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Box Patent Application
Commissioner for Patents
Washington, D.C. 20231

EXPRESS MAIL RECEIPT NO. ET 649646520 US

Re: U.S. Patent Application for "WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION"
Our File: WEST14-00103

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Very truly yours,

Novakov Davis & Munck, P.C.

William A. Munck

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Enclosures

DOCKET NO. 2000-0075

DOCKET NO. WEST14-00103 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: : Paul F. Struhsaker

For : WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

BOX PATENT APPLICATION
Commissioner for Patents
Washington, D.C. 20231

09/946,855 - 09/05/01

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ATTY. DOCKET NO. WEST14-00103 PATENT

WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

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WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention is related to those disclosed in the following United States Provisional and Non-Provisional Patent Applications:

1) Serial No. 09/713,684, filed on November 15, 2000, entitled "SUBSCRIBER INTEGRATED ACCESS DEVICE FOR USE IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00004];

2) Serial No. 09/838,810, filed April 20, 2001, entitled "WIRELESS COMMUNICATION SYSTEM USING BLOCK FILTERING AND FAST EQUALIZATION-DEMODULATION AND METHOD OF OPERATION" [Docket No. WEST14-00005];

3) Serial No. 09/839,726, filed April 20, 2001, entitled "APPARATUS AND ASSOCIATED METHOD FOR OPERATING UPON DATA SIGNALS RECEIVED AT A RECEIVING STATION OF A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00014];

4) Serial No. 09/839,729, filed April 20, 2001, entitled "APPARATUS AND METHOD FOR OPERATING A SUBSCRIBER INTERFACE IN A FIXED WIRELESS SYSTEM" [Docket No. WEST14-00015];

5) Serial No. 09/839,719, filed April 20, 2001, entitled

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"APPARATUS AND METHOD FOR CREATING SIGNAL AND PROFILES AT A RECEIVING STATION" [Docket No. WEST14-00016];

6) Serial No. 09/838,910, filed April 20, 2001, entitled "SYSTEM AND METHOD FOR INTERFACE BETWEEN A SUBSCRIBER MODEM AND SUBSCRIBER PREMISES INTERFACES" [Docket No. WEST14-00017];

7) Serial No. 09/839,509, filed April 20, 2001, entitled "BACKPLANE ARCHITECTURE FOR USE IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00018];

8) Serial No. 09/839,514, filed April 20, 2001, entitled "SYSTEM AND METHOD FOR ON-LINE INSERTION OF LINE REPLACEABLE UNITS IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00019];

9) Serial No. 09/839,512, filed April 20, 2001, entitled "SYSTEM FOR COORDINATION OF TDD TRANSMISSION BURSTS WITHIN AND BETWEEN CELLS IN A WIRELESS ACCESS SYSTEM AND METHOD OF OPERATION" [Docket No. WEST14-00020];

10) Serial No. 09/839,259, filed April 20, 2001, entitled "REDUNDANT TELECOMMUNICATION SYSTEM USING MEMORY EQUALIZATION APPARATUS AND METHOD OF OPERATION" [Docket No. WEST14-00021];

11) Serial No. 09/839,457, filed April 20, 2001, entitled "WIRELESS ACCESS SYSTEM FOR ALLOCATING AND SYNCHRONIZING UPLINK AND DOWNLINK OF TDD FRAMES AND METHOD OF OPERATION"

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[Docket No. WEST14-00022];

12) Serial No. 09/839,075, filed April 20, 2001, entitled "TDD FDD AIR INTERFACE" [Docket No. WEST14-00023];

13) Serial No. 09/839,499, filed April 20, 2001, entitled "APPARATUS, AND AN ASSOCIATED METHOD, FOR PROVIDING WLAN SERVICE IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00024];

14) Serial No. 09/839,458, filed April 20, 2001, entitled "WIRELESS ACCESS SYSTEM USING MULTIPLE MODULATION" [Docket No. WEST14-00026];

15) Serial No. 09/839,456, filed April 20, 2001, entitled "WIRELESS ACCESS SYSTEM AND ASSOCIATED METHOD USING MULTIPLE MODULATION FORMATS IN TDD FRAMES ACCORDING TO SUBSCRIBER SERVICE TYPE" [Docket No. WEST14-00027];

16) Serial No. 09/838,924, filed April 20, 2001, entitled "APPARATUS FOR ESTABLISHING A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00028];

17) Serial No. 09/839,858, filed April 20, 2001, entitled "APPARATUS FOR REALLOCATING COMMUNICATION RESOURCES TO ESTABLISH A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00029];

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18) Serial No. 09/839,734, filed April 20, 2001, entitled "METHOD FOR ESTABLISHING A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00030];

19) Serial No. 09/839,513, filed April 20, 2001, entitled "SYSTEM AND METHOD FOR PROVIDING AN IMPROVED COMMON CONTROL BUS FOR USE IN ON-LINE INSERTION OF LINE REPLACEABLE UNITS IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00033];

20) Serial No. 60/262,712, filed on January 19, 2001, entitled "WIRELESS COMMUNICATION SYSTEM USING BLOCK FILTERING AND FAST EQUALIZATION-DEMODULATION AND METHOD OF OPERATION" [Docket No. WEST14-00005];

21) Serial No. 60/262,825, filed on January 19, 2001, entitled "APPARATUS AND ASSOCIATED METHOD FOR OPERATING UPON DATA SIGNALS RECEIVED AT A RECEIVING STATION OF A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00014];

22) Serial No. 60/262,698, filed on January 19, 2001, entitled "APPARATUS AND METHOD FOR OPERATING A SUBSCRIBER INTERFACE IN A FIXED WIRELESS SYSTEM" [Docket No. WEST14-00015];

23) Serial No. 60/262,827, filed on January 19, 2001, entitled "APPARATUS AND METHOD FOR CREATING SIGNAL AND PROFILES AT A RECEIVING STATION" [Docket No. WEST14-00016];

24) Serial No. 60/262,826, filed on January 19, 2001, entitled

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"SYSTEM AND METHOD FOR INTERFACE BETWEEN A SUBSCRIBER MODEM AND SUBSCRIBER PREMISES INTERFACES" [Docket No. WEST14-00017];

25) Serial No. 60/262,951, filed on January 19, 2001, entitled "BACKPLANE ARCHITECTURE FOR USE IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00018];

26) Serial No. 60/262,824, filed on January 19, 2001, entitled "SYSTEM AND METHOD FOR ON-LINE INSERTION OF LINE REPLACEABLE UNITS IN WIRELESS AND WIRELINE ACCESS SYSTEMS" [Docket No. WEST14-00019];

27) Serial No. 60/263,101, filed on January 19, 2001, entitled "SYSTEM FOR COORDINATION OF TDD TRANSMISSION BURSTS WITHIN AND BETWEEN CELLS IN A WIRELESS ACCESS SYSTEM AND METHOD OF OPERATION" [Docket No. WEST14-00020];

28) Serial No. 60/263,097, filed on January 19, 2001, entitled "REDUNDANT TELECOMMUNICATION SYSTEM USING MEMORY EQUALIZATION APPARATUS AND METHOD OF OPERATION" [Docket No. WEST14-00021];

29) Serial No. 60/273,579, filed March 5, 2001, entitled "WIRELESS ACCESS SYSTEM FOR ALLOCATING AND SYNCHRONIZING UPLINK AND DOWNLINK OF TDD FRAMES AND METHOD OF OPERATION" [Docket No. WEST14-00022];

30) Serial No. 60/262,955, filed January 19, 2001, entitled "TDD FDD AIR INTERFACE" [Docket No. WEST14-00023];

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31) Serial No. 60/262,708, filed on January 19, 2001, entitled "APPARATUS, AND AN ASSOCIATED METHOD, FOR PROVIDING WLAN SERVICE IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00024];

32) Serial No. 60/273,689, filed March 5, 2001, entitled "WIRELESS ACCESS SYSTEM USING MULTIPLE MODULATION" [Docket No. WEST14-00026];

33) Serial No. 60/273,757, filed March 5, 2001, entitled "WIRELESS ACCESS SYSTEM AND ASSOCIATED METHOD USING MULTIPLE MODULATION FORMATS IN TDD FRAMES ACCORDING TO SUBSCRIBER SERVICE TYPE" [Docket No. WEST14-00027];

34) Serial No. 60/270,378, filed February 21, 2001, entitled "APPARATUS FOR ESTABLISHING A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00028];

35) Serial No. 60/270,385, filed February 21, 2001, entitled "APPARATUS FOR REALLOCATING COMMUNICATION RESOURCES TO ESTABLISH A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00029]; and

36) Serial No. 60/270,430, filed February 21, 2001, entitled "METHOD FOR ESTABLISHING A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM" [Docket No. WEST14-00030].

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The above applications are commonly assigned to the assignee of the present invention. The disclosures of these related patent applications are hereby incorporated by reference for all purposes as if fully set forth herein.

TECHNICAL FIELD OF THE INVENTION

The present invention is directed, in general, to wireless access systems and, more specifically, to a burst packet transmission media access system using selectively adaptable beam forming in a fixed wireless access network.

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BACKGROUND OF THE INVENTION

Telecommunications access systems provide for voice, data, and multimedia transport and control between the central office (CO) of the telecommunications service provider and the subscriber (customer) premises. Prior to the mid-1970s, the subscriber was provided phone lines (e.g., voice frequency (VF) pairs) directly from the Class 5 switching equipment located in the central office of the telephone company. In the late 1970s, digital loop carrier (DLC) equipment was added to the telecommunications access architecture. The DLC equipment provided an analog phone interface, voice CODEC, digital data multiplexing, transmission interface, and control and alarm remotely from the central office to cabinets located within business and residential locations for approximately 100 to 2000 phone line interfaces. This distributed access architecture greatly reduced line lengths to the subscriber and resulted in significant savings in both wire installation and maintenance. The reduced line lengths also improved communication performance on the line provided to the subscriber.

By the late 1980s, the limitations of data modem connections over voice frequency (VF) pairs were becoming obvious to both subscribers and telecommunications service providers. ISDN (Integrated Services Digital Network) was introduced to provide

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universal 128 kbps service in the access network. The subscriber interface is based on 64 kbps digitization of the VF pair for digital multiplexing into high speed digital transmission streams (e.g., T1/T3 lines in North America, E1/E3 lines in Europe). ISDN was a logical extension of the digital network that had evolved throughout the 1980s. The rollout of ISDN in Europe was highly successful. However, the rollout in the United States was not successful, due in part to artificially high tariff costs which greatly inhibited the acceptance of ISDN.

More recently, the explosion of the Internet and deregulation of the telecommunications industry have brought about a broadband revolution characterized by greatly increased demands for both voice and data services and greatly reduced costs due to technological innovation and intense competition in the telecommunications marketplace. To meet these demands, high speed DSL (digital subscriber line) modems and cable modems have been developed and introduced. The DLC architecture was extended to provide remote distributed deployment at the neighborhood cabinet level using DSL access multiplexer (DSLAM) equipment. The increased data rates provided to the subscriber resulted in upgrade DLC/DSLAM transmission interfaces from T1/E1 interfaces (1.5/2.0 Mbps) to high speed DS3 and OC3 interfaces. In a similar fashion,

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the entire telecommunications network backbone has undergone and is undergoing continuous upgrade to wideband optical transmission and switching equipment.

Similarly, wireless access systems have been developed and deployed to provide broadband access to both commercial and residential subscriber premises. Initially, the market for wireless access systems was driven by rural radiotelephony deployed solely to meet the universal service requirements imposed by government (i.e., the local telephone company is required to serve all subscribers regardless of the cost to install service). The cost of providing a wired connection to a small percentage of rural subscribers was high enough to justify the development and expense of small-capacity wireless local loop (WLL) systems.

Deregulation of the local telephone market in the United States (e.g., Telecommunications Act of 1996) and in other countries shifted the focus of fixed wireless access (FWA) systems deployment from rural access to competitive local access in more urbanized areas. In addition, the age and inaccessibility of much of the older wired telephone infrastructure makes FWA systems a cost-effective alternative to installing new, wired infrastructure. Also, it is more economically feasible to install FWA systems in developing countries where the market penetration is limited (i.e.,

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the number and density of users who can afford to pay for services is limited to small percent of the population) and the rollout of wired infrastructure cannot be performed profitably. In either case, broad acceptance of FWA systems requires that the voice and data quality of FWA systems must meet or exceed the performance of wired infrastructure.

Wireless access systems must address a number of unique operational and technical issues including:

1) Relatively high bit error rates (BER) compared to wire line or optical systems; and

2) Transparent operation with network protocols and protocol time constraints for the following protocols:

a) ATM;

b) Class 5 switch interfaces (domestic GR-303 and international V5.2);

c) TCP/IP with quality-of-service QoS for voice over IP (VoIP) (i.e., RTP) and other H.323 media services;

d) Distribution of synchronization of network time out to the subscribers;

3) Increased use of voice, video and/or media compression and concentration of active traffic over the air interface to conserve bandwidth;

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4) Switching and routing within the access system to distribute signals from the central office to multiple remote cell sites containing multiple cell sectors and one or more frequencies of operation per sector; and

5) Remote support and debugging of the subscriber equipment, including remote software upgrade and provisioning.

Unlike physical optical or wire systems that operate at bit error rates (BER) of 10^{-11}, wireless access systems have time varying channels that typically provide bit error rates of 10^{-3} to 10^{-6}. The wireless physical (PHY) layer interface and the media access control (MAC) layer interface must provide modulation, error correction and ARQ (automatic request for retransmission) protocol that can detect and, where required, correct or retransmit corrupted data so that the interfaces at the network and at the subscriber site operate at wire line bit error rates.

The wide range of equipment and technology capable of providing either wireline (i.e., cable, DSL, optical) broadband access or wireless broadband access has allowed service providers to match the needs of a subscriber with a suitable broadband access solution. However, in many areas, the cost of cable modem or DSL service is high. Additionally, data rates may be slow or coverage incomplete due to line lengths. In these areas and in areas where

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the high cost of replacing old telephone equipment or the low density of subscribers makes it economically unfeasible to introduce either DSL or cable modem broadband access, fixed wireless broadband systems offer a viable alternative. Fixed wireless broadband systems use a group of transceiver base stations to cover a region in the same manner as the base stations of a cellular phone system. The base stations of a fixed wireless broadband system transmit forward channel (i.e., downstream) signals in directed beams to fixed location antennas attached to the residences or offices of subscribers. The base stations also receive reverse channel (i.e., upstream) signals transmitted by the broadband access equipment of the subscriber.

Media access control (MAC) protocols refer to techniques that increase utilization of two-way communication channel resources by subscribers that use the channel resources. The MAC layer may use a number of possible configurations to allow multiple access. These configurations include:

1. FDMA - frequency division multiple access. In a FDMA system, subscribers use separate frequency channels on a permanent or demand access basis.

2. TDMA - time division multiple access. In a TDMA system, subscribers share a frequency channel but allocate spans of time to

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different users.

3. CDMA - code division multiple access. In a CDMA system, subscribers share a frequency but use a set of orthogonal codes to allow multiple access.

4. SDMA - space division multiple access - In a SDMA system, subscribers share a frequency but one or more physical channels are formed using antenna beam forming techniques.

5. PDMA - polarization division multiple access - In a PDMA system, subscribers share a frequency but change polarization of the antenna.

Each of these MAC techniques makes use of a fundamental degree of freedom (physical property) of a communications channel. In practice, combinations of these degrees of freedom are often used. As an example, cellular systems use a combination of FDMA and either TDMA or CDMA to support a number of users in a cell.

To provide a subscriber with bi-directional (two-way) communication in a shared media, such as a coaxial cable, a multi-mode fiber (optical), or an RF radio channel, some type of duplexing technique must be implemented. Duplexing techniques include frequency division duplexing (FDD) and time division duplexing (TDD). In FDD, a first channel (frequency) is used for transmission and a second channel (frequency) is used for

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reception. To avoid physical interference between the transmit and receive channels, the frequencies must have a separation know as the duplex spacing. In TDD, a single channel is used for transmission and reception and specific periods of time (i.e., slots) are allocated for transmission and other specific periods of time are allocated for reception.

Finally, a method of coordinating the use of bandwidth must be established. There are two fundamental methods: distributed control and centralized control. In distributed control, subscribers have a shared capability with or without a method to establish priority. An example of this is CSMA (carrier sense multiple access) used in IEEE802.3 Ethernet and IEEE 802.11 Wireless LAN. In centralized control, subscribers are allowed access under the control of a master controller. Cellular systems, such as IS-95, IS-136, and GSM, are typical examples. Access is granted using forms of polling and reservation (based on polled or demand access contention).

A number of references and overviews of demand access are available including the following:

1. Sklar, Bernard. "Digital Communications Fundamentals and Applications," Prentice Hall, Englewood Cliffs, New Jersey, 1988. Chapter 9.

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2. Rappaport, Theodore. "Wireless Communications, Principles and Practice," Prentice Hall, Upper Saddle River, New Jersey, 1996. Chapter 8.

3. TR101-173V1.1. "Broadband Radio Access Networks, Inventory of Broadband Radio Technologies and Techniques," ETSI, 1998. Chapter 7.

The foregoing references are hereby incorporated by reference into the present disclosure as if fully set forth herein.

In 1971, the University of Hawaii began operation of a random access shared channel ALOHA TDD system. The lack of channel coordination resulted in poor utilization of the channel. This lead to the introduction of time slots (slotted Aloha) that set a level of coordination between the subscribers that doubled the channel throughput. Finally, the researchers introduced the concept of a central controller and the use of reservations (reservation Aloha). Reservation techniques made it possible to make trade-offs between throughput and latency.

This work was fundamental to the development of media access control (MAC) techniques for dynamic random access and the use of ARQ (automatic request for retransmission) to retransmit erroneous packets. While the work at the University of Hawaii explored the fundamentals of burst transmission and random access, the work did

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not introduce the concept of a frame and/or super-frame structure to the TDD/TDMA access techniques. One of the more sophisticated systems developed in the 1970s and in current use is Joint Tactical Information Distribution System (JTIDS). This system was based on the joint use of TDMA and time duplexing over frequency-hopping spread-spectrum channels. This was the culmination of research to allow flexible allocation of bandwidth to a large group of users. The key aspect of the JTIDS system was the introduction of dynamic allocation of bandwidth resources and explicit variable symmetry (downlink vs. uplink bandwidth) in the link.

IEEE 802.11 Wireless LAN equipment provides for a centrally coordinated TDD system that does not have a specific frame or slotting structure. IEEE 802.11 did introduce the concept of variable modulation and spreading inherent in the structure of the transmission bursts. A significant improvement was incorporated in United States Patent No. 6,052,408, entitled "Cellular Communications System with Dynamically Modified Data Transmission Parameters." This patent introduced specific burst packet transmission formats that provide for adaptive modulation, transmit power, and antenna beam forming and an associated method of determining the highest data rate for a defined error rate floor for the link between the base station and a plurality of

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subscribers assigned to that base station. With the exception of variable spreading military systems and NASA space communication systems, this was one of the first commercial patents that address variable transmission parameters to increase system throughput.

Another example of TDD systems are digital cordless phones, also referred to as low-tier PCS systems. The Personal Access Communications (PAC) system and Digital European Cordless Telephone (DECT, as specified by ETSI document EN 300-175-3) are two examples of these systems. Digital cordless phones met with limited success for their intended use as pico-cellular fixed access products. The systems were subsequently modified and repackaged for wireless local loop (WLL) applications with extended range using increased transmission (TX) power and greater antenna gain.

These TDD/TDMA systems use fixed symmetry and bandwidth between the uplink and the downlink. The TDD frame consists of a fixed set of time slots for the uplink and the downlink. The modulation index (or type) and the forward error correction (FEC) format for all data transmissions are fixed in these systems. These systems did not include methods for coordinating TDD bursts between systems. This resulted in inefficient use of spectrum in the frequency planning of cells.

While DECT and PAC systems based on fixed frames with fixed

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and symmetric allocation of time slots (or bandwidth) provides excellent latency and low jitter, and can support time bounded services, such as voice and Nx64 Kbps video, these systems do not provide efficient use of the spectrum when asymmetric data services are used. This has lead to research and development of packet based TDD systems based on Internet protocol (IP) or asynchronous transfer mode (ATM), with dynamic allocation of TDD time slots and the uplink-downlink bandwidth, combined with efficient algorithms to address both best efforts and real-time low-latency service for converged media access (data and multi-media).

One example of a TDD system with dynamic slot and bandwidth assignment is the ETSI HYPERLAN II specification based on the Dynamic Slot Assignment algorithm described in "Wireless ATM: Performance Evaluation of a DSA++ MAC Protocol with Fast Collision resolution by Probing Algorithm," D. Petras and A. Kramling, International Journal of Wireless Information Networks, Vol. 4, No. 4, 1997. This system allows both contention-based and contention-free access to the physical TDD channel slots. This system also introduced the broadcast of resource allocation at the start of every frame by the base station controller. Other wireless standards, including IEEE 802.16 wireless metropolitan network standards, use this combination of an allocation map of the

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uplink and downlink at the start of the dynamic TDD frame to set resource use for the next TDD frame.

An further improvement to this TDD system was described in "Multiple Access Control Protocols for Wireless ATM: Problem Definition and Design Objectives," O. Kubbar and H. Mouftah, IEEE Communications, November 1997, pp. 93-99. This system expanded on the packet reservation multiple access (PRMA) method developed in 1989 at Rutgers University WINLAB for ATM and IP based transport [see "Packet Reservation Multiple Access for Local Wireless Communications," Goodman et al., IEEE Transaction on Communications, Vol. 37, No. 8, pp. 885-890]. Like PRMA, this system logically arranged all the downlink transmissions in the start of a fixed duration TDD frame and all uplink transmissions at the end of the TDD frame. This eliminated the inefficiencies in the DCA++ Hyperlan II protocol. Adaptive allocation of uplink and downlink bandwidth is supported. The system provided for fixed, random, and demand assignment mechanisms. Priority is given to quality of service (QoS) applications with resources being removed from best efforts demand access users as required.

The above-described prior art concern the allocation of services in an individual sector of a cell. A cell may consist of M sectors, wherein each sector generally covers a 360/M degree arc

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around the cell site. Each sector serves N_m subscribers, where m=1 to M. These references did not expressly provide protocol mechanisms or rules for the operation of a given system.

United States Patent No. 6,016,311 expressly addresses one possible implementation to the TDD bandwidth allocation problem. The system described continuously measures and adapts the bandwidth requirements based on the evaluation of the average bandwidth required by all the subscribers in a cell and the number of times bandwidth is denied to the subscribers. Changes to the bandwidth allocation are applied based on a set of rules described in Patent No. 6,016,311. While measurements of multiple sectors are performed and recorded at a central base station controller, no global coordination of bandwidth allocation of multiple sectors in a cell or across multiple cells is provided.

Thus, the prior art does not address two very important factors in allocation of bandwidth. First, bandwidth allocation must contemplate stringent bandwidth availability requirements for specific groups of services based on planning of the network. For example, consider life-line toll quality voice service. Toll quality voice requires that a system guarantee a specific maximum blocking probability for all voice users based on peak busy hour call usage. A description of voice traffic planning is provided in

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"Digital Telephony - 2nd Edition," by J. Bellamy, John Wiley and Sons, New York, New York, 1990. If a TDD system is designed to meet life-line voice requirements, the allocation protocol must be able to rapidly (i.e., less than 100 msec) reallocate bandwidth resources up to the capacity necessary to meet the call blocking requirements. Another service group example is a guaranteed service level agreements (SLA). Again, bandwidth must be rapidly restored to meet the SLA conditions. More generally, one may consider G possible service groups having a set of weighted priority level and associated minimum and maximum levels. The weighted priority levels and minimum and maximum levels may be used to bound the bandwidth dynamics of the TDD bandwidth allocation. Minimum levels set a floor for bandwidth allocation and maximum levels set a ceiling. Then averaging can be applied.

Second, the TDD bandwidth allocation must consider adjacent and co-channel interference from both modems and sectors within a cell and between cells. Cell planning tools can be used to establish the relationships for interference. For systems that operate below 10 GHz, antennas and antenna placement at a cell site will not provide adequate signal isolation. These co-channel interference issues are well documented in "Frequency Reuse and System Deployment in Local Multipoint Distribution Service," by V.

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Roman, IEEE Personal Communications, December 1999, pp. 20 to 27.

Therefore, there is a need in the art for a fixed wireless access network that maximizes spectral efficiency between the base stations of the fixed wireless access network and the subscriber access devices located at the subscriber premises. In particular, there is a need for a fixed wireless access network that implements an air interface that minimizes uplink and downlink interference between different sectors within the same base station cell site. There also is a need for a fixed wireless access network that implements an air interface that minimizes uplink and downlink interference between different cell sites within the fixed wireless access network.

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SUMMARY OF THE INVENTION

To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide a transceiver for use in a wireless access network comprising a plurality of base stations, each of the plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in a corresponding cell site of the wireless access network. According to an advantageous embodiment of the present invention, the transceiver is associated with a first of the plurality of base stations and comprises transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals in a sector of a cell site associated with the first base station. The transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal comprising a start of frame field and subsequently transmits downlink data traffic in a downlink portion of the TDD frame to at least one of the wireless access devices using at least one directed scanning beam.

According to one embodiment of the present invention, the broadcast beam signal further comprises a first beam map containing scanning beam information usable by the at least one wireless

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access device to detect the least one directed scanning beam.

According to another embodiment of the present invention, the scanning beam information identifies a downlink time slot in the downlink portion during which the at least one directed scanning beam transmits the downlink data traffic.

According to still another embodiment of the present invention, the scanning beam information identifies at least one modulation format associated with the at least one directed scanning beam.

According to yet another embodiment of the present invention, the scanning beam information identifies at least one forward error correction code level associated with the at least one directed scanning beam.

According to a further embodiment of the present invention, the transceiver further comprising receive path circuitry associated with the beam forming network capable of receiving uplink data traffic transmitted by the at least one wireless access device in an uplink portion of the TDD frame.

According to a still further embodiment of the present invention, the first beam map further contains uplink transmission information identifying an uplink time slot in the uplink portion during which the at least one wireless access device transmits the

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uplink data traffic.

According to a yet further embodiment of the present invention, the uplink transmission information further identifies at least one modulation format used by the at least one wireless access device to transmit the uplink data traffic.

According to still another embodiment of the present invention, the uplink transmission information further identifies at least one at least one forward error correction code level used by the at least one wireless access device to transmit the uplink data traffic.

The foregoing has outlined rather broadly the features and technical advantages of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they may readily use the conception and the specific embodiment disclosed as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the invention in its broadest form.

