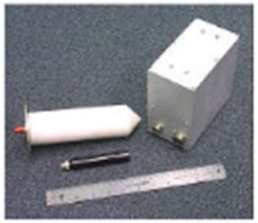
Roberto Aiello, "Discrete Time PHY Proposal for TG3a," IEEE 802.15-03/099r1. March 2003.

Fontana at 2

UWB APPLICATIONS

Figure 1 illustrates an ultra wideband, handheld transceiver that was designed for full duplex voice and data transmission at rates of up to 128 kb/s (CVSD) and 115.2 kb/s (RS232). The radio has an operational center frequency in L-band (1.5 GHz) with an instantaneous bandwidth of 400 MHz (27% fractional BW). Peak power output from the UWB transceiver was measured at 2.0 Watts, with a resultant average power (worst case) of 640 µW. This results in a worst case power density of 1.6 pW/Hz. These units have a range of approximately 1 to 2 km (with small antennas shown and line-of-sight), and an extended range of 10 to 20 miles with small gain antennas.

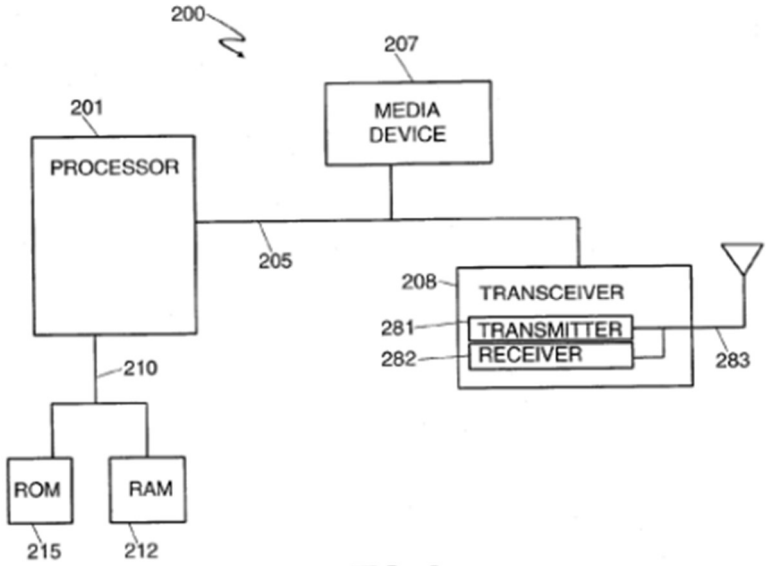
Claims	Prior Art
	Fontana at Figure 1 **Figure 1.** Full Duplex UWB Handheld Transceivers. Fontana at 3 Figure 3 illustrates a high-speed (up to 25 Mb/s) UWB radio designed for transmission of compressed video and command & control information across an asymmetric, bi-directional link. This system was also designed to operate in the 1.3 to 1.7 GHz region (27% fractional BW) with a 4W peak power output. An earlier design, developed under funding from the U.S. Defense Advanced research Projects Agency (DARPA), operated with a 500 MHz instantaneous bandwidth in the C-band region (5.4 to 5.9 GHz). Fontana at Figure 6 **Figure 6.** UWB *Wireless Intercom Communications System* (WICS). Fontana at 5 Ultra wideband technology was considered for this application because of its ability to transmit large amounts of data at high speed in a mobile, multipath-prone environment. The UWB tag operated in the L-band region (1.4 to 1.65 GHz) and had a peak output power of approximately 250 mW for a demonstrated range of over 300 meters. The image of the driver was stored as a compressed JPEG file, together with additional ASCII data, in EEPROM and periodically transmitted at a 400 kb/s burst rate to a UWB receiver with display. The tag operated off of two AAA batteries (3.0V) and, in an operational scenario,

Claims	Prior Art
	was mounted behind the front grill of the automobile. Fontana at 5 Figure 6 illustrates a set of prototype UWB transceivers designed for the U.S. Navy to provide a wireless intercom capability on-board Navy aircraft. The prototype UWB transceivers provide multichannel, full duplex, 32 kb/s digital voice over a range of approximately 100 meters. An ultra wideband waveform was selected because of its ability to operate in severe multipath (created by multiple RF reflections inside and around aircraft), and because of its non-interfering, low probability of intercept signature. Fontana at Figure 8  **Figure 8.** UWB Precision Geolocation System Transceiver. Fontana at 6 The system in Figure 8 utilizes a 2.5 ns, 4 Watt peak, UWB pulse, again operating in the 1.3 to 1.7 GHz region. Line-of-sight range for the system is better than 2 kilometers utilizing small, omnidirectional vertically polarized (smaller) or circularly polarized (larger) antennas. Within a building, the range becomes limited by wall and obstacle attenuation; however, ranges exceeding 100 meters inside have been attained. An unique feature of the system is the ability to detect the pulse leading edge through the use of a charge sensitive, tunnel diode detector. Leading edge detection is critical to the resolution of the direct path from the plethora of multipath returns produced from internal reflections. The UWB geolocation system was originally developed to permit a soldier to determine his or her position to within 1 foot resolution in an urban environment. It is currently being used to augment a video capture system for 3-D modeling, and for materiel location onboard a Navy ship.

Claims	Prior Art
	Fontana at Figure 10 **Figure 10.** UWB Backup Sensor. Fontana at 7 Several variants of the Hummingbird radar have also been developed. For example, Figure 10 illustrates an ultra wideband backup sensor for the detection of personnel, vehicles and other objects behind large construction and mining vehicles. [Figure 10] Operating with approximately 250 mW peak in the C-band region from 5.4 to 5.9 GHz, the backup sensor utilizes a dual antenna configuration for the detection of objects as close as 1 foot to beyond 350 feet from the vehicle. Ultra wideband provides a significant advantage for this application because of the ability to provide precision range gating to eliminate clutter which, with conventional Doppler-based sensors, often results in large false alarm rates. This sensor was developed for the National Institute of Occupational Safety and Health. McCorkle ’032 at Abstract A method for conveying application data via carrierless ultra wideband wireless signals, and signals embodied in a carrierless ultra wideband waveform. Application data is encoded into wavelets that are transmitted as a carrierless ultra wideband waveform. The carrierless ultra wideband waveform is received by an antenna, and the application data is decoded from the wavelets included in the waveform. The waveforms of the signals include wavelets that have a predetermined shape that is used to modulate the data. The signals may convey, for example, Web pages and executable programs between mobile devices. The signals are low power and can penetrate obstructions making them favorable for use with a wireless node of a network McCorkle ’032 at 2:3–7 1. Field of the Invention The present invention is directed to methods and signals for ultra wideband communications, and more

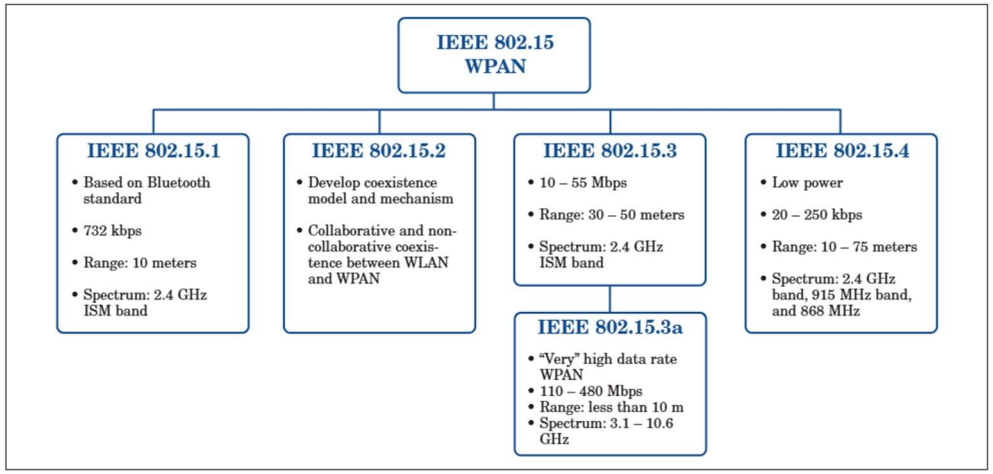
Claims	Prior Art
	particularly to methods and signals for conveying application data via carrierless ultra wideband wireless signals. McCorkle ’032 at 3:22–41 An object of the present invention is to provide a method for communicating information using carrierless wireless signals. The inventors of the present invention have recognized that low power carrierless transmissions can be effectively used to communicate at high data rates without interfering with narrowband or spread spectrum signals, and if the power is kept sufficiently low, the transmissions do not need to be as broadcast devices. Accordingly, another object of the present invention is to encode digital data into multi-phase wavelets that can be transmitted without a carrier at low power and at high data rates over short distances. In one embodiment, the present invention is implemented as a method for conveying application data with carrierless ultra wideband wireless signals. The application data is encoded into wavelets that are transmitted without modulating them onto a carrier waveform. In another embodiment, the present invention is implemented as a computer data signal that is embodied in a carrierless ultra wideband waveform. McCorkle ’032 at 3:57–58 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver, according to the present invention; McCorkle ’032 at 3:61–63 FIG. 2 is a block diagram of the transceiver of FIG. 1a, that manipulates a shape of UWB pulses, according to the present invention; and McCorkle ’032 at 4:4–15 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver. In FIG. 1a , the transceiver includes three major components, namely, receiver 11, radio controller and interface 9, and transmitter 13. Alternatively, the system may be implemented as a separate receiver 11 and radio controller and interface 9, and a separate transmitter 13 and radio controller and interface 9. The radio controller and interface 9 serves as a media access control (MAC) interface between the UWB wireless communication functions implemented by the receiver 11 and transmitter 13 and applications that use the UWB communications channel for exchanging data with remote devices.

Claims	Prior Art
	McCorkle ’032 at 4:16–26 The receiver 11 includes an antenna 1 that converts a UWB electromagnetic waveform into an electrical signal (or optical signal) for subsequent processing. The UWB signal is generated with a sequence of shape-modulated wavelets, where the occurrence times of the shape-modulated wavelets may also be modulated. For analog modulation, at least one of the shape control parameters is modulated with the analog signal. More typically, the wavelets take on M possible shapes. Digital information is encoded to use one or a combination of the M wavelet shapes and occurrence times to communicate information. McCorkle ’032 at 6:43–61 A feature of the present invention is that the M-ary parameter set used to control the wavelet shape is chosen so as to make a UWB signal, wherein the center frequency f_c and the bandwidth B of the power spectrum of g(t) satisfies $2f_c>B>0.25f_c$. It should be noted that conventional equations define in-phase and quadrature signals (e.g., often referred to as I and Q) as sine and cosine terms. An important observation, however, is that this conventional definition is inadequate for UWB signals. The present invention recognizes that use of such conventional definition may lead to DC offset problems and inferior performance. Furthermore, such inadequacies get progressively worse as the bandwidth moves away from $0.25f_c$ and toward $2f_c$. A key attribute of the exemplary wavelets (or e.g., those described in co-pending U.S. patent application Ser. No. 09/209,460) is that the parameters are chosen such that neither f nor h in Equation 2 above has a DC component, yet f and h exhibit the required wide relative bandwidth for UWB systems. McCorkle ’032 at 9:30–44 FIG. 2 is a block diagram of a transceiver embodiment of the present invention in which the modulation scheme employed is able to manipulate the shape and time of the UWB pulses. In FIG. 2, when receiving energy through the antenna 1, 15 (e.g., corresponding antennas 1 and 15 of FIG. 1a) the energy is coupled in to a transmit/receive (T/R) switch 27, which passes the energy to a radio front end 3. The radio front end 3 filters, extracts noise, and adjusts the amplitude of the signal before providing the same to a splitter 29. The splitter 29 divides the signal up into one of N different signals and applies the N different signals to different tracking correlators 31_1-31_N. Each of the tracking correlators 31_1-31_N receives a clock input signal from a respective timing generator 7_1-7_N of a timing generator module 7, 19, as shown in FIG. 2. McCorkle ’032 at 11:49–12:5 The UWB transceiver of FIG. 1a or 2 may be used to perform a radio transport function for interfacing with different applications as part of a stacked protocol architecture. In such a configuration, the UWB transceiver performs signal creation, transmission and reception functions as a communications service to

Claims	Prior Art
	applications that send data to the transceiver and receive data from the transceiver much like a wired I/O port. Moreover, the UWB transceiver may be used to provide a wireless communications function to any one of a variety of devices that may include interconnection to other devices either by way of wired technology or wireless technology. Thus, the UWB transceiver of FIG. 1a or 2 may be used as part of a local area network (LAN) (connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example. In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention, as will be apparent to those skilled in the microprocessor systems art. Appropriate software can be readily prepared by programmers of ordinary skill based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. Aiello '273 at Fig. 2  FIG. 2 Aiello '273 at [0003] The present invention relates to a system for transmitting data using Ultra Wide Band (UWB) radio frequencies. More particularly, this invention relates to a system using UWB to transmit data in a de-centralized system and where the data is time sensitive. Still more particularly, this invention relates to

Claims	Prior Art
	transmitting data using UWB in a home entertainment system. Aiello ’273 at [0014] UWB is a form of radio transmission. UWB employs short pulses of energy that spread across a wide range of frequencies. A UWB signal is a radio signal with a fractional bandwidth larger than 25%. For example, a UWB signal with a center frequency of 3 GHz has a minimum bandwidth of 750 MHz. Unlike conventional RF technologies, UWB modulates information into RF signals with a series of baseband, pulsed emissions transmitted without a carrier signal. Aiello ’273 at [0015] Therefore UWB has several inherent features that make UWB desirable for use for wireless communications for systems, such as home entertainment systems. First, UWB signals utilize a spectrum of frequencies already designated for other devices. Secondly, UWB signals also have a low power density which allows coexistence with other RF devices with minimal interference. Thirdly, UWB has a low probability of multi-path fading and interference. Aiello ’273 at [0017] The above and other problems are solved and an advance in the art is made by the De-centralized UWB system of this invention. This invention provides a wireless system that has a high data transfer rate required for multi-media applications such as video. This invention also provides high stability under a wide range of loads. Loads mean the amount of RF transmissions in an environment. This invention also provides a wireless system that supports mixed traffic. Mixed traffic is priority, dedicated traffic such as video and audio data as well as burst traffic used for applications such as Internet access. Aiello ’273 at [0019] In accordance with this invention, each device in the system includes a transceiver having an RF transmitter and RF receiver. The transmitter and receiver are each configured to operate with UWB signals. The transceiver is connected to a processing unit that executes applications to transmit and receive data packets via UWB. Aiello ’273 at [0020] The processing unit executes instructions from software stored in a memory of firmware to transmit data in accordance with this invention. In accordance with this invention, the processor in a device that

Claims	Prior Art
	requires a data transmission receives UWB signals being transmitted. When the device detects the system is idle of transmissions, the processor directs the transmitter to transmit arbitration pulses. The processor then waits to receive arbitration pulse signals from other devices requiring a data transmission. The processor then determines whether device has control of the system. Aiello '273 at [0021] If the device has control of the system, the processor generates a control header including synchronization data. The synchronization data is used as described below by receiving devices to adjust a local clock for use in processing the received data. Encryption initialization data, link adaptation data, a source address of the transmitting device, a destination address of devices to receive the data, and a length of a data field of the packet may also be included in the control header. The control header is then placed in a data packet and sent to the transmitter. The transmitter then transmits the data packet using UWB. Aiello '273 at [0045] Transceiver 208 receives and transmits data to processing unit 201 via I/O bus 205. Transceiver 208 includes a transmitter 281 which receives data from processing unit 201 and converts the data to UWB signals that are then applied to antenna 283 for transmission. In transmitter 208, circuitry may shape the time domain signal so that the associated spectrum optimizes the antenna transfer function for minimum transmission loss. Aiello '273 at [0055] fter the payload is generated, the processor in the transmitting device generates the payload in step 335 from the control header and generated payload. The processor then transmits the packet to the transceiver. The transmitter in the transceiver then transmits the packet in UWB signals. Aiello '273 at [0059] A process 400 by which a device in decentralized network 100 receives and processes packets is illustrated in FIG. 4. Process 400 begins when a processor in a receiving device receives a packet that was converted to data by a receiver in the device from UWB signals received by the device in step 405. In step 410, the control header of the received packet is read. From the control header, the processor in receiving device determines whether the packet is addressed to the receiving device in step 420. If the packet is not addressed to the receiving device, process 400 may end or wait until another packet is received.