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Before undertaking the DETAILED DESCRIPTION OF THE INVENTION below, it may be advantageous to set forth definitions of certain words and phrases used throughout this patent document: the terms "include" and "comprise," as well as derivatives thereof, mean inclusion without limitation; the term "or," is inclusive, meaning and/or; the phrases "associated with" and "associated therewith," as well as derivatives thereof, may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like; and the term "controller" means any device, system or part thereof that controls at least one operation, such a device may be implemented in hardware, firmware or software, or some combination of at least two of the same. It should be noted that the functionality associated with any particular controller may be centralized or distributed, whether locally or remotely. Definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such definitions apply to prior, as well as future uses of such defined words and phrases.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, wherein like numbers designate like objects, and in which:

FIGURE 1 illustrates an exemplary fixed wireless access network according to one embodiment of the present invention;

FIGURE 2 illustrates in greater detail an alternate view of selected portions of the exemplary fixed wireless access network according to one embodiment of the present invention;

FIGURE 3 illustrates an exemplary time division duplex (TDD) time division multiple access (TDMA) frame according to one embodiment of the present invention;

FIGURE 4 illustrates the timing recovery and distribution circuitry in an exemplary RF modem shelf according to one embodiment of the present invention;

FIGURE 5A illustrates an exemplary time division duplex (TDD) frames according to one embodiment of the present invention;

FIGURE 5B illustrates an exemplary transmission burst containing a single FEC block according to one embodiment of the present invention;

FIGURE 5C illustrates an exemplary transmission burst

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containing multiple FEC blocks according to one embodiment of the present invention;

FIGURE 6 is a flow diagram illustrating the adaptive modification of the uplink and downlink bandwidth in the air interface in wireless access network according to one embodiment of the present invention;

FIGURE 7 is a flow diagram illustrating the adaptive assignment of selected link parameters, such as modulation format, forward error correction (FEC) codes, and antenna beam forming, to the uplink and downlink channels used by each subscriber in the exemplary wireless access network according to one embodiment of the present invention;

FIGURE 8 is a flow diagram illustrating the adaptive assignment of selected link parameters to the different service connections used by each subscriber in the wireless access network according to one embodiment of the present invention;

FIGURE 9 illustrates selected portions of the receive path of an exemplary conventional analog beam-forming system.

FIGURE 10 represents an exemplary spatial response of the receive path of the exemplary analog beam-forming system in FIGURE 9;

FIGURE 11 illustrates selected portions of the transmit path

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and the receive path of an exemplary conventional digital beam-forming system;

FIGURE 12A illustrates an exemplary beam scanning pattern according to one embodiment of the present invention;

FIGURE 12B represents the spatial response of the transmit and receive scanning beams in the exemplary beam scanning pattern in FIGURE 12A;

FIGURE 13A illustrates an exemplary broadcast pattern according to one embodiment of the present invention;

FIGURE 13B represents the spatial response of the broadcast beam in FIGURE 13A; and

FIGURE 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) frames according to one embodiment of the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

FIGURES 1 through 14, discussed below, and the various embodiments used to describe the principles of the present invention in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the invention. Those skilled in the art will understand that the principles of the present invention may be implemented in any suitably arranged wireless access system.

FIGURE 1 illustrates exemplary fixed wireless access network 100 according to one embodiment of the present invention. Fixed wireless network 100 comprises a plurality of transceiver base stations, including exemplary transceiver base station 110, that transmit forward channel (i.e., downlink or downstream) broadband signals to a plurality of subscriber premises, including exemplary subscriber premises 121, 122 and 123, and receive reverse channel (i.e., uplink or upstream) broadband signals from the plurality of subscriber premises. Subscriber premises 121-123 transmit and receive via fixed, externally-mounted antennas 131-133, respectively. Subscriber premises 121-123 may comprise many different types of residential and commercial buildings, including single family homes, multi-tenant offices, small business enterprises (SBE), medium business enterprises (MBE), and so-called

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"SOHO" (small office/home office) premises.

The transceiver base stations, including transceiver base station 110, receive the forward channel (i.e., downlink) signals from external network 150 and transmit the reverse channel (i.e., uplink) signals to external network 150. External network 150 may be, for example, the public switched telephone network (PSTN) or one or more data networks, including the Internet or proprietary Internet protocol (IP) wide area networks (WANs) and local area networks (LANs). Exemplary transceiver base station 110 is coupled to RF modem shelf 140, which, among other things, up-converts baseband data traffic received from external network 150 to RF signals transmitted in the forward channel to subscriber premises 121-123. RF modem shelf 140 also down-converts RF signals received in the reverse channel from subscriber premises 121-123 to baseband data traffic that is transmitted to external network 150.

RF modem shelf 140 comprises a plurality of RF modems capable of modulating (i.e., up-converting) the baseband data traffic and demodulating (i.e., down-converting) the reverse channel RF signals. In an exemplary embodiment of the present invention, each of the transceiver base stations covers a cell site area that is divided into a plurality of sectors. In an advantageous embodiment of the present invention, each of the RF modems in RF modem

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shelf 140 may be assigned to modulate and demodulate signals in a particular sector of each cell site. By way of example, the cell site associated with transceiver base station 110 may be partitioned into six sectors and RF modem shelf 140 may comprise six primary RF modems (and, optionally, a seventh spare RF modem), each of which is assigned to one of the six sectors in the cell site of transceiver base station 110. In another advantageous embodiment of the present invention, each RF modem in RF modem shelf 140 comprises two or more RF modem transceivers which may be assigned to at least one of the sectors in the cell site. For example, the cell site associated with transceiver base station 110 may be partitioned into six sectors and RF modem shelf 140 may comprise twelve RF transceivers that are assigned in pairs to each one of the six sectors. The RF modems in each RF modem pair may alternate modulating and demodulating the downlink and uplink signals in each sector.

RF modem shelf 140 is located proximate transceiver base station 110 in order to minimize RF losses in communication line 169. RF modem shelf 140 may receive the baseband data traffic from external network 150 and transmit the baseband data traffic to external network 150 via a number of different paths. In one embodiment of the present invention, RF modem shelf 140 may

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transmit baseband data traffic to, and receive baseband data traffic from, external network 150 through central office facility 160 via communication lines 166 and 167. In such an embodiment, communication line 167 may be a link in a publicly owned or privately owned backhaul network. In another embodiment of the present invention, RF modem shelf 140 may transmit baseband data traffic to, and receive baseband data traffic from, external network 150 directly via communication line 168 thereby bypassing central office facility 160.

Central office facility 160 comprises access processor shelf 165. Access processor shelf 165 provides a termination of data traffic for one or more RF modem shelves, such as RF modem shelf 140. Access processor shelf 165 also provides termination to the network switched circuit interfaces and/or data packet interfaces of external network 150. One of the principal functions of access processor shelf 165 is to concentrate data traffic as the data traffic is received from external network 150 and is transferred to RF modem shelf 140. Access processor shelf 165 provides data and traffic processing of the physical layer interfaces, protocol conversion, protocol management, and programmable voice and data compression.

FIGURE 2 illustrates in greater detail an alternate view of

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selected portions of exemplary fixed wireless access network 100 according to one embodiment of the present invention. FIGURE 2 depicts additional transceiver base stations, including exemplary transceiver base stations 110A through 110F, central office facilities 160A and 160B, and remote RF modem shelves 140A through 140D. Central office facilities 160A and 160B comprise internal RF modems similar to RF modem shelves 140A through 140D. Transceiver base stations 110A, 110B, and 110C are disposed in cells sites 201, 202, and 203, respectively. In the exemplary embodiment, cell sites 201-203 (shown in dotted lines) are partitioned into four sectors each. In alternate embodiments, sites 201, 202, and 203 may be partitioned into a different number of sectors, such as six sectors, for example.

As in FIGURE 1, RF modem shelves 140A-140D and the internal RF modems of central office facilities 160A and 160B transmit baseband data traffic to, and receive baseband data traffic from, access processors in central office facilities 160A and 160B of the PSTN. RF modem shelves 140A-140D and the internal RF modems of central office facilities 160A and 160B also up-convert incoming baseband data traffic to RF signals transmitted in the forward (downlink) channel to the subscriber premises and down-convert incoming RF signals received in the reverse (uplink) channel to baseband data

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traffic that is transmitted via a backhaul network to external network 150.

Baseband data traffic may be transmitted from remote RF modem shelves 140A-140D to central office facilities 160A and 160B by a wireless backhaul network or by a wireline backhaul network, or both. As shown in FIGURE 2, baseband data traffic is carried between central office facility 160A and remote RF modem 140A by a wireline backhaul network, namely wireline 161, which may be, for example, a DS3 line or one to N T1 lines. A local multipoint distribution service (LMDS) wireless backhaul network carries baseband data traffic between central office facilities 160A and 160B and remote RF modem shelves 140B, 140C, and 140D. In a LMDS wireless backhaul network, baseband data traffic being sent to remote RF modem shelves 140B, 140C, and 140D is transmitted by microwave from microwave antennas mounted on transceiver base stations 110A, 110C, and 110F to microwave antennas mounted on transceiver base stations 110B, 110D, and 110E. Baseband data traffic being sent from remote RF modem shelves 140B, 140C, and 140D is transmitted by microwave in the reverse direction (i.e., from transceiver base stations 110B, 110D, and 110E to transceiver base stations 110A, 110C, and 110F).

At each of transceiver base stations 110B, 110D, and 110E,

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downlink data traffic from central office facilities 160A and 160B is down-converted from microwave frequencies to baseband signals before being up-converted again for transmission to subscriber premises within each cell site. Uplink data traffic received from the subscriber premises is down-converted to baseband signals before being up-converted to microwave frequencies for transmission back to central office facilities 160A and 160B.

Generally, there is an asymmetry of data usage in the downlink and the uplink. This asymmetry is typically greater than 4:1 (downlink:uplink). Taking into account the factors of data asymmetry, channel propagation, and available spectrum, an advantageous embodiment of the present invention adopts a flexible approach in which the physical (PHY) layer and the media access (MAC) layer are based on the use of time division duplex (TDD) time division multiple access (TDMA). TDD operations share a single RF channel between a transceiver base station and a subscriber premises and use a series of frames to allocate resources between each user uplink and downlink. A great advantage of TDD operation is the ability to dynamically allocate the portions of a frame allocated between the downlink and the uplink. This results in an increased efficiency of operation relative to frequency division duplex (FDD) techniques. TDD operations typically may achieve a

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forty to sixty percent advantage in spectral efficiency over FDD operations under typical conditions. Given the short duration of the transmit and receive time slots relative to changes in the channel, TDD operations also permit open loop power control, switched diversity techniques, and feedforward and cyclo-stationary equalization techniques that reduce system cost and increase system throughput.

To aid with periodic functions in the system, TDD frames are grouped into superframes (approximately 10 to 20 milliseconds). The superframes are further grouped into hyperframes (approximately 250 to 1000 milliseconds). This provides a coordinated timing reference to subscriber integrated access devices in the system. FIGURE 3 illustrates an exemplary time division duplex (TDD) time division multiple access (TDMA) framing hierarchy according to one embodiment of the present invention. At the highest level, the TDD-TDMA framing hierarchy comprises hyperframe 310, which is X milliseconds (msec.) in length (e.g., 250 msec. < X < 1000 msec.). Hyperframe 310 comprises N superframes, including exemplary superframes 311-316. Each of superframes 311-316 is 20 milliseconds in duration.

Superframe 313 is illustrated in greater detail. Superframe 313 comprises ten (10) TDD frames, including exemplary

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TDD frames 321-324, which are labeled TDD Frame 0, TDD Frame 1, TDD Frame 2, and TDD Frame 9, respectively. In the exemplary embodiment, each TDD frame is 2 milliseconds in duration. A TDD transmission frame is based on a fixed period of time during which access to the channel is controlled by the transceiver base station.

Exemplary TDD frame 321 is illustrated in greater detail. TDD frame 321 comprises a downlink portion (i.e, base station to subscriber transmission) and an uplink portion (i.e., subscriber to base station transmission). In particular, TDD frame 321 comprises:

Frame header 330 - Frame header 330 is a broadcast message that synchronizes the start of frame and contains access control information on how the remainder of TDD frame 321 is configured. The modulation format of frame header 330 is chosen so that all subscribers in a sector of the transceiver base station can receive frame header 330. Generally, this means that frame header 330 is transmitted in a very low complexity modulation format, such as binary phase shift keying (BPSK or 2-BPSK), or perhaps quadrature phase shift keying (QPSK or 4-BPSK).

D downlink slots - The D downlink slots, including exemplary downlink slots 341-343, contain transceiver base station-to-

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subscriber transmissions of user traffic and/or control signals. The modulation format of each slot is optimized for maximum possible data transmission rates. Downlink slots may be grouped in blocks to form modulation groups as shown in FIGURE 5A. Subscribers who receive data using the same modulation format (or modulation index) and the same forward error correction (FEC) codes are grouped together in the same modulation group. In some embodiment of the present invention, two or more modulation groups may have the same modulation format and FEC codes. In alternate embodiments of the present invention, downlink slots may be grouped in blocks based on physical beam forming, rather than on modulation format and FEC codes. For example, a transceiver base station may transmit data to several subscribers that are directionally along the same antenna beam in consecutive bursts. In still other embodiments of the present invention, downlink slots may be grouped in blocks based on any combination of two or more of: 1) physical beam forming, 2) modulation format, and 3) FEC codes. For the purpose of simplicity, the term "modulation group" shall be used hereafter to refer to a group of downlink slots that are transmitted to one or more subscribers using a common scheme consisting of one or more of modulation format, FEC codes, and physical beam forming.

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U uplink slots - The U uplink slots, including exemplary uplink slots 361-363, contain subscriber-to-transceiver base station transmissions of user traffic and/or control signals. Again, the modulation format (modulation index) is optimized for maximum possible data transmission rates. Generally, the modulation format and FEC codes in the uplink slots are less complex than in the downlink slots. This moves complexity to the receivers in the base stations and lowers the cost and complexity of the subscriber access device. Uplink slots may be grouped in blocks to form sub-burst groups as shown in FIGURE 5A. Subscribers who transmit data using the same modulation format (or modulation index) and the same forward error correction (FEC) codes are grouped together in the same sub-burst group. In some embodiments of the present invention, two or more sub-burst groups may have the same modulation format and FEC codes. In other embodiments of the present invention, uplink slots may be grouped in blocks based on physical beam forming, rather than on modulation format and FEC codes. In other embodiments, uplink slots may be grouped in blocks based on any combination of two or more of: 1) physical beam forming, 2) modulation format, and 3) FEC codes. For the purpose of simplicity, the term "sub-burst group" shall be used hereafter to refer to a group of uplink slots that are transmitted to one or

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more subscribers using a common scheme consisting of one or more of modulation format, FEC codes, and physical beam forming.

Contention slots 360 - Contention slots 360 precede the U uplink slots and comprise a small number of subscriber-to-base transmissions that handle initial requests for service. A fixed format length and a single modulation format suitable for all subscriber access devices are used during contention slots 360. Generally, this means that contention slots 360 are transmitted in a very low complexity modulation format, such as binary phase shift keying (BPSK or 2-BPSK), or perhaps quadrature phase shift keying (QPSK or 4-BPSK). Collisions (more than one user on a time slot) result in the use of back-off procedures similar to CSMA/CD (Ethernet) in order to reschedule a request.

TDD transition period 350 - TDD transition period 350 separates the uplink portion and the downlink portion and allows for transmitter (TX) to receiver (RX) propagation delays for the maximum range of the cell link and for delay associated with switching hardware operations from TX to RX or from RX to TX. The position of TDD transition period 350 may be adjusted, thereby modifying the relative sizes of the uplink portion and the downlink portion to accommodate the asymmetry between data traffic in the uplink and the downlink.

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A key aspect of the present invention is that the timing of the downlink and uplink portions of each TDD frame must be precisely aligned in order to avoid interference between sectors within the same cell and/or to avoid interference between cells. It is recalled from above that each sector of a cell site is served by an individual RF modem in RF modem shelves 140A-140D and the internal RF modem shelves of central office facilities 160A and 160B. Each RF modem uses an individual antenna to transmit and to receive in its assigned sector. The antennas for different sectors in the same cell site are mounted on the same tower and are located only a few feet apart. If one RF modem (and antenna) are transmitting in the downlink while another RF modem (and antenna) are receiving in the uplink, the power of the downlink transmission will overwhelm the downlink receiver.

Thus, to prevent interference between antennas in different sectors of the same cell site, the present invention uses a highly accurate distributed timing architecture to align the start points of the downlink transmissions. The present invention also determines the length of the longest downlink transmission and ensures that none of the uplink transmissions begin, and none of the base station receivers begin to receive, until after the longest downlink is completed.

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Furthermore, the above-described interference between uplink and downlink portions of TDD frames can also occur between different cell sites. To prevent interference between antennas in different cell sites, the present invention also uses the highly accurate distributed timing architecture to align the start points of the downlink transmissions between cell sites. The present invention also determines the length of the longest downlink transmission among two or more cell sites and ensures that none of the base station receivers in any of the cells begins to receive in the uplink until after the longest downlink transmission is completed.

Within a cell site, a master interface control processor (ICP), as described below in FIGURE 4, may be used to align and allocate the uplink and downlink portions of the TDD frames for all of the RF modems in an RF modem shelf. Between cell sites, the access processor may communicate with several master ICPs to determine the longest downlink. The access processor may then allocated the uplinks and downlinks across several cell sites in order to minimize interference between cell sites and may designate on master ICP to control the timing of all of the master ICPs.

FIGURE 4 illustrates the timing recovery and distribution circuitry in exemplary RF modem shelf 140 according to one

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embodiment of the present invention. RF modem shelf 140 comprises front panel interface 410 having connectors 411-414 for receiving input clock references and transmitting clock references. Exemplary connector 411 receives a first clock signal from a first external source (External Source A) and exemplary connector 414 receives a second clock signal from a second external source (External Source B). Connector 412 outputs an internally generated clock signal (Master Source Out) and connector 413 receives an external one second system clock signal (External 1 Second Clock).

RF modem shelf 140 also comprises a plurality of interface control processor (ICP) cards, including exemplary ICP cards 450, 460, 470 and 480. ISP card 450 is designated as a master ICP card and ICP card 480 is designated as a spare ICP card in case of a failure of master ICP card 450. Within RF modem shelf 140, the ICP cards provide for control functions, timing recovery and distribution, network interface, backhaul network interface, protocol conversion, resource queue management, and a proxy manager for EMS for the shelf. The ICP cards are based on network processor(s) that allow software upgrade of network interface protocols. The ICP cards may be reused for control and routing functions and provide both timing and critical TDD coordinated burst timing for all the RF modems in RF modem

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shelf 140 and for shelf-to-shelf timing for stacked frequency high density cell configurations.

The timing and distribution architecture in RF modem shelf 140 allows for three reference options:

Primary - An external input derived from another remote modem shelf acting as a master. BITS (Building Integrated Timing Supply) reference is a single building master timing reference (e.g., External Source A, External Source B) that supplies DS1 and DS0 level timing throughout an office (e.g., 64K or 1.544/2.048 Mbps).

Secondary - A secondary reference may be derived from any designated input port in RF modem shelf 140. For remote RF modem shelf 140, this is one of the backhaul I/O ports. An ICP card is configured to recover a timing source and that source is placed on a backplane as a reference (i.e., Network Reference (A/B)) to master ICP card 450.

Tertiary - An internal phase locked loop (PLL) may be used.

By default, two ICP cards are configured as a master ICP card and a spare ICP card. The active master ICP card distributes timing for all of RF modem shelf 140. The timing distribution architecture of RF modem shelf 140 meets Stratum 3 levels of performance, namely a free-run accuracy of +/- 4.6 PPM (parts per million), a pull-in capability of 4.6 PPM, and a holdover stability

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of less than 255 slips during the first day.

There are three components to the timing distribution for the access processor backplane:

1. Timing masters (ICP cards 450 and 480).
2. Timing slaves (ICP cards 460 and 470).
3. Timing references.

The timing masters are capable of sourcing all clocks and framing signals necessary for the remaining cards within the AP backplane. Within a backplane, there are two timing masters (ICP cards 450 and 480), which are constrained to the slots allocated as the primary and secondary controllers. The timing masters utilize the redundant timing references (External Source A, External Source B, External 1 Second Clock) found on the backplane to maintain network-qualified synchronization. ISP card 450 (and ISP card 480) comprises backhaul network input/output (I/O) port 451, multiplexer 452 and PLL-clock generator 453. MUX 452 selects anyone of External Source A, External Source B, Network Reference (A/B), and the signal from I/O port 451 to be applied to PLL-clock generator 453. The timing master has missing clock detection logic that allows it to switch from one timing reference to another in the event of a failure.

Timing is distributed across a redundant set of clock and

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framing signals, designated Master Clock Bus in FIGURE 4. Each timing master (i.e., ICP cards 450 and 480) is capable under software control of driving either of the two sets of clock and framing buses on the backplane. Both sets of timing buses are edge-synchronous such that timing slaves can interoperate while using either set of clocks.

The timing supplied by the timing master (e.g., ICP card 450) consists of a 65.536 MHZ clock and an 8 KHz framing reference. There is a primary and secondary version of each reference. To generate these references, the primary and secondary timing masters are provisioned to recover the timing from one of the following sources:

Source	Frequency
External BITS (EXT REF A)	64K, 1544K, 2048K
External BITS/GPS (EXT REF B)	64K, 1544K, 2048K
External GPS Sync. Pulse	1 second pulse
On-Card Reference	Per I/O reference
Network I/O Derived Reference A	Per I/O reference
Network I/O Derived Reference B	Per I/O reference

Table of Clock Source Interface Definitions

To simplify clock distribution and to provide redundancy all the clocks are derived from a common clock source. The following

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table summarizes the backplane reference clocks as well as the clock rates of the various backplane resources and how they are derived from these references.

Clock	Frequency	Division or Ratio
Common Reference Clock	65.536 MHZ	Not Applicable
Common Sync Pulse	1 Hz	Not Applicable
Framing Reference	8 KHz (125 usec)	Free-run framing provided by Primary or Secondary Clock Masters Referenced to Common Reference Clock
Cell/Packet Clock Rate	32.768 MHZ	Reference Clock/2
TDM Bus Rate	8.192 MHZ	Reference Clock/8
RF Reference Clock	10.000 MHZ	Free-run RF reference clock
Communications Bus	100 MHZ	Derived from free-run Reference Clock
High-speed Serial Links	1.31072 GHz	REF. Clock x 20
High-speed Serial Links	2.62144 GHz	REF. Clock x 40
High-speed Serial Links	TBD	REF. Clock x N

Table of Buses and Associated Clocks

Timing slaves (i.e., ICP cards 460 and 470) receive the timing provided by redundant sets of clock and framing buses. Under

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software control, timing slaves choose a default set of clocks from either the A-side or B-side timing buses. They also contain failure detection logic such that clock and framing signal failures can be detected. Once a clock or framing failure is detected, the timing slave automatically switches to the alternate set of timing buses. ICP cards 460 and 470 contain backhaul I/O ports 461 and 471, respectively, which may be used to bring in external timing signals from other RF modem shelves in the network. The timing masters (i.e., ICP cards 450 and 480) also contain the timing slave function insofar as they also utilize the timing provided on the backplane clock and framing buses.

A qualified timing reference is required for the timing master to derive backplane timing and to maintain synchronization within network 100 and with any outside network. Under software control, an access processor card can be assigned to derive this timing and to drive one of the two timing reference buses. Ideally, a second, physically separate card will contain a second qualified timing source and drive the second backplane timing reference.

In the event that no qualified timing is present from trunk interfaces, the access processor backplane has connections which allow external reference timing (e.g., a GPS-derived clock) from the interface tray to be applied to the backplane. A one pulse-

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per-second (1PPS) signal is distributed to all system cards for time stamping of system events and errors. Installations involving multiple access processor shelves require the timing reference to be distributed between all access processor backplanes. In this scenario, the timing reference for a given backplane is cabled to the remaining backplanes through external cabling. Multiple remote modem shelves are utilized to distribute high-capacity back-haul traffic to one or more additional co-located modem shelves. Traffic is distributed among the shelves through T1, T3, OC3 and/or other broadband telecommunication circuits. To maintain network timing, the additional shelves are slaved to these distribution links and recover timing through the same PLL mechanisms as the head-end shelf.

FIGURE 5A illustrates exemplary time division duplex (TDD) frame 500 according to one embodiment of the present invention. FIGURE 5B illustrates exemplary transmission burst 520 containing a single FEC block according to one embodiment of the present invention. FIGURE 5C illustrates exemplary transmission burst 530 containing multiple FEC blocks according to one embodiment of the present invention.

TDD frame 500 comprises a downlink portion containing preamble field 501, management field 502, and N modulation groups, including

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modulation group 503 (labeled Modulation Group 1), modulation group 504 (labeled Modulation Group 2), and modulation group 505 (labeled Modulation Group N). As explained above in FIGURE 3, a modulation group is a group of downlink slots transmitted to one or more subscribers using a common scheme of one or more of: 1) modulation format, 2) FEC codes, and 3) physical beam forming.

TDD frame 500 also comprises an uplink portion containing transmitter-transmitter guard (TTG) slot 506, 0 to N registration (REG) minislots 506, 1 to N contention (CON) request minislots 508, N sub-burst groups, including sub-burst group 509 (labeled Sub-Burst 1) and sub-burst group 510 (labeled Sub-Burst N), and receiver-transmitter guard (RTG) slot 511. As explained above in FIGURE 3, a sub-burst group is a group of uplink slots transmitted to one or more subscribers using a common scheme of one or more of: 1) modulation format, 2) FEC codes, and 3) physical beam forming.

Each modulation group and each sub-burst group comprises one or more transmission bursts. Exemplary transmission burst 520 may be used within a single modulation group in the downlink and covers one or more downlink slots. Transmission burst 520 also may be used within a single sub-burst group in the downlink and covers one or more uplink slots. Transmission burst 520 comprises physical media dependent (PMD) preamble field 521, MAC header field 522,

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data packet data unit (PDU) field 523, and block character redundancy check (CRC) field 524. Transmission burst 530 comprises physical media dependent (PMD) preamble field 531, MAC header field 532, data PDU field 533, block CRC field 534, data PDU field 535, block CRC field 536.

The start of every frame includes a Start-Of-Frame (SOF) field and a PHY Media Dependent Convergence (PMD) field. PMD preambles are used to assist in synchronization and time-frequency recovery at the receiver. The SOF field allows subscribers using fixed diversity to test reception conditions of the two diversity antennas.

The SOF PMD field is 2^N symbols long (typically 16, 32, 64 symbols long) and consists of pseudo-random noise (PN) code sequences, Frank sequences, CAZAC sequences, or other low cross-correlation sequences, that are transmitted using BPSK or QPSK modulation. The SOF field is followed by downlink management messages broadcast from the base station to all subscribers using the lowest modulation or FEC index and orthogonal expansion. Management messages are transmitted both periodically (N times per hyperframe) and as required to change parameters or allocate parameters. Management messages include:

1. DownLink Map indicating the physical slot (PS) where

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downstream modulation changes (transmitted every frame);

2. UpLink Map indicating uplink subscriber access grants and associated physical slot start of the grant (transmitted when changed and at a minimum of one second hyperframe periods (shorter periods are optional));

3. TDD frame and physical layer attributes (periodic at a minimum of one second hyperframe period); and

4. Other management messages including ACK, NACK, ARQ requests, and the like (transmitted as required).

The downlink management messages are followed by multi-cast and uni-cast bursts arranged in increasing modulation complexity order. The present invention introduces the term "modulation group" to define a set of downstream bursts with the same modulation and FEC protection. A subscriber continuously receives all the downstream data in the TDD frame downlink until the last symbol of the highest modulation group supported by the link is received. This allows a subscriber maximum time to perform receive demodulation updates.

The downlink-to-uplink transition provides a guard time (TTG) to allow for propagation delays for all the subscribers. The TTG position and duration is fully programmable and set by management physical layer attribute messages. The TTG is followed by a set of

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allocated contention slots that are subdivided between acquisition uplink ranging mini-slots and demand access request mini-slots. The Uplink Map message establishes the number and location of each type of slot. Ranging slots are used for both initial uplink synchronization of subscribers performing net entry and for periodic update of synchronization of active subscribers. Contention slots provide a demand access request mechanism to establish subscriber service for a single traffic service flow. As collisions are possible, the subscriber uses random back-off, in integer TDD frame periods and retries based on a time out for request of service. Contention slots use the lowest possible modulation, FEC, and orthogonal expansion supported by the base station.

The contention slots are followed by individual subscriber transmissions (sub-bursts) that have been scheduled and allocated by the base station in the uplink Map. Each subscriber transmission burst is performed at the maximum modulation, FEC, and orthogonal expansion supported by the subscriber. Finally, the subscriber transmissions are followed by the uplink-to-downlink transition which provides a guard time (RTG) to allow for propagation delays for all the subscribers. The RTG duration is fully programmable and set by management physical layer attribute

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messages.

In the downlink, the Physical Media Dependent (PMD) burst synchronization is not used. The transmission burst begins with the MAC header and is followed by the packet data unit (PDU) and the associated block CRC field that protects both the PDU and the header. The PDU may be a complete packet transmission or a fragment of a much larger message. When a channel requires more robust FEC, the PDU may be broken into segments that are protected by separate FEC CRC fields. This avoids wasting bandwidth with additional MAC headers.

One significant difference between the uplink and the downlink is the addition of the PMD preamble. The PMD preamble length and pattern can be programmed by transceiver base station 110. Like the SOF field at the beginning of the TDD Frame, the preamble provides a synchronization method for the base station receiver. Uplink registration and ranging packet bursts use longer PMD preambles.

The medium access control (MAC) layer protocol is connection oriented and provides multiple connections of different quality of service (QoS) to each subscriber. The connections are established when a subscriber is installed and enters operation fixed wireless access network 100. Additional connections can be established and

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terminated with the base station transceivers as subscriber requirements changes.

As an example, suppose a subscriber access device supports two voice channels and a data channel. The quality of service (QoS) on both of the voice channels and data can set based on the service structure set by the wireless service provider. At installation, a subscriber may start with two service connections: a toll quality voice channel and a medium data rate broadband data connection. At a later point in time, the subscriber may order and upgrade service to two toll quality voice channels and high speed data connection (a total of three connections).

The maintenance of connections varies based on the type of connection established. T1 or fractional T1 service requires almost no maintenance due to the periodic nature of transmissions. A TCP/IP connection often experiences bursty on-demand communication that may be idle for long periods of time. During those idle periods, periodic ranging and synchronization of the subscriber is required.

In an exemplary embodiment of fixed wireless access network 100, each subscriber maintains a 64-bit EUI for globally unique addressing purposes. This address uniquely defines the subscriber from within the set of all possible vendors and

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equipment types. This address is used during the registration process to establish the appropriate connections for a subscriber. It is also used as part of the authentication process by which the transceiver base station and the subscriber each verify the identity of the other.

In the exemplary embodiment, a connection may be identified by a 16-bit connection identifier (CID) in MAC header 522 or MAC header 532. Every subscriber must establish at least two connections in each direction (upstream and downstream) to enable communication with the base station. The basic CIDs, assigned to a subscriber at registration, are used by the base station MAC layer and the subscriber MAC layer to exchange MAC control messages, provisioning and management information.

The connection ID can be considered a connection identifier even for nominally connectionless traffic like IP, since it serves as a pointer to destination and context information. The use of a 16-bit CID permits a total of 64K connections within the sector.

In an exemplary embodiment of fixed wireless access network 100, the CID may be divided into 2 fields. Bits [16:x] may be used to uniquely identify a subscriber. In a cyclo-stationary receiver processing at a base station, this would set the antenna, equalizer, and other receiver parameters. Bits [x:1] may be used

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to indicate a connection to a type of service. Each subscriber service can have individual modulation format, FEC, and ARQ. Thus, within a single sub-burst group transmitted by a subscriber, the voice data may use one type of modulation format, FEC, and ARQ, and the broadband internet service may use a different modulation format, FEC, and ARQ. Similarly, within a single modulation group transmitted to the subscriber, the voice data may use one type of modulation format, FEC, and ARQ, and the broadband internet service may use a different modulation format, FEC, and ARQ.

As an example, bits [16:7] of the CID may identify 2^10 (or 1024) distinct subscribers and bits [6:1] may identify 2^6 = 64 possible connections. An apartment building could be given a set of subscriber ports [16:9] so that bits [9:7] allow 2^8 connections or 256 connections.

Requests for transmission are based on these connection IDs, since the allowable bandwidth may differ for different connections, even within the same service type. For example, a subscriber unit serving multiple tenants in an office building would make requests on behalf of all of them, though the contractual service limits and other connection parameters may be different for each of them.

Many higher-layer sessions may operate over the same wireless connection ID. For example, many users within a company may be

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communicating with TCP/IP to different destinations, but since they all operate within the same overall service parameters, all of their traffic is pooled for request/grant purposes. Since the original LAN source and destination addresses are encapsulated in the payload portion of the transmission, there is no problem in identifying different user sessions.

Fragmentation is the process by which a portion of a subscriber payload (uplink or downlink) is divided into two or more PDUs. Fragmentation allows efficient use of available bandwidth while maintaining the QoS requirements of one or more of services used by the subscriber. Fragmentation may be initiated by a base station for a downlink connection or the subscriber access device for the uplink connection. A connection may be in only one fragmentation state at any given time. The authority to fragment data traffic on a connection is defined when the connection is created.

The MAC layer protocol in wireless access network 100 also supports concatenation of multiple PDUs in a single transmission in both the uplink and the downlink, as shown in FIGURE 5C. Since each PDU contains a MAC header with the CID, the receiving MAC layer can determine routing and processing by higher layer protocols. A base station MAC layer creates concatenated PDUs in

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the uplink Map. Management, traffic data, and bandwidth may all be concatenated. This process occurs naturally in the downlink. In the uplink, concatenation has the added benefit of eliminating additional PMD preambles.

FIGURE 6 depicts flow diagram 600, which illustrates the adaptive modification of the uplink and downlink bandwidth in the air interface in wireless access network 100 according to one embodiment of the present invention. Initially, an RF modem shelf, such as RF modem shelf 140A, receives new access requests from subscriber access devices in fixed wireless access network 100 and determines traffic requirements for each new and existing subscriber in each sector of a single cell site (process step 605). The traffic requirements of each subscriber may be established in a number of ways, including minimum QoS requirements, service level agreements, past usage, and current physical layer parameters, such as modulation index, FEC codes, antenna beam forming, and the like. The RF modem shelf then determines from the subscriber traffic requirements the longest downlink portion of any TDD frame in each sector of a single cell site (process step 610).

Next, the access processor for the RF modem shelf (or the RF modem shelf itself) determines the appropriate allocation of downlink and uplink portions of TDD frames for a single cell site

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in order to minimize or eliminate interference within the cell site (process step 615). Bandwidth is allocated, and TDD transition period 350 is positioned, such that the longest downlink transmission is complete before any receiver in the cell site starts to listen for the uplink transmission.

Next, if global allocation of downlink and uplink bandwidth across multiple cell sites is being implemented (generally the case), the access processor determines the longest downlink portion of any TDD frame across several closely located cell sites stations (process step 620). The access processor then determines the allocation of uplink and downlink bandwidth for all TDD frames across several closely located cell sites in order to minimize or eliminate cell-to-cell interference (process step 625). Again, bandwidth is allocated, and TDD transition period 350 is positioned, such that the longest downlink transmission is complete before any receiver in any of the closely located cell sites starts to listen for uplink transmissions. Finally, the downlink portions of the TDD frames are launched simultaneously using the highly accurate clock from the distributed timing architecture (process step 630).

The dynamic application of TDD bandwidth allocation is bounded by set minimum and maximum boundaries set by the service provider,

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based on traffic and network analysis. Further, the bandwidth bounds may be allocated in sub-groupings based on established quality of service (QoS) requirements (e.g., voice data) and Service Level Agreements (SLA) (e.g., broadband data rate) as the primary consideration and with best efforts, non-QoS data, and IP traffic as secondary considerations. The bandwidth bounds may be allocated based on the fact that a subscriber may support more that one interface and thus more than one modulation format in order to achieve required error rates for one or more services provided to the subscriber.

FIGURE 7 depicts flow diagram 700, which illustrates the adaptive assignment of selected link parameters, such as modulation format, forward error correction (FEC) codes, and antenna beam forming, to the uplink and downlink channels used by each subscriber in wireless access network 100 according to one embodiment of the present invention. The RF modem shelf monitors data traffic between subscribers and base station and determines for each subscriber the most efficient combination of modulation format, FEC code, and/or antenna beam forming for the uplink and downlink.

The selected combination is based at least in part on the error rates detected by the RF modem shelf when monitoring the data

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traffic. If the error rate for a particular subscriber is too high in either the uplink or the downlink, the RF modem shelf can decrease the modulation format complexity and use a higher level of FEC code protection in either the uplink or the downlink in order to reduce the error rate. Conversely, if the error rate for a particular subscriber is very low in either the uplink or the downlink, the RF modem shelf can increase the modulation format complexity and use a lower level of FEC code protection in either the uplink or the downlink in order to increase the spectral efficiency, provided the error rate remains acceptably low. Different modulation formats and FEC codes may be used for different services (e.g., voice, data) used by a subscriber (process step 705).

Next, the RF modem shelf assigns subscribers to modulation groups in the downlink and to sub-burst groups in the uplink (process step 710). The base station transceiver then transmits media access fields (e.g., signaling, ACK & NACK) using the lowest modulation format/FEC code complexity. The base station transceiver then transmits the remaining modulation groups in the downlink to the subscribers in increasing order of modulation format/FEC code complexity (process step 715). When the downlink is complete, the base station transceiver receives registration &

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contention minislots transmitted by the subscriber access devices using the lowest modulation format/FEC code complexity. The base station transceiver then receives the remaining sub-burst groups transmitted by the subscribers in increasing order of modulation format/FEC code complexity (process step 720).

The use of adaptive link parameters improves the link throughput and correspondingly affects the bandwidth allocation described above in FIGURE 6. Link parameters apply not only to the transmitter but to the receiver as well. The present invention uses a bounded (finite) set of modulation formats to maximize bandwidth utilization to each subscriber in a channel or sector. In an exemplary embodiment of the present invention, the low complexity (low bandwidth efficiency) modulation formats used for media access fields (e.g., signaling, ACK, NACK) are binary phase shift keying (BSPK or 2-PSK) and quadrature phase shift keying (QPSK or 4-PSK). The present invention may also use multiple-code orthogonal expansion codes in conjunction with the low complexity modulation formats for extremely robust communication. The higher complexity (higher efficiency) modulation formats used for the modulation groups and the sub-burst groups may be 8-PSK, 16 quadrature amplitude modulation (QAM), 32 QAM, 64 QAM, 128 QAM, and the like.

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The present invention also uses bounded set of FEC codes to maximize bandwidth utilization to each subscriber in a channel or sector. The level of FEC code protection is based on the services provided. Each subscriber may support multiple services.

In an advantageous embodiment of the present invention, the RF modem shelf may use packet fragmentation to transport data in either the uplink or the downlink. Fragmentation is the division of larger packets into smaller packets (fragments) combined with an ARQ (automatic request for retransmission) mechanism to retransmit and recover erroneous fragments. The RF modem shelf automatically reduces fragment size for high error rate channels. Fragmentation is applied for guaranteed error-free sources. The degree of fragmentation and ARQ is based on the service provided, since each subscriber may support multiple services.

FIGURE 8 depicts flow diagram 800, which illustrates the adaptive assignment of selected link parameters to the different service connections used by each subscriber in wireless access network 100 according to one embodiment of the present invention. The RF modem shelf assigns connection identification (CID) values to the uplink and to the uplink connections used by a subscriber. If a subscriber uses more than one service (e.g., two voice, One data), the RF modem shelf assigns separate CID values to each

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uplink connection and separate CID values to each downlink connection (process step 805). As noted above, the CID comprises a bit field with the uppermost bits identifying the subscriber and the lowermost bits identifying a specific connection to the subscriber. While many sets of adaptive transmission and reception parameters are possible, there are a finite number of combination that make logical sense. These combinations are grouped into physical layer usage codes that are broadcast to subscribers as part of the general header of TDD superframe or frame header on a periodic basis. These apply to both the base station transmissions and the subscriber transmissions.

The RF modem shelf monitors data traffic between subscriber and base station and determines for each connection the most efficient combination of modulation format, FEC code, and/or antenna beam forming for the uplink and downlink (process step 810). The RF modem shelf then assigns each subscriber connection to a modulation group in the downlink and to a sub-burst group in the uplink (process step 815). The base station transmits media access fields (e.g., signaling, ACK & NACK) using the lowest modulation format/FEC code complexity. Then base station then transmits modulation groups to subscribers in increasing order of modulation format/FEC code complexity (process step 820). Finally,

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the base station receives registration & contention minislots using the lowest modulation format/FEC code complexity. Then base station then receives sub-burst groups from subscribers in increasing order of modulation format/FEC code complexity (process step 825).

Physical layer usage codes are bound to subscriber CID values by a service establishment protocol. If there is a degradation or improvement in the channel between a subscriber and the base station, a protocol exists so the subscriber access device and the base station may revise the physical layer usage code and subscriber CID code. The codes and bindings can be added and deleted based on services requirements of the subscriber.

The present invention applies beam forming in the transmit and receive paths of wireless access network 100 for a number of reasons, including greatly improved to carrier-to-interference ratio, which allows frequency reuse patterns that require less spectrum, two to four times the amount of spatial reuse using multiple simultaneous beams, and increased cell radius, particularly for the band where the uplink from the subscriber to the base can use higher receive gain to overcome uplink loss problems. The use of advanced antenna technology introduces an additional level of media access control (MAC) complexity.

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The MAC layer and physical (PHY) layer have an added spatial/beam component that must be factored into MAC layer coordination of the PHY layer. On a subscriber-by-subscriber basis (i.e., link-by-link basis), the MAC layer and PHY layer must coordinate the following parameters:

1) Communications burst duration

   a) Individual uplink or downlink for TDD system; and

   b) Joint uplink and downlink for FDD system;

2) Modulation complexity;

3) FEC rate; and

4) Beam/combining parameters.

Beam forming and advanced antennas change the basic paradigm that all subscribers have the capability of simultaneously receiving broadcast information from the base station. Transmit and receive beams are formed to optimize communications with a given subscriber with a channel response $H_n(t)$ and beam parameters $B_n(t)$. The base station forms the beam and either sends or receives from the subscribers in an order determined by the MAC layer.

To support advanced antenna systems both FDD and TDD links must be designed to provide transmissions based on self-contained bursts. Conceptually, TDD is easy to understand. A beam is formed

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for each transmitted burst in either the upstream or the downstream. These simple sequential cases can be expanded to advanced beam forming techniques to provide simultaneous multiple access to spatially independent users. A beam-forming network can create two or more independent beams with low self-interference that allow simultaneous communications using the same frequency. While beam-forming complexity is increased, spectral reuse is also increased. The complexity of PHY layer hardware and MAC layer scheduling software also increase proportionally with the number of beams created. The MAC and PHY also need to perform burst scheduling and transmission based on spatial concatenation. One or more subscribers can be supported by a single set of beam-forming parameters due to close physical proximity.

A beam-forming network is a series of antenna elements combined with a delay-weight network that combines the RF energy of a wave front incident on the antenna elements. This enhances gain in a given direction or steers a null in a specific direction. A beam-forming system consisting of N antenna elements is generally arranged in a line or in a rectangular array. The N element array can theoretically steer N-1 nulls. Beam-forming networks are much less efficient at creating gain patterns for distinct beams.

The array elements are spaced by W/N, where N is an integer

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value 1, 2, 4, 8,..., and W is the wavelength of the signal. Typically, the elements are spaced at W/4. Each of these elements is connected to a circuit that can be programmed with a variable delay and phase to each element. The signal products are summed together to form the final beam (e.g., the ideal constructed beam diagram). Conceptually this is very much like a FIR signal filter. The array coherently sums the wave front components from a given direction by forming a time/phased delay at each element.

Beam forming can be performed at RF frequencies using analog delay and phase elements or at baseband frequencies using digital techniques. FIGURE 9 illustrates selected portions of the receive path of conventional analog beam-forming system 900. Analog beam-forming system 900 comprises beam-forming network 910, antennas 931-936, and modem/MAC layer control block 950. Beam-forming network 910 comprises programmable delay and phase controller 920, delay (D) elements 921-926, and signal combiner 940. An incident wave front is detected by antenna 931 at time T1, by antenna 932 at time T2, by antenna 933 at time T3, by antenna 934 at time T4, by antenna 935 at time T5, and by antenna 936 at time T6.

As FIGURE 9 illustrates, the delay of the signal wave at each element for a given angle of signal arrival is given by:

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$$t = L/c$$

where c is the speed of light. The distance, L, between wave fronts to each element is based on the angle of arrival of the signal relative the antenna elements. As an example, if the delay, D, for the antenna elements are all set to be equal, then the antenna has maximum gain at 0 degrees. If the delays are incrementally set from delay element 926 to delay element 921 to have the values 0, W/4c, 2W/4c, 3W/4c,..., 5W/4c, then the beam that is formed at the output of signal combiner 940 has maximum gain at 90 degrees (i.e., to the right).

FIGURE 10 represents an exemplary spatial response of the receive path of conventional analog beam-forming system 900. Power lobe 1010 represents the received beam formed by conventional analog beam-forming system 900. The signal gain maximum occurs at an angle of approximately +40 degrees to the right of an arbitrary 0 degree reference in the sector covered by the antennas of conventional analog beam-forming system 900.

Analog beam forming has numerous benefits. Analog beam-forming capabilities can be retrofitted to existing systems by adding telemetry and time coordination. There is a much lower cost relative to the baseband configuration. Analog beam-forming systems also have excellent back-lobe/front-to-back emission

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characteristics to meet ETSI TM4 standards. However, analog beam forming systems are limited in the number of simultaneous beams according to the maximum number of RF cables up a tower and RF combiner losses.

FIGURE 11 illustrates selected portions of the transmit path and the receive path of conventional digital beam-forming system 1100. Digital beam-forming system 1100 comprises modem processors 1110, 1120 and 1130, transmit signal combiner 1140, digital signal bus 1145 and a plurality of transceiver front-end elements. Modem processor 1110 is representative of modem processors 1120 and 1130. Modem processor 1110 comprises modem 1111, programmable transmitter (TX) weight/delay controller 1112, and programmable receiver (RX) weight/delay controller 1113.

Three exemplary transceiver front-end elements are illustrated. A first transceiver front-end element comprises antenna 1151, radio frequency/intermediate frequency (RF/IF) converter 1152, analog-to-digital converter (ADC) 1153, and digital-to-analog (DAC) 1154. A second transceiver front-end element comprises antenna 1161, radio frequency/intermediate frequency (RF/IF) converter 1162, analog-to-digital converter (ADC) 1163, and digital-to-analog (DAC) 1164. Finally, the first

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transceiver front-end element comprises antenna 1171, radio frequency/intermediate frequency (RF/IF) converter 1172, analog-to-digital converter (ADC) 1173, and digital-to-analog (DAC) 1174.

As FIGURE 11 illustrates, each antenna has a RF/IF down-converter and up-converter (i.e., RF/IF converters 1152, 1162, and 1172), an A/D converter, and a D/A converter. The receive path signals are distributed on high-speed digital signal bus 1145 to be processed by programmable RX weight/delay controller 1113 and modem 1110 in each baseband modem processor 1110. The transmit path differs slightly from the receive path. Programmable TX weight/delay controller 1112 performs the delay and phase adjustments to the signal to be feed to each antenna element. Then, transmit signal combiner 1140 (generally an individual card) sums the transmit signals from the multiple simultaneous channels if more than one channel is to be transmitted. This summed signal is presented to the RF/IF converter for each antenna.

Digital baseband beam forming has the numerous benefits. Digital baseband beam-forming systems provide the most flexible configuration and provide all antenna data to the receiver circuits to allow for rapid calculation of adaptive cancellation. Digital baseband beam-forming systems also provide all-digital processing of weights and delay values and reduce the size of the RF

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amplifier. However, digital baseband beam-forming systems have a very high up-front cost. To limit costs, sparse arrays (as opposed to array panel configurations) are sometimes used, which causes beam pattern back-lobe problems and sometimes results in failure to consistently meet ETSI TM4 (i.e., cell-to-cell interference) standards. Also, critical tower loading is still a problem. High performance (large number of antenna element) configurations must have full demodulation and electro-optic interfaces at the tower.

The present invention uses a combination of the following techniques to maximize frequency re-use and the number of subscribers per base station in wireless access network 100:

1) beam scanning within a cell sector; and

2) spread spectrum transmission to allow down-link broadcast of synchronization and beam maps for the MAC layer with a cell sector.

The present invention uses pre-programmed sets of directed beam patterns to cover a cell in an angular fashion. This is referred to herein as "beam scanning". FIGURE 12A illustrates exemplary beam scanning pattern 1210 according to one embodiment of the present invention. Beam scanning pattern 1210 covers an cell sector that is approximately 90 degrees wide. Beam scanning patter 1210 is covered by nine directed scanning beams, each

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approximately 10 degrees wide. The base station establishes a set of beams to cover the cell. Based on physical location in the sector, a specific beam is used to communicate with one or more subscribers that lie in that sector. The nine scanning beams may be transmitted or received in any order.

FIGURE 12B represents exemplary spatial response 1220 of the transmit and receive scanning beams in beam scanning pattern 1210. Nine signal gain maximums occur, one for each scanning beam. The leftmost signal gain maximum is formed at an angle of approximately -40 degrees to the left of an arbitrary 0 degree reference in the sector. The rightmost signal gain maximum is formed at an angle of approximately +40 degrees to the right of an arbitrary 0 degree reference in the sector. The nine signal gain maximums are spaced 10 degrees apart.

An important issue when using a spatial/beam component in wireless access network 100 is subscriber acquisition and maintaining system synchronization. If wireless access network 100 could guarantee equal distribution of subscribers into the sector beam set, a simple round robin polling method could be used. However, uniform distribution is not guaranteed and wireless access network 100 may use a large number of beams to cover a sector. The revisit time to any specific beam may result in subscribers falling

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out of synchronization.

One alternative to a guaranteed minimum revisit time is to have a full-sector coverage broadcast beam and use of spread spectrum processing gain in the air interface. The broadcast beam is shown in FIGURES 13A and 13B. FIGURE 13A illustrates exemplary broadcast pattern 1310 according to one embodiment of the present invention. Broadcast pattern 1310 covers all of the 90 degree cell sector in FIGURE 12A. FIGURE 13B represents exemplary spatial response 1320 of the broadcast beam. The broadcast beam covers the 90 degree sector fairly uniformly.

By introducing spread spectrum and a broadcast beam operating on the Start of Frame (SOF) field of every frame, the present invention provides improved performance for acquisition and synchronization as opposed to either equal duration round robin polling per scan beam or dynamic weighted polling per scan beam based on the throughput per cell.

The key elements for the air interface are:

1) subscriber receiver (RX) acquisition and synchronization;

2) transmitter (TX) acquisition and ranging;

3) map information for beam scheduling and up/down link maps for a given frame; and

4) demand access mechanisms.

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According to an advantageous embodiment of the present invention, the air interface is implemented using a TDD frame format. According to one embodiment, beam switching occurs on a frame-by-frame basis so that for a complete TDD frame, only one beam is active. However, in alternate embodiments of the present invention, more than one beam may be used in each TDD frame, particularly in the downlink due to typical 4:1 asymmetry. The uplink may be limited to a single scanning beam per frame.

To implement the added complexity of switched beam access, the exemplary TDD frame in FIGURE 14 may be used. FIGURE 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) signal 1400 according to one embodiment of the present invention. In FIGURE 14, single beam per frame mode is depicted.

TDD signal 1400 comprises a first TDD frame having a downlink portion comprising a first start-of-frame field (SOF1), a first beam map field (Beam Map 1), and a first scan map field (Scan Map 1). The remainder of the downlink portion comprises preamble field 501, management field 502, and N modulation groups, including exemplary modulation groups 503 and 505, which were described above in greater detail in FIGURE 5. The first TDD frame also has an uplink portion comprising a transmitter-transmitter guard (TTG)

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slot, a plurality of registration (REG) minislots, a plurality of contention (CON) request minislots, and N sub-burst groups, including sub-burst groups 509 and 510, and receiver-transmitter guard (RTG) slot 511, which were described above in greater detail in FIGURE 5.

The first TDD frame is followed by a second TDD frame in which portions of the downlink are shown. The second TDD frame comprises a second start-of-frame field (SOF2), a second beam map field (Beam Map 2), and a second scan map field (Scan Map 2).

According to one embodiment of the present invention, an exemplary spread spectrum Broadcast Beam is used to transmit the start-of-frame fields (SOF1 and SOF2) and the beam map fields (Beam Map 1 and Beam Map 2) in each TDD frame, and distinct scan beams (i.e., Scan Beam A and Scan Beam B) are used to transmit the scan map fields (Scan Map 1 and Scan Map 2) and the remainder of the uplink and downlink portions of each TDD frame.