Claims	Prior Art
	Mandke 2003B at 23 On February 14, 2002, the FCC amended the Part 15 rules which govern unlicensed radio devices to include the operation of ultra wideband (UWB) devices. The use of UWB under the FCC guidelines [1] offers tremendous capacity potential (several Gbps) over short ranges (less than 10 meters) at low radiated power (mean EIRP of –41.3 dBm/MHz). The FCC defines UWB signals as having a fractional bandwidth (the ratio of baseband bandwidth to RF carrier frequency) of greater than 0.20, or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [9]. Mandke 2003B at Figure 2  Figure 2 · Organization of IEEE 802.15. Mandke 2003B at 23 The fact that the FCC specified that UWB be a minimum bandwidth of 500 MHz is important—while UWB can occupy several GHz of bandwidth using small pulses (as pioneered by Xtreme Spectrum and Time Domain [23], [30]), the 500 MHz bandwidth rule has provided the impetus for chip makers to consider channelization, or a multiband approach, in the UWB standardization activity, mainly as a hedge against foreign governments who may not authorize the full U.S. 3.1 to 10.6 GHz allocation. Mandke 2003B at 25 After its July 2003 meeting, TG3a is now left with two primary contenders: (1) The Texas Instruments

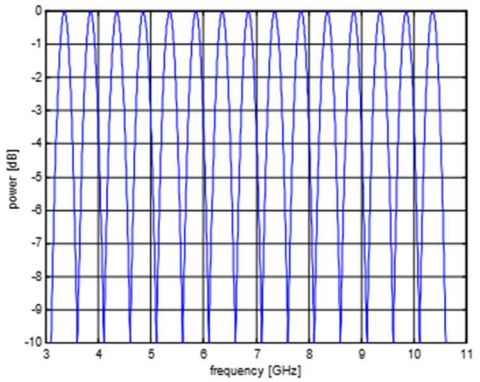
Claims	Prior Art
	OFDM-based multiband approach which uses 528 MHz channels (three mandatory lower band channels and four optional upper band channels) supported by the Multiband-OFDM Coalition, and (2) the Xtreme Spectrum-Motorola dual-band Impulse Radio spread spectrum approach, where there is a high band (above the 5.2 - 5.8 GHz unlicensed band) and a low band (from 3.1 GHz to just below the 5.2 - 5.8 GHz unlicensed band), and which exploits all of the UWB spectrum allocation. Discrete Time Proposal at Slide 5 ***Summary*** • Compliant with FCC 02-48, UWB Report & Order • 3.1-10.6GHz, 500MHz band spacing • Varies symbol rate and number of bands, from 16Mbps to 600Mbps at PHY-SAP • Scalable down to lower bit rates for lower power, lower cost • Due to time constraints this presentation addresses – Frequency plan – Modulation scheme – Performance in AWGN channel – MAC considerations – Location awareness (contribution from Uri Kareev, Pulsicom) – Concepts of pulse shaping and multiple access • Remaining material will be presented at the next opportunity in May 2003 – Performance in multipath – Channelization – Implementation feasibility – Self evaluation criteria – Other issues that will emerge from group's feedback

Claims	Prior Art
	Discrete Time Proposal at Slide 7 ***FCC compliant*** • It is UWB but is similar in principle to frequency hopping • FCC compliant according to FCC UWB R&O • In this proposal the transmit signal occupies 500MHz **at all times**: frequency change is used to reduce ISI, not to spread the spectrum • "Thus, as long as the transmission system **complies with** the fractional bandwidth or **minimum bandwidth requirements** at all times during its transmission, we agree that it should be permitted to operate under the UWB regulations. We recognize that **this may preclude** certain types of modulations, such as swept frequency (e.g., FMCW), stepped frequency or **frequency hopping systems**. The current measurement procedures require that measurements of swept frequency devices be made with the frequency sweep stopped." [FCC UWB R&O, B-32]

Claims	Prior Art
	Discrete Time Proposal at Slide 8

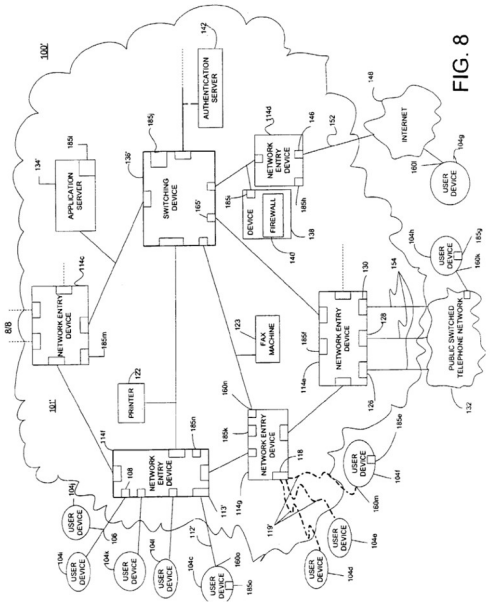
Multi-band frequency plan

band#	fc (GHz)	fl (GHz)	fh (GHz)
1	3.35	3.1	3.6
2	3.85	3.6	4.1
3	4.35	4.1	4.6
4	4.85	4.6	5.1
5	5.35	5.1	5.6
6	5.85	5.6	6.1
7	6.35	6.1	6.6
8	6.85	6.6	7.1
9	7.35	7.1	7.6
10	7.85	7.6	8.1
11	8.35	8.1	8.6
12	8.85	8.6	9.1
13	9.35	9.1	9.6
14	9.85	9.6	10.1
15	10.35	10.1	10.6



- 500MHz bandwidth at –10dB point
- Spaced 500MHz away

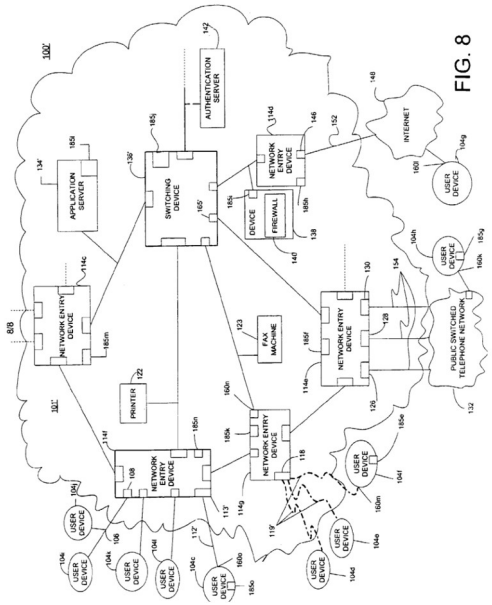
Claims	Prior Art
	Discrete Time Proposal at Slide 17 ***Multiple access scheme: fractional bands*** band# | fc (GHz) | fl (GHz) | fh (GHz) 1 | 3.35 | 3.1 | 3.6 2 | 3.85 | 3.6 | 4.1 3 | 4.35 | 4.1 | 4.6 4 | 4.85 | 4.6 | 5.1 5 | 5.35 | 5.1 | 5.6 6 | 5.85 | 5.6 | 6.1 7 | 6.35 | 6.1 | 6.6 8 | 6.85 | 6.6 | 7.1 9 | 7.35 | 7.1 | 7.6 10 | 7.85 | 7.6 | 8.1 11 | 8.35 | 8.1 | 8.6 12 | 8.85 | 8.6 | 9.1 13 | 9.35 | 9.1 | 9.6 14 | 9.85 | 9.6 | 10.1 15 | 10.35 | 10.1 | 10.6 band# | fc (GHz) | fl (GHz) | fh (GHz) 1.5 | 3.6 | 3.35 | 3.85 2.5 | 4.1 | 3.85 | 4.35 3.5 | 4.6 | 4.35 | 4.85 4.5 | 5.1 | 4.85 | 5.35 5.5 | 5.6 | 5.35 | 5.85 6.5 | 6.1 | 5.85 | 6.35 7.5 | 6.6 | 6.35 | 6.85 8.5 | 7.1 | 6.85 | 7.35 9.5 | 7.6 | 7.35 | 7.85 10.5 | 8.1 | 7.85 | 8.35 11.5 | 8.6 | 8.35 | 8.85 12.5 | 9.1 | 8.85 | 9.35 13.5 | 9.6 | 9.35 | 9.85 14.5 | 10.1 | 9.85 | 10.35 • Fractional bands are placed between the integer bands: their center frequencies are 250MHz off with respect to the integer bands • This allows frequency division multiplexing • Collision with co-located piconets is further reduced by hopping sequences and low duty cycle Engels ’850 at Abstract An indoor to outdoor unit is described for placement outside of a building and adjacent to a structural part of the building. The unit has first antenna means (12) for communication with at least one indoor antenna (13) placed inside said building, the first antenna means having a reflector for reflecting radio signals towards the inside of the building. For instance, the first antenna means may be adapted to be located with respect to a wall of the building in such a way that a part of the wall is situated in the near-field region of the first antenna means. The first antenna means may be adapted for connection to a cable network. Alternatively; the unit may also have a second antenna means (10) for communication with at least one outdoor antenna (9) located outside the building. The first and second antenna means are adapted for attachment to or located in a housing. In operation some signals received by the second antenna means (10) from the one outdoor antenna (9) are transmitted to the first antenna means (12) and some signals transmitted from the second antenna means (10) to the one outdoor antenna (9) are received from the first antenna means (12) so that the unit acts as a repeater. Roese ’556 at Abstract A method for location discovery in a data network includes receiving, at a first device, connection

Claims	Prior Art
	information from a neighboring network device and determining a physical location of the first device based on the connection information. The method can include receiving, at the first device, the physical location transmitted from the neighboring network device. The method can further include associating a level of trust with the physical location based on the neighboring network device. The first device be one of a variety of devices, such as a router, a switch, a network entry device, a firewall device, or a gateway. Roese '556 at FIG. 8  FIG. 8 Roese '556 at 31:31–48 Network entry devices 114 and end user devices 104 can come in a wide array of configurations. For example, user devices 104 can include individual computers, printers, servers, cellular phones, laptops, handheld electronic devices, telephones, Internet Protocol (IP)-configured telephones, switch devices, and the like. Network entry devices 114 can include, for example, switches, routers, hubs, bridges, repeaters, wireless access points, data communications equipment, server computers, modems, multiplexers, Private Branch Exchanges (PBXs), virtually any devices used to interconnect data equipment or end devices, and the like. The discreet boundaries of infrastructure 101′ are for illustration only. For example, system 100′ may include a server outside of the illustrated boundary while remaining logically part of infrastructure 101′. In another example, there may be a portion of network infrastructure 101′ connected to system 100′

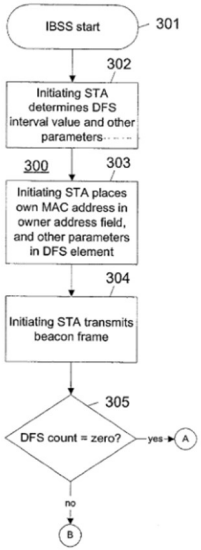
Claims	Prior Art
	located in a remote network, such as Internet 148. 802-15-3a at PAR Form, Page 2 The intent of this project is to provide a standard for a low complexity, low cost, low power consumption alternate PHY for 802.15.3 (comparable to the goals for 802.15.3). The data rate will be high enough, 110 Mb/s or more (see 18a), to satisfy an evolutionary set of consumer multi-media industry needs for WPAN communications. The project will address the requirements to support multimedia data types in multiple compliant co-located systems and also coexistence (18b). **14. Intellectual Property:** **Sponsor has reviewed the IEEE patent policy with the working group?** Yes **Sponsor is aware of copyrights relevant to this project?** No **Sponsor is aware of trademarks relevant to this project?** No **Sponsor is aware of possible registration of objects or numbers due to this project?** No **15. Are you aware of other standards or projects with a similar scope?** No **Similar Scope Project Information:** **16. Is there potential for this standard (in part or in whole) to be submitted to an international organization for review/adoption?:** Do not Know **If yes, please answer the following questions:** **Which International Organization/Committee?** **International Contact Information?** **17. Will this project focus on Health, Safety or Environmental Issues?** No **18. Additional Explanatory Notes: (Item Number and Explanation)** 18a] The CFAs responses collected by study group 802.15.SG3a over the past several months indicate an evolutionary market developing for a group of applications that will not be addressed by 802.15.3. For example, high data rates, at least 110 Mb/s, will be required for simultaneous time dependent applications such as multiple HDTV video streams without sacrificing the requirements for low complexity, low cost, and low power consumption. In addition to at least 110 Mbps data rate, additional data rates, both lower and higher, may be supported. 18b] It is in the best interest of users and the industry to strive for a level of coexistence with other wireless systems, especially those in similar market spaces. Coexistence requirements will be established in SG3a selection criteria against which the proposals will be evaluated.
[1b] a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1a].

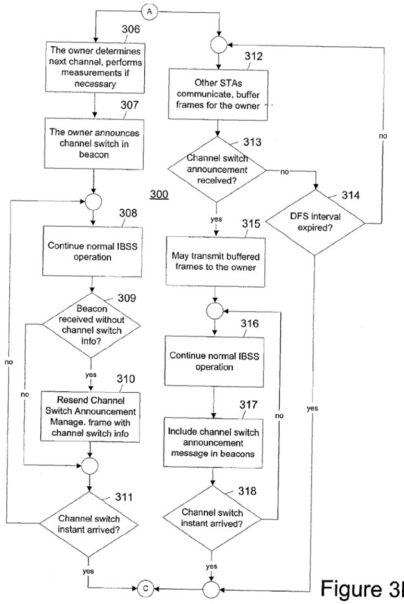
Claims	Prior Art
[1c] wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver;	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" would have been incorporated into a wireless network device with reasonable expectation of success. Fontana at 3 As in the above example, this radio was capable of both digital voice and data transmission to 128 kb/s and had an operational range over water of approximately 10 miles using a standard SINCGARS (30-88 MHz) VHF military antenna. Operational range over land depended upon terrain, but was observed to be from 1 to 5 miles with intervening foliage, buildings and hills. [Note that multipath cancellation is a serious problem over water, even with UWB impulse technology, because of the typically low grazing angles (resulting in small differential delays between direct and reflected paths) and strong, out-of-phase reflection from the water surface. Thus, both higher frequency UWB systems as well as more conventional narrowband VHF/UHF radios were unable to provide the requisite performance.] Also unique to the receiver design was the addition of anti-jam circuitry to prevent loss of sensitivity due to strong, in-band interferers commonly observed in this frequency range. The units could also be operated in a "digipeater" mode in which packet store-and-forward techniques were used to transmit data from one radio to another via an intermediate repeater link.
[1d] wherein the wireless network device is configured for processing wireless data received by the wireless receiver, and	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further

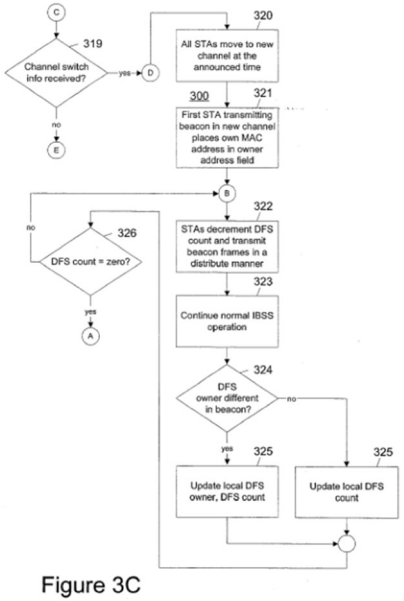
Claims	Prior Art
	demonstrate that the claimed “wherein the wireless network device is configured for processing wireless data received by the wireless receiver” would have been incorporated into a wireless network device with reasonable expectation of success. Fontana at 3 As in the above example, this radio was capable of both digital voice and data transmission to 128 kb/s and had an operational range over water of approximately 10 miles using a standard SINCGARS (30-88 MHz) VHF military antenna. Operational range over land depended upon terrain, but was observed to be from 1 to 5 miles with intervening foliage, buildings and hills. [Note that multipath cancellation is a serious problem over water, even with UWB impulse technology, because of the typically low grazing angles (resulting in small differential delays between direct and reflected paths) and strong, out-of-phase reflection from the water surface. Thus, both higher frequency UWB systems as well as more conventional narrowband VHF/UHF radios were unable to provide the requisite performance.] Also unique to the receiver design was the addition of anti-jam circuitry to prevent loss of sensitivity due to strong, in-band interferers commonly observed in this frequency range. The units could also be operated in a "digipeater" mode in which packet store-and-forward techniques were used to transmit data from one radio to another via an intermediate repeater link.

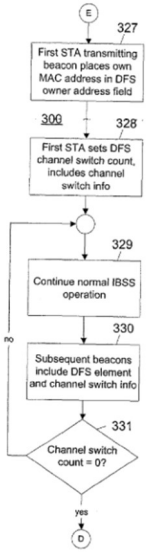
Claims	Prior Art
	Roese ’556 at FIG. 8  FIG. 8
[1e] wherein the wireless network is configured for determining whether and, a portion, or all information in the processed wireless data should be transmitted by the wireless transmitter,	It was well known and routine at the time of the alleged invention for a wireless network device to include “wherein the wireless network is configured for determining whether and, a portion, or all information in the processed wireless data should be transmitted by the wireless transmitte.” To the extent a wireless network device disclosed in any of Defendants’ other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include “wherein the wireless network is configured for determining whether and, a portion, or all information in the processed wireless data should be transmitted by the wireless transmitte” as claimed in light of the teachings in the references set forth below and in Defendants’ other invalidity charts. These prior art references further demonstrate that the claimed “wherein the wireless network is configured for determining whether and, a portion, or all information in the processed wireless data should be transmitted by the wireless transmitte” would have been incorporated into a wireless network device with reasonable expectation of success. Fontana at 3 As in the above example, this radio was capable of both digital voice and data transmission to 128 kb/s and had an operational range over water of approximately 10 miles using a standard SINCGARS (30-88 MHz) VHF military antenna. Operational range over land depended upon terrain, but was observed to be

Claims	Prior Art
	from 1 to 5 miles with intervening foliage, buildings and hills. [Note that multipath cancellation is a serious problem over water, even with UWB impulse technology, because of the typically low grazing angles (resulting in small differential delays between direct and reflected paths) and strong, out-of-phase reflection from the water surface. Thus, both higher frequency UWB systems as well as more conventional narrowband VHF/UHF radios were unable to provide the requisite performance.] Also unique to the receiver design was the addition of anti-jam circuitry to prevent loss of sensitivity due to strong, in-band interferers commonly observed in this frequency range. The units could also be operated in a "digipeater" mode in which packet store-and-forward techniques were used to transmit data from one radio to another via an intermediate repeater link.
[1f] wherein the wireless network device is configured for transmitting beacon frames with the wireless transmitter.	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for transmitting beacon frames with the wireless transmitter." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for transmitting beacon frames with the wireless transmitter" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless network device is configured for transmitting beacon frames with the wireless transmitter" would have been incorporated into a wireless network device with reasonable expectation of success. Soomro '456 at Abstract Dynamic frequency selection for an IEEE 802.11 basic service set network is enabled by a dynamic frequency selection (DFS) element within beacon and probe response frames defining a DFS owner, a DFS interval specifying the time until channel switch in beacon intervals, a DFS count specifying a time in beacon intervals until the DFS owner initiates selection of the next channel frequency from the supported channel set, and a DFS recovery interval specifying a time after the end of the DFS interval when recovery procedures are initiated if no channel switch information was received during that DFS interval. Channel switch information is presented in beacons following the end of the channel selection process, and within beacons during the DFS recovery interval.