The Broadcast Beam Maps provide data indicating which scanning beam (or beams) are used at which time (measured in symbols or other baud-oriented time unit) for the frame. For each scanning beam used, an uplink map and a downlink map must be provided. The Scanning Beam Map provides the Uplink and downlink maps. The Scanning Beam Map states at which time in the frame, using the

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scanning beam described in the Broadcast Beam Map, the downlink modulation groups and specific uplink slots with associated CIDs are allocated for the frame using the specific scanning beam.

According to an exemplary embodiment, the Broadcast Beam uses DSSS spectrum spreading to make up antenna gain loss and transmits as few fields and frame information as possible to maintain efficiency. The Broadcast Beam transmits the SOF synchronization field so that all subscribers, even those that are not actively communicating (i.e., idle subscribers) can maintain synchronization.

Beam Map 1 and Beam Map 2 comprise a Frame Beam Map and Super-Frame Beam Map containing information that defines scanning beams that cover the sector, the adjoining sectors of the same base station, and the sectors of adjoining base stations. The Frame Beam Map defines the number of downlink beams in the remainder of the current frame and lists a beam number and frame time (physical slot) in which each beam starts. The Frame Beam Map also defines the Uplink beam numbers for each subscriber. The Super-Frame Beam Map defines the number of beams in the relevant sector.

Scan Beams A and B provides 802.16 MAP/MAC and standard packet communications using standard modulation formats. The remainder of the TDD frame is processed using the Uplink/Downlink Map

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information provided by the Broadcast Beam. In such an embodiment, the Broadcast Beam and the associated Super-Frame and Frame Beam Maps inform all subscriber wireless access devices which beams are used. Once the scanning beam is activated, communications are limited to the subscribers associated with that beam.

As note above, the Scanning Beam Map used in the scanning beams are downlink maps and uplink maps. The downlink map indicates the modulation format and forward error correction code (FEC) and time slots enabled on the downlink (i.e., modulation group). The uplink map indicates the specific subscriber, modulation format, FEC, and equalizer (cyclo-stationary processing) for the allowed uplink data bursts.

The acquisition steps are as follows:

1) SOF and Beam Map fields allow initial acquisition identical to a conventional single beam system, including coarse and fine frame alignment, baud and frequency NCO lock, and equalizer initialization;

2) access equipment at the subscriber premises creates a histogram of received signal strength and quality on a per beam basis;

3) subscriber access equipment selects the best scan beam based on the histogram data; and

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4) uplink acquisition and ranging initiated by subscriber on the best scan beam.

Although the present invention has been described in detail, those skilled in the art should understand that they can make various changes, substitutions and alterations herein without departing from the spirit and scope of the invention in its broadest form.

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WHAT IS CLAIMED IS:

1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals in a sector of a cell site associated with said first base station, wherein said transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal comprising a start of frame field and subsequently transmits downlink data traffic in a downlink portion of said TDD frame to at least one of said wireless access devices using at least one directed scanning beam signal.

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2. The transceiver as set forth in Claim 1 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said at least one wireless access device to detect said least one directed scanning beam signal.

3. The transceiver as set forth in Claim 2 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said at least one directed scanning beam signal transmits said downlink data traffic.

4. The transceiver as set forth in Claim 3 wherein said scanning beam information identifies at least one modulation format associated with said at least one directed scanning beam signal.

5. The transceiver as set forth in Claim 3 wherein said scanning beam information identifies at least one forward error correction code level associated with said at least one directed scanning beam signal.

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6. The transceiver as set forth in Claim 2 further comprising receive path circuitry associated with said beam forming network capable of receiving uplink data traffic transmitted by said at least one wireless access device in an uplink portion of said TDD frame.

7. The transceiver as set forth in Claim 6 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

8. The transceiver as set forth in Claim 7 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

9. The transceiver as set forth in Claim 8 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

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10. A fixed wireless access network comprising:

a plurality of base stations, each of said base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in a cell site associated with said each base station, wherein said each base station comprises:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals in a sector of said cell site associated with said each station, wherein said transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal comprising a start of frame field and subsequently transmits downlink data traffic in a downlink portion of said TDD frame to at least one of said wireless access devices using at least one directed scanning beam signal.

11. The fixed wireless access network as set forth in Claim 10 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said at least one wireless access device to detect said least one directed scanning beam signal.

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12. The fixed wireless access network as set forth in Claim 11 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said at least one directed scanning beam signal transmits said downlink data traffic.

13. The fixed wireless access network as set forth in Claim 12 wherein said scanning beam information identifies at least one modulation format associated with said at least one directed scanning beam signal.

14. The fixed wireless access network as set forth in Claim 12 wherein said scanning beam information identifies at least one forward error correction code level associated with said at least one directed scanning beam signal.

15. The fixed wireless access network as set forth in Claim 11 wherein said each base station further comprises receive path circuitry associated with said beam forming network capable of receiving uplink data traffic transmitted by said at least one wireless access device in an uplink portion of said TDD frame.

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16. The fixed wireless access network as set forth in Claim 15 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

17. The fixed wireless access network as set forth in Claim 16 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

18. The fixed wireless access network as set forth in Claim 17 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

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19. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a method of communicating with a first of said plurality of base stations comprising the steps of:

transmitting at a start of a TDD frame a broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and

transmitting downlink data traffic in a downlink portion of said TDD frame to at least one of said wireless access devices in a sector of a cell site associated with said first base station using at least one directed scanning beam signal.

20. The method as set forth in Claim 19 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said at least one wireless access device to receive said least one directed scanning beam signal.

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21. The method as set forth in Claim 20 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said at least one directed scanning beam signal transmits said downlink data traffic.

22. The method as set forth in Claim 21 wherein said scanning beam information identifies at least one modulation format associated with said at least one directed scanning beam signal.

23. The method as set forth in Claim 21 wherein said scanning beam information identifies at least one forward error correction code level associated with said at least one directed scanning beam signal.

24. The method as set forth in Claim 20 further the step of receiving uplink data traffic transmitted by said at least one wireless access device in an uplink portion of said TDD frame.

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25. The method as set forth in Claim 24 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

26. The method as set forth in Claim 25 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

27. The method as set forth in Claim 26 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

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WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

ABSTRACT OF THE DISCLOSURE

A transceiver for use in a wireless access network comprising a plurality of base stations, each of the plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in a corresponding cell site of the wireless access network. The transceiver is associated with a first base station and comprises transmit path circuitry associated with a beam forming network for transmitting directed scanning beam signals in a sector of a cell site of the first base station. The transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal comprising a start of frame field and subsequently transmits downlink data traffic in a downlink portion of the TDD frame to at least one of the wireless access devices using at least one directed scanning beam.

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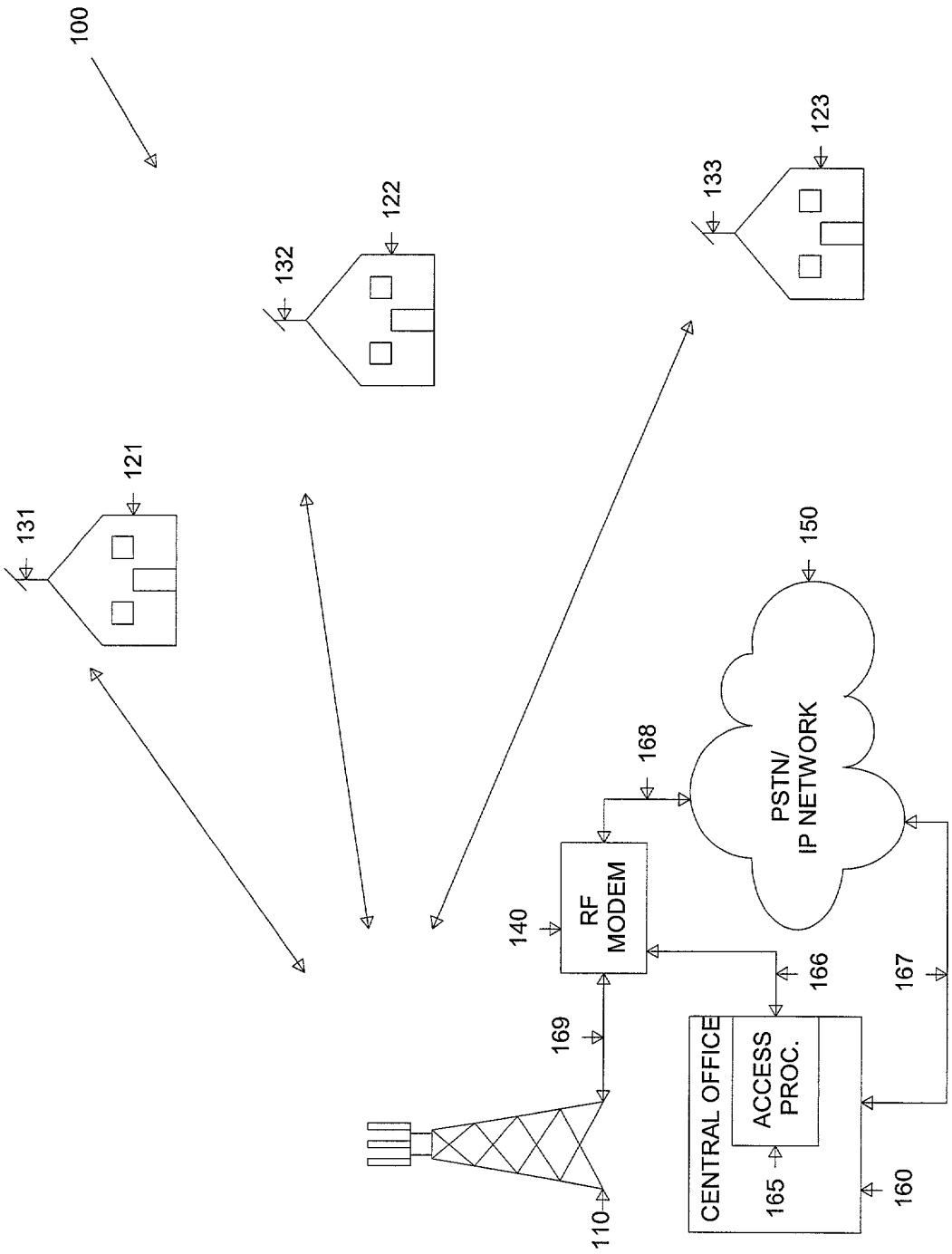

100
131
121
132
122
133
123
150
PSTN/
IP NETWORK
168
140
RF
MODEM
169
166
167
CENTRAL OFFICE
ACCESS
PROC.
165
160
110

FIGURE 1

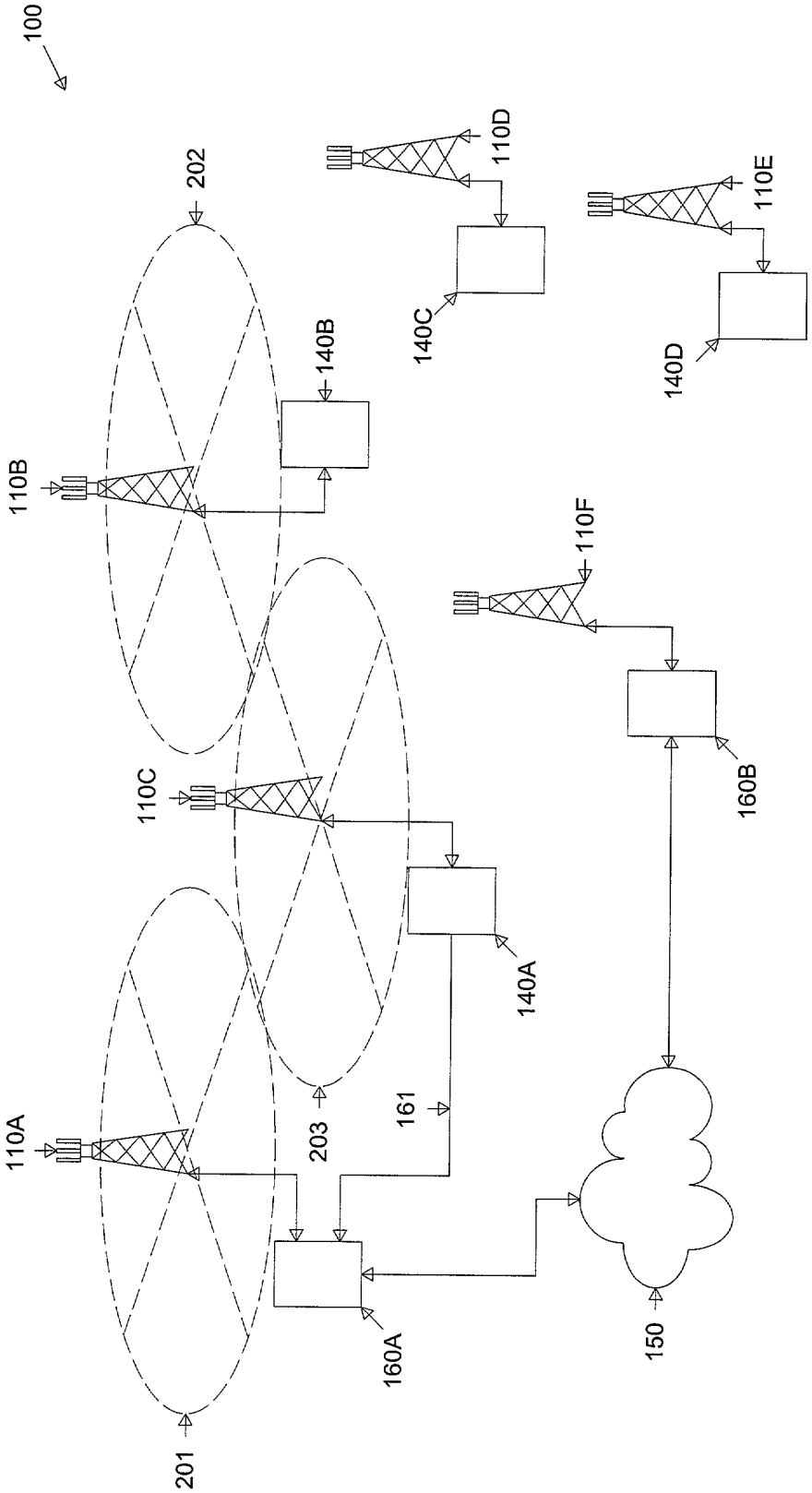


FIGURE 2

PETITIONER VERIZON
EX. 1012
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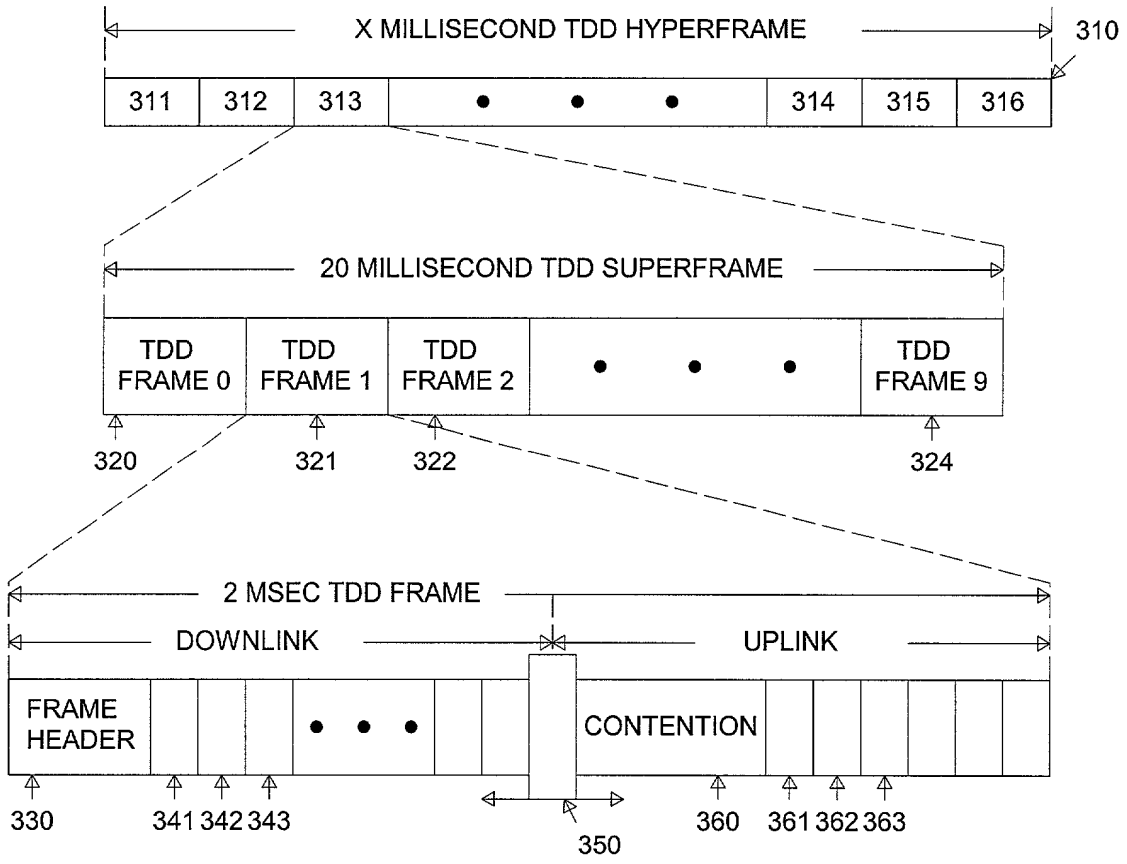


FIGURE 3

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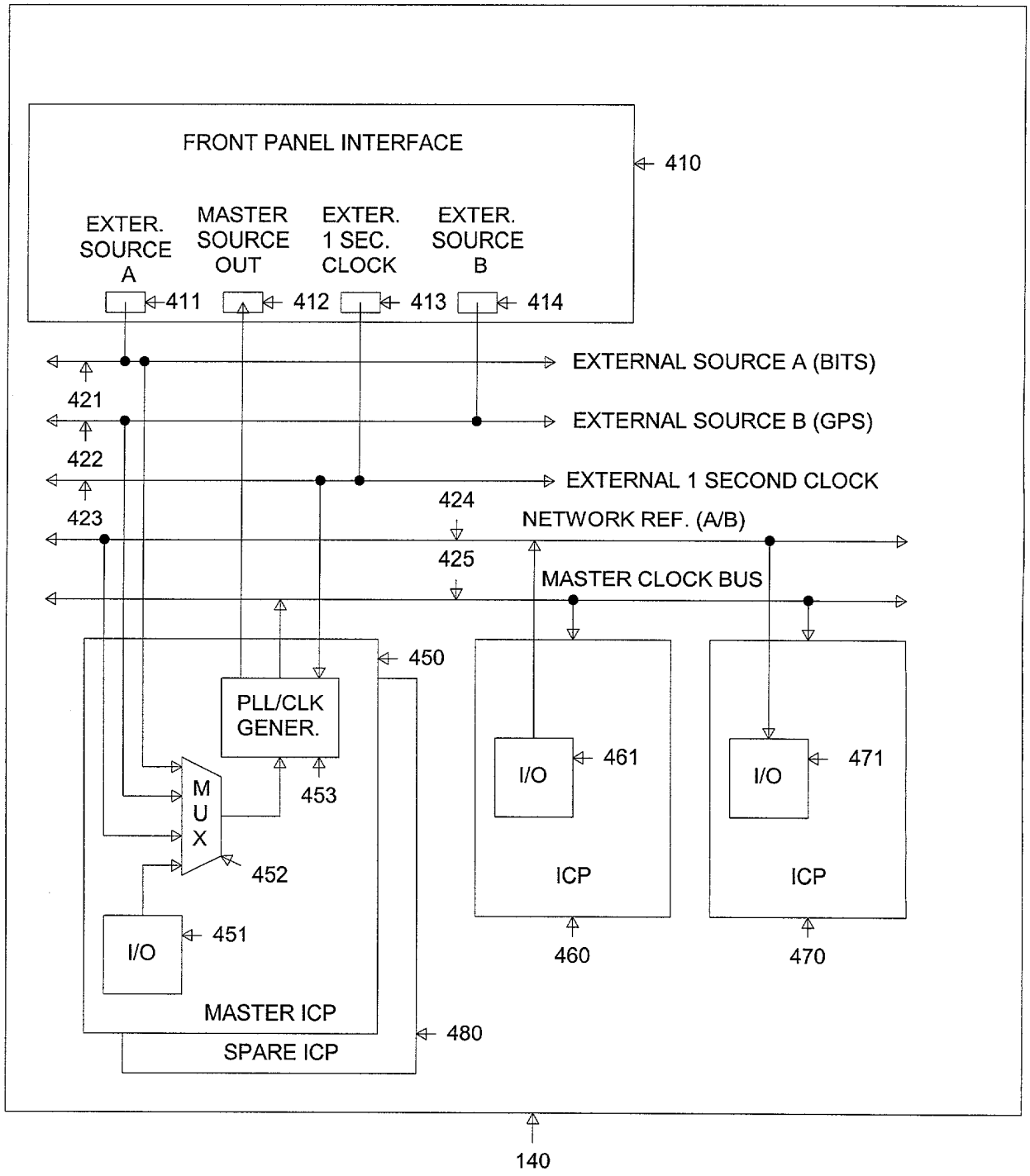

FRONT PANEL INTERFACE
410
EXTER. SOURCE A
MASTER SOURCE OUT
EXTER. 1 SEC. CLOCK
EXTER. SOURCE B
411
412
413
414
EXTERNAL SOURCE A (BITS)
421
EXTERNAL SOURCE B (GPS)
422
EXTERNAL 1 SECOND CLOCK
423
424
NETWORK REF. (A/B)
425
MASTER CLOCK BUS
450
PLL/CLK GENER.
453
M U X
452
I/O
451
MASTER ICP
SPARE ICP
480
I/O
461
ICP
460
I/O
471
ICP
470
140

FIGURE 4

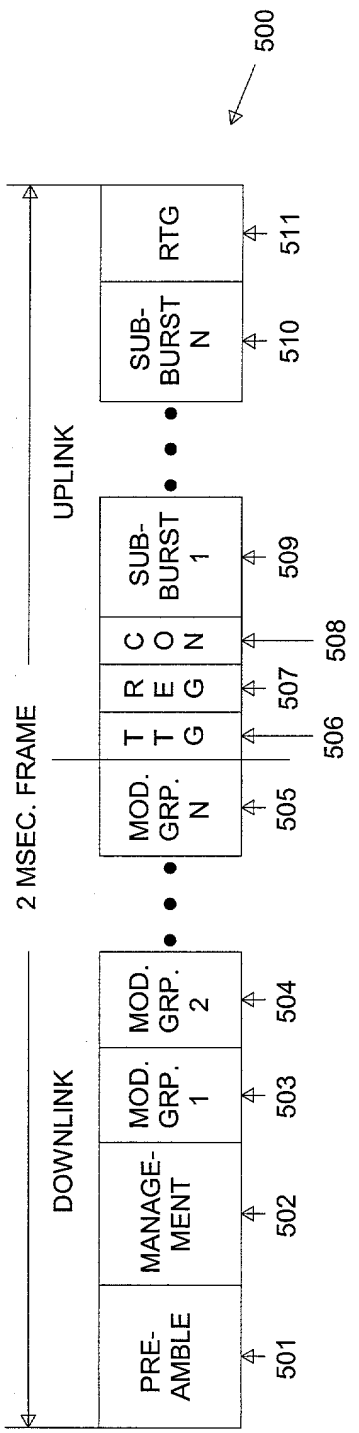


FIGURE 5A

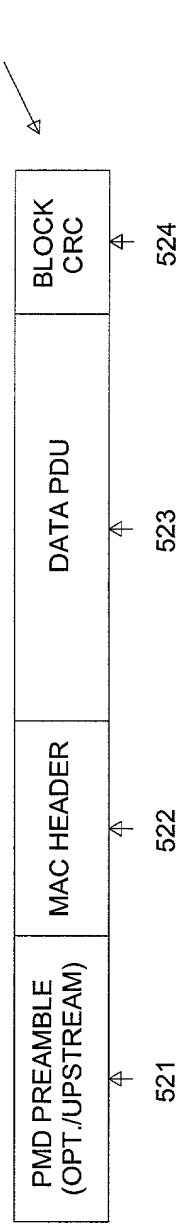


FIGURE 5B

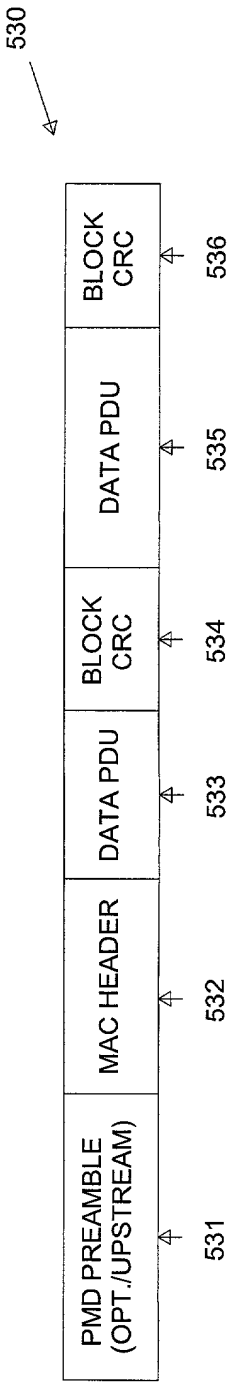


FIGURE 5C

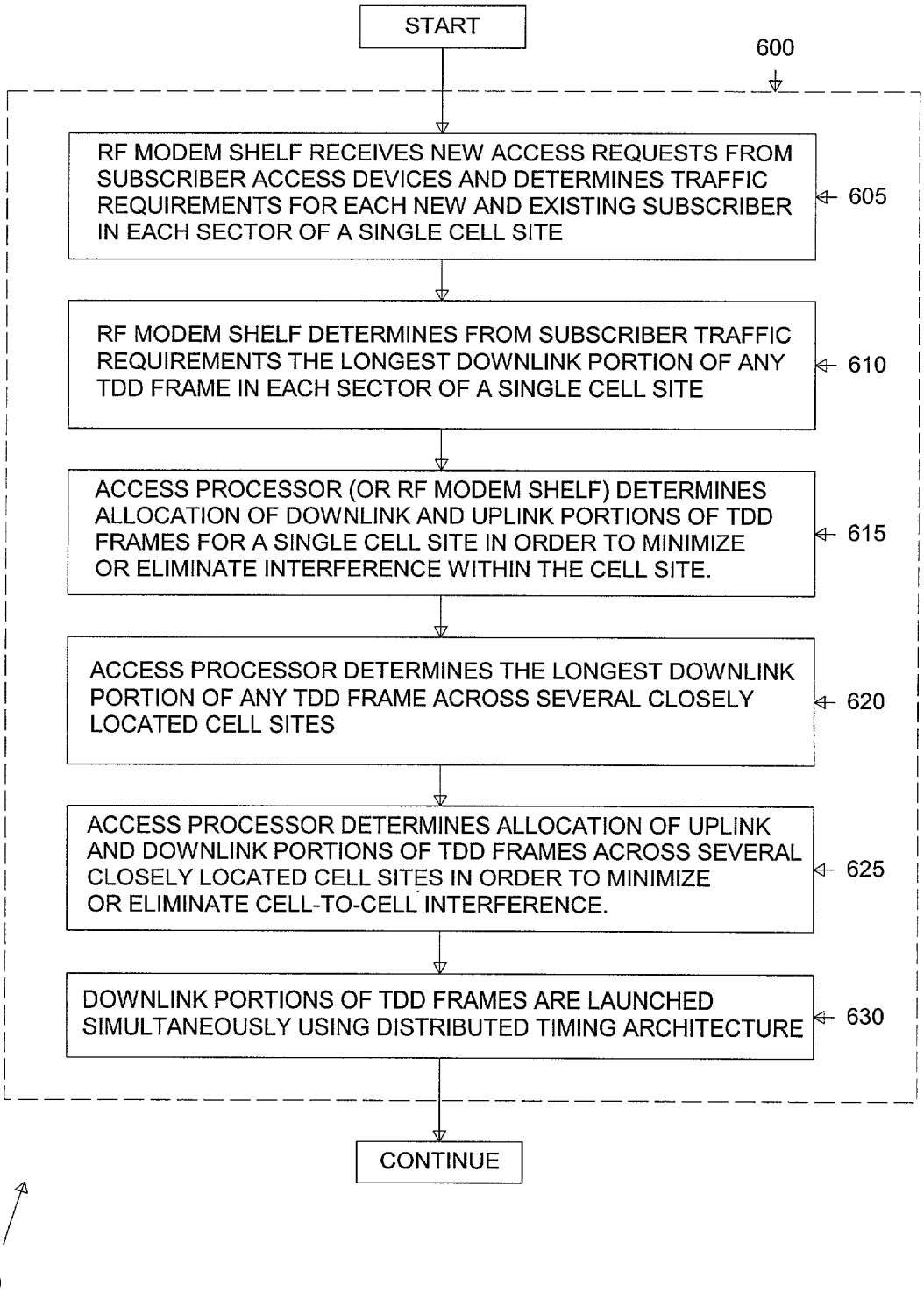


FIGURE 6

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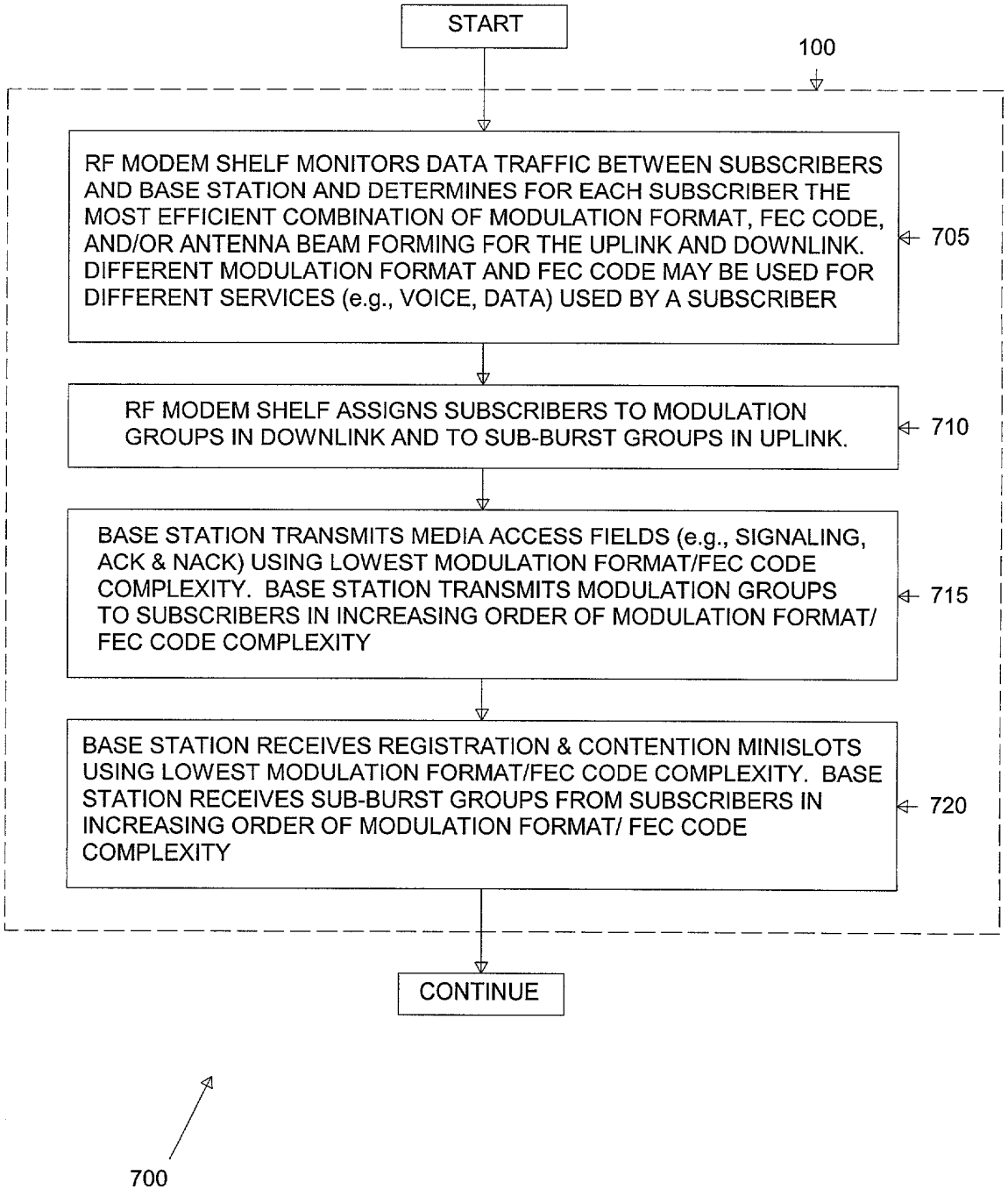


FIGURE 7

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EX. 1012
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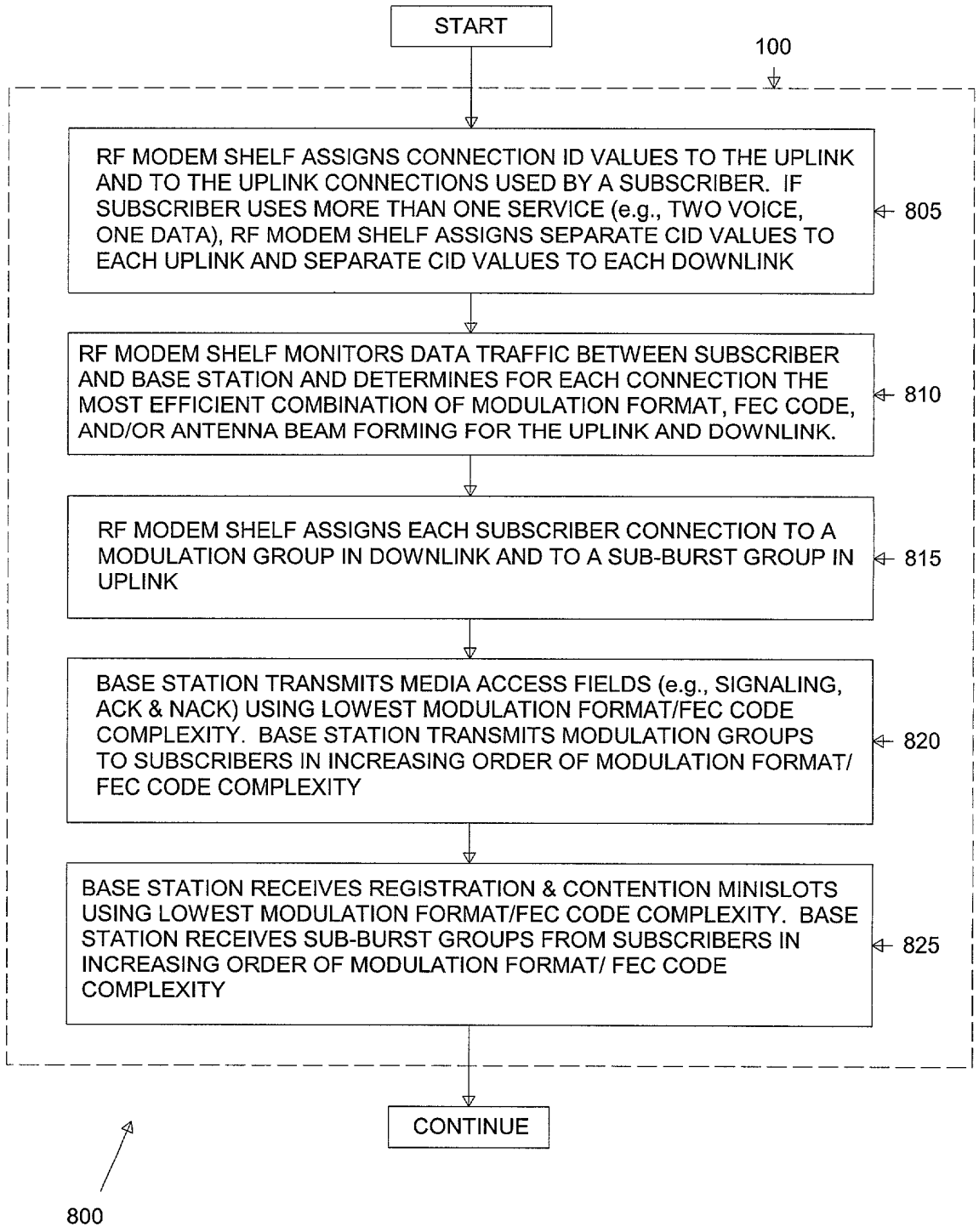


FIGURE 8

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EX. 1012
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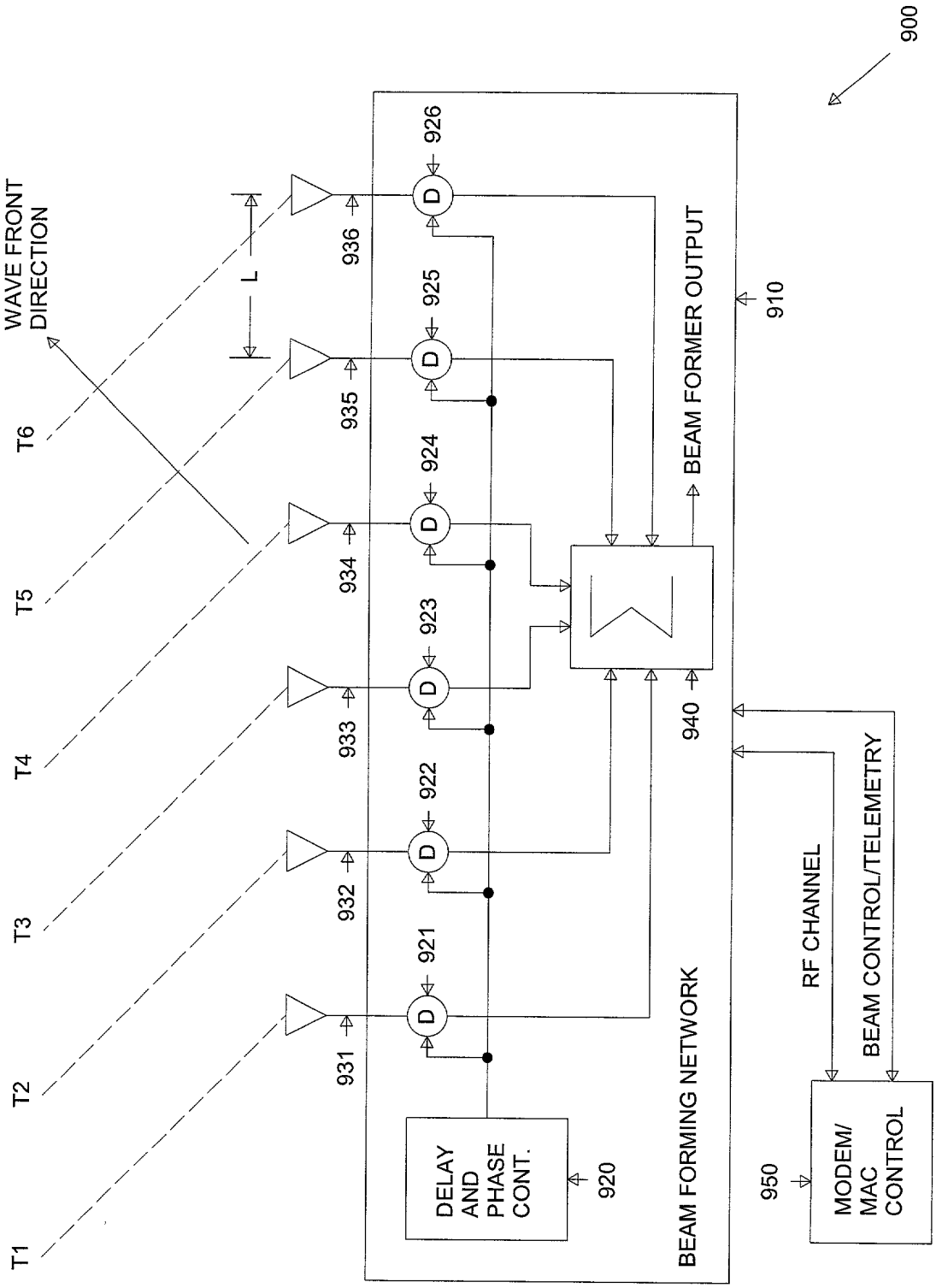

900
910
BEAM FORMER OUTPUT
BEAM FORMING NETWORK
WAVE FRONT DIRECTION
L
T1
T2
T3
T4
T5
T6
931
932
933
934
935
936
921
922
923
924
925
926
D
940
DELAY AND PHASE CONT.
920
RF CHANNEL
BEAM CONTROL/TELEMETRY
950
MODEM/ MAC CONTROL

FIGURE 9

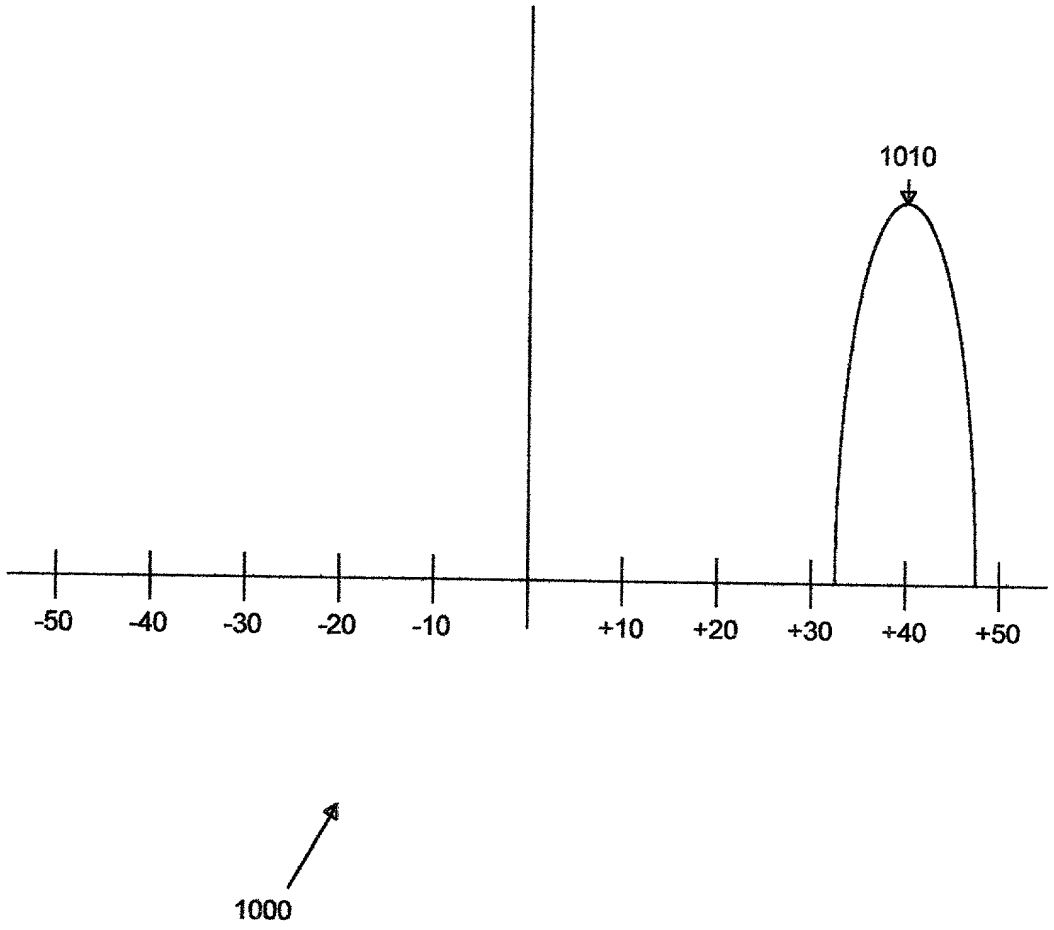


FIGURE 10

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EX. 1012
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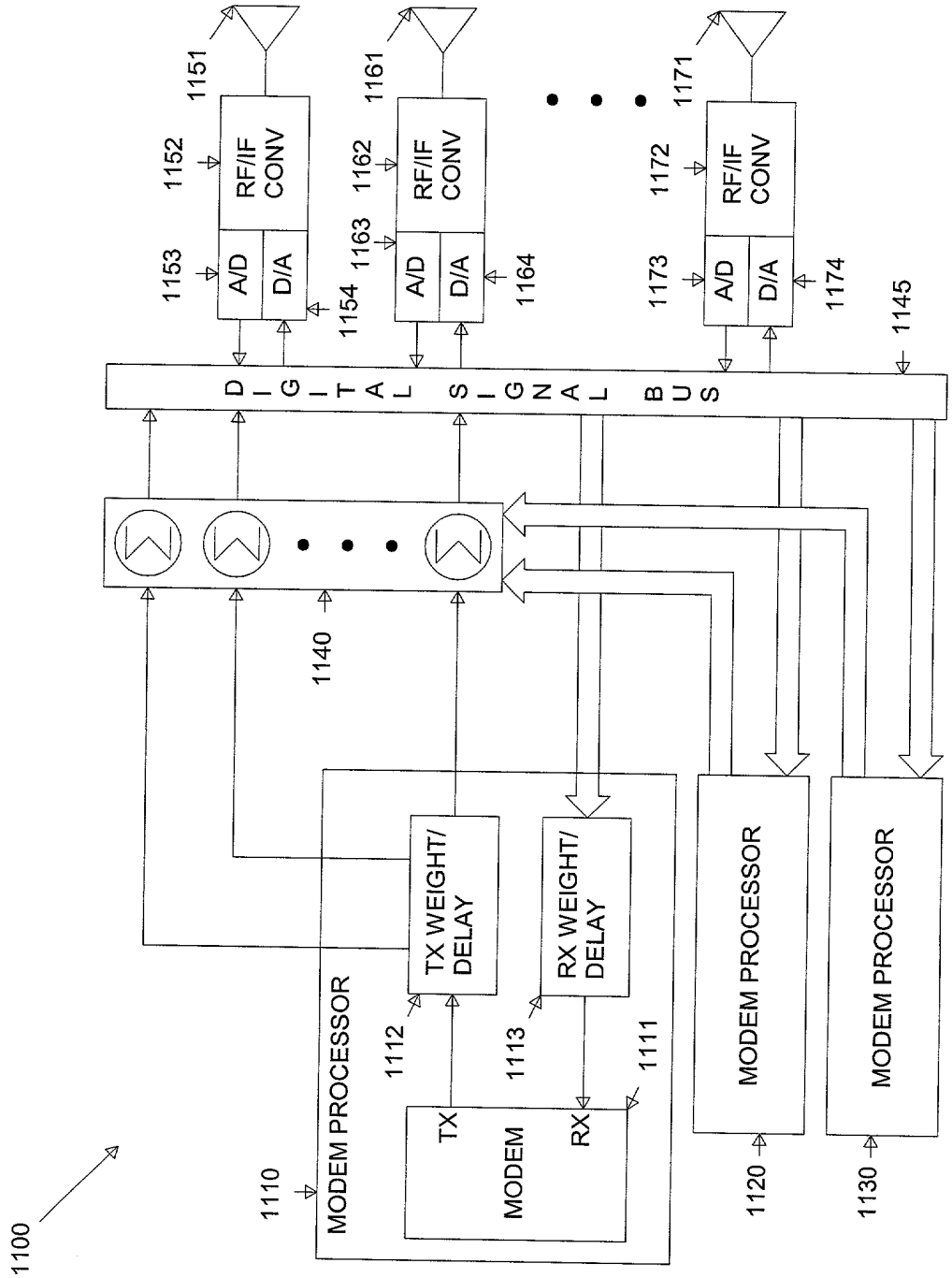


FIGURE 11

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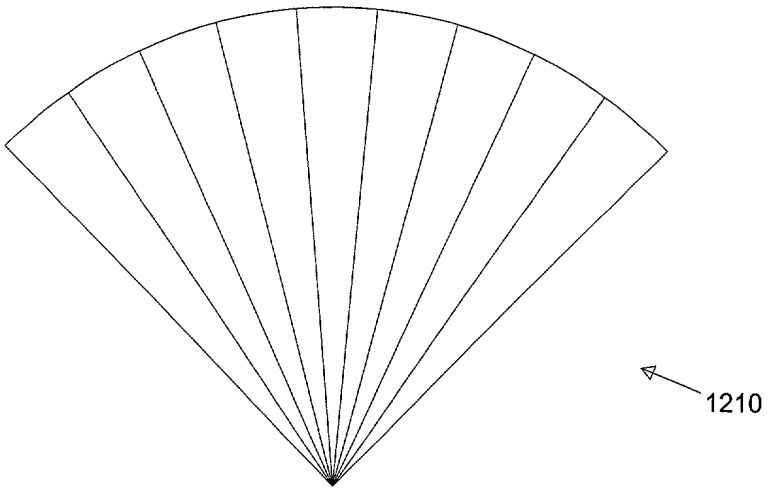