Claims	Prior Art
	Soomro ’456 at FIG. 3A  Figure 3A

Claims	Prior Art
	Soomro ’456 at FIG. 3B  Figure 3B

Claims	Prior Art
	Soomro ’456 at FIG. 3C  Figure 3C

Claims	Prior Art
	Soomro ’456 at FIG. 3D  Figure 3D Soomro ’456 at [0008] To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide, for use in an independent basic service set (IBSS) network, a dynamic frequency selection (DFS) process enabled by a DFS element within beacon and probe response frames defining a DFS owner, a DFS interval specifying the time until channel switch in beacon intervals, a DFS count specifying a time in beacon intervals until the dynamic frequency selection owner initiates selection of the next operating channel frequency from the supported channel set, and a DFS recovery interval specifying a time after the end of the DFS interval when recovery procedures are initiated if no channel switch information was received during the past DFS interval. Channel switch information is presented in beacons following the end of the channel selection process, and within beacons during the DFS recovery interval. Soomro ’456 at [0013] FIG. 2 is a data structure diagram of the DFS element portion of beacon and probe response frames employed in wireless communications with dynamic frequency selection according to one embodiment of

Claims	Prior Art
	the present invention; Soomro ’456 at [0014] FIGS. 3A-3D depict a high level flowchart for a process of employing beacon frames with a DFS element within an IBSS network according to one embodiment of the present invention; Soomro ’456 at [0026] Additionally, wireless stations seeking to initiate wireless network communications with wireless networks 101-103 transmit probe request frames, to which at least one station within the receiving wireless network 101-103 responds with a management frame of the probe response subtype. Those skilled in the art will recognize that the content of IEEE 802.11 beacon and probe response frames is substantially similar. As with all IEE 802.11 management frames, each beacon and probe response frame begins with a media access control (MAC) header including frame control, frame duration, destination address (DA), source address (SA), basic service set identification (BSSID), and sequence control information and ends with a frame check sequence (FCS). Soomro ’456 at [0027] The bodies of beacon and probe response frames contain similar elements including a timestamp, a beacon interval, capability information, service set identification (SSID), an identification of supported rates, a frequency-hopping (FH) parameter set in frames from stations utilizing frequency-hopping physical (PHY) layer, a direct sequence (DS) parameters in frames from stations utilizing direct sequence physical (PHY) layer, a contention free (CF) parameter set in frames from access points supporting point coordination function (PCF), and an independent basic service set parameter set in frames from stations within an IBSS network. In the present invention, the beacon and probe response frame bodies also include a DFS parameter set as described in further detail below, either in addition to or in lieu of other parameter sets, in frames from stations (STAs). Soomro ’456 at [0034] FIGS. 3A through 3D depict a high level flowchart for a process of employing beacon frames with a DFS element within an IBSS network according to one embodiment of the present invention. Those skilled in the art will recognize that a substantially similar process, suitably modified, may be employed for probe response frames and/or infrastructure BSS networks.

Claims	Prior Art
	Soomro ’456 at [0035] Referring first to FIG. 3A, the process 300 begins during the IBSS start phase (step 301) with the STA initiating the IBSS network selecting a DFS interval value (step 302), together with values for the beacon interval and announcement traffic information message (ATIM) size, the channel sets to be supported by all stations within the IBSS network, and the BSS basic rate set/operational rate set, as in the case of IEEE 802.11-1999. The initiating station takes the ownership of the first channel selection process and includes its own MAC address within the DFS owner address parameter of the DFS information element of the beacon frame (step 303). Soomro ’456 at [0036] The initiating STA then transmits the beacon frame in a distributed manner based on the beacon transmission rule within the IEEE 802.11-1999 standard. Upon receiving a beacon frame, each receiving STA updates the locally stored DFS owner and DFS count values—that is, replaces the old DFS owner address and DFS count with the new values found in the received beacon frame, effectively replacing the DFS owner if different from that specified within the most recently received prior beacon. Soomro ’456 at [0037] In the normal situation, any STA subsequently transmitting a beacon frame decrements the DFS count value within the transmitted frame by one, if the DFS count value is not already equal to zero. If the DFS count value is zero, the beacon is transmitted with a DFS count of zero. If any STA experiences bad channel conditions, that station is permitted to decrease the DFS count value to any value larger than one, allowing the network to remain within a channel in which one STA experiences bad channel conditions, although other STAs possibly do not experience such bad channel conditions, for a shorter time. Soomro ’456 at [0038] As long as the DFS count value is non-zero (step 305), STAs transmitting beacon frames at beacon intervals continue to decrement the DFS count value within the transmitted frame. Soomro ’456 at [0039] Referring to FIG. 3B, in which steps 306-311 apply only to the DFS owner STA and steps 312-318 apply to all STAs other than the DFS owner, immediately after receiving a beacon with a DFS count value of zero, the DFS owner STA within the IBSS network performs channel measurements (step 307), if necessary, to enable selection of a new channel. The channel(s) selected and measured are limited to the

Claims	Prior Art
	BSS supported channel set. When the DFS owner STA has completed any required measurements and the channel switch decision, the DFS owner STA announces, within the current channel, the next channel to be utilized by the IBSS network through the next beacon frame or the channel switch announcement information element within a channel switch announcement management frame addressed to the broadcast address (step 307), whichever comes first. Normal IBSS operations are then continued (step 308). Soomro '456 at [0040] While the DFS owner STA is out of the current channel performing channel measurements and selecting the next channel, the remaining STAs communicate normally, except that frames addressed to the DFS owner STA are held and buffered (step 312). The buffered frames may be transmitted to the DFS owner STA when that STA returns to the current channel (step 315), which is known by the receipt of a beacon or channel switch announcement management frame with a channel switch announcement element from the DFS owner STA (step 313). As long as no channel switch announcement is received and the DFS interval has not expired (step 314), all STAs other than the DFS owner continue communicating and buffering frames as necessary (step 312). Soomro '456 at [0041] All STAs which receive the beacon or channel switch announcement management frame with the channel switch announcement element from the DFS owner STA continue with normal IBSS operation (step 316) but include the channel switch information within their subsequent beacon frames (step 317) before the channel switch time is reached (step 318). After the channel switch, none of the STAs will include such channel switch information within beacon frames until another beacon or channel switch announcement management frame with a channel switch announcement information element is received, unless recovery procedures are initiated as described below. Soomro '456 at [0042] After announcing the channel switch, the DFS owner STA continues normal IBSS operation (step 308) but checks subsequent beacons from other STAs for the channel switch announcement information element (step 309). If a beacon following the initial beacon or channel switch announcement management frame with the channel switch announcement information element lacks the channel switch announcement information element, the DFS owner STA transmits another channel switch announcement management frame with the channel switch announcement information element (step 310). This may be necessary when a STA which did not receive either the first beacon or channel switch announcement management

Claims	Prior Art
	frame with the channel switch announcement information element or the following beacons with the channel switch announcement information element happens to send a beacon. The DFS owner STA checks all received beacons and retransmits the channel switch announcement management frame with the channel switch announcement information element until the channel switch time (step 316), the target beacon transmission time. Soomro '456 at [0043] Referring now to FIG. 3C, if the channel switch information has been received (step 319) prior to expiration of the DFS interval (step 311 and 318 in FIG. 3B), all STAs move into the announced frequency channel at or immediately before the channel switch/target beacon transmission time (step 319). The first STA transmitting a beacon in the new channel places its own MAC address in the owner address field (step 320), taking ownership of the dynamic frequency selection process, and sets the DFS count value. While the DFS count value may be set to any value less than the DFS interval, the DFS count should be large enough to allow for several beacon transmissions with a non-zero DFS count value. Similarly, the total duration implied by the DFS count and the maximum measurement duration of the DFS owner station should be less than the DFS interval by a margin sufficient to insure that the channel switch announcement information element is conveyed several times within beacons for the IBSS network prior to the channel switch. Soomro '456 at [0044] The first beacon transmitted in the new channel may not be received correctly by a particular STA as a result of channel errors or collision. That STA, in transmitting a subsequent beacon, will therefore erroneously believe that the beacon being transmitted is the first beacon within the new channel. To handle such beacon errors, any STA that receives a valid beacon within the new channel containing a DFS owner address which differs from a locally stored DFS owner address updates the locally stored information with the new information from the beacon. With a sufficient number of beacon intervals in the new channel, the chance of having any discrepancy in locally stored DFS owner addresses across the STAs within the IBSS is minimal. Soomro '456 at [0045] Accordingly, STAs transmitting beacons after the first beacon in the new channel decrement the DFS count (step 321), and IBSS operations continue normally (step 322) except all STAs receiving any beacons within the new channel check the DFS owner address within the beacon against the locally stored information (step 323). If the two DFS owner addresses differ, the locally stored DFS owner address and

Claims	Prior Art
	DFS count value are updated from the received beacon (step 324). If the two DFS owner addresses are identical, the locally stored DFS count value is updated from the received beacon (step 325). Soomro ’456 at [0046] Similarly, any received channel switch information such as new channel frequency, channel switch time, etc. from the most recent beacon or channel switch announcement management frame is employed to update the locally stored channel switch information. When the DFS count value in the new channel reaches zero (step 326), the channel selection and measurement process is repeated, followed by channel switch announcement and movement to the new channel. Soomro ’456 at [0047] Referring to FIG. 3D, if a STA has not received a channel switch announcement management frame or beacon containing a channel switch announcement information element prior to elapse of the current DFS interval (step 319 in FIG. 3C), that STA performs a DFS recovery procedure. During DFS recovery, the first STA to successfully transmit a beacon includes its own MAC address within the DFS owner field of the DFS element (step 328). Soomro ’456 at [0048] The first STA to successfully transmit a beacon also sets the DFS count and channel switch count values, and includes channel switch information within the beacon based on its own information about other channel conditions, which should be available to any STA even if not up-to-date. Soomro ’456 at [0049] The first beacon during the DFS recovery period sets the initial DFS count value within the DFS element and the initial channel switch count value within the channel switch information element as specified by the DFS recovery interval field in the DFS element in order to expedite a channel switch. Normal IBSS operation continues (step 329), except the DFS owner and channel switch information are repeated in subsequent beacons (step 330), and the DFS count and channel switch count are decremented in each beacon as described above. During recovery procedures, a STA receiving a beacon containing a different DFS owner address or different channel switch information than that which is locally stored updates the local values with those from the beacon, and attempts to transmit the next beacon with the updated information. When the channel switch count value equals zero (step 331), all STAs switch to the next

Claims	Prior Art
	channel (step 320 in FIG. 3C). 802.11b-1999 at Page 2 **7.2.3.1 Beacon frame format** *Change Notes 1 and 2 of Table 5 as shown:* **Table 5—Beacon frame body** | Order	Information	Note
---	---	---
1	Timestamp	—
2	Beacon interval	—
3	Capability Information	—
4	SSID	—
5	Supported Rates	—
6	FH Parameter Set	1
7	DS Parameter Set	2
8	CF Parameter Set	3
9	IBSS Parameter Set	4
10	TIM	5	 NOTES: 1—The FH Parameter Set information element is **only** present within Beacon frames generated by STAs using frequency-hopping PHYs. 2—The DS Parameter Set information element is **only** present within Beacon frames generated by STAs using direct sequence PHYs. 3—The CF Parameter Set information element is only present within Beacon frames generated by APs supporting a PCF. 4—The IBSS Parameter Set information element is only present within Beacon frames generated by STAs in an IBSS. 5—The TIM information element is only present within Beacon frames generated by APs.

Claims	Prior Art
	802.11b-1999 at Page 3

7.2.3.9 Probe Response frame format

Change Notes 1 and 2 of Table 12 as shown:

Table 12—Probe Response frame body

Order	Information	Note
1	Timestamp	—
2	Beacon interval	—
3	Capability Information	—
4	SSID	—
5	Supported Rates	—
6	FH Parameter Set	1
7	DS Parameter Set	2
8	CF Parameter Set	3
9	IBSS Parameter Set	4

NOTES:

1—The FH Parameter Set information element is **only** present within Probe Response frames generated by STAs using frequency-hopping PHYs.

2—The DS Parameter Set information element is **only** present within Probe Response frames generated by STAs using direct sequence PHYs.

3—The CF Parameter Set information element is only present within Probe Response frames generated by APs supporting a PCF.

4—The IBSS Parameter Set information element is only present within Probe Response frames generated by STAs in an IBSS.

Claims	Prior Art

802.11b-1999 at Page 4

Insert the following text at the end of 7.3.1.4:

APs (as well as STAs in IBSSs) shall set the Short Preamble subfield to 1 in transmitted Beacon, Probe Response, Association Response, and Reassociation Response management MMPDUs to indicate that the use of the Short Preamble option, as described in 18.2.2.2, is allowed within this BSS. To indicate that the use of the Short Preamble option is not allowed, the Short Preamble subfield shall be set to 0 in Beacon, Probe Response, Association Response, and Reassociation Response management MMPDUs transmitted within the BSS.

STAs shall set the Short Preamble subfield to 1 in transmitted Association Request and Reassociation Request MMPDUs when the MIB attribute dot11ShortPreambleOptionImplemented is true. Otherwise, STAs shall set the Short Preamble subfield to 0 in transmitted Association Request and Reassociation Request MMPDUs.

APs (as well as STAs in IBSSs) shall set the PBCC subfield to 1 in transmitted Beacon, Probe Response, Association Response, and Reassociation Response management MMPDUs to indicate that the use of the PBCC Modulation option, as described in 18.4.6.6, is allowed within this BSS. To indicate that the use of the PBCC Modulation option is not allowed, the PBCC subfield shall be set to 0 in Beacon, Probe Response, Association Response, and Reassociation Response management MMPDUs transmitted within the BSS.

STAs shall set the PBCC subfield to 1 in transmitted Association Request and Reassociation Request MMPDUs when the MIB attribute dot11PBCCOptionImplemented is true. Otherwise, STAs shall set the PBCC subfield to 0 in transmitted Association Request and Reassociation Request MMPDUs.

Bit 7 of the Capabilities Information field shall be used to indicate the usage of Channel Agility by the HR/DSSS PHY. STAs shall set the Channel Agility bit to 1 when Channel Agility is in use, and shall set it to 0 otherwise.

Bits 8–15 of the Capability Information field are reserved.

802.11b-1999 at Page 5

7.3.2.2 Supported Rates element

Change the text in 7.3.2.2 as shown.

The Supported Rates element specifies ~~all~~ the values ~~rates that this station is capable of receiving~~ in the Operational-Rate-Set parameter, as described in the MLME_Join.request and MLME_Start.request primitives. The information field is encoded as 1–8 octets, where each octet describes a single Supported Rate ~~in units of 500 kbit/s~~.

Within Beacon, Probe Response, Association Response, and Reassociation Response management frames, each Supported Rate belonging to the ~~BSSBasic Rate Set~~ BSS basic rate set is encoded as an octet with the msb (bit 7) set to 1 (e.g., a 1 Mbit/s rate belonging to the ~~BSSBasicRateSet~~ BSS basic rate set is encoded as X'82'). Rates not belonging to the ~~BSSBasicRateSet~~ BSS basic rate set are encoded with the msb set to 0 (e.g., a 2 Mbit/s rate not belonging to the ~~BSSBasicRateSet~~ BSS basic rate set is encoded as X'04'). The msb of each Supported Rate octet in other management frame types is ignored by receiving STAs.

~~BSSBasicRateSet~~ The BSS basic rate set information in Beacon and Probe Response management frames is delivered to the management entity in an STA via the BSSBasicRateSet parameter in the MLME_Scan.confirm primitive. It is used by the management entity in an STAs ~~in order~~ to avoid associating with a BSS if the STA cannot receive and transmit all the data rates in the ~~BSSBasicRateSet~~ BSS basic rate set (see Figure 36).

Claims	Prior Art
	802.11b-1999 at Page 7

10.3.2.2.2 Semantics of the service primitive

Change the table as shown:

Name	Type	Valid range	Description
BSSID	MACAddress	N/A	The BSSID of the found BSS.
SSID	Octet string	1–32 octets	The SSID of the found BSS.
BSSType	Enumeration	INFRASTRUCTURE, INDEPENDENT	The type of the found BSS.
Beacon Period	Integer	N/A	The Beacon period of the found BSS (in TU).
DTIM Period	Integer	As defined in frame format	The DTIM period of the BSS (in beacon periods).
Timestamp	Integer	N/A	The timestamp of the received frame (probe response/beacon) from the found BSS.
Local Time	Integer	N/A	The value of STA's TSF timer at the start of reception of the first octet of the timestamp field of the received frame (probe response or beacon) from the found BSS.
PHY Parameter Set	As defined in frame format	As defined in frame format	The parameter set relevant to the PHY.
CF Parameter Set	As defined in frame format	As defined in frame format	The parameter set for the CF periods, if found BSS supports CF mode.
IBSS Parameter Set	As defined in frame format	As defined in frame format	The parameter set for the IBSS, if found BSS is an IBSS.
Capability Information	As defined in frame format	As defined in frame format	The advertised capabilities of the BSS.
BSSBasicRateSet	Set of intergers	1–27 inclusive (for each integer in the set)	The set of data rates ~~(in units of 500 kb/s)~~ that must be supported by all STAs that desire to join this BSS. The STAs must be able to receive and transmit at each of the data rates listed in the set.

Claims	Prior Art
	802.11b-1999 at Page 8

10.3.3.1.2 Semantics of the service primitive

Change the table as shown:

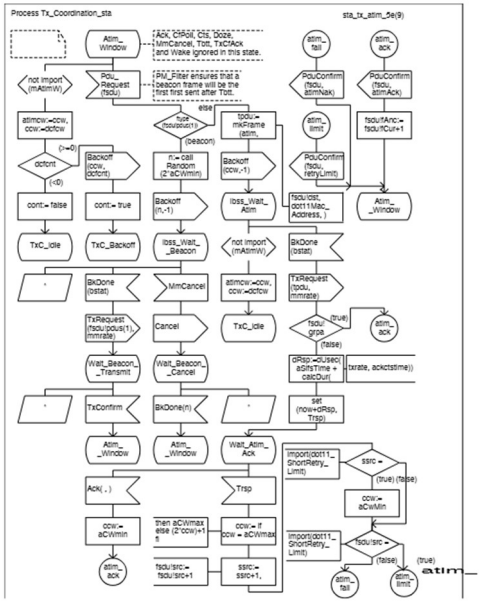
Name	Type	Valid range	Description
BSSDescription	BSSDescription	N/A	The BSSDescription of the BSS to join. The BSSDescription is a member of the set of descriptions that was returned as a result of a MLME-SCAN.request.
JoinFailureTimeout	Integer	≥ 1	The time limit, in units of beacon intervals, after which the join procedure will be terminated.
ProbeDelay	Integer	N/A	Delay (in μs) to be used prior to transmitting a Probe frame during active scanning.
OperationalRateSet	Set of integers	1–127 inclusive (for each integer in the set)	The set of data rates ~~(in units of 500 kbit/s)~~ that the STA desires to use for communication within the BSS. The STA must be able to receive at each of the data rates listed in the set. ~~The OperationalRateSet~~ This set is a superset of the ~~BSSBasicRateSet~~ BSS basic rate set advertised by the BSS.

Claims	Prior Art
	802.11b-1999 at Page 9

10.3.10.1.2 Semantics of the service primitive

Change the table as shown:

Name	Type	Valid range	Description
SSID	Octet string	1–32 octets	The SSID of the BSS.
BSSType	Enumeration	INFRASTRUCTURE, INDEPENDENT	The type of the BSS.
Beacon period	Integer	≥ 1	The Beacon period of the BSS (in TU).
DTIM period	Integer	As defined in 7.3.12.6	The DTIM period of the BSS (in Beacon periods).
CF Parameter Set	As defined in Frame Format	As defined in 7.3.2.5	The Parameter Set for CF periods, if the BSS supports CF mode. aCFPPeriod is modified as a side effect of the issuance of a MLME-START.request primitive.
PHY Parameter Set	As defined in Frame Format	As defined in 7.3.2.3 or 7.3.2.4	The Parameter Set relevant to the PHY.
IBSS Parameter Set	As defined in Frame Format	As defined in 7.3.2.7	The Parameter Set for the IBSS, if BSS is an IBSS.
ProbeDelay	Integer	N/A	Delay (in μs) to be used prior to transmitting a Probe frame during active scanning.
CapabilityInformation	As defined in Frame Format	As defined in 7.3.1.4	The capabilities to be advertised for the BSS.
BSSBasicRateSet	Set of integers	1–127 inclusive (for each integer in the set)	The set of data rates ~~(in units of 500 kbit/s)~~ that must be supported by all STAs that desire to join this BSS. The STA that is creating the BSS must be able to receive and transmit at each of the data rates listed in the set.
OperationalRateSet	Set of integers	1–127 inclusive (for each integer in the set)	The set of data rates ~~(in units of 500 kbit/s)~~ that the STA desires to use for communication within the BSS. The STA must be able to receive at each of the data rates listed in the set. ~~The OperationalRateSet~~ This set is a superset of the BSS basic rate set ~~BSSBasicRateSet~~ advertised by the BSS.

Claims	Prior Art
	802.11b-1999 at Page 80 

Claims	Prior Art
	802.11b-1999 at Page 89 **High Rate PHY/frequency-hopping interoperability** The Channel Agility option described in 18.4.6.7 provides for IEEE 802.11 FH PHY interoperability with the High Rate PHY. The frequency-hopping patterns, as defined within this annex, enable synchronization with an FH PHY compliant BSS in North America and most of Europe. In addition, CCA requirements on a High Rate station using this mode provide for CCA detection of 1 MHz wide FH signals within the wide-band DS channel selected. FH PHY stations operating in mixed mode FH/DS environments are advised to use similar cross PHY CCA mechanisms. The frequency-hopping (Channel Agility) and cross CCA mecha-nisms provide the basic mechanisms to enable coexistence and interoperability. The MAC elements include both DS and FH elements in beacons and probe responses when the Channel Agility option is turned on. Added capability fields indicate the ability to support the Channel Agility option and to indicate whether the option is turned on. These fields allow synchronization to the hopping sequence and timing, identification of what modes are being used within a BSS when joining on either High Rate or FHSS sides, and rejection of an association request in some cases. Interoperability within an infrastructure BSS can be achieved, as an example, using a virtual dual access point (AP). A virtual dual AP is defined, for purposes of discussion, as two logically separate APs that exist within a single physical AP with a single radio (one transmit and one receive path). Both FHSS and High Rate logical APs send out their own beacons, DTIMs, and other nondirected packets. The two sides interact in the sharing of the medium and the AP's processor and radio. Addressing and association issues may be handled in one of several ways and are left as an implementation choice. Minimal interoperability with a non-hopping High Rate or legacy DSSS is provided by the use of a channel at least 1/7 or more of the time. While throughput would be significantly reduced by having a channel only 1/7 of the time, connection and minimal throughput can be provided.
2. The wireless network device of claim 1 wherein the wireless transmitter is configured for transmitting wireless data at more than one data rate.	It was well known and routine at the time of the alleged invention for a wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless transmitter is configured for transmitting wireless data at more than one data rate." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless transmitter is configured for transmitting wireless data at more than one data rate" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "[t]he wireless network device of claim 1 wherein the wireless transmitter is configured for transmitting wireless data at more than one data rate" would have been incorporated into a wireless network device with reasonable expectation of success. Bareis '373 at [0097] To summarize, there has been disclosed a broadband multidrop local network architecture for use in intercoupling multimedia traffic to and from a wide variety of addressable network devices. Each network device may be coupled via a network interface or broadband transceiver to a single wireline coupled to an external broadband communication service. Such communication service may be provided, e.g., via fiber

Claims	Prior Art
	optic link to a curbside terminal by an interconnection company, without requiring a complete secondary network and the associated equipment such as modems, routers, converters, hubs, switches, etc. The full data traffic capability at the full bandwidth achievable with relatively short runs (e.g., on the order of 100 meters) of twisted pair copper wire may be utilized when all traffic for all of the participating network devices is packetized on a wired medium for distribution thereon without the bandwidth, point-to-point, or data rate restrictions associated with conventional individual DSL (digital subscriber line) or similar services. In effect, the useable spectrum that exists on the broadband multidrop local network as disclosed hereinabove is a closed spectrum; that is, the entire bandwidth technically feasible on a twisted-pair medium over these relatively short distances is dedicated to the broadband communication capability implemented in each local network such that total data rates, with present standards and technologies, of at least 100 Mbps, and beyond to over 500 Mbps at reasonable distances, are available for each local network transferring data packets at the maximum packet rate of all network devices attachable thereto even when all of the network devices are transmitting. Each network device (computers, peripherals, telecommunications equipment, security systems, broadcast audio and video, to name just a few) may be assigned a bandwidth or packet data rate rating such that its use on the network appropriates a required portion of the total available data traffic capabilities of the network when in use and the user knows immediately what portion of his/her network capacity is being utilized. Mandke 2003B at 24 The IEEE 802.15.3 task group is developing WPANs up to 55 Mbps. The draft standard operates on five 15 MHz channels in the 2.4 GHz ISM band, two of which interfere with IEEE 802.11b traffic. Modulation (QPSK, DQPSK, 16/32/64-QAM) and coding (trellis-coded modulation) are varied to provide five data rates (11 Mbps, 22 Mbps, 33 Mbps, 44 Mbps, and 55 Mbps) [5]. The MAC layer described by this standard allows for the coordination of WPAN devices to form piconets. The MAC layer also allows for multimedia quality of service (QoS), power management, and ad-hoc networking support. IEEE 802.15.3 gained sponsor ballot approval in May 2003. The focus of UWB occurs in a separate task group, IEEE 802.15.3.a, which is discussed below. Treadaway ’477 at 2:28–63 The invention is a method and apparatus for achieving a data transmission rate of multiples of 100 mega-bits per second (Mbps) in a terminal for a wireless metropolitan area network. In accordance with an aspect of the present invention, a method of communicating data packets in a wireless network includes steps of receiving a first data packet wherein the first data packet is received according to a first rate of data communication, receiving a second data packet wherein the second data packet is received according

Claims	Prior Art
	to a second rate of data communication and wherein the step of receiving the second data packet is performed simultaneously with the step of receiving the first data packet, time division multiplexing the first data packet and the second data packet to a radio frame, and communicating the radio frame via a wireless link wherein the radio frame is communicated at a third rate of data communication wherein the third rate of data communication is equal to at least a sum of the first rate of data communication and the second rate of data communication. The method can also include a step of buffering the first data packet prior to time division multiplexing the first data packet such that the step of buffering the first data packet synchronizes the first data packet to the radio frame. The method can also include a step of buffering the second data packet prior to providing the second data packet to the radio framer such that the step of buffering the second data packet synchronizes the second data packet to the radio frame. The first and second data packets can be received from an Ethernet local area network. The first data packet can be a 100 mega-bit per second (Mbps) Fast Ethernet data packet. The second data packet can be a 10 Mbps Ethernet data packet. The method can include steps of receiving a third data packet, and time division multiplexing the third data packet to the radio frame. The method can include a step of encrypting the first data packet prior to performing the step of time division multiplexing. Treadaway ’477 at 2:64–3:34 According to another aspect of the invention, a method of communicating data packets in a wireless network includes steps of receiving a first Fast Ethernet data packet into a first MAC unit wherein the first data packet is received at a rate of 100 Mbps, receiving a second Fast Ethernet data packet into a second MAC unit wherein the second data packet is received at a rate of 100 Mbps and wherein the step of receiving the second data packet is performed simultaneously with the step of receiving the first data packet, providing the first data packet and the second data packet to a radio framer according to time division multiplexing thereby forming a time division multiplexed radio frame, and communicating the time division multiplexed radio frame via a wireless link wherein the time division multiplexed radio frame is communicated at a rate of at least 200 Mbps. The first Fast Ethernet data packet can be received from an Ethernet local area network coupled to the first MAC unit. The method can include steps of receiving a third Fast Ethernet data packet into a third MAC unit wherein the third data packet is received at a rate of 100 Mbps, and providing the third data packet to the radio framer according to time division multiplexing. In which case, the time division multiplexed radio frame can be communicated at a rate of at least 300 Mbps. The method can include a step of buffering the first data packet in the first MAC unit prior to providing the first data packet to the radio framer. The step of buffering the first data packet can synchronize the first data packet to the radio frame. The method can also include a step of buffering the second data packet in the second MAC unit prior to providing the second data packet to the radio framer such that the step of buffering the second data packet synchronizes the second data packet to the radio

Claims	Prior Art
	frame. The method can include a step of encrypting the first data packet prior to performing the step of providing the first data packet to the radio framer. The method can also include a step of receiving an Ethernet data packet into the first MAC unit wherein the Ethernet data packet is received at a rate of 10 Mbps. Treadaway '477 at 8:38–50 The TFU 106 provides three interfaces to customer equipment, including the router or switch 116 (FIG. 1) and the DS 124 (FIG. 1). These include a full-duplex 100 Mbps interface via the regenerator 200, a half-duplex 10 Mbps interface via the repeater 204 and an RS232 serial port via the converter 206. Though the payload data traffic is generally directed through the 100 Mbps interface while network management and link control traffic is generally directed through the 10 Mbps interface, a user of the terminal 100 can combine network management and link control signals with the payload data traffic in the 100 Mbps interface depending upon the particular capabilities of the router or switch 116 (FIG. 1).
3. The wireless network device of claim 1 wherein the wireless receiver is configured for receiving wireless data at more than one data rate.	It was well known and routine at the time of the alleged invention for a wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless receiver is configured for receiving wireless data at more than one data rate." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless receiver is configured for receiving wireless data at more than one data rate" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "[t]he wireless network device of claim 1 wherein the wireless receiver is configured for receiving wireless data at more than one data rate" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row 2.
6. The wireless network device of claim 1 wherein the wireless network device is configured to operate in a cellular network.	It was well known and routine at the time of the alleged invention for a wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless network device is configured to operate in a cellular network." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "[t]he wireless network device of claim 1 wherein the wireless network device is configured to operate in a cellular network" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further

Claims	Prior Art
	demonstrate that the claimed "[t]he wireless network device of claim 1 wherein the wireless network device is configured to operate in a cellular network" would have been incorporated into a wireless network device with reasonable expectation of success. McCorkle '032 at 11:49–12:5 The UWB transceiver of FIG. 1a or 2 may be used to perform a radio transport function for interfacing with different applications as part of a stacked protocol architecture. In such a configuration, the UWB transceiver performs signal creation, transmission and reception functions as a communications service to applications that send data to the transceiver and receive data from the transceiver much like a wired I/O port. Moreover, the UWB transceiver may be used to provide a wireless communications function to any one of a variety of devices that may include interconnection to other devices either by way of wired technology or wireless technology. Thus, the UWB transceiver of FIG. 1a or 2 may be used as part of a local area network (LAN) (connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example. In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention, as will be apparent to those skilled in the microprocessor systems art. Appropriate software can be readily prepared by programmers of ordinary skill based on the teachings of the present disclosure, as will be apparent to those skilled in the software art.
13[pre]. A wireless network device, comprising:	"A wireless network device" was well known at the time of the alleged invention. A person of ordinary skill in the art would have found it obvious to modify an existing device to include the claimed elements as set forth below and in Defendants' other invalidity charts. For example: See, e.g.: 783-A01 U.S. Pat. No. 6,584,080 ("Ganz '080") 783-A02 U.S. Pat. Pub. No. 2002/0028655("Rosener '655") 783-A03 U.S. Pat. Pub. No. 2004/0160928 ("Perlman '928") 783-A04 U.S. Pat. No. 6,188,496 ("Krishna '496") 783-A05 U.S. Pat. No. 7,209,523 ("Larrick '523") 783-A06 U.S. Pat. No. 4,056,780 ("Faulkner '780") 783-A07 U.S. Pat. No. 6,497,656 ("Evans '656")

Claims	Prior Art
	783-A08 U.S. Pat. Pub. No. 2003/0120809 ("Bellur '809") 783-A09 U.S. Pat. No. 8,125,940 ("Perlman '940") 783-A10 U.S. Pat. Pub. No. 2005/0201326 ("Lakkis '326") 783-A11 U.S. Pat. Pub. No. 2004/0048574 ("Walker '574") 786–A12 XtremeSpectrum Trinity Chipset *See* above at row 1[pre].
[13a] a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1a].
[13b] a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless receiver that receives wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success.

Claims	Prior Art
	See above at row [1a].
[13c] wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver;	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1c]. To the extent that Ganz '080, Larrick '523, Soomro '456, and Bareis '373 does not disclose any elements of this claim limitation, it would have been obvious to a person having ordinary skill in the art to combine, with the teachings of Ganz '080, Larrick '523, Soomro '456, and Bareis '373, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
[13d] wherein the wireless network device is configured for processing wireless data received by the wireless receiver,	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless network device is configured for processing wireless data received by the wireless receiver" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1d].
[13e] wherein the wireless network device is configured for	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for determining whether any, a portion, or all information

Claims	Prior Art
determining whether any, a portion, or all informaiton in the process wireless data should be transmitted by the wireless transmitter;	in the process wireless data should be transmitted by the wireless transmitter." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1e].
[13f] wherein the wireless transmitter is configured for transmitting wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz; and	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless transmitter is configured for transmitting wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. Soomro '456 at [0004] Two competing standards have emerged for wireless local area networks in the 5 gigahertz band(s): implementations of the IEEE 802.11a standard are currently being developed for use within the U.S., while the European Telecommunications Standards Institute (ETSI) has promulgated the High Performance European Radio Local Area Network version 2 (HiperLAN2) standard. Both standards are based on orthogonal frequency division multiplexing (OFDM) for the physical (PHY) layer, and both allow data rates of up to 54 megabits per second (Mbps). Mandke 2003A at 2 IEEE 802.15.3 would not be able to provide the data rates necessary to support many of these

Claims	Prior Art
	applications. In November 2001, an additional task group within IEEE 802.15, Task Group 3a, was formed to identify a higher speed physical layer alternative that could support data rates between 110 Mbps and 480 Mbps over short ranges of less than 10 meters. The February 2002 FCC approval of ultra wideband (UWB) devices prompted many companies to consider UWB radio when proposing physical layers to IEEE 802.15.3a. Mandke 2003A at 3 In February of 2002, the FCC amended their Part 15 rules (concerning unlicensed radio devices) to include the operation of UWB devices without a license. The FCC defines UWB signals as having a fractional bandwidth of greater than 0.20 or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [2]. Mandke 2003A at 5 TG3a has set out to develop a flexible standard which will enable high data rate WPAN (110 Mbps at 10m, 200 Mbps at 4m, and 480 Mbps at an unspecified distance) over a cost effective architecture. This new standard will enable a broad range of applications including the wireless transmission of images and video. The goal of this paper is to explore the unique design issues specific to UWB, engineering trade-offs faced by standards developers, and the current state of IEEE 802.15.3a. Section 2 will discuss the unique aspects of indoor UWB channels and the four of the proposed TG3a channel models. Section 3 compares a traditional impulse radio approach to UWB with a more recent multibanded approach (which has been employed in many TG3a proposals). Section 4 details the requirements and specifications set forth by IEEE 802.15.3a, and categorize the proposals being considered in order to form a clear picture of the current state of UWB technology as it relates to WPANs.

Claims	Prior Art
	Mandke 2003A at Table 4

Company	Texas Instruments
Spectrum Allocation:	
# of bands	3 (additional bands can be added in the future)
Bandwidths	503.25 MHz
Frequency ranges	3.168 GHz – 4.752 GHz
Modulation Scheme	TFI-OFDM, QPSK

13

Mandke 2003A at Table 4

Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	not available
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

Table 4: Overview of the TI Physical Layer Proposal for IEEE 802.15.3a [22].

Claims	Prior Art
	Mandke 2003A at Table 5

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Avoidance
# of simultaneous piconets	Ternary CDMA
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

Table 5: Overview of the XtremeSpectrum CFP Document [23].

Mandke 2003A at 14

As shown in Table 3, Texas Instruments chose to implement a multibanded UWB system. In [22], the authors argue that, due to path loss, attenuation, and losses in current RF technology, the use of the frequency bands above 5 GHz only yields minor improvements in capacity at the cost of increased receiver complexity. For this reason, Texas Instruments chose to use only 3 bands located below the 5 GHz ISM band for their implementation. Each band uses orthogonal frequency division multiplexing (OFDM) which allows for each UWB band to be divided into a set of orthogonal narrowband channels (with much larger symbol period duration). Because of the increased length of the OFDM symbol period, this modulation method can successfully reduce the effects of ISI. However, this robust multipath tolerance comes at the price of increased transceiver complexity, the need to combat inner carrier interference (ICI), and tighter linear constraint on amplifying circuit elements.