FIGURE 12A

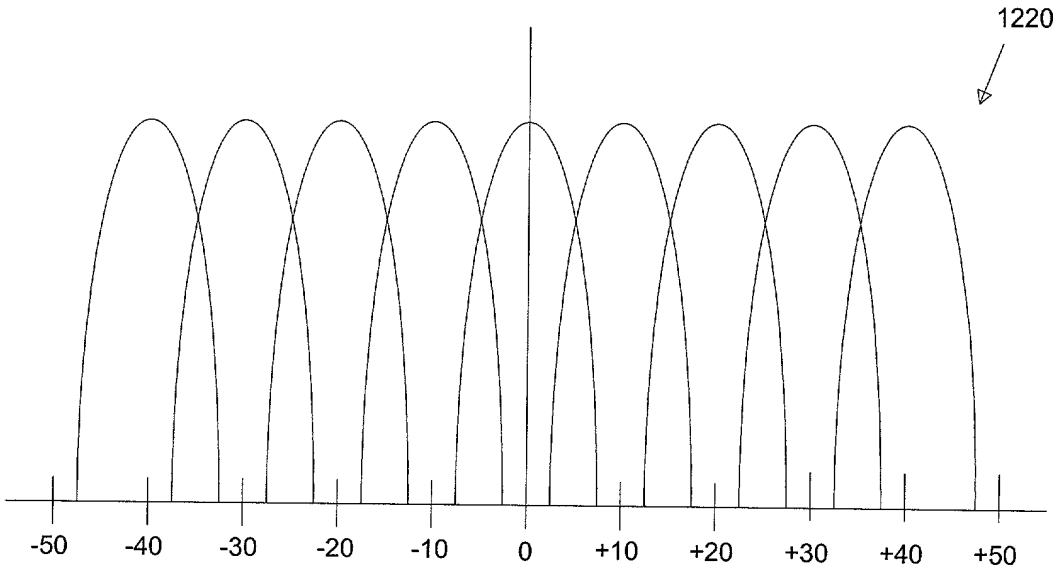


FIGURE 12B

Received: 25 Sep 2014

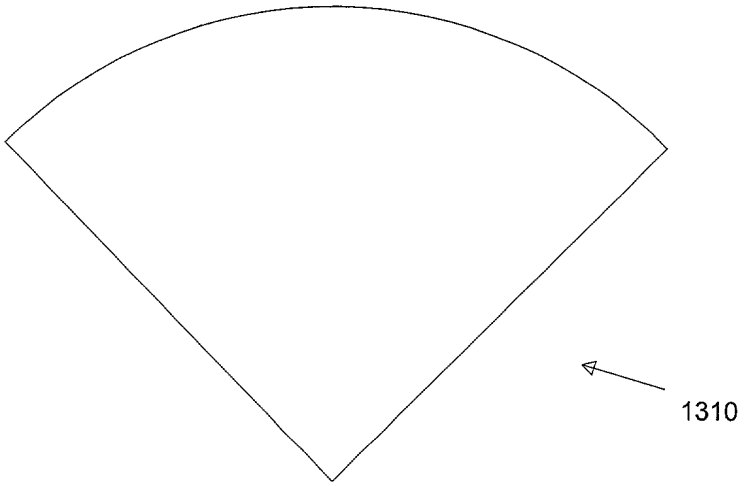


FIGURE 13A

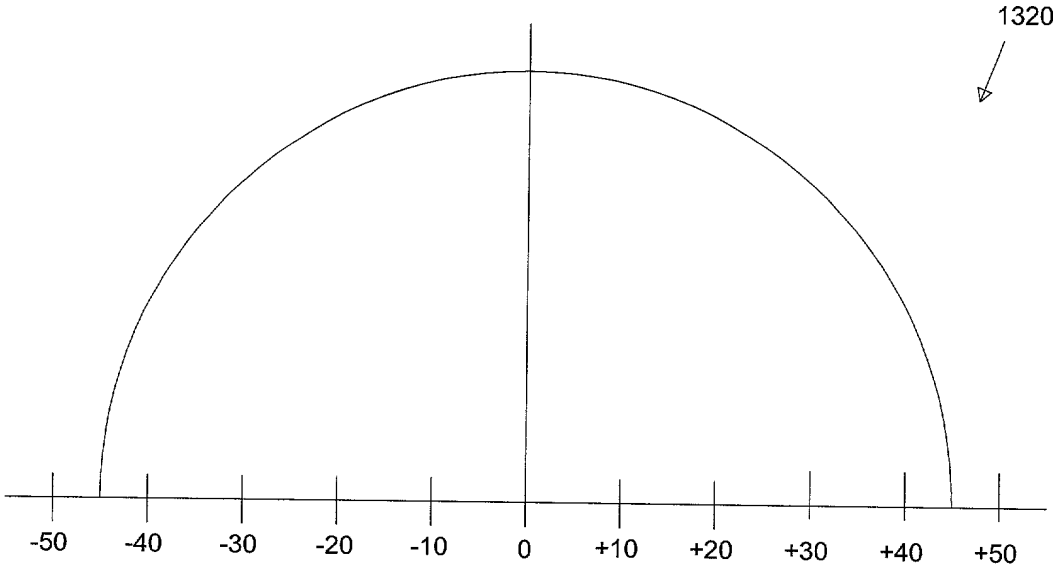


FIGURE 13B

Patent Application Publication

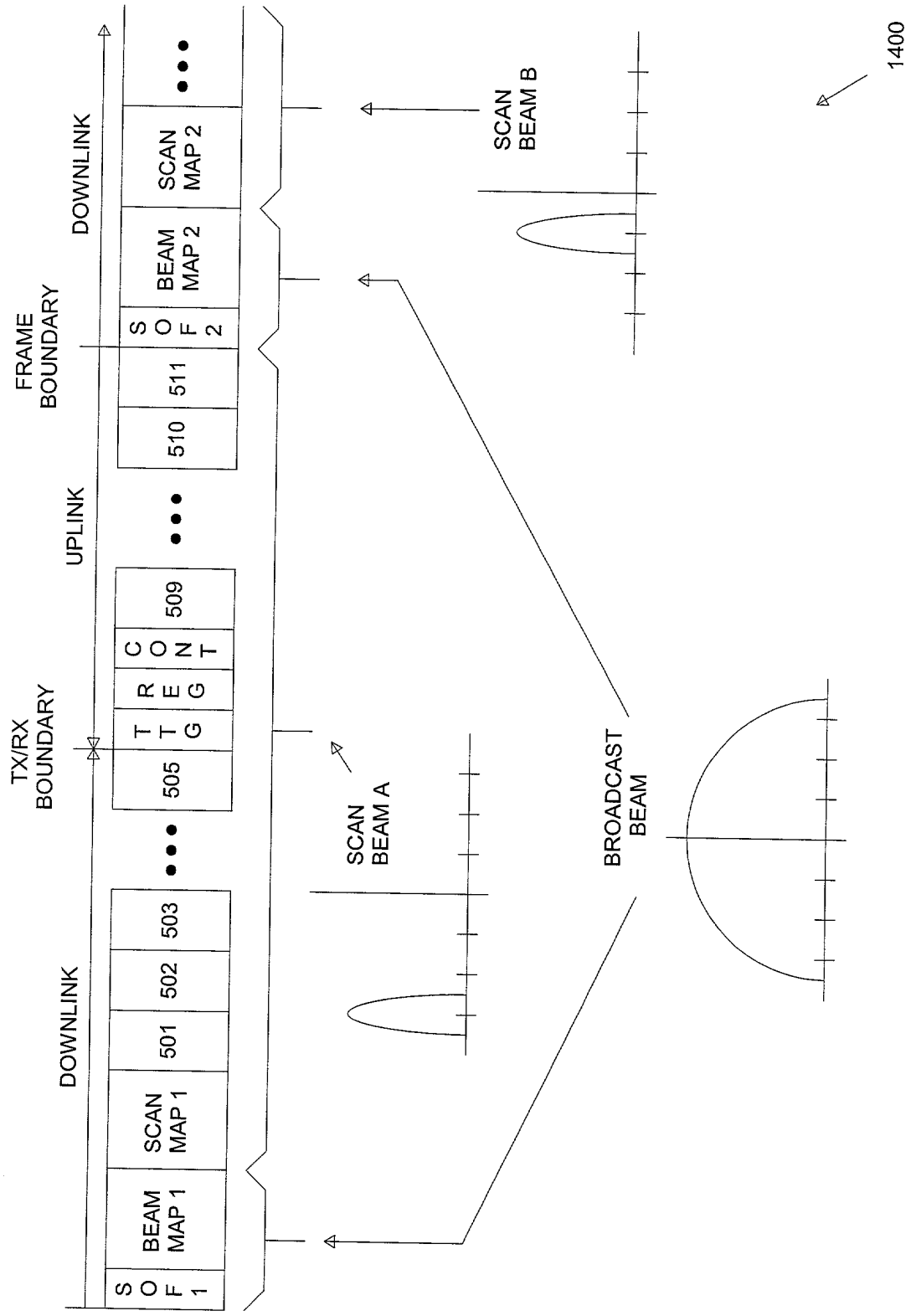


FIGURE 14

PETITIONER VERIZON
EX. 1012
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DECLARATION AND POWER OF ATTORNEY

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention, design or discovery entitled:

"WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION"

the specification of which is attached hereto.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability of this application as defined by Title 37, Code of Federal Regulations, § 1.56.

I hereby claim no foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate on which priority is claimed.

I hereby claim no benefit under Title 35, United States Code, § 120 of any United States application. I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in § 1.56 which became available between the filing date of any prior application(s) and the national or PCT international filing date of this application.

I hereby appoint:

William A. Munck, Registration No. 39,308
John T. Mockler, Registration No. 39,775

my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith, and to file and prosecute any international patent applications filed thereon before any international authorities under the Patent Cooperation Treaty.

Send correspondence to:	Docket Clerk P.O. Drawer 800889 Dallas, Texas 75380
Direct telephone calls to:	(214) 922-9221
Atty. Docket No.:	WEST14-00103

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of inventor:	Paul F. Struhsaker
Inventor's signature:	_____
Date:	_____
Residence (City, County, State):	Plano, Collin County, Texas
Citizenship:	United States of America
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Bib Data Sheet

CONFIRMATION NO. 5591

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/948,059	09/05/2001 RULE	455	2681	WEST14-00103

APPLICANTS

Paul F. Struhsaker, Plano, TX;

**** CONTINUING DATA ***************************

THIS APPLN CLAIMS BENEFIT OF 60/262,712 01/19/2001
AND CLAIMS BENEFIT OF 60/262,825 01/19/2001
AND CLAIMS BENEFIT OF 60/262,698 01/19/2001
AND CLAIMS BENEFIT OF 60/262,827 01/19/2001
AND CLAIMS BENEFIT OF 60/262,826 01/19/2001
AND CLAIMS BENEFIT OF 60/262,951 01/19/2001
AND CLAIMS BENEFIT OF 60/262,824 01/19/2001
AND CLAIMS BENEFIT OF 60/263,101 01/19/2001
AND CLAIMS BENEFIT OF 60/263,097 01/19/2001
AND CLAIMS BENEFIT OF 60/273,579 03/05/2001
AND CLAIMS BENEFIT OF 60/262,955 01/19/2001
AND CLAIMS BENEFIT OF 60/262,708 01/19/2001
AND CLAIMS BENEFIT OF 60/273,689 03/05/2001
AND CLAIMS BENEFIT OF 60/273,757 03/05/2001
AND CLAIMS BENEFIT OF 60/270,378 02/21/2001
AND CLAIMS BENEFIT OF 60/270,385 02/21/2001
AND CLAIMS BENEFIT OF 60/270,430 02/21/2001

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

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
*** 10/06/2001

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☐ no	TX	14	27	3
35 USC 119 (a-d) conditions met	☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged	Examiner's Signature Initials				

ADDRESS

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS , TX 75240

TITLE

Wireless access system using selectively adaptable beam forming in TDD frames and method of operation

☐ All Fees

FILING FEE RECEIVED 498	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	27	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	27 minus 20=	*
INDEPENDENT CLAIMS	3 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL		OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

CLAIMS ONLY

SERIAL NO.	FILING DATE
APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1		✓			
2		1				
3		1				
4		1				
5		1				
6		1				
7		1				
8		1				
9		1				
10	1		✓			
11		1				
12		1				
13		1				
14		1				
15		1				
16		1				
17		1				
18		1				
19	1		✓			
20		1				
21		1				
22		1				
23		1				
24		1				
25						
26		1				
27		1				
28						
29						
30						
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35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
TOTAL IND.	3	⬇		⬇		⬇
TOTAL DEP.	24					
TOTAL CLAIMS	27					

	*		*		*	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
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64						
65						
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67						
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91						
92						
93						
94						
95						
96						
97						
98						
99						
100						
TOTAL IND.		⬇		⬇		⬇
TOTAL DEP.						
TOTAL CLAIMS						

* *MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS*

FORM PTO-2022 (1-98)

U.S.DEPARTMENT OF COMMERCE
Patent and Trademark Office

*U.S. Government Printing Office: 1998 - 433-214/70303

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103

CONFIRMATION NO. 5591

FORMALITIES LETTER

OC000000006867633

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

Date Mailed: 10/09/2001

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **355** *to complete the basic filing fee for a small entity.*
- Total additional claim fee(s) for this application is $63.
  - **$63** for **7** total claims over 20.
- The oath or declaration is unsigned.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(l) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.
- **The balance due by applicant is $ 483.**

A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202

PART 3 - OFFICE COPY

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

O I P E
JAN 1 0 2002
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	Not Yet Assigned

BOX MISSING PARTS
Commissioner of Patents
Washington, D. C. 20231

Sir:

RESPONSE TO MISSING PARTS OF APPLICATION

In response to the Notice to File Missing Parts of Application dated February 20, 2001, attached are the following documents:

1. A copy of the Notice to File Missing Parts of Application;
2. Declaration and Power of Attorney;
3. Fourteen (14) Sheets of Formal Drawings;
4. Assignment and Recordation Form Cover Sheet;
5. Check in the amount of $538.00 to cover the missing parts surcharge, patent application filing fee and assignment recordal fee;
6. Certificate of Mailing by First Class Mail; and,
7. Our postcard receipt.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Novakov Davis Deposit Account No. 50-0208.

Respectfully submitted,

NOVAKOV DAVIS & MUNCK, P.C.

Date: Dec 10, 2003

William A. Munck
Registration No. 39,308

Docket Clerk
P.O. Drawer 800889
Dallas, Texas 75380
Phone: (214) 922-9221
Fax: (214) 969-7557
Email: wmunck@novakov.com

OIPE JC154 JAN 10 2002 PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	Not Yet Assigned

BOX MISSING PARTS
Commissioner of Patents
Washington, D. C. 20231

Sir:

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

The undersigned hereby certifies that the following documents:

1. Response to Missing Parts of Application;
2. A copy of the Notice to File Missing Parts of Application;
3. Declaration and Power of Attorney;
4. Assignment and Recordation Form Cover Sheet;
5. Fourteen (14) Sheets of Formal Drawings;
6. Check in the amount of $538.00 to cover the missing parts surcharge, patent application and assignment recordal filing fees;
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8. Our postcard receipt.

relating to the above application, were deposited as "First Class Mail", with the United States Postal Service, addressed to: BOX MISSING PARTS, Commissioner for Patents, Washington, D.C. 20231, on December 10, 2001.

Date: 12/10/01

Mailer

Date: Dec 10, 2001

William A. Munck
Reg. No. 39,308

P.O. Drawer 800889
Dallas, Texas 75380
Phone: (214) 922-9221
Fax: (214) 969-7557
E-mail: wmunck@novakov.com

OIPE JC154
JAN 10 2002
PATENT & TRADEMARK OFFICE

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103

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FORMALITIES LETTER

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900 THREE GALLERIA TOWER
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DALLAS, TX 75240

Date Mailed: 10/09/2001

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

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- The statutory basic filing fee is missing. $ 370
  Applicant must submit $ ~~355~~ to complete the basic filing fee for a small entity.
- Total additional claim fee(s) for this application is $63.
  - **$63** for **7** total claims over 20.
- The oath or declaration is unsigned.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(l) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.
- **The balance due by applicant is $ ~~433~~ $ 498.60**

A copy of this notice MUST be returned with the reply.

RECEIVED
OCT 15 2001
NOVAKOV DAVIS & MUNCK

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 1 - ATTORNEY/APPLICANT COPY

01/16/2002 MBIZUNES 00000015 09948059

02 FC:205 65.00 OP
03 FC:201 370.00 OP
04 FC:203 63.00 OP

DOCKETED
OCT 16 2001

O I P E JC154
JAN 10 2002
PATENT & TRADEMARK OFFICE

DECLARATION AND POWER OF ATTORNEY

As a below named sole inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention, design or discovery entitled:

"WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION"

the specification of which was filed on September 5, 2001 and assigned U.S. Serial No. 09/948,059.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability of this application as defined by Title 37, Code of Federal Regulations, § 1.56.

I hereby claim no foreign priority benefits under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate on which priority is claimed.

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in § 1.56 which became available between the filing date of any prior application(s) and the national or PCT international filing date of this application.

APPLICATION SERIAL NO.	DATE FILED	STATUS
N/A		

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in § 1.56 which became available between the filing date of any prior application(s) and the national or PCT international filing date of this application.

APPLICATION SERIAL NO.	DATE FILED	STATUS
N/A		

I hereby appoint:

William A. Munck, Registration No. 39,308
John T. Mockler, Registration No. 39,775

all of the firm of NOVAKOV DAVIS & MUNCK, P.C. my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith, and to file and prosecute any international patent applications filed thereon before any international authorities under the Patent Cooperation Treaty.

Send correspondence to:	Docket Clerk P.O. Drawer 800889 Dallas, Texas 75380
Direct telephone calls to:	William A. Munck, Esq. (214) 922-9221
Atty. Docket No.:	WEST14-00103

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of sole inventor:	Paul F. Struhsaker
Inventor's signature:	
Date:	9 NOV 2001
Residence (City, County, State):	Plano, Collin County, Texas
Citizenship:	United States of America
Post Office Address:	5304 Brouette Court Plano, Texas 75023