Claims	Prior Art
	Mandke 2003A at Table 6

Company	Intel
Spectrum Allocation:	
# of bands	7 (+ optional 6 bands for future use)
Bandwidths	550 MHz
Frequency ranges	3.6 GHz – 6.9 GHz, (7.45 GHz – 10.2 GHz optional)
Modulation Scheme	M-ary Bi-orthogonal Keying, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	DS/FH CDMA, optional FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	6/32 @ 110 Mbps, 5/16 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	6.3 dB @ 10 m @ 108 Mbps, 8.0 dB @ 4 m @ 288 Mbps, 4.0 dB @ 4 m @ 577 Mbps
Symbol period	3 ns
Multipath mitigation method	frequency interleaving of MBOK chips; time frequency codes; feed forward filter

Table 6: Overview of the Intel CFP Presentation for a UWB PHY [24].

Mandke 2003A at Page 24

Company	Texas Instruments
Spectrum Allocation:	
# of bands	3 (additional bands can be added in the future)
Bandwidths	503.25 MHz
Frequency ranges	3.168 GHz – 4.752 GHz
Modulation Scheme	TFI-OFDM, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	not available
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

A. Batra, et. al. "TI Physical Layer Proposal for IEEE 802.15 Task Group 3a," IEEE P802.15-03/142r0. March 3, 2003.

Claims	Prior Art
	Mandke 2003A at Page 24

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Ternary CDMA
# of simultaneous piconets	4 piconets/band
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

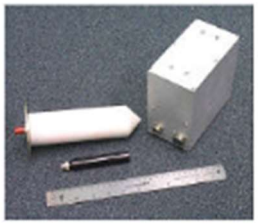
R. Roberts, "XtremeSpectrum CFP Document," IEEE P802.15-03/154r1. March 3, 2003.

Mandke 2003A at Page 27

Company	Discrete Time
Spectrum Allocation:	
# of bands	15 bands
Bandwidths	500 MHz
Frequency ranges	3.1 GHz – 10.6 GHz,
Modulation Scheme	QPSK, FH
Coexistence method	sacrifice 2 band for WLAN coexistence (5 GHz)
Multiple access method	FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	½ @ 110 Mbps
Link margin	15.1 dB @ 4m @ 110 Mbps, 12 dB @ 4 m @ 220 Mbps, 11.1 dB @ 4 m @ 480 Mbps
Symbol period	8.9 ns @ 110 Mbps, 4.5 ns @ 200 Mbps, 2.1 ns @ 480 Mbps
Multipath mitigation method	not available

Roberto Aiello, "Discrete Time PHY Proposal for TG3a," IEEE 802.15-03/099r1. March 2003.

Claims	Prior Art
	Fontana at 2 UWB APPLICATIONS Figure 1 illustrates an ultra wideband, handheld transceiver that was designed for full duplex voice and data transmission at rates of up to 128 kb/s (CVSD) and 115.2 kb/s (RS232). The radio has an operational center frequency in L-band (1.5 GHz) with an instantaneous bandwidth of 400 MHz (27% fractional BW). Peak power output from the UWB transceiver was measured at 2.0 Watts, with a resultant average power (worst case) of 640 μW. This results in a worst case power density of 1.6 pW/Hz. These units have a range of approximately 1 to 2 km (with small antennas shown and line-of-sight), and an extended range of 10 to 20 miles with small gain antennas. Fontana at 3 Figure 3 illustrates a high-speed (up to 25 Mb/s) UWB radio designed for transmission of compressed video and command & control information across an asymmetric, bi-directional link. This system was also designed to operate in the 1.3 to 1.7 GHz region (27% fractional BW) with a 4W peak power output. An earlier design, developed under funding from the U.S. Defense Advanced research Projects Agency (DARPA), operated with a 500 MHz instantaneous bandwidth in the C-band region (5.4 to 5.9 GHz). Fontana at 5 Ultra wideband technology was considered for this application because of its ability to transmit large amounts of data at high speed in a mobile, multipath-prone environment. The UWB tag operated in the L-band region (1.4 to 1.65 GHz) and had a peak output power of approximately 250 mW for a demonstrated range of over 300 meters. The image of the driver was stored as a compressed JPEG file, together with additional ASCII data, in EEPROM and periodically transmitted at a 400 kb/s burst rate to a UWB receiver with display. The tag operated off of two AAA batteries (3.0V) and, in an operational scenario, was mounted behind the front grill of the automobile.

Claims	Prior Art
	Fontana at Figure 8  **Figure 8.** UWB Precision Geolocation System Transceiver. Fontana at 6 The system in Figure 8 utilizes a 2.5 ns, 4 Watt peak, UWB pulse, again operating in the 1.3 to 1.7 GHz region. Line-of-sight range for the system is better than 2 kilometers utilizing small, omnidirectional vertically polarized (smaller) or circularly polarized (larger) antennas. Within a building, the range becomes limited by wall and obstacle attenuation; however, ranges exceeding 100 meters inside have been attained. An unique feature of the system is the ability to detect the pulse leading edge through the use of a charge sensitive, tunnel diode detector. Leading edge detection is critical to the resolution of the direct path from the plethora of multipath returns produced from internal reflections. The UWB geolocation system was originally developed to permit a soldier to determine his or her position to within 1 foot resolution in an urban environment. It is currently being used to augment a video capture system for 3-D modeling, and for materiel location onboard a Navy ship. Fontana at Figure 10 **Figure 10.** UWB Backup Sensor. Fontana at 7 Several variants of the Hummingbird radar have also been developed. For example, Figure 10 illustrates an ultra wideband backup sensor for the detection of personnel, vehicles and other objects behind large construction and mining vehicles.

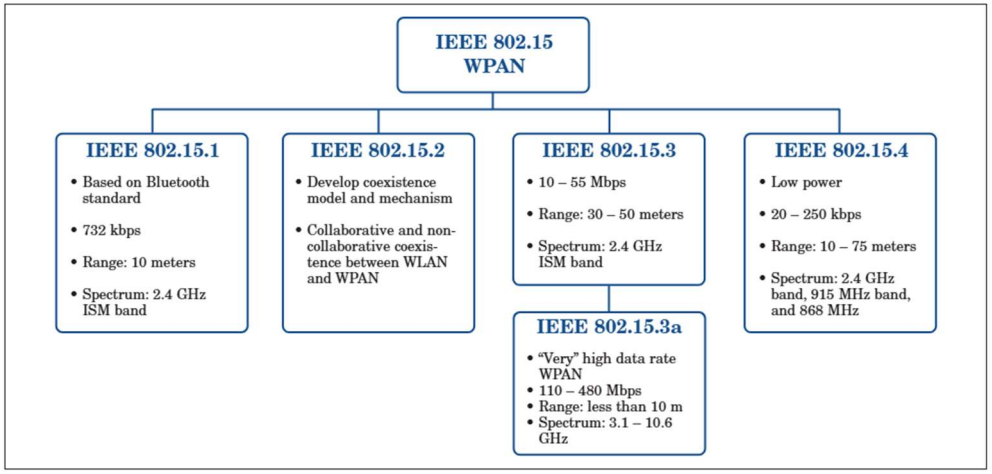
Claims	Prior Art
	[Figure 10] Operating with approximately 250 mW peak in the C-band region from 5.4 to 5.9 GHz, the backup sensor utilizes a dual antenna configuration for the detection of objects as close as 1 foot to beyond 350 feet from the vehicle. Ultra wideband provides a significant advantage for this application because of the ability to provide precision range gating to eliminate clutter which, with conventional Doppler-based sensors, often results in large false alarm rates. This sensor was developed for the National Institute of Occupational Safety and Health. McCorkle ’032 at Abstract A method for conveying application data via carrierless ultra wideband wireless signals, and signals embodied in a carrierless ultra wideband waveform. Application data is encoded into wavelets that are transmitted as a carrierless ultra wideband waveform. The carrierless ultra wideband waveform is received by an antenna, and the application data is decoded from the wavelets included in the waveform. The waveforms of the signals include wavelets that have a predetermined shape that is used to modulate the data. The signals may convey, for example, Web pages and executable programs between mobile devices. The signals are low power and can penetrate obstructions making them favorable for use with a wireless node of a network McCorkle ’032 at 2:3–7 1. Field of the Invention The present invention is directed to methods and signals for ultra wideband communications, and more particularly to methods and signals for conveying application data via carrierless ultra wideband wireless signals. McCorkle ’032 at 3:22–41 An object of the present invention is to provide a method for communicating information using carrierless wireless signals. The inventors of the present invention have recognized that low power carrierless transmissions can be effectively used to communicate at high data rates without interfering with narrowband or spread spectrum signals, and if the power is kept sufficiently low, the transmissions do not need to be as broadcast devices. Accordingly, another object of the present invention is to encode digital data into multi-phase wavelets that can be transmitted without a carrier at low power and at high data rates over short distances. In one embodiment, the present invention is implemented as a method for conveying application data with carrierless ultra wideband wireless signals. The application data is encoded into wavelets that are transmitted without modulating them onto a carrier waveform. In another embodiment, the present

Claims	Prior Art
	invention is implemented as a computer data signal that is embodied in a carrierless ultra wideband waveform. McCorkle ’032 at 3:57–58 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver, according to the present invention; McCorkle ’032 at 3:61–63 FIG. 2 is a block diagram of the transceiver of FIG. 1a, that manipulates a shape of UWB pulses, according to the present invention; and McCorkle ’032 at 4:4–15 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver. In FIG. 1a , the transceiver includes three major components, namely, receiver 11, radio controller and interface 9, and transmitter 13. Alternatively, the system may be implemented as a separate receiver 11 and radio controller and interface 9, and a separate transmitter 13 and radio controller and interface 9. The radio controller and interface 9 serves as a media access control (MAC) interface between the UWB wireless communication functions implemented by the receiver 11 and transmitter 13 and applications that use the UWB communications channel for exchanging data with remote devices. McCorkle ’032 at 6:43–61 A feature of the present invention is that the M-ary parameter set used to control the wavelet shape is chosen so as to make a UWB signal, wherein the center frequency f_c and the bandwidth B of the power spectrum of g(t) satisfies $2f_c>B>0.25f_c$. It should be noted that conventional equations define in-phase and quadrature signals (e.g., often referred to as I and Q) as sine and cosine terms. An important observation, however, is that this conventional definition is inadequate for UWB signals. The present invention recognizes that use of such conventional definition may lead to DC offset problems and inferior performance. Furthermore, such inadequacies get progressively worse as the bandwidth moves away from $0.25f_c$ and toward $2f_c$. A key attribute of the exemplary wavelets (or e.g., those described in co-pending U.S. patent application Ser. No. 09/209,460) is that the parameters are chosen such that neither f nor h in Equation 2 above has a DC component, yet f and h exhibit the required wide relative bandwidth for UWB systems. McCorkle ’032 at 9:30–44 FIG. 2 is a block diagram of a transceiver embodiment of the present invention in which the modulation scheme employed is able to manipulate the shape and time of the UWB pulses. In FIG. 2, when receiving

Claims	Prior Art
	energy through the antenna 1, 15 (e.g., corresponding antennas 1 and 15 of FIG. 1a) the energy is coupled in to a transmit/receive (T/R) switch 27, which passes the energy to a radio front end 3. The radio front end 3 filters, extracts noise, and adjusts the amplitude of the signal before providing the same to a splitter 29. The splitter 29 divides the signal up into one of N different signals and applies the N different signals to different tracking correlators 31_1-31_N. Each of the tracking correlators 31_1-31_N receives a clock input signal from a respective timing generator 7_1-7_N of a timing generator module 7, 19, as shown in FIG. 2. McCorkle '032 at 11:49–12:5 The UWB transceiver of FIG. 1a or 2 may be used to perform a radio transport function for interfacing with different applications as part of a stacked protocol architecture. In such a configuration, the UWB transceiver performs signal creation, transmission and reception functions as a communications service to applications that send data to the transceiver and receive data from the transceiver much like a wired I/O port. Moreover, the UWB transceiver may be used to provide a wireless communications function to any one of a variety of devices that may include interconnection to other devices either by way of wired technology or wireless technology. Thus, the UWB transceiver of FIG. 1a or 2 may be used as part of a local area network (LAN) (connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example. In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention, as will be apparent to those skilled in the microprocessor systems art. Appropriate software can be readily prepared by programmers of ordinary skill based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. Aiello '273 at [0003] The present invention relates to a system for transmitting data using Ultra Wide Band (UWB) radio frequencies. More particularly, this invention relates to a system using UWB to transmit data in a de-centralized system and where the data is time sensitive. Still more particularly, this invention relates to transmitting data using UWB in a home entertainment system. Aiello '273 at [0014] UWB is a form of radio transmission. UWB employs short pulses of energy that spread across a wide range of frequencies. A UWB signal is a radio signal with a fractional bandwidth larger than 25%. For example, a UWB signal with a center frequency of 3 GHz has a minimum bandwidth of 750 MHz. Unlike conventional RF technologies, UWB modulates information into RF signals with a series of baseband,

Claims	Prior Art
	pulsed emissions transmitted without a carrier signal. Aiello ’273 at [0015] Therefore UWB has several inherent features that make UWB desirable for use for wireless communications for systems, such as home entertainment systems. First, UWB signals utilize a spectrum of frequencies already designated for other devices. Secondly, UWB signals also have a low power density which allows coexistence with other RF devices with minimal interference. Thirdly, UWB has a low probability of multi-path fading and interference. Aiello ’273 at [0017] The above and other problems are solved and an advance in the art is made by the De-centralized UWB system of this invention. This invention provides a wireless system that has a high data transfer rate required for multi-media applications such as video. This invention also provides high stability under a wide range of loads. Loads mean the amount of RF transmissions in an environment. This invention also provides a wireless system that supports mixed traffic. Mixed traffic is priority, dedicated traffic such as video and audio data as well as burst traffic used for applications such as Internet access. Aiello ’273 at [0019] In accordance with this invention, each device in the system includes a transceiver having an RF transmitter and RF receiver. The transmitter and receiver are each configured to operate with UWB signals. The transceiver is connected to a processing unit that executes applications to transmit and receive data packets via UWB. Aiello ’273 at [0020] The processing unit executes instructions from software stored in a memory of firmware to transmit data in accordance with this invention. In accordance with this invention, the processor in a device that requires a data transmission receives UWB signals being transmitted. When the device detects the system is idle of transmissions, the processor directs the transmitter to transmit arbitration pulses. The processor then waits to receive arbitration pulse signals from other devices requiring a data transmission. The processor then determines whether device has control of the system. Aiello ’273 at [0021] If the device has control of the system, the processor generates a control header including synchronization

Claims	Prior Art
	data. The synchronization data is used as described below by receiving devices to adjust a local clock for use in processing the received data. Encryption initialization data, link adaptation data, a source address of the transmitting device, a destination address of devices to receive the data, and a length of a data field of the packet may also be included in the control header. The control header is then placed in a data packet and sent to the transmitter. The transmitter then transmits the data packet using UWB. Aiello '273 at [0055] fter the payload is generated, the processor in the transmitting device generates the payload in step 335 from the control header and generated payload. The processor then transmits the packet to the transceiver. The transmitter in the transceiver then transmits the packet in UWB signals. Aiello '273 at [0059] A process 400 by which a device in decentralized network 100 receives and processes packets is illustrated in FIG. 4. Process 400 begins when a processor in a receiving device receives a packet that was converted to data by a receiver in the device from UWB signals received by the device in step 405. In step 410, the control header of the received packet is read. From the control header, the processor in receiving device determines whether the packet is addressed to the receiving device in step 420. If the packet is not addressed to the receiving device, process 400 may end or wait until another packet is received. Mandke 2003B at 23 On February 14, 2002, the FCC amended the Part 15 rules which govern unlicensed radio devices to include the operation of ultra wideband (UWB) devices. The use of UWB under the FCC guidelines [1] offers tremendous capacity potential (several Gbps) over short ranges (less than 10 meters) at low radiated power (mean EIRP of –41.3 dBm/MHz). The FCC defines UWB signals as having a fractional bandwidth (the ratio of baseband bandwidth to RF carrier frequency) of greater than 0.20, or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [9].