PETITIONER VERIZON
EX. 1012
P. 123

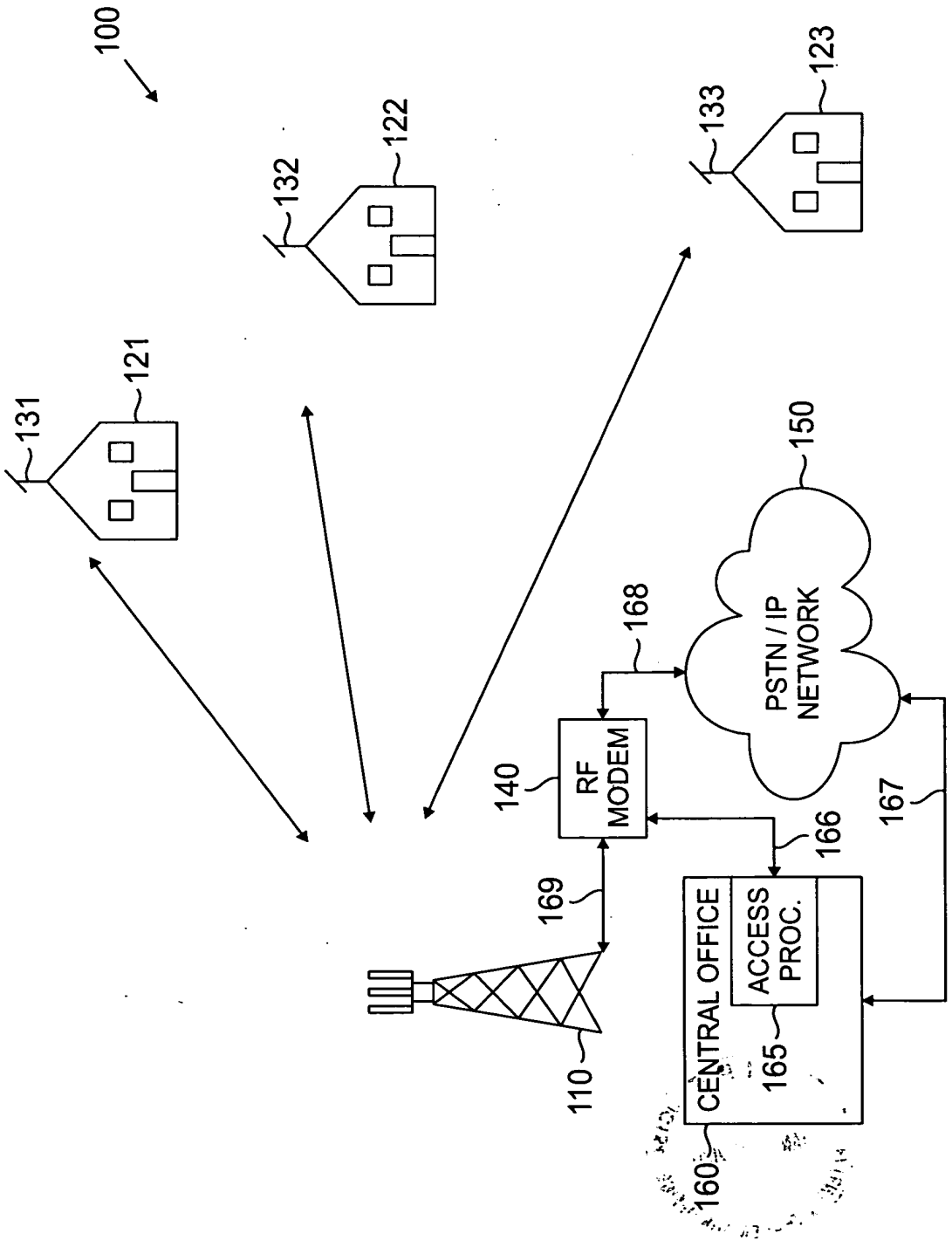

100
131
121
132
122
133
123
150
PSTN / IP NETWORK
168
140
RF MODEM
167
166
169
CENTRAL OFFICE
ACCESS PROC.
165
110
160

FIG. 1

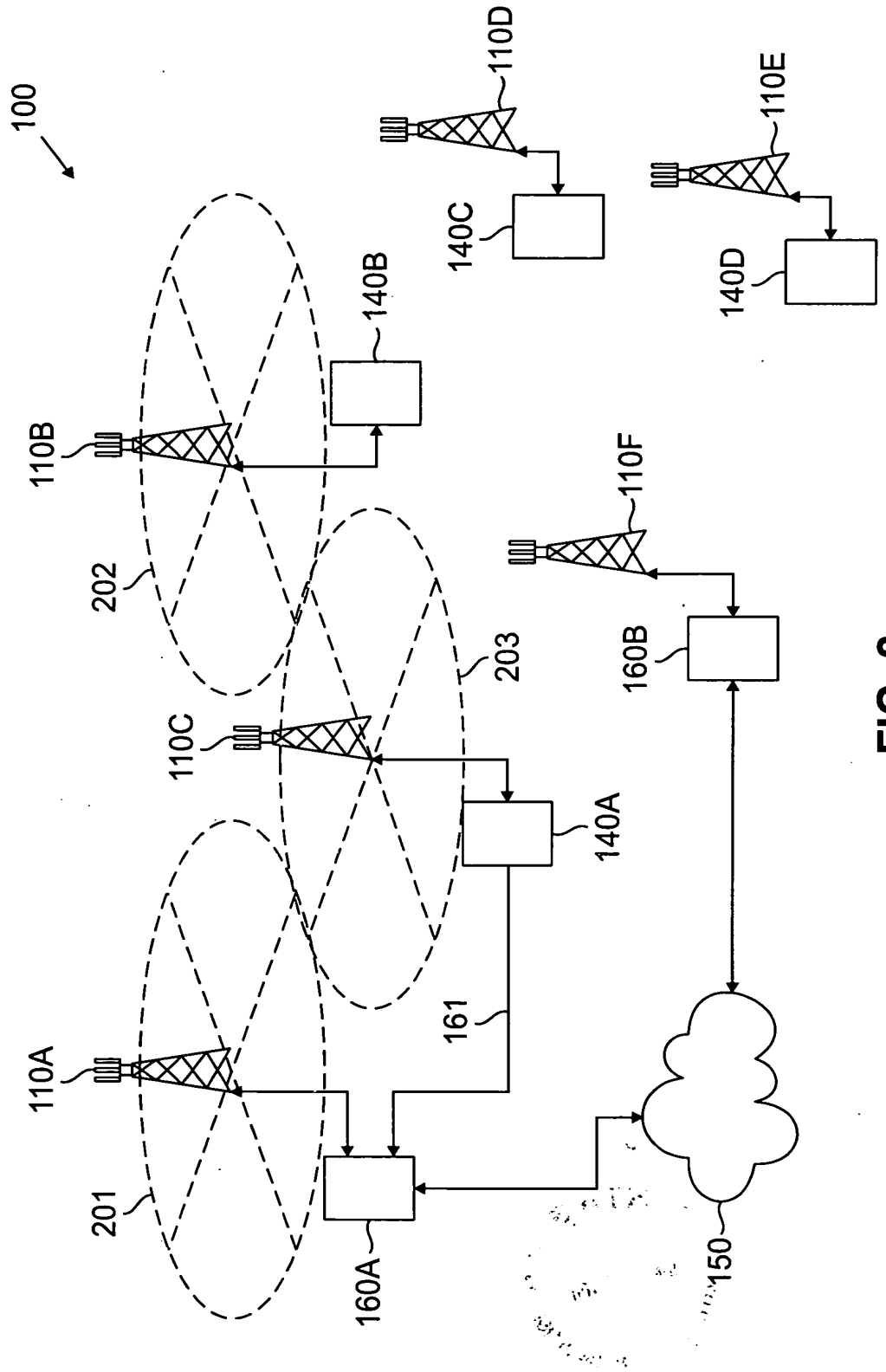

100
110D
110E
140C
140D
140B
110B
110F
202
203
160B
110C
140A
161
110A
201
160A
150

FIG. 2

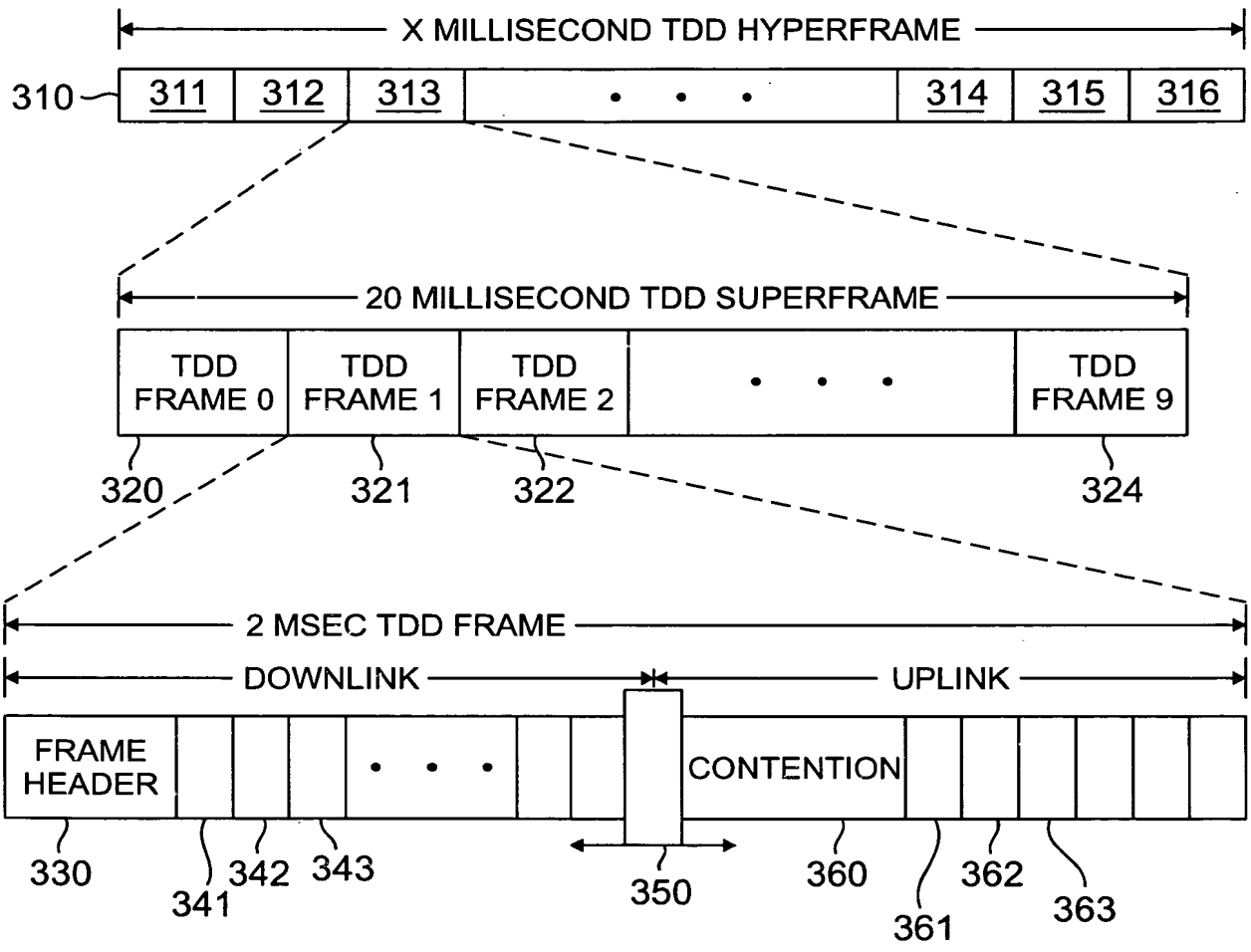


FIG. 3

PETITIONER VERIZON
EX. 1012
P. 126

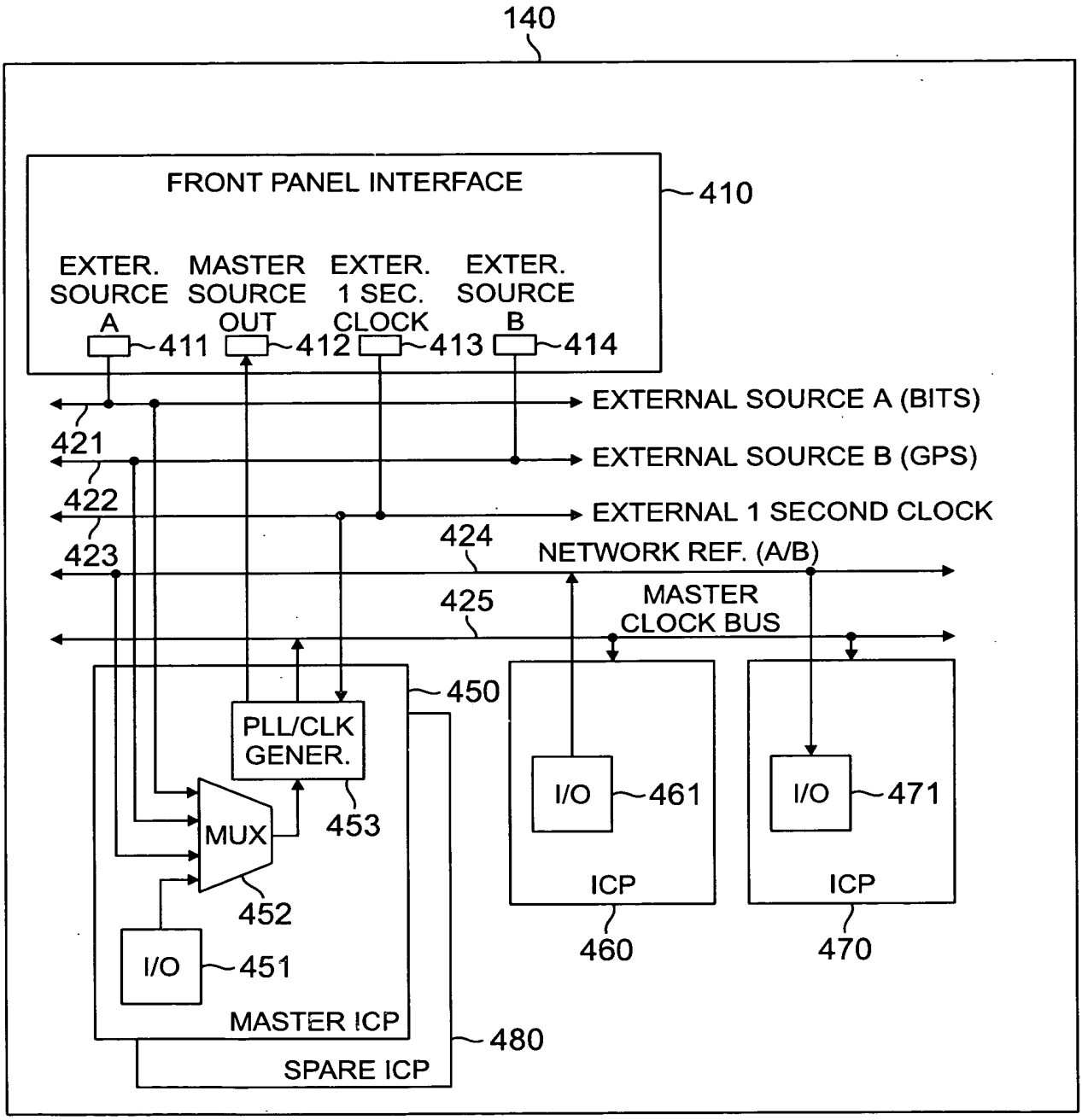


FIG. 4

PETITIONER VERIZON
EX. 1012
P. 127

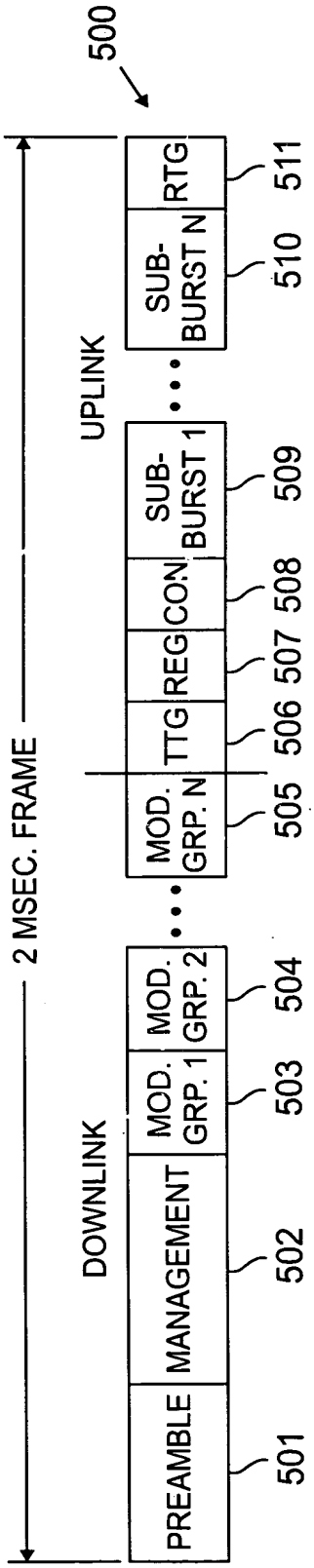


FIG. 5A

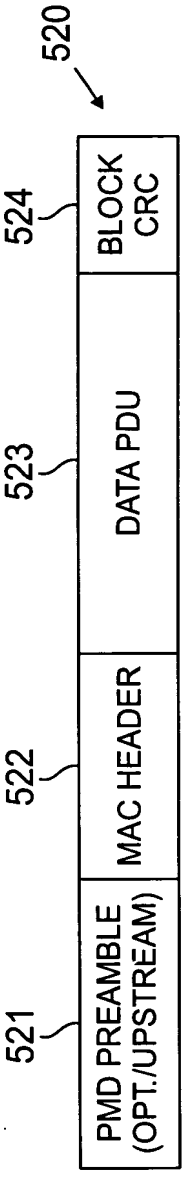


FIG. 5B

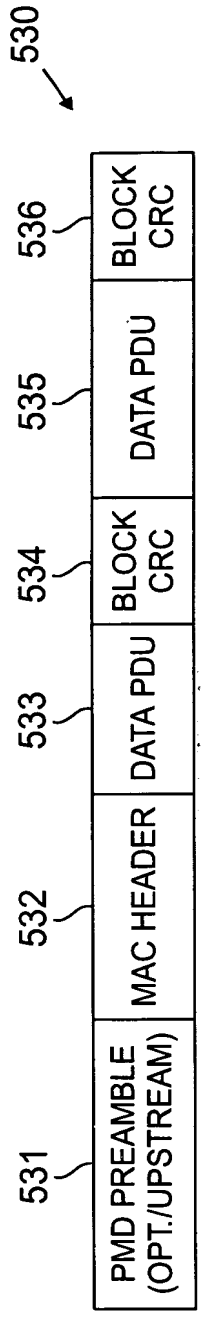


FIG. 5C

PETITIONER VERIZON
EX. 1012
P. 128

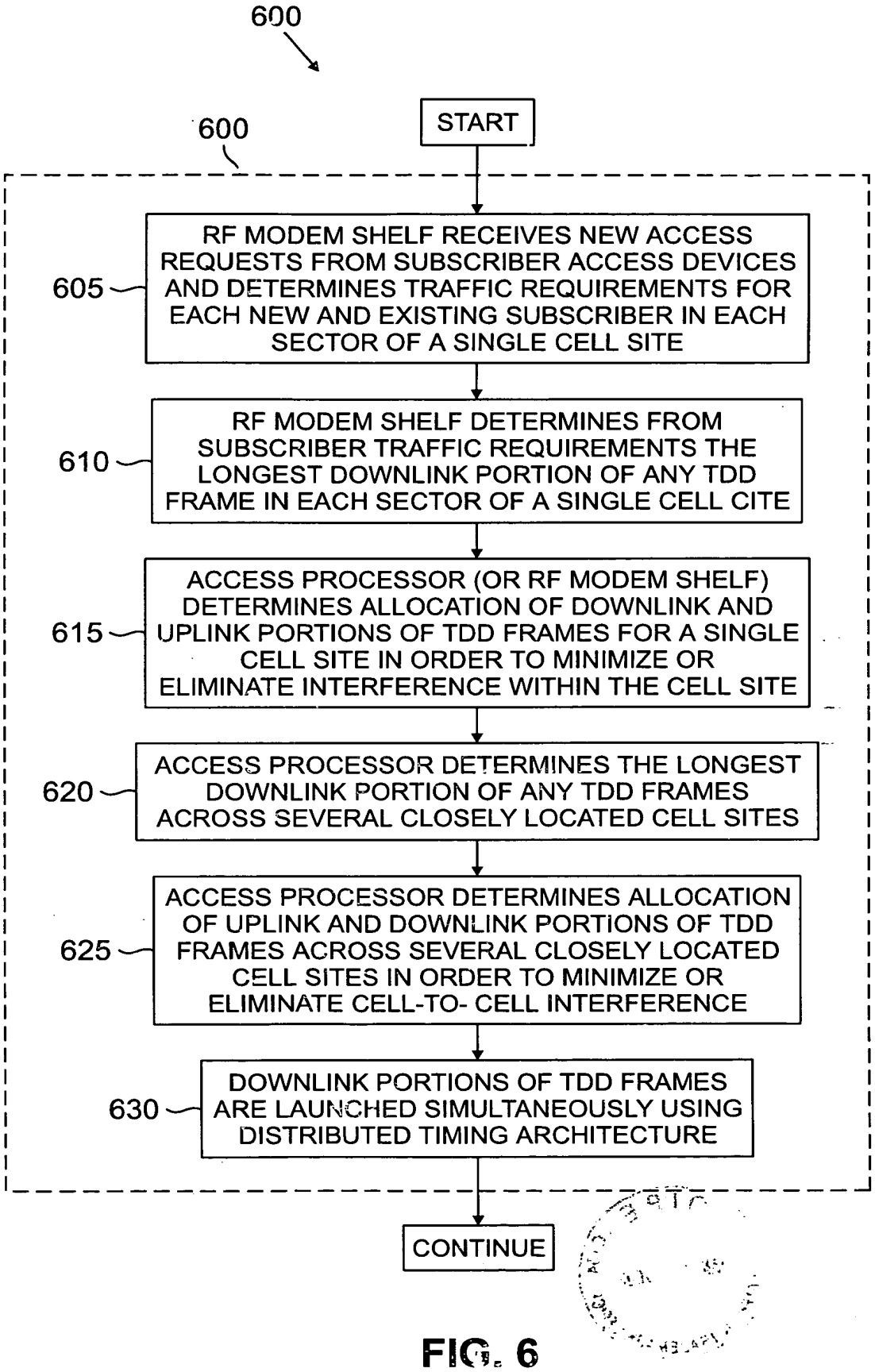


FIG. 6

PETITIONER VERIZON
EX. 1012
P. 129

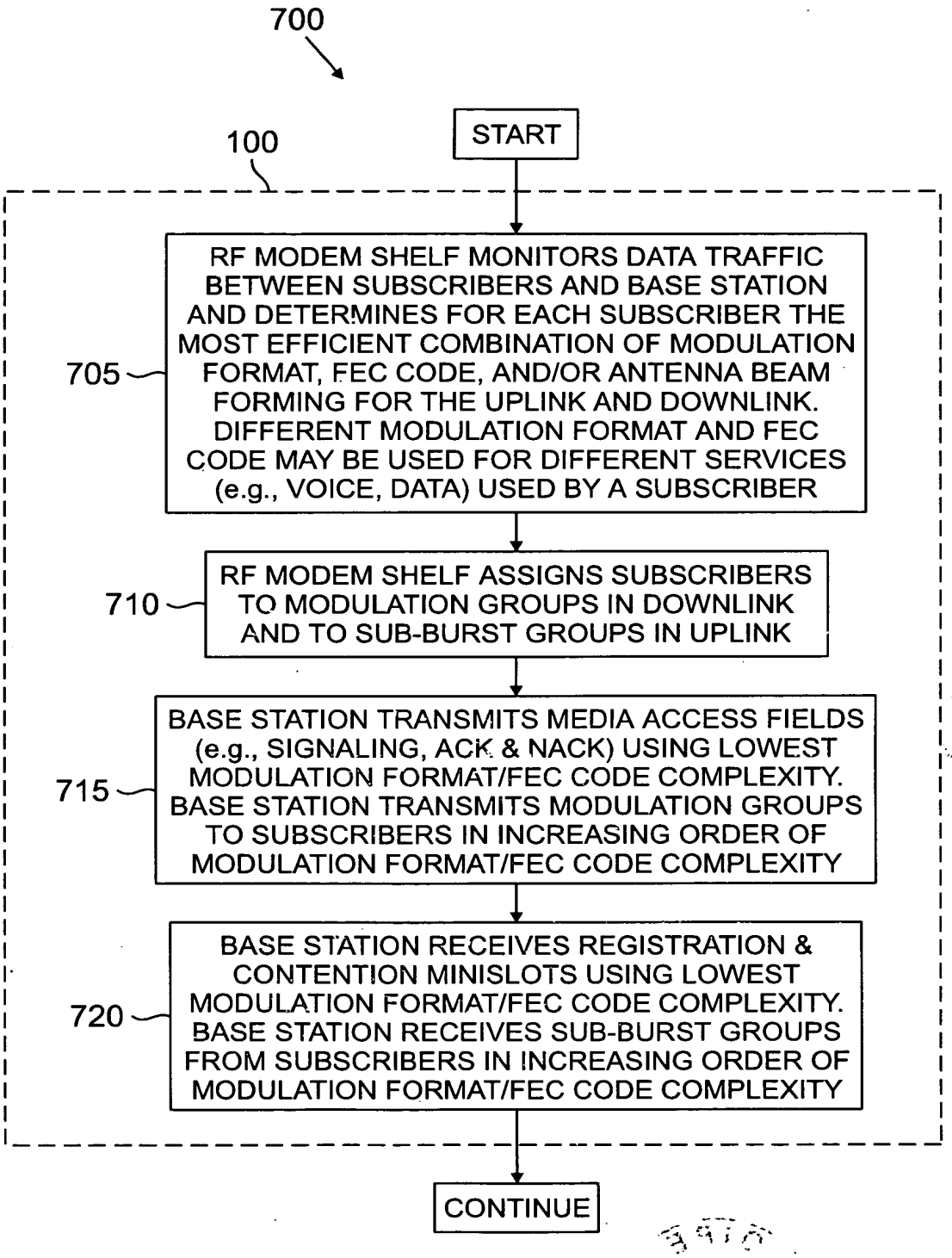


FIG. 7

PETITIONER VERIZON
EX. 1012
P. 130

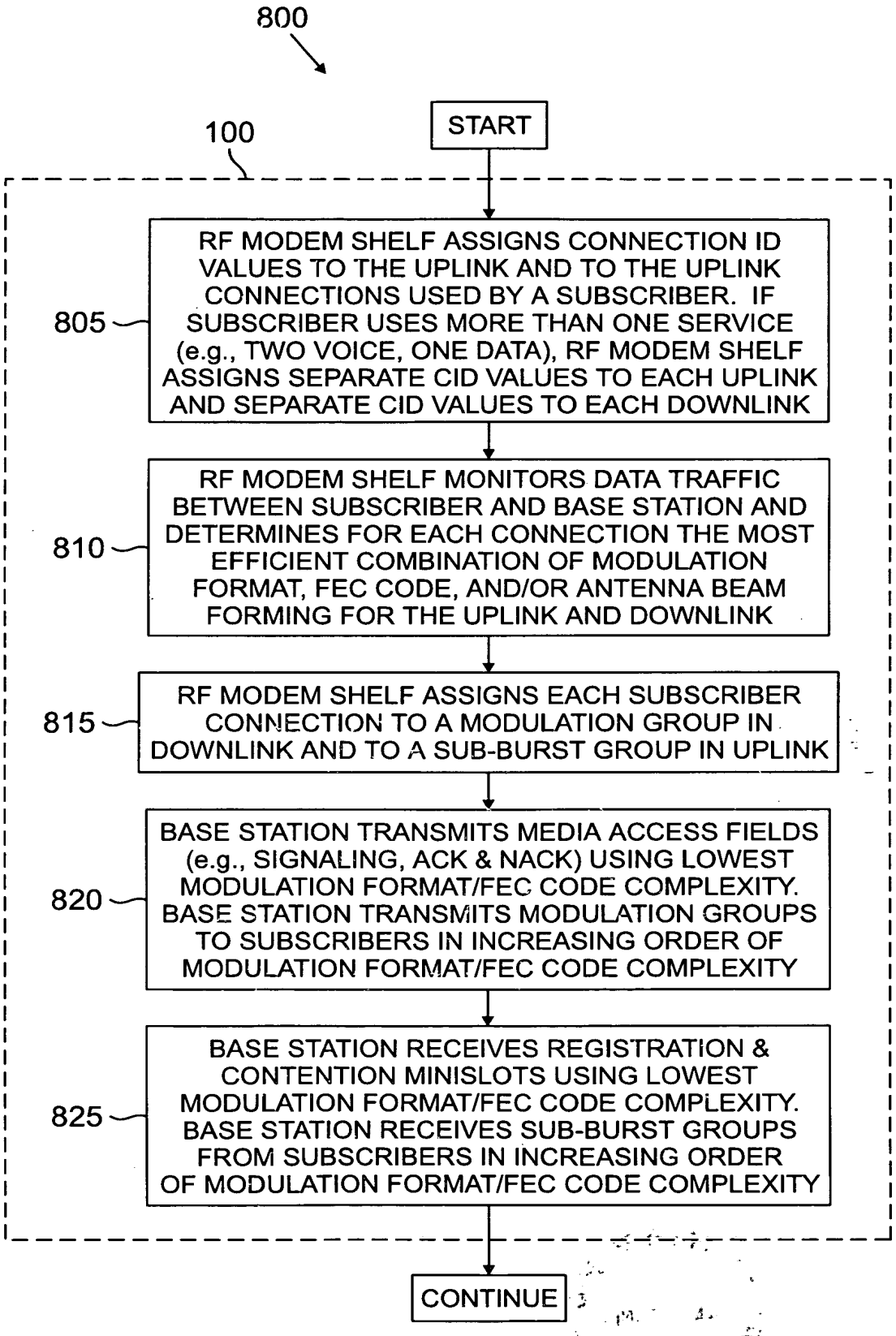


FIG. 8

PETITIONER VERIZON
EX. 1012
P. 131

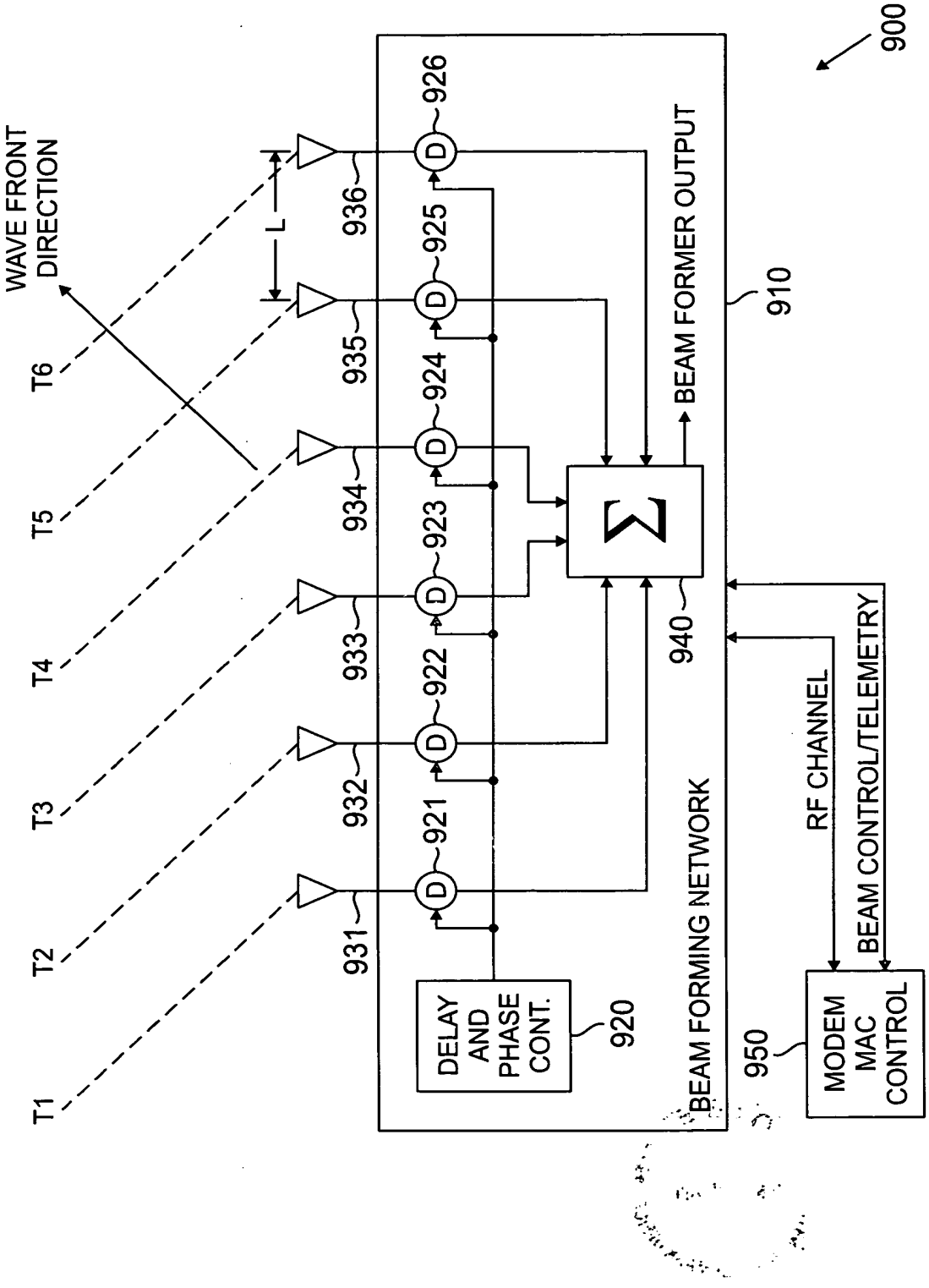

900
910
BEAM FORMER OUTPUT
BEAM FORMING NETWORK
WAVE FRONT DIRECTION
T1
T2
T3
T4
T5
T6
L
931
932
933
934
935
936
921
922
923
924
925
926
D
Σ
940
DELAY AND PHASE CONT.
920
950
MODEM MAC CONTROL
RF CHANNEL
BEAM CONTROL/TELEMETRY

FIG. 9

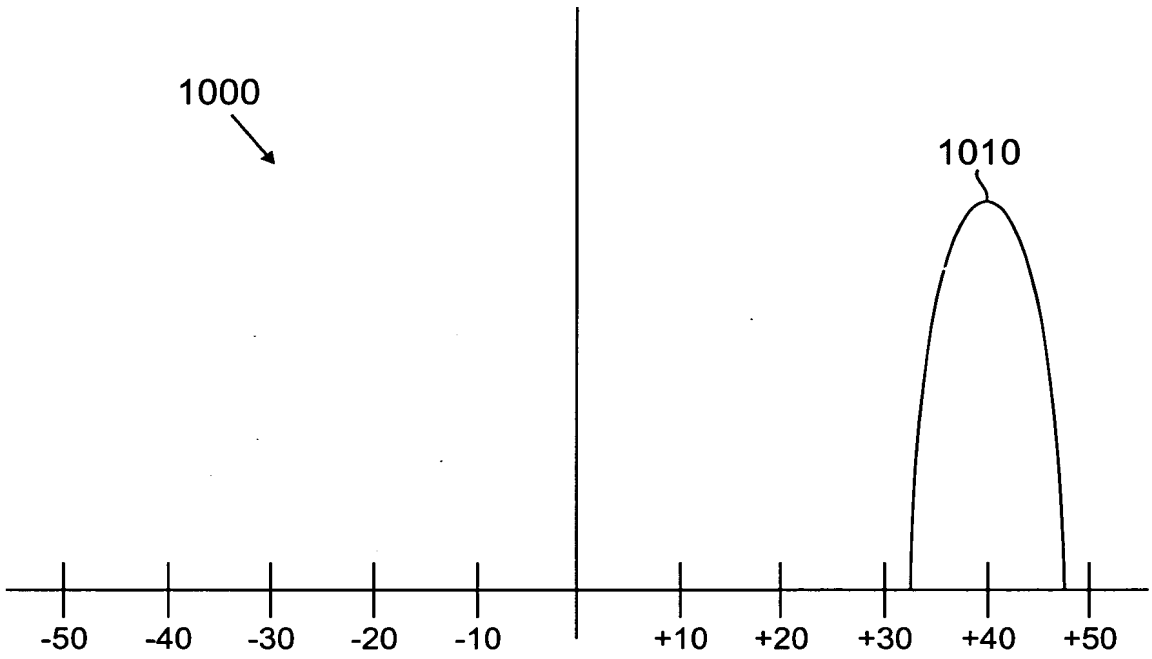


FIG. 10

PETITIONER VERIZON
EX. 1012
P. 133

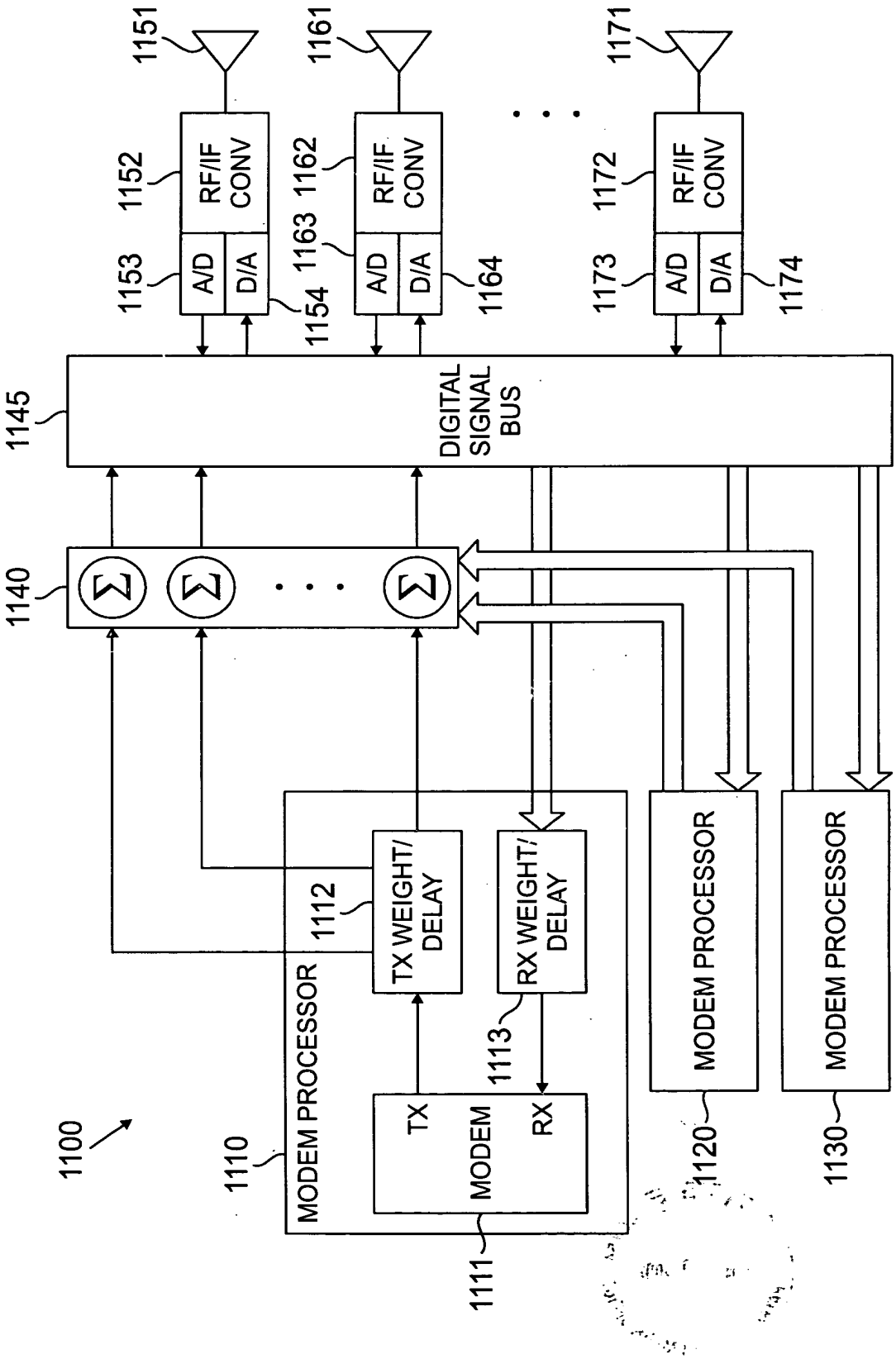

1151
1161
1171
1152
RF/IF CONV
1162
1172
1153
A/D
D/A
1163
1154
1164
1173
1174
1145
DIGITAL SIGNAL BUS
1140
Σ
1112
TX WEIGHT/ DELAY
RX WEIGHT/ DELAY
MODEM PROCESSOR
1113
TX
MODEM
RX
1110
1111
1100
1120
1130