Claims	Prior Art
	Mandke 2003B at Figure 2  Figure 2 · Organization of IEEE 802.15. Mandke 2003B at 23 The fact that the FCC specified that UWB be a minimum bandwidth of 500 MHz is important—while UWB can occupy several GHz of bandwidth using small pulses (as pioneered by Xtreme Spectrum and Time Domain [23], [30]), the 500 MHz bandwidth rule has provided the impetus for chip makers to consider channelization, or a multiband approach, in the UWB standardization activity, mainly as a hedge against foreign governments who may not authorize the full U.S. 3.1 to 10.6 GHz allocation. Mandke 2003B at 25 Since IEEE 802.15.3a began hearing proposals in March 2003, many companies have merged their ideas and collaborated to form coalitions to support a single proposal. Before TG3a's May 2003 meeting, the UWB Multiband-Coalition (www.uwbmultiband.org) was led by Intel and includes several other major companies [33-38] that support a multiband approach which employs pulsed modulation. On July 14, 2003, industry titans Intel and Texas Instruments merged their proposals to form a united approach that employs multiple bands and uses OFDM modulation. The newly formed Multiband-OFDM Coalition (www.multibandofdm.org), whose membership includes TI and the UWB Multiband-Coalition, endorses a proposal which is essentially the same as the original TI proposal, with an optional operating mode which uses seven bands (as opposed to three) [43]. TG3a heard its final round of proposals at their July 21-25, 2003 meeting and now faces the task of selecting one or more approaches from which to draft a

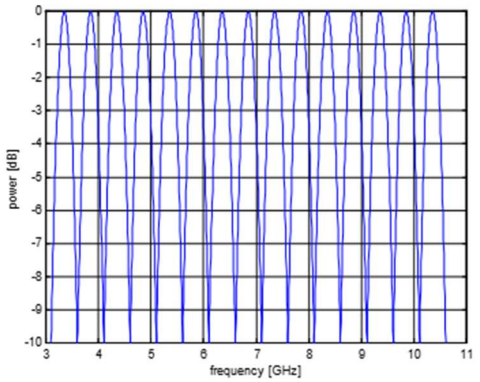
Claims	Prior Art
	standard. Mandke 2003B at 25 After its July 2003 meeting, TG3a is now left with two primary contenders: (1) The Texas Instruments OFDM-based multiband approach which uses 528 MHz channels (three mandatory lower band channels and four optional upper band channels) supported by the Multiband-OFDM Coalition, and (2) the Xtreme Spectrum-Motorola dual-band Impulse Radio spread spectrum approach, where there is a high band (above the 5.2 - 5.8 GHz unlicensed band) and a low band (from 3.1 GHz to just below the 5.2 - 5.8 GHz unlicensed band), and which exploits all of the UWB spectrum allocation. Discrete Time Proposal at Slide 5 ***Summary*** • Compliant with FCC 02-48, UWB Report & Order • 3.1-10.6GHz, 500MHz band spacing • Varies symbol rate and number of bands, from 16Mbps to 600Mbps at PHY-SAP • Scalable down to lower bit rates for lower power, lower cost • Due to time constraints this presentation addresses – Frequency plan – Modulation scheme – Performance in AWGN channel – MAC considerations – Location awareness (contribution from Uri Kareev, Pulsicom) – Concepts of pulse shaping and multiple access • Remaining material will be presented at the next opportunity in May 2003 – Performance in multipath – Channelization – Implementation feasibility – Self evaluation criteria – Other issues that will emerge from group's feedback

Claims	Prior Art
	Discrete Time Proposal at Slide 7 ***FCC compliant*** • It is UWB but is similar in principle to frequency hopping • FCC compliant according to FCC UWB R&O • In this proposal the transmit signal occupies 500MHz **at all times**: frequency change is used to reduce ISI, not to spread the spectrum • "Thus, as long as the transmission system **complies with** the fractional bandwidth or **minimum bandwidth requirements** at all times during its transmission, we agree that it should be permitted to operate under the UWB regulations. We recognize that **this may preclude** certain types of modulations, such as swept frequency (e.g., FMCW), stepped frequency or **frequency hopping systems**. The current measurement procedures require that measurements of swept frequency devices be made with the frequency sweep stopped." [FCC UWB R&O, B-32]

Claims	Prior Art
	Discrete Time Proposal at Slide 8

Multi-band frequency plan

band#	fc (GHz)	fl (GHz)	fh (GHz)
1	3.35	3.1	3.6
2	3.85	3.6	4.1
3	4.35	4.1	4.6
4	4.85	4.6	5.1
5	5.35	5.1	5.6
6	5.85	5.6	6.1
7	6.35	6.1	6.6
8	6.85	6.6	7.1
9	7.35	7.1	7.6
10	7.85	7.6	8.1
11	8.35	8.1	8.6
12	8.85	8.6	9.1
13	9.35	9.1	9.6
14	9.85	9.6	10.1
15	10.35	10.1	10.6



- 500MHz bandwidth at –10dB point
- Spaced 500MHz away

Claims	Prior Art
	Discrete Time Proposal at Slide 17 ***Multiple access scheme: fractional bands*** band# | fc (GHz) | fl (GHz) | fh (GHz) 1 | 3.35 | 3.1 | 3.6 2 | 3.85 | 3.6 | 4.1 3 | 4.35 | 4.1 | 4.6 4 | 4.85 | 4.6 | 5.1 5 | 5.35 | 5.1 | 5.6 6 | 5.85 | 5.6 | 6.1 7 | 6.35 | 6.1 | 6.6 8 | 6.85 | 6.6 | 7.1 9 | 7.35 | 7.1 | 7.6 10 | 7.85 | 7.6 | 8.1 11 | 8.35 | 8.1 | 8.6 12 | 8.85 | 8.6 | 9.1 13 | 9.35 | 9.1 | 9.6 14 | 9.85 | 9.6 | 10.1 15 | 10.35 | 10.1 | 10.6 band# | fc (GHz) | fl (GHz) | fh (GHz) 1.5 | 3.6 | 3.35 | 3.85 2.5 | 4.1 | 3.85 | 4.35 3.5 | 4.6 | 4.35 | 4.85 4.5 | 5.1 | 4.85 | 5.35 5.5 | 5.6 | 5.35 | 5.85 6.5 | 6.1 | 5.85 | 6.35 7.5 | 6.6 | 6.35 | 6.85 8.5 | 7.1 | 6.85 | 7.35 9.5 | 7.6 | 7.35 | 7.85 10.5 | 8.1 | 7.85 | 8.35 11.5 | 8.6 | 8.35 | 8.85 12.5 | 9.1 | 8.85 | 9.35 13.5 | 9.6 | 9.35 | 9.85 14.5 | 10.1 | 9.85 | 10.35 • Fractional bands are placed between the integer bands: their center frequencies are 250MHz off with respect to the integer bands • This allows frequency division multiplexing • Collision with co-located piconets is further reduced by hopping sequences and low duty cycle Engels ’850 at 12:19–26 Secondly, the energy of the radiation of the original signal is still useful for the receiving device. A particular embodiment of a multipath tolerant modulation format is an OFDM or a DMT signal with cyclic prefix. OFDM systems are described in "OFDM for Wireless Multimedia Communications", by R. van Nee and R. Prasad, Artech House 2000, and in “Wireless OFDM Systems”, by M. Engels [Ed.], Kluwer Academic Publishers, 2002. In such a system a block of data inputs is modulated and distributed over various carriers in the frequency domain. Next the frequency domain signal is transformed by a block of samples in the time domain.

Claims	Prior Art
	802-15-3a at PAR Form, Page 2 The intent of this project is to provide a standard for a low complexity, low cost, low power consumption alternate PHY for 802.15.3 (comparable to the goals for 802.15.3). The data rate will be high enough, 110 Mb/s or more (see 18a), to satisfy an evolutionary set of consumer multi-media industry needs for WPAN communications. The project will address the requirements to support multimedia data types in multiple compliant co-located systems and also coexistence (18b). **14. Intellectual Property:** **Sponsor has reviewed the IEEE patent policy with the working group?** Yes **Sponsor is aware of copyrights relevant to this project?** No **Sponsor is aware of trademarks relevant to this project?** No **Sponsor is aware of possible registration of objects or numbers due to this project?** No **15. Are you aware of other standards or projects with a similar scope?** No **Similar Scope Project Information:** **16. Is there potential for this standard (in part or in whole) to be submitted to an international organization for review/adoption?:** Do not Know **If yes, please answer the following questions:** **Which International Organization/Committee?** **International Contact Information?** **17. Will this project focus on Health, Safety or Environmental Issues?** No **18. Additional Explanatory Notes: (Item Number and Explanation)** 18a] The CFAs responses collected by study group 802.15.SG3a over the past several months indicate an evolutionary market developing for a group of applications that will not be addressed by 802.15.3. For example, high data rates, at least 110 Mb/s, will be required for simultaneous time dependent applications such as multiple HDTV video streams without sacrificing the requirements for low complexity, low cost, and low power consumption. In addition to at least 110 Mbps data rate, additional data rates, both lower and higher, may be supported. 18b] It is in the best interest of users and the industry to strive for a level of coexistence with other wireless systems, especially those in similar market spaces. Coexistence requirements will be established in SG3a selection criteria against which the proposals will be evaluated.
[13g] wherein the wireless receiver is configured for receiving wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz.	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless receiver is configured for receiving wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless receiver is configured for receiving wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless receiver is configured for receiving wireless data through OFDM electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [13f].
14. The wireless network device of claim 13 wherein the wireless	It was well known and routine at the time of the alleged invention for a wireless network device to include "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting

Claims	Prior Art
transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 100 MHz.	wireless data through electromagnetic signals that have a bandwidth of 100 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 100 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 100 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. McCorkle '032 at 3:57–58 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver, according to the present invention; Gardner '709 at [0027] Multi-channel extended 802.11 systems might simultaneously transmit on several 20 MHz channels, whereas a legacy 802.11 a system only transmits on a single 20 MHz channel using a single antenna, or if the legacy system does transmit with more than one antenna, each of the antennas transmits the same 802.11a signal, possibly with some delay differences between signals. As a result, data rates can be increased over 802.11a data rates using multiple transmit antennas or multiple channels or a combination of both. Thus, in a communication channel, such as the airspace of a wireless network cloud, several types of packets might be present: Gardner '709 at [0029] 2) Extended SISO in multiple 20 MHz channels (e.g., 40, 60, 80, or 100 MHz channels) Gardner '709 at [0031] 4) Extended MIMO in multiple 20 MHz channels (e.g., 40, 60, 80, or 100 MHz channels) Gardner '709 at [0055] One example of a modified preamble is the preamble shown in FIG. 1 modified as shown in FIG. 8. The long training symbol values for these out-of-band subcarriers can be the same as in the case of FIG. 1. The long training symbol is followed by a replica of the Signal field with identical subcarrier values in each of the 20 MHz channels. This ensures that a receiver that operates on just one of the 20 MHz channels will

Claims	Prior Art
	still be able to successfully decode at least the first part of the packet containing the Signal field and defer for the rest of the packet, as decoding the Signal field provides the receiver with information about the length of the packet and thus how long to defer. The same technique can be extended to an arbitrary number of channels.
15. The wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 160 MHz.	It was well known and routine at the time of the alleged invention for a wireless network device to include "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 160 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 160 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "[t]he wireless network device of claim 13 wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth of 160 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. Gardner '709 at [0027] Multi-channel extended 802.11 systems might simultaneously transmit on several 20 MHz channels, whereas a legacy 802.11 a system only transmits on a single 20 MHz channel using a single antenna, or if the legacy system does transmit with more than one antenna, each of the antennas transmits the same 802.11a signal, possibly with some delay differences between signals. As a result, data rates can be increased over 802.11a data rates using multiple transmit antennas or multiple channels or a combination of both. Thus, in a communication channel, such as the airspace of a wireless network cloud, several types of packets might be present: Gardner '709 at [0029] 2) Extended SISO in multiple 20 MHz channels (e.g., 40, 60, 80, or 100 MHz channels) Gardner '709 at [0031] 4) Extended MIMO in multiple 20 MHz channels (e.g., 40, 60, 80, or 100 MHz channels)

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	Gardner ’709 at [0055] One example of a modified preamble is the preamble shown in FIG. 1 modified as shown in FIG. 8. The long training symbol values for these out-of-band subcarriers can be the same as in the case of FIG. 1. The long training symbol is followed by a replica of the Signal field with identical subcarrier values in each of the 20 MHz channels. This ensures that a receiver that operates on just one of the 20 MHz channels will still be able to successfully decode at least the first part of the packet containing the Signal field and defer for the rest of the packet, as decoding the Signal field provides the receiver with information about the length of the packet and thus how long to defer. The same technique can be extended to an arbitrary number of channels.
16[pre]. A wireless network device, comprising:	“A wireless network device” was well known at the time of the alleged invention. A person of ordinary skill in the art would have found it obvious to modify an existing device to include the claimed elements as set forth below and in Defendants’ other invalidity charts. For example: See, e.g.: 783-A01 U.S. Pat. No. 6,584,080 (“Ganz ’080”) 783-A02 U.S. Pat. Pub. No. 2002/0028655(“Rosener ’655”) 783-A03 U.S. Pat. Pub. No. 2004/0160928 (“Perlman ’928”) 783-A04 U.S. Pat. No. 6,188,496 (“Krishna ’496”) 783-A05 U.S. Pat. No. 7,209,523 (“Larrick ’523”) 783-A06 U.S. Pat. No. 4,056,780 (“Faulkner ’780”) 783-A07 U.S. Pat. No. 6,497,656 (“Evans ’656”) 783-A08 U.S. Pat. Pub. No. 2003/0120809 (“Bellur ’809”) 783-A09 U.S. Pat. No. 8,125,940 (“Perlman ’940”) 783-A10 U.S. Pat. Pub. No. 2005/0201326 (“Lakkis ’326”) 783-A11 U.S. Pat. Pub. No. 2004/0048574 (“Walker ’574”) 786–A12 XtremeSpectrum Trinity Chipset *See* above at row 1[pre].

Claims	Prior Art
[16a] a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless transmitter that transmits wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1a].
[16b] a wireless receiver that receives wireless data through electromagnetic signals that have a bnadwidth greater than or equal to 100 MHz and less than or equal to 500 MHz;	It was well known and routine at the time of the alleged invention for a wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bnadwidth greater than or equal to 100 MHz and less than or equal to 500 MHz." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "a wireless receiver that receives wireless data through electromagnetic signals that have a bnadwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "a wireless receiver that receives wireless data through electromagnetic signals that have a bnadwidth greater than or equal to 100 MHz and less than or equal to 500 MHz" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1a].
[16c] wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver;	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts.

Claims	Prior Art
	These prior art references further demonstrate that the claimed "wherein the wireless transmitter is configured for transmitting wireless data that contains information present in or determined from wireless data that has been received by the wireless receiver" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1c].
[16d] wherein the wireless network device is configured for processing wireless data received by the wireless receiver,	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for processing wireless data received by the wireless receiver" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless network device is configured for processing wireless data received by the wireless receiver" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1d].
[16e] wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter;	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless network device is configured for determining whether any, a portion, or all information in the process wireless data should be transmitted by the wireless transmitter" would have been incorporated into a wireless network device with reasonable expectation of success. *See* above at row [1e].

Claims	Prior Art
[16f] wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second; and	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless transmitter is configured for transmitting wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second" would have been incorporated into a wireless network device with reasonable expectation of success. Mandke 2003A at 2 IEEE 802.15.3 would not be able to provide the data rates necessary to support many of these applications. In November 2001, an additional task group within IEEE 802.15, Task Group 3a, was formed to identify a higher speed physical layer alternative that could support data rates between 110 Mbps and 480 Mbps over short ranges of less than 10 meters. The February 2002 FCC approval of ultra wideband (UWB) devices prompted many companies to consider UWB radio when proposing physical layers to IEEE 802.15.3a. Mandke 2003A at 3 In February of 2002, the FCC amended their Part 15 rules (concerning unlicensed radio devices) to include the operation of UWB devices without a license. The FCC defines UWB signals as having a fractional bandwidth of greater than 0.20 or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [2]. Mandke 2003A at 5 TG3a has set out to develop a flexible standard which will enable high data rate WPAN (110 Mbps at 10m, 200 Mbps at 4m, and 480 Mbps at an unspecified distance) over a cost effective architecture. This new standard will enable a broad range of applications including the wireless transmission of images and

Claims	Prior Art
	video. The goal of this paper is to explore the unique design issues specific to UWB, engineering trade-offs faced by standards developers, and the current state of IEEE 802.15.3a. Section 2 will discuss the unique aspects of indoor UWB channels and the four of the proposed TG3a channel models. Section 3 compares a traditional impulse radio approach to UWB with a more recent multibanded approach (which has been employed in many TG3a proposals). Section 4 details the requirements and specifications set forth by IEEE 802.15.3a, and categorize the proposals being considered in order to form a clear picture of the current state of UWB technology as it relates to WPANs. Mandke 2003A at 12 Scalability parameters include; power consumption, payload bit rate and data throughput measured at the PHY-service access point (PHY-SAP), channelization (physical or coding), complexity, range, frequencies of operation, occupied bandwidth of operation, and other functions deemed appropriate. The alt-PHY should scale up to 480 Mbps and beyond, as well as 110Mbps and below. The MAC should be able to support the scaling of the alt-PHY. Mandke 2003A at 12 The proposed PHY should operate in the close proximity of multiple uncoordinated piconets, at bit rates of 110 Mbps, 200 Mbps and the optional 480 Mbps. A minimum of 200 packets should be used in estimating the packet error rate. Mandke 2003A at Table 4 **Company** | **Texas Instruments** Spectrum Allocation: # of bands | 3 (additional bands can be added in the future) Bandwidths | 503.25 MHz Frequency ranges | 3.168 GHz – 4.752 GHz Modulation Scheme | TFI-OFDM, QPSK 13

Claims	Prior Art
	Mandke 2003A at Table 4

Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	not available
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

Table 4: Overview of the TI Physical Layer Proposal for IEEE 802.15.3a [22].

Mandke 2003A at Table 5

Company	**XtremeSpectrum**
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Avoidance
# of simultaneous piconets	Ternary CDMA
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

Table 5: Overview of the XtremeSpectrum CFP Document [23].

Claims	Prior Art
	Mandke 2003A at Table 6

Company	Intel
Spectrum Allocation:	
# of bands	7 (+ optional 6 bands for future use)
Bandwidths	550 MHz
Frequency ranges	3.6 GHz – 6.9 GHz, (7.45 GHz – 10.2 GHz optional)
Modulation Scheme	M-ary Bi-orthogonal Keying, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	DS/FH CDMA, optional FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	6/32 @ 110 Mbps, 5/16 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	6.3 dB @ 10 m @ 108 Mbps, 8.0 dB @ 4 m @ 288 Mbps, 4.0 dB @ 4 m @ 577 Mbps
Symbol period	3 ns
Multipath mitigation method	frequency interleaving of MBOK chips; time frequency codes; feed forward filter

Table 6: Overview of the Intel CFP Presentation for a UWB PHY [24].

Mandke 2003A at Page 24

Company	Texas Instruments
Spectrum Allocation:	
# of bands	3 (additional bands can be added in the future)
Bandwidths	503.25 MHz
Frequency ranges	3.168 GHz – 4.752 GHz
Modulation Scheme	TFI-OFDM, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	not available
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps, ¾ @ 480 Mbps
Link margin	5.5 dB @ 10 m @ 110 Mbps, 10.2 dB @ 4 m @ 200 Mbps, 12.2 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

A. Batra, et. al. "TI Physical Layer Proposal for IEEE 802.15 Task Group 3a," IEEE P802.15-03/142r0. March 3, 2003.

Claims	Prior Art
	Mandke 2003A at Page 24

Company	XtremeSpectrum
Spectrum Allocation:	
# of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.1 GHz – 5.15 GHz, 5.825 GHz – 10.6 GHz
Modulation Scheme	BPSK, QPSK
Coexistence method	null band for WLAN (~5 GHz)
Multiple access method	Ternary CDMA
# of simultaneous piconets	4 piconets/band
Error correction codes	Convolutional code, Reed-Soloman code
Code rates	½ @ 110 Mbps, RS(255,223) @ 200 Mbps, RS(255,223) @ 480 Mbps
Link margin	9.9 dB @ 10 m @ 110 Mbps, 13.2 dB @ 4 m @ 200 Mbps, 3.4 dB @ 2 m @ 600 Mbps
Chip duration	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer

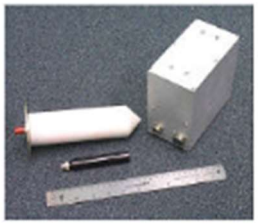
R. Roberts, "XtremeSpectrum CFP Document," IEEE P802.15-03/154r1. March 3, 2003.

Mandke 2003A at Page 27

Company	Discrete Time
Spectrum Allocation:	
# of bands	15 bands
Bandwidths	500 MHz
Frequency ranges	3.1 GHz – 10.6 GHz,
Modulation Scheme	QPSK, FH
Coexistence method	sacrifice 2 band for WLAN coexistence (5 GHz)
Multiple access method	FDMA
# of simultaneous piconets	not available
Error correction codes	Convolutional code
Code rates	½ @ 110 Mbps
Link margin	15.1 dB @ 4m @ 110 Mbps, 12 dB @ 4 m @ 220 Mbps, 11.1 dB @ 4 m @ 480 Mbps
Symbol period	8.9 ns @ 110 Mbps, 4.5 ns @ 200 Mbps, 2.1 ns @ 480 Mbps
Multipath mitigation method	not available

Roberto Aiello, "Discrete Time PHY Proposal for TG3a," IEEE 802.15-03/099r1. March 2003.

Claims	Prior Art
	Fontana at 2 UWB APPLICATIONS Figure 1 illustrates an ultra wideband, handheld transceiver that was designed for full duplex voice and data transmission at rates of up to 128 kb/s (CVSD) and 115.2 kb/s (RS232). The radio has an operational center frequency in L-band (1.5 GHz) with an instantaneous bandwidth of 400 MHz (27% fractional BW). Peak power output from the UWB transceiver was measured at 2.0 Watts, with a resultant average power (worst case) of 640 μW. This results in a worst case power density of 1.6 pW/Hz. These units have a range of approximately 1 to 2 km (with small antennas shown and line-of-sight), and an extended range of 10 to 20 miles with small gain antennas. Fontana at 3 Figure 3 illustrates a high-speed (up to 25 Mb/s) UWB radio designed for transmission of compressed video and command & control information across an asymmetric, bi-directional link. This system was also designed to operate in the 1.3 to 1.7 GHz region (27% fractional BW) with a 4W peak power output. An earlier design, developed under funding from the U.S. Defense Advanced research Projects Agency (DARPA), operated with a 500 MHz instantaneous bandwidth in the C-band region (5.4 to 5.9 GHz). Fontana at 5 Ultra wideband technology was considered for this application because of its ability to transmit large amounts of data at high speed in a mobile, multipath-prone environment. The UWB tag operated in the L-band region (1.4 to 1.65 GHz) and had a peak output power of approximately 250 mW for a demonstrated range of over 300 meters. The image of the driver was stored as a compressed JPEG file, together with additional ASCII data, in EEPROM and periodically transmitted at a 400 kb/s burst rate to a UWB receiver with display. The tag operated off of two AAA batteries (3.0V) and, in an operational scenario, was mounted behind the front grill of the automobile.

Claims	Prior Art
	Fontana at Figure 8  **Figure 8.** UWB Precision Geolocation System Transceiver. Fontana at 6 The system in Figure 8 utilizes a 2.5 ns, 4 Watt peak, UWB pulse, again operating in the 1.3 to 1.7 GHz region. Line-of-sight range for the system is better than 2 kilometers utilizing small, omnidirectional vertically polarized (smaller) or circularly polarized (larger) antennas. Within a building, the range becomes limited by wall and obstacle attenuation; however, ranges exceeding 100 meters inside have been attained. An unique feature of the system is the ability to detect the pulse leading edge through the use of a charge sensitive, tunnel diode detector. Leading edge detection is critical to the resolution of the direct path from the plethora of multipath returns produced from internal reflections. The UWB geolocation system was originally developed to permit a soldier to determine his or her position to within 1 foot resolution in an urban environment. It is currently being used to augment a video capture system for 3-D modeling, and for materiel location onboard a Navy ship. Fontana at Figure 10 **Figure 10.** UWB Backup Sensor. Fontana at 7 Several variants of the Hummingbird radar have also been developed. For example, Figure 10 illustrates an ultra wideband backup sensor for the detection of personnel, vehicles and other objects behind large construction and mining vehicles.

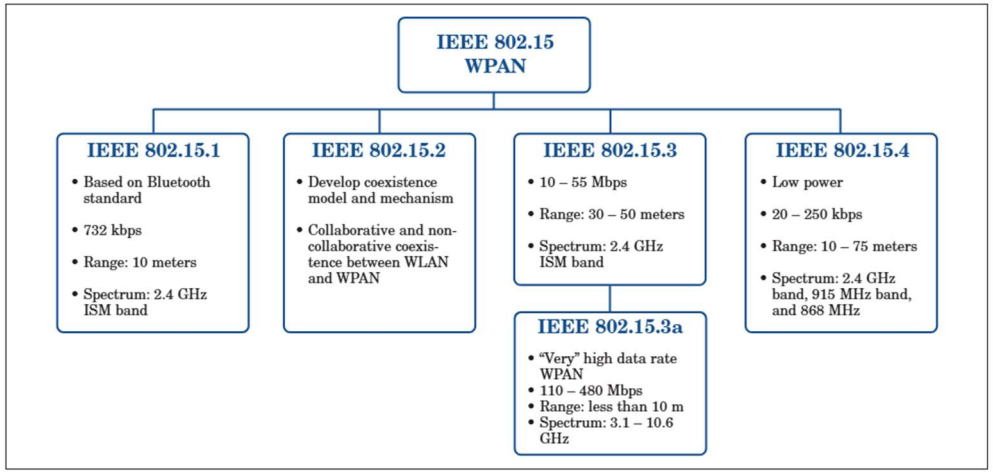
Claims	Prior Art
	[Figure 10] Operating with approximately 250 mW peak in the C-band region from 5.4 to 5.9 GHz, the backup sensor utilizes a dual antenna configuration for the detection of objects as close as 1 foot to beyond 350 feet from the vehicle. Ultra wideband provides a significant advantage for this application because of the ability to provide precision range gating to eliminate clutter which, with conventional Doppler-based sensors, often results in large false alarm rates. This sensor was developed for the National Institute of Occupational Safety and Health. McCorkle ’032 at Abstract A method for conveying application data via carrierless ultra wideband wireless signals, and signals embodied in a carrierless ultra wideband waveform. Application data is encoded into wavelets that are transmitted as a carrierless ultra wideband waveform. The carrierless ultra wideband waveform is received by an antenna, and the application data is decoded from the wavelets included in the waveform. The waveforms of the signals include wavelets that have a predetermined shape that is used to modulate the data. The signals may convey, for example, Web pages and executable programs between mobile devices. The signals are low power and can penetrate obstructions making them favorable for use with a wireless node of a network McCorkle ’032 at 2:3–7 1. Field of the Invention The present invention is directed to methods and signals for ultra wideband communications, and more particularly to methods and signals for conveying application data via carrierless ultra wideband wireless signals. McCorkle ’032 at 3:22–41 An object of the present invention is to provide a method for communicating information using carrierless wireless signals. The inventors of the present invention have recognized that low power carrierless transmissions can be effectively used to communicate at high data rates without interfering with narrowband or spread spectrum signals, and if the power is kept sufficiently low, the transmissions do not need to be as broadcast devices. Accordingly, another object of the present invention is to encode digital data into multi-phase wavelets that can be transmitted without a carrier at low power and at high data rates over short distances. In one embodiment, the present invention is implemented as a method for conveying application data with carrierless ultra wideband wireless signals. The application data is encoded into wavelets that are transmitted without modulating them onto a carrier waveform. In another embodiment, the present

Claims	Prior Art
	invention is implemented as a computer data signal that is embodied in a carrierless ultra wideband waveform. McCorkle ’032 at 3:57–58 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver, according to the present invention; McCorkle ’032 at 3:61–63 FIG. 2 is a block diagram of the transceiver of FIG. 1a, that manipulates a shape of UWB pulses, according to the present invention; and McCorkle ’032 at 4:4–15 FIG. 1a is a block diagram of an ultra-wide band (UWB) transceiver. In FIG. 1a , the transceiver includes three major components, namely, receiver 11, radio controller and interface 9, and transmitter 13. Alternatively, the system may be implemented as a separate receiver 11 and radio controller and interface 9, and a separate transmitter 13 and radio controller and interface 9. The radio controller and interface 9 serves as a media access control (MAC) interface between the UWB wireless communication functions implemented by the receiver 11 and transmitter 13 and applications that use the UWB communications channel for exchanging data with remote devices. McCorkle ’032 at 6:43–61 A feature of the present invention is that the M-ary parameter set used to control the wavelet shape is chosen so as to make a UWB signal, wherein the center frequency f_c and the bandwidth B of the power spectrum of g(t) satisfies $2f_c>B>0.25f_c$. It should be noted that conventional equations define in-phase and quadrature signals (e.g., often referred to as I and Q) as sine and cosine terms. An important observation, however, is that this conventional definition is inadequate for UWB signals. The present invention recognizes that use of such conventional definition may lead to DC offset problems and inferior performance. Furthermore, such inadequacies get progressively worse as the bandwidth moves away from $0.25f_c$ and toward $2f_c$. A key attribute of the exemplary wavelets (or e.g., those described in co-pending U.S. patent application Ser. No. 09/209,460) is that the parameters are chosen such that neither f nor h in Equation 2 above has a DC component, yet f and h exhibit the required wide relative bandwidth for UWB systems. McCorkle ’032 at 9:30–44 FIG. 2 is a block diagram of a transceiver embodiment of the present invention in which the modulation scheme employed is able to manipulate the shape and time of the UWB pulses. In FIG. 2, when receiving

Claims	Prior Art
	energy through the antenna 1, 15 (e.g., corresponding antennas 1 and 15 of FIG. 1a) the energy is coupled in to a transmit/receive (T/R) switch 27, which passes the energy to a radio front end 3. The radio front end 3 filters, extracts noise, and adjusts the amplitude of the signal before providing the same to a splitter 29. The splitter 29 divides the signal up into one of N different signals and applies the N different signals to different tracking correlators 31_1-31_N. Each of the tracking correlators 31_1-31_N receives a clock input signal from a respective timing generator 7_1-7_N of a timing generator module 7, 19, as shown in FIG. 2. McCorkle '032 at 11:49–12:5 The UWB transceiver of FIG. 1a or 2 may be used to perform a radio transport function for interfacing with different applications as part of a stacked protocol architecture. In such a configuration, the UWB transceiver performs signal creation, transmission and reception functions as a communications service to applications that send data to the transceiver and receive data from the transceiver much like a wired I/O port. Moreover, the UWB transceiver may be used to provide a wireless communications function to any one of a variety of devices that may include interconnection to other devices either by way of wired technology or wireless technology. Thus, the UWB transceiver of FIG. 1a or 2 may be used as part of a local area network (LAN) (connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example. In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention, as will be apparent to those skilled in the microprocessor systems art. Appropriate software can be readily prepared by programmers of ordinary skill based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. Aiello '273 at [0003] The present invention relates to a system for transmitting data using Ultra Wide Band (UWB) radio frequencies. More particularly, this invention relates to a system using UWB to transmit data in a de-centralized system and where the data is time sensitive. Still more particularly, this invention relates to transmitting data using UWB in a home entertainment system. Aiello '273 at [0014] UWB is a form of radio transmission. UWB employs short pulses of energy that spread across a wide range of frequencies. A UWB signal is a radio signal with a fractional bandwidth larger than 25%. For example, a UWB signal with a center frequency of 3 GHz has a minimum bandwidth of 750 MHz. Unlike conventional RF technologies, UWB modulates information into RF signals with a series of baseband,

Claims	Prior Art
	pulsed emissions transmitted without a carrier signal. Aiello ’273 at [0015] Therefore UWB has several inherent features that make UWB desirable for use for wireless communications for systems, such as home entertainment systems. First, UWB signals utilize a spectrum of frequencies already designated for other devices. Secondly, UWB signals also have a low power density which allows coexistence with other RF devices with minimal interference. Thirdly, UWB has a low probability of multi-path fading and interference. Aiello ’273 at [0017] The above and other problems are solved and an advance in the art is made by the De-centralized UWB system of this invention. This invention provides a wireless system that has a high data transfer rate required for multi-media applications such as video. This invention also provides high stability under a wide range of loads. Loads mean the amount of RF transmissions in an environment. This invention also provides a wireless system that supports mixed traffic. Mixed traffic is priority, dedicated traffic such as video and audio data as well as burst traffic used for applications such as Internet access. Aiello ’273 at [0019] In accordance with this invention, each device in the system includes a transceiver having an RF transmitter and RF receiver. The transmitter and receiver are each configured to operate with UWB signals. The transceiver is connected to a processing unit that executes applications to transmit and receive data packets via UWB. Aiello ’273 at [0020] The processing unit executes instructions from software stored in a memory of firmware to transmit data in accordance with this invention. In accordance with this invention, the processor in a device that requires a data transmission receives UWB signals being transmitted. When the device detects the system is idle of transmissions, the processor directs the transmitter to transmit arbitration pulses. The processor then waits to receive arbitration pulse signals from other devices requiring a data transmission. The processor then determines whether device has control of the system. Aiello ’273 at [0021] If the device has control of the system, the processor generates a control header including synchronization

Claims	Prior Art
	data. The synchronization data is used as described below by receiving devices to adjust a local clock for use in processing the received data. Encryption initialization data, link adaptation data, a source address of the transmitting device, a destination address of devices to receive the data, and a length of a data field of the packet may also be included in the control header. The control header is then placed in a data packet and sent to the transmitter. The transmitter then transmits the data packet using UWB. Aiello '273 at [0055] fter the payload is generated, the processor in the transmitting device generates the payload in step 335 from the control header and generated payload. The processor then transmits the packet to the transceiver. The transmitter in the transceiver then transmits the packet in UWB signals. Aiello '273 at [0059] A process 400 by which a device in decentralized network 100 receives and processes packets is illustrated in FIG. 4. Process 400 begins when a processor in a receiving device receives a packet that was converted to data by a receiver in the device from UWB signals received by the device in step 405. In step 410, the control header of the received packet is read. From the control header, the processor in receiving device determines whether the packet is addressed to the receiving device in step 420. If the packet is not addressed to the receiving device, process 400 may end or wait until another packet is received. Mandke 2003B at 23 On February 14, 2002, the FCC amended the Part 15 rules which govern unlicensed radio devices to include the operation of ultra wideband (UWB) devices. The use of UWB under the FCC guidelines [1] offers tremendous capacity potential (several Gbps) over short ranges (less than 10 meters) at low radiated power (mean EIRP of –41.3 dBm/MHz). The FCC defines UWB signals as having a fractional bandwidth (the ratio of baseband bandwidth to RF carrier frequency) of greater than 0.20, or a UWB bandwidth greater than 500 MHz. UWB bandwidth is defined as "the frequency band bounded by the points that are 10 dB below the highest radiated emission" [9].

Claims	Prior Art
	Mandke 2003B at Figure 2  Figure 2 · Organization of IEEE 802.15. Mandke 2003B at 23 The fact that the FCC specified that UWB be a minimum bandwidth of 500 MHz is important—while UWB can occupy several GHz of bandwidth using small pulses (as pioneered by Xtreme Spectrum and Time Domain [23], [30]), the 500 MHz bandwidth rule has provided the impetus for chip makers to consider channelization, or a multiband approach, in the UWB standardization activity, mainly as a hedge against foreign governments who may not authorize the full U.S. 3.1 to 10.6 GHz allocation. Mandke 2003B at 24 The remainder of this article focuses on the up-to-the minute standardization activities of IEEE 802.15.3a, concerned with very high data rate WPAN, where UWB is employed. IEEE 802.15 Task Group 3a was formed in late 2001 to identify a higher speed physical layer alternative to 802.15.3. The IEEE 802.15.3a task group is aimed at developing physical layer standards to support data rates between 110 Mbps and 480 Mbps over short ranges of less than 10 meters (i.e. alternatives to the original IEEE 802.15.3 physical layer). It should be noted that 802.15.3.a is only concerned with physical layer alternatives and uses the same MAC layer as IEEE 802.15.3, which is described in [8].

Claims	Prior Art
	Mandke 2003B at Table 2

Parameter	Value
Data rates (measured at PHY-SAP)	110, 220, and (optional 480 Mbps
Range	10 m, 4 m and below
Power consumption	100 mW and 250 mW
Power management modes	Capabiliites such as power save, wake up etc.
Co-located piconets	4
Interference susceptibility	Robust to IEEE systems, PER <8% for a 1024 byte packet
Co-existence capability	Reduced interference to IEEE systems, interfering average power at least 6 dB below the minimum sensitivity level of non-802.15.3a device
Cost	Similar to Bluetooth
Location awareness	Location information to be propagated to a suitable management entity
Scalability	Backwards compatibility with 802.15, adaptable to various regulatory regions (such as the US, European countries or Japan)
Signal Acquisition	<20 μs for acquisition from the beginning of the preamble to the beginning of the header
Antenna practicality	Size and form factor consistent with original device

Table 2 - Summary of Technical Requirements and Selection Criteria for 802.15.3a. (19, 20).

Mandke 2003B at 25

> The flexible standard to be developed by TG3a will enable data rates of 110 - 480 Mbps (data rates necessary for wireless USB), WPAN over a cost effective architecture, and will operate on the IEEE 802.15.3 MAC layer which is already well defined [8]. The new TG3a standard will enable a broad range of applications, including multimedia requiring in excess of 100 Mbps, such as wireless video conferencing.