FIG. 11

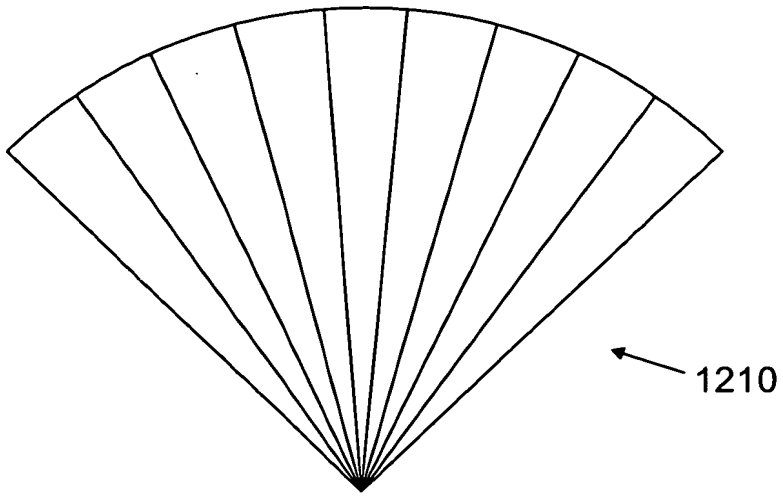


FIG. 12A

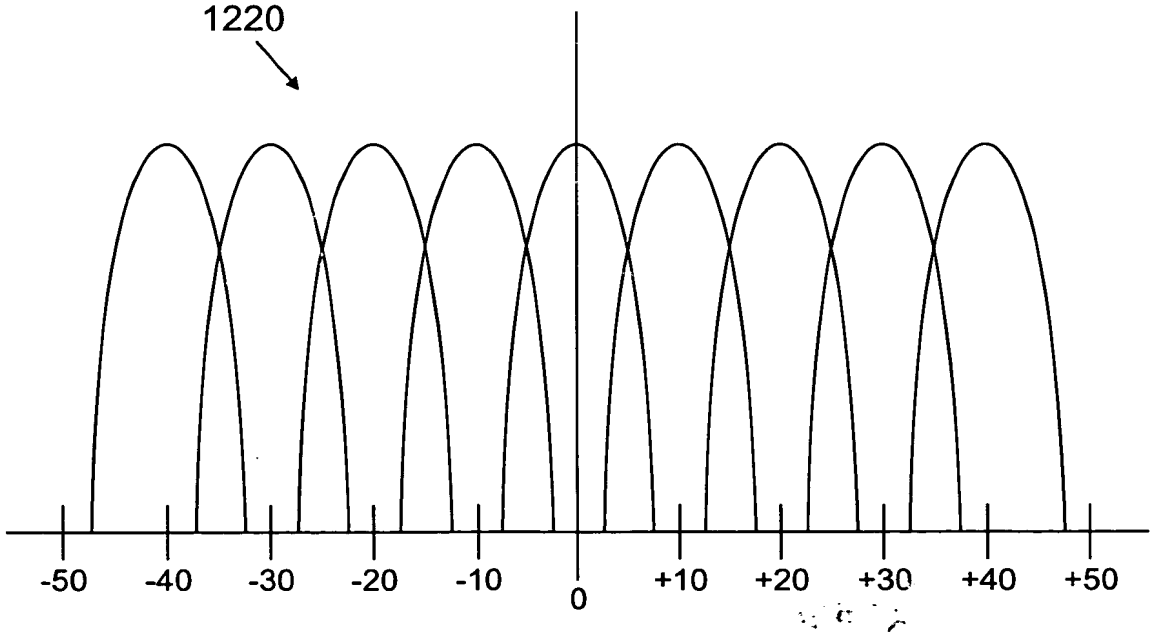


FIG. 12B

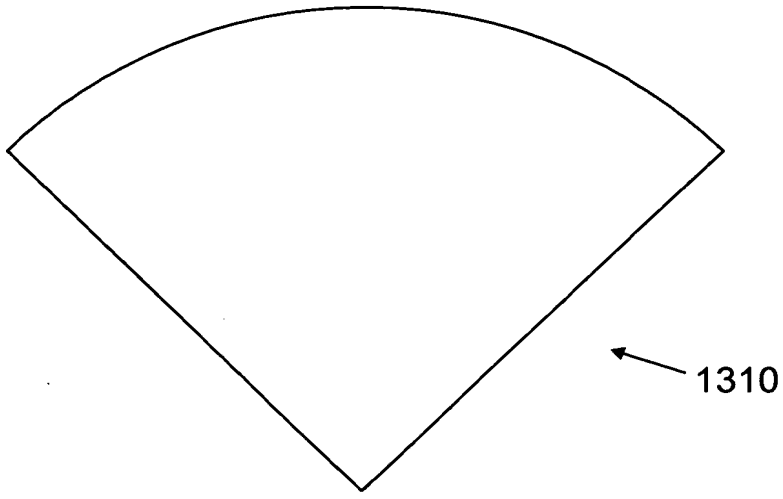


FIG. 13A

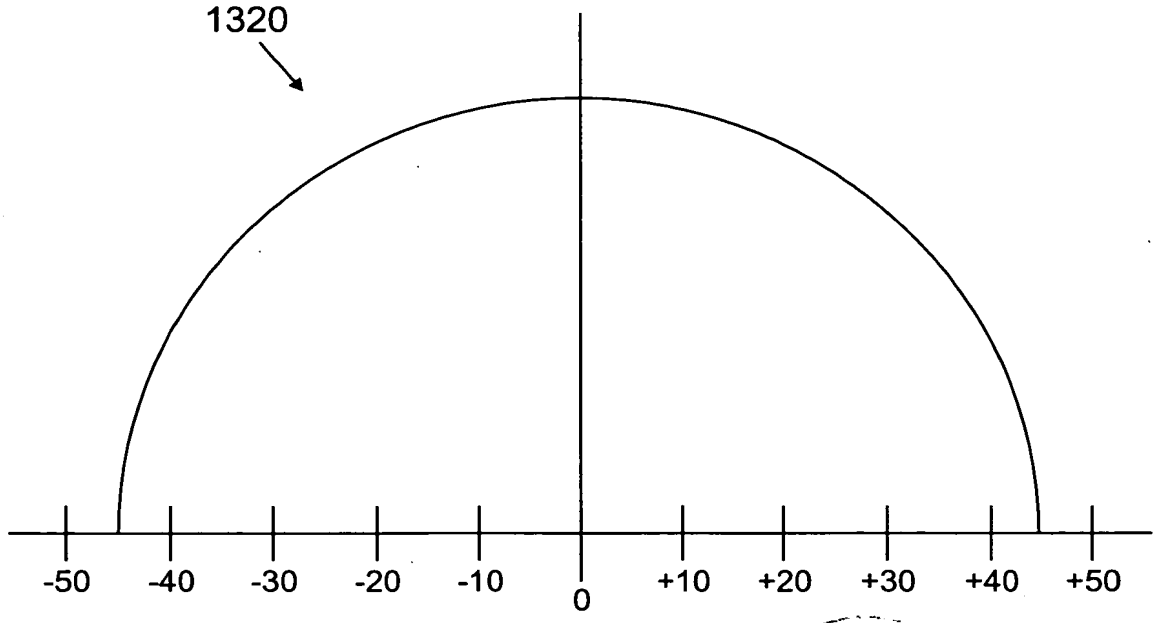


FIG. 13B

PETITIONER VERIZON
EX. 1012
P. 136

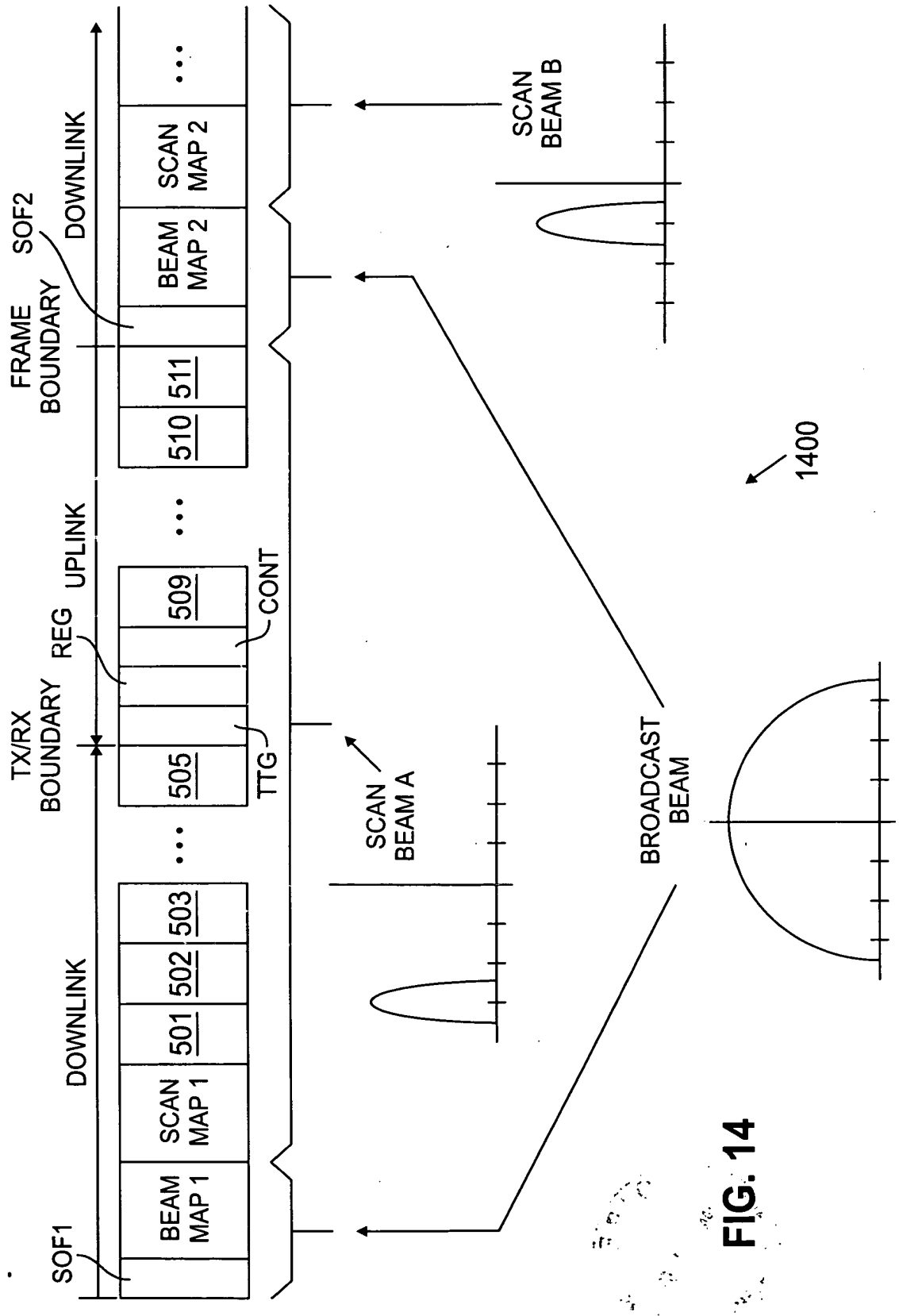

SOF1
DOWNLINK
BEAM MAP 1
SCAN MAP 1
501
502
503
TX/RX BOUNDARY
REG
UPLINK
505
509
CONT
TTG
FRAME BOUNDARY
SOF2
DOWNLINK
BEAM MAP 2
SCAN MAP 2
510
511
SCAN BEAM A
SCAN BEAM B
BROADCAST BEAM
1400

FIG. 14

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

O I P E
JAN 1 0 2002
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	Not Yet Assigned

BOX MISSING PARTS
Commissioner of Patents
Washington, D. C. 20231

Sir:

RESPONSE TO MISSING PARTS OF APPLICATION

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5. Check in the amount of $538.00 to cover the missing parts surcharge, patent application filing fee and assignment recordal fee;
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7. Our postcard receipt.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Novakov Davis Deposit Account No. 50-0208.

Respectfully submitted,

NOVAKOV DAVIS & MUNCK, P.C.

Date: Dec 10, 2003

William A. Munck
Registration No. 39,308

Docket Clerk
P.O. Drawer 800889
Dallas, Texas 75380
Phone: (214) 922-9221
Fax: (214) 969-7557
Email: wmunck@novakov.com

OIPE JC154 JAN 10 2002 PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	Not Yet Assigned

BOX MISSING PARTS
Commissioner of Patents
Washington, D. C. 20231

Sir:

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

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relating to the above application, were deposited as "First Class Mail", with the United States Postal Service, addressed to: BOX MISSING PARTS, Commissioner for Patents, Washington, D.C. 20231, on December 10, 2001.

Date: 12/10/01

Mailer

Date: Dec 10, 2001

William A. Munck
Reg. No. 39,308

P.O. Drawer 800889
Dallas, Texas 75380
Phone: (214) 922-9221
Fax: (214) 969-7557
E-mail: wmunck@novakov.com

OIPE JC154 JAN 10 2002

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103

CONFIRMATION NO. 5591

FORMALITIES LETTER

OC000000006867633

NOVAKOV DAVIS & MUNCK
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An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing. $ 370
  Applicant must submit $ ~~355~~ to complete the basic filing fee for a small entity.
- Total additional claim fee(s) for this application is $63.
  - **$63** for **7** total claims over 20.
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- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(l) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.
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2681 #4
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DOCKET NO.: WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER, ET AL.
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	(Not yet assigned)

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relating to the above application, were deposited as "First Class Mail" with the United States Postal Service, addressed to Commissioner for Patents, Washington, D.C. 20231, on February 3, 2003.

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DOCKET NO.: WEST14-00103 **PATENT**
Customer No. 23990

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Group No.	:	2681
Examiner	:	(Not yet assigned)

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INFORMATION DISCLOSURE STATEMENT

Pursuant to the duty of disclosure under 37 C.F.R. § 1.56, Applicant submits this statement. This submittal is made in accordance with 37 C.F.R. §§ 1.97 and 1.98 and § 609 of the Manual of Patent Examining Procedure. The patents, publications and other information herein are listed below and on the attached Form PTO-SB-08. These references were located in a International Search Report issued in the related PCT Patent Application No. PCT/IB02/03571, a copy of which is attached hereto. Copies of the listed references are submitted herewith.

U.S. Patents

Patent No.	Inventor	Date
6,181,955	Dartois	Jan. 30, 2001

PETITIONER VERIZON
EX. 1012
P. 143

Foreign Patents

Patent No.	Country	Date
WO 96/37970	PCT	Nov. 28, 1996

Publications

BENYAMIN-SEEYAR, Anader, et al; "DRAFT DOCUMENT FOR SC-FDE PHY LAYER SYSTEM FOR SUB 11 GHz BWA"; XP-002224912; IEEE 802.16.3c01-58r2; IEEE 802.16 Broadband Wireless Access Working Group, 'Online!; May 17, 2001; pages 0-87;

LEIBA, Yigal, et al.; "MAC AND PHY SUPPORT FOR AAS"; XP-002224913; IEEE C802.16a-02/49; IEEE 802.16 Broadband Wireless Access Working Group, 'Oneline!; May 10, 2002, pages 1-10

Applicant hereby expressly reserves the right to swear behind the effective dates of any of the above Patents and to question the relevance and materiality of the Patents and Publications listed herein, in whole, in part, or in combination, subsequent to filing this Information Disclosure Statement.

Respectfully submitted,

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Date: Jan. 31, 2003

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Sheet 1 of 2

Complete if Known	
Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Art Unit	2681
Examiner Name	Not yet assigned
Attorney Docket Number	WEST14-00103

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number: Number - Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	AA	US- 6,181,955	01/30/2001	Dartois	
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	AB	WO 96/37970	11/28/1996	Nokia Telecommunications OY		

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Application Number	09/948,059
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First Named Inventor	Paul F. Struhsaker
Group Art Unit	2681
Examiner Name	Not yet assigned
Attorney Docket Number	WEST14-00103

OTHER PRIOR ART -- NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	AC	BENYAMIN-SEEYAR, Anader, et al; "DRAFT DOCUMENT FOR SC-FDE PHY LAYER SYSTEM FOR SUB 11 GHz BWA"; XP-002224912; IEEE 802.16.3c01-58r2; IEEE 802.16 Broadband Wireless Access Working Group, 'Online!; May 17, 2001; pages 0-87;	
	AD	LEIBA, Yigal, et al.; "MAC AND PHY SUPPORT FOR AAS"; XP-002224913; IEEE C802.16a-02/49; IEEE 802.16 Broadband Wireless Access Working Group, 'Oneline!; May 10, 2002, pages 1-10	

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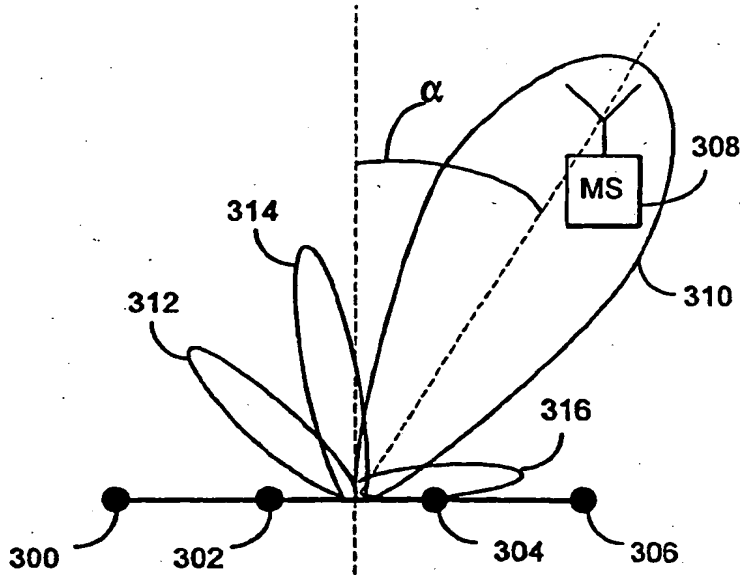
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(54) Title: METHOD FOR TRANSMITTING PILOT CHANNELS, AND A CELLULAR RADIO SYSTEM

(57) Abstract

The invention relates to a cellular radio system and a method for transmitting pilot channels in a cellular radio network, which comprises in each cell at least one base station (550) communicating with mobile stations (552, 554) located within its area, which base stations transmit a data signal in the downlink direction by using transmission directions changing in time and which transmit information about the system to the mobile stations on control channels. In order to enable as efficient use of the pilot channels as possible, the base stations transmit at least one first pilot channel with a predetermined radiation pattern (560), which determines the cell coverage area, and second pilot channels on transmission directions (556, 558) changing in time.



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Method for transmitting pilot channels, and a cellular radio system

The invention relates to a method for transmitting pilot channels in a cellular radio network, which comprises in each cell at least one base station communicating with mobile stations located within its area, which base stations transmit a data signal in the downlink direction by using transmission directions changing in time and which transmit information about the system to the mobile stations on control channels.

In order to operate, mobile stations in a cellular radio network require a great deal of information about the base station in the area of which they are located. In order to be able to communicate with the base station, the mobile stations should first of all be informed of the existence of the base station and be synchronized with the transmission of the base station. They also need information for example about the network which the base station belongs to and about the traffic channels used. In the present cellular systems, the base stations regularly transmit information of the kind described above in each cell on channels allocated for the purpose.

The present invention is applicable for use especially in a cellular system utilizing code division multiple access. Code division multiple access (CDMA) is a multiple access method, which is based on the spread spectrum technique and which has been applied recently in cellular radio systems, in addition to the prior FDMA and TDMA methods. CDMA has several advantages over the prior methods, for example spectral efficiency and the simplicity of frequency planning. An example of a known CDMA system is disclosed in the EIA/TIA Interim Standard: Mobile Station-Base Station Compatibility

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Standard for Dual-Mode Wideband Spread Spectrum Cellular System, TIA/EIA/IS-95, July 1993, EIA/TIA IS-95, which is incorporated herein by reference.

In the CDMA method, the narrow-band data signal of the user is multiplied to a relatively wide band by a spreading code having a considerably broader band than the data signal. In known test systems, bandwidths such as 1.25 MHz, 10 MHz and 25 MHz have been used. In connection with multiplying, the data signal spreads to the entire band to be used. All users transmit by using the same frequency band simultaneously. A separate spreading code is used over each connection between a base station and a mobile station, and the signals of the different users can be distinguished from one another in the receivers on the basis of the spreading code of each user.

Matched filters provided in the receivers are synchronized with a desired signal, which they recognize on the basis of a spreading code. The data signal is restored in the receiver to the original band by multiplying it again by the same spreading code that was used during the transmission. Signals multiplied by some other spreading code do not correlate in an ideal case and are not restored to the narrow band. They appear thus as noise with respect to the desired signal. The spreading codes of the system are preferably selected in such a way that they are mutually orthogonal, i.e. they do not correlate with each other.

In a CDMA cellular radio system, it is possible to use a so-called pilot channel in the transmission direction of base station to subscriber equipments, i.e. in the downlink direction. A pilot channel is a data-unmodulated signal which is transmitted with a specific spreading code and utilizing the same frequency band on which the actual traffic channels are situated, the

pilot signal being distinguishable from them only on the basis of the spreading code. The pilot signal is a channel known and listened to by all subscriber equipments within the cell area, and it is used for example in power measurements and in the generation of a coherent phase reference. Each base station of the system transmits its own pilot signal on the basis of which the subscriber equipments can distinguish the transmissions of different base stations from each other.

US patent 5109390, which is incorporated herein by reference, and the aforementioned IS-95 standard disclose a prior art CDMA cellular system utilizing a separate pilot channel that is transmitted to the same coverage area with the data signals.

In a typical mobile phone environment, the signals between a base station and a mobile station propagate along several paths between the transmitter and the receiver. This multipath propagation is mainly due to the reflections of the signal from the surrounding surfaces. Signals which have propagated along different paths arrive at the receiver at different times due to their different transmission delays. CDMA differs from the conventional FDMA and TDMA in that the multipath propagation can be exploited in the reception of the signal. The receiver generally utilized in a CDMA system is a multibranch receiver structure where each branch is synchronized with a signal component which has propagated along an individual path. Each branch is an independent receiver element, the function of which is to compose and demodulate one received signal component. In a conventional CDMA receiver, the signals of the different receiver elements are combined advantageously, either

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coherently or incoherently, whereby a signal of good quality is achieved.

CDMA systems can also apply a soft handover wherein a mobile station may simultaneously communicate with several base stations by utilizing macrodiversity. The connection quality of the mobile station thus remains high during the handover and the user does not notice a break in the connection.

Interference caused by other connections in the desired connection thus appears in the receiver as noise that is evenly distributed. This is also true when a signal is examined in an angular domain according to the incoming directions of the signals detected in the receivers. The interference caused by the other connections in the desired connection thus also appears in the receiver as distributed in the angular domain, i.e. the interference is rather evenly distributed into the different incoming directions.

The capacity of the CDMA, which can be measured by means of spectral efficiency, has been further improved with sectorization. A cell is then divided into sectors of a desired size that are serviced by directional antennas. The mutual noise level caused by the mobile stations can thus be reduced significantly in the base station receiver. This is based on the fact that on average the interference is evenly distributed between the different incoming directions, the number of which can thus be reduced by means of sectorization. The sectorization can naturally be implemented in both transmission directions. The advantage provided in the capacity by the sectorization is proportional to the number of the sectors.

A sectorized cell may also utilize a softer handover wherein a mobile station performs a handover from one sector to another by communicating

simultaneously with both sectors. Even though soft handover improves the connection quality and sectorization increases the system capacity, the movement of the mobile stations naturally leads to the stations performing several handovers from one sector to another. This loads the processing capacity of the base station controller. Several soft handovers also produce a situation where several mobile stations communicate simultaneously with more than one (usually two) sector, whereby the increased capacity provided by the sectorization is lost as a signal of a mobile station is audible in a wide sector.

The multiple access interference of the CDMA systems has also been reduced by means of different known multiple access interference cancellation (IC) methods and multi-user detection (MUD). These methods are best suited for reducing the interference produced within the user's own cell, and the system capacity can thus be increased to about a double compared to a system implemented without interference cancellation. However, these methods do not significantly improve the size of the coverage area of the base station compared to known technology. Also, the IC/MUD techniques are complicated to realize, wherefore they have mainly been developed in the uplink direction.

Another method that has been developed is an SDMA (Space Division Multiple Access) method wherein the users are distinguished from one another on the basis of their location. This is performed in such a way that the beams of the receiver antennas at the base station are adjusted to the desired directions according to the location of the mobile stations. For