Claims	Prior Art
	Mandke 2003B at Table 3

Spectrum Allocation	
No. of bands	3 (1st generation bands), 10 optional bands
Bandwidths	528 MHz
Frequency ranges	Group A: 3.168-4.752 GHz Group B: 4.752-6.072 GHz Group C: 6.072-8.184 GHz Group D: 8.184-10.296 GHz
Modulation scheme	TFI-OFDM (with 128-point FFT), QPSK
Coexistence method	Null band for WLAN (~5 GHz)
Multiple access method	Time-frequency interleaving
No. of simultaneous piconets	4
Error correction codes	Convolutional code
Code rates	11/32 @ 110 Mbps, 5/8 @ 200 Mbps 3/4 @ 480 Mbps
Link margin	5.3 dB @ 10 m @ 110 Mbps 10.0 dB @ 4 m @ 200 Mbps 11.5 dB @ 2 m @ 480 Mbps
Symbol period	312.5 ns OFDM symbol
Multipath mitigation method	1-tap (robust to 60.6 ns delay spread)

Table 3 - Overview of the TI Multiband-OFDM Physical Layer proposal supported by the newly-formed Multiband-OFDM Coalition (28, 43).

Mandke 2003B at 25

> After its July 2003 meeting, TG3a is now left with two primary contenders: (1) The Texas Instruments OFDM-based multiband approach which uses 528 MHz channels (three mandatory lower band channels and four optional upper band channels) supported by the Multiband-OFDM Coalition, and (2) the Xtreme Spectrum-Motorola dual-band Impulse Radio spread spectrum approach, where there is a high band (above the 5.2 - 5.8 GHz unlicensed band) and a low band (from 3.1 GHz to just below the 5.2 - 5.8 GHz unlicensed band), and which exploits all of the UWB spectrum allocation.

Claims	Prior Art
	Mandke 2003B at Table 4

Spectrum Allocation	
No. of bands	2
Bandwidths	1.368 GHz, 2.736 GHz
Frequency ranges	3.2 – 5.15 GHz 5.825 – 10.6 GHz
Modulation scheme	BPSK, QPSK, DS-SS
Coexistence method	Null band for WLAN (~5 GHz)
Multiple access method	Ternary CDMA
No. of simultaneous piconets	8
Error correction codes	Convolutional code, Reed-Solomon code
Code rates	1/2 @ 110 Mbps RS(255,223) @ 200 Mbps RS(255,223) @ 480 Mbps
Link margin	6.7 dB @ 10 m @ 114 Mbps 11.9 dB @ 4 m @ 200 Mbps 1.7 dB @ 2 m @ 600 Mbps
Chip time	731 ps (Low band), 365.5 ps (High band)
Multipath mitigation method	Decision feedback equalizer and RAKE

Table 4 - Overview of the Xtreme Spectrum CFP Document (30).

Treadaway ’477 at Abstract

A method and apparatus for a data transmission rate of multiples of 100 mega-bits per second (Mbps) in a terminal for a wireless metropolitan area network. A terminal includes a first media access control unit (MAC) unit for receiving Fast Ethernet data packets at a rate of 100 Mbps for communication over a wireless link, n−1 additional MAC units for receiving Fast Ethernet data packets at a rate of 100 Mbps for communication over the wireless link, a multiplexer having n inputs, wherein each input is coupled to receive the data packets from a corresponding one of the MAC units and wherein the output of the multiplexer provides time-division multiplexed data, a packet formatting apparatus coupled to the output of the multiplexer for formatting the time division multplexed data according to radio frames, and a wireless transceiver coupled to the packet formatting apparatus for communicating the radio frames over a wireless link wherein the wireless link has a maximum bandwidth capacity of at least n times 100 Mbps. Each MAC unit can include a rate control unit and a rate buffer for temporarily storing data packets received by the corresponding MAC unit prior to providing them to a corresponding one of the inputs of the multiplexer. Each MAC unit can include a corresponding layer-two or layer-three switch having a 100 Mbps port. The maximum transmission rate is limited only by the bandwidth of the wireless link.

Claims	Prior Art
	Treadaway ’477 at 2:28–63 The invention is a method and apparatus for achieving a data transmission rate of multiples of 100 mega-bits per second (Mbps) in a terminal for a wireless metropolitan area network. In accordance with an aspect of the present invention, a method of communicating data packets in a wireless network includes steps of receiving a first data packet wherein the first data packet is received according to a first rate of data communication, receiving a second data packet wherein the second data packet is received according to a second rate of data communication and wherein the step of receiving the second data packet is performed simultaneously with the step of receiving the first data packet, time division multiplexing the first data packet and the second data packet to a radio frame, and communicating the radio frame via a wireless link wherein the radio frame is communicated at a third rate of data communication wherein the third rate of data communication is equal to at least a sum of the first rate of data communication and the second rate of data communication. The method can also include a step of buffering the first data packet prior to time division multiplexing the first data packet such that the step of buffering the first data packet synchronizes the first data packet to the radio frame. The method can also include a step of buffering the second data packet prior to providing the second data packet to the radio framer such that the step of buffering the second data packet synchronizes the second data packet to the radio frame. The first and second data packets can be received from an Ethernet local area network. The first data packet can be a 100 mega-bit per second (Mbps) Fast Ethernet data packet. The second data packet can be a 10 Mbps Ethernet data packet. The method can include steps of receiving a third data packet, and time division multiplexing the third data packet to the radio frame. The method can include a step of encrypting the first data packet prior to performing the step of time division multiplexing. Treadaway ’477 at 2:64–3:34 According to another aspect of the invention, a method of communicating data packets in a wireless network includes steps of receiving a first Fast Ethernet data packet into a first MAC unit wherein the first data packet is received at a rate of 100 Mbps, receiving a second Fast Ethernet data packet into a second MAC unit wherein the second data packet is received at a rate of 100 Mbps and wherein the step of receiving the second data packet is performed simultaneously with the step of receiving the first data packet, providing the first data packet and the second data packet to a radio framer according to time division multiplexing thereby forming a time division multiplexed radio frame, and communicating the time division multiplexed radio frame via a wireless link wherein the time division multiplexed radio frame is communicated at a rate of at least 200 Mbps. The first Fast Ethernet data packet can be received from an Ethernet local area network coupled to the first MAC unit. The method can include steps of receiving a third Fast Ethernet data packet into a third MAC unit wherein the third data packet is received at a rate of 100 Mbps, and providing the third data packet to the radio framer according to time division

Claims	Prior Art
	multiplexing. In which case, the time division multiplexed radio frame can be communicated at a rate of at least 300 Mbps. The method can include a step of buffering the first data packet in the first MAC unit prior to providing the first data packet to the radio framer. The step of buffering the first data packet can synchronize the first data packet to the radio frame. The method can also include a step of buffering the second data packet in the second MAC unit prior to providing the second data packet to the radio framer such that the step of buffering the second data packet synchronizes the second data packet to the radio frame. The method can include a step of encrypting the first data packet prior to performing the step of providing the first data packet to the radio framer. The method can also include a step of receiving an Ethernet data packet into the first MAC unit wherein the Ethernet data packet is received at a rate of 10 Mbps. Treadaway ’477 at 6:29–38 Referring to FIG. 1, the wireless link 102 preferably includes a primary radio channel 102A which carries full duplex 100 mega-bits-per-second (Mbps) data traffic, including payload data, and an auxiliary radio channel 102B which carries full-duplex control data for network management and control over the manner of transmission over the link 102 (link control). For example, changes to the manner of transmission initiated through link control can include changing transmission power, data bit rate, amplitude modulation scheme, spectrum spreading and transmission path. Treadaway ’477 at 8:38–50 The TFU 106 provides three interfaces to customer equipment, including the router or switch 116 (FIG. 1) and the DS 124 (FIG. 1). These include a full-duplex 100 Mbps interface via the regenerator 200, a half-duplex 10 Mbps interface via the repeater 204 and an RS232 serial port via the converter 206. Though the payload data traffic is generally directed through the 100 Mbps interface while network management and link control traffic is generally directed through the 10 Mbps interface, a user of the terminal 100 can combine network management and link control signals with the payload data traffic in the 100 Mbps interface depending upon the particular capabilities of the router or switch 116 (FIG. 1).

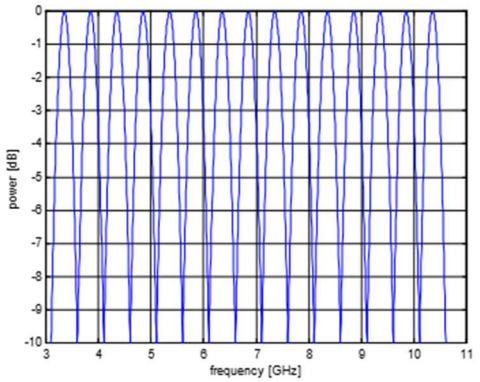
Claims	Prior Art
	Discrete Time Proposal at Slide 4 • Meet all system requirements – 7.1dB link margin at 110Mbps (30ft) – 12dB link margin at 220Mbps (12ft) – 11.1dB link margin at 480Mbps (12ft) Discrete Time Proposal at Slide 5 ***Summary*** • Compliant with FCC 02-48, UWB Report & Order • 3.1-10.6GHz, 500MHz band spacing • Varies symbol rate and number of bands, from 16Mbps to 600Mbps at PHY-SAP • Scalable down to lower bit rates for lower power, lower cost • Due to time constraints this presentation addresses – Frequency plan – Modulation scheme – Performance in AWGN channel – MAC considerations – Location awareness (contribution from Uri Kareev, Pulsicom) – Concepts of pulse shaping and multiple access • Remaining material will be presented at the next opportunity in May 2003 – Performance in multipath – Channelization – Implementation feasibility – Self evaluation criteria – Other issues that will emerge from group's feedback

Claims	Prior Art
	Discrete Time Proposal at Slide 7 ***FCC compliant*** • It is UWB but is similar in principle to frequency hopping • FCC compliant according to FCC UWB R&O • In this proposal the transmit signal occupies 500MHz **at all times**: frequency change is used to reduce ISI, not to spread the spectrum • "Thus, as long as the transmission system **complies with** the fractional bandwidth or **minimum bandwidth requirements** at all times during its transmission, we agree that it should be permitted to operate under the UWB regulations. We recognize that **this may preclude** certain types of modulations, such as swept frequency (e.g., FMCW), stepped frequency or **frequency hopping systems**. The current measurement procedures require that measurements of swept frequency devices be made with the frequency sweep stopped." [FCC UWB R&O, B-32]

Claims	Prior Art
	Discrete Time Proposal at Slide 8

Multi-band frequency plan

band#	fc (GHz)	fl (GHz)	fh (GHz)
1	3.35	3.1	3.6
2	3.85	3.6	4.1
3	4.35	4.1	4.6
4	4.85	4.6	5.1
5	5.35	5.1	5.6
6	5.85	5.6	6.1
7	6.35	6.1	6.6
8	6.85	6.6	7.1
9	7.35	7.1	7.6
10	7.85	7.6	8.1
11	8.35	8.1	8.6
12	8.85	8.6	9.1
13	9.35	9.1	9.6
14	9.85	9.6	10.1
15	10.35	10.1	10.6

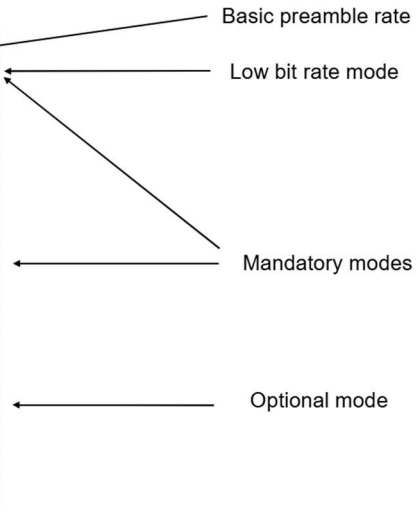


- 500MHz bandwidth at –10dB point
- Spaced 500MHz away

Claims	Prior Art
	Discrete Time Proposal at Slide 10

Modes parameters (Mbps vs. bands and hopping frequency)

# of bands/Hopping freq (MHz)	16	32	40
1	16	32	40
2	32	64	80
3	48	96	120
4	64	128	160
5	80	160	200
6	96	192	240
7	112	224	280
8	128	256	320
9	144	288	360
10	160	320	400
11	176	352	440
12	192	384	480
13	208	416	520
14	224	448	560
15	240	480	600



Claims	Prior Art
	Discrete Time Proposal at Slide 17

Multiple access scheme: fractional bands

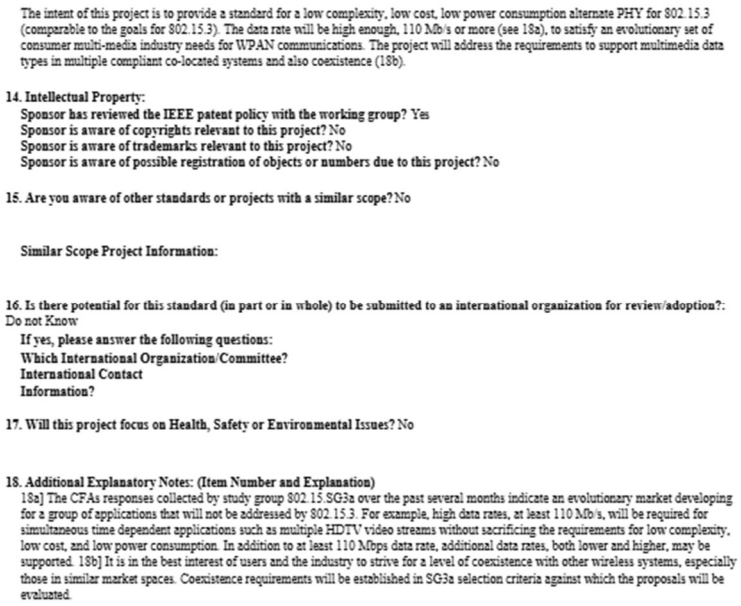
band#	fc (GHz)	fl (GHz)	fh (GHz)
1	3.35	3.1	3.6
2	3.85	3.6	4.1
3	4.35	4.1	4.6
4	4.85	4.6	5.1
5	5.35	5.1	5.6
6	5.85	5.6	6.1
7	6.35	6.1	6.6
8	6.85	6.6	7.1
9	7.35	7.1	7.6
10	7.85	7.6	8.1
11	8.35	8.1	8.6
12	8.85	8.6	9.1
13	9.35	9.1	9.6
14	9.85	9.6	10.1
15	10.35	10.1	10.6

band#	fc (GHz)	fl (GHz)	fh (GHz)
1.5	3.6	3.35	3.85
2.5	4.1	3.85	4.35
3.5	4.6	4.35	4.85
4.5	5.1	4.85	5.35
5.5	5.6	5.35	5.85
6.5	6.1	5.85	6.35
7.5	6.6	6.35	6.85
8.5	7.1	6.85	7.35
9.5	7.6	7.35	7.85
10.5	8.1	7.85	8.35
11.5	8.6	8.35	8.85
12.5	9.1	8.85	9.35
13.5	9.6	9.35	9.85
14.5	10.1	9.85	10.35

- Fractional bands are placed between the integer bands: their center frequencies are 250MHz off with respect to the integer bands
- This allows frequency division multiplexing
- Collision with co-located piconets is further reduced by hopping sequences and low duty cycle

Claims	Prior Art
	Discrete Time Proposal at Slide 28 ***Flexibility*** • Scalable bit rate (from 16Mbps to 600Mbps) • Control individual bands to manage – Interference – Co-existence – Worldwide regulations • Scale power consumption – Variable number of bands – Variable hopping and symbol rate

Claims	Prior Art
	Discrete Time Proposal at Slide 29 **Conclusions** • UWB multi-band system • Similar to frequency hopping • Meet all system requirements – 7.1dB link margin at 110Mbps (30ft) – 12dB link margin at 220Mbps (12ft) – 11.1dB link margin at 480Mbps (12ft) • Low signal repetition frequency to reduce ISI and need for high speed digital circuits (lower power consumption) • "Narrow" UWB bandwidth to reduce complexity • Remaining material will be presented at the next opportunity in May 2003

Claims	Prior Art
	802-15-3a at PAR Form, Page 2  The intent of this project is to provide a standard for a low complexity, low cost, low power consumption alternate PHY for 802.15.3 (comparable to the goals for 802.15.3). The data rate will be high enough, 110 Mb/s or more (see 18a), to satisfy an evolutionary set of consumer multi-media industry needs for WPAN communications. The project will address the requirements to support multimedia data types in multiple compliant co-located systems and also coexistence (18b). **14. Intellectual Property:** **Sponsor has reviewed the IEEE patent policy with the working group?** Yes **Sponsor is aware of copyrights relevant to this project?** No **Sponsor is aware of trademarks relevant to this project?** No **Sponsor is aware of possible registration of objects or numbers due to this project?** No **15. Are you aware of other standards or projects with a similar scope?** No **Similar Scope Project Information:** **16. Is there potential for this standard (in part or in whole) to be submitted to an international organization for review/adoption?:** Do not Know **If yes, please answer the following questions:** **Which International Organization/Committee?** **International Contact Information?** **17. Will this project focus on Health, Safety or Environmental Issues?** No **18. Additional Explanatory Notes: (Item Number and Explanation)** 18a] The CFAs responses collected by study group 802.15.SG3a over the past several months indicate an evolutionary market developing for a group of applications that will not be addressed by 802.15.3. For example, high data rates, at least 110 Mb/s, will be required for simultaneous time dependent applications such as multiple HDTV video streams without sacrificing the requirements for low complexity, low cost, and low power consumption. In addition to at least 110 Mbps data rate, additional data rates, both lower and higher, may be supported. 18b] It is in the best interest of users and the industry to strive for a level of coexistence with other wireless systems, especially those in similar market spaces. Coexistence requirements will be established in SG3a selection criteria against which the proposals will be evaluated.
[16g] wherein the wireless receiver is configured for receiving wireless data throught electormagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second.	It was well known and routine at the time of the alleged invention for a wireless network device to include "wherein the wireless receiver is configured for receiving wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second." To the extent a wireless network device disclosed in any of Defendants' other invalidity charts is found not to disclose this limitation, a person of ordinary skill in the art would have found it obvious to modify an existing wireless network device to include "wherein the wireless receiver is configured for receiving wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second" as claimed in light of the teachings in the references set forth below and in Defendants' other invalidity charts. These prior art references further demonstrate that the claimed "wherein the wireless receiver is configured for receiving wireless data through electromagnetic signals that have a bandwidth greater than or equal to 100 MHz and less than or equal to 500 MHz at a data rate greater than or equal to 100 megabits per second and less than or equal to 480 megabits per second" would have been incorporated into a wireless network device with reasonable expectation of success.

Claims	Prior Art
	See above at row [16f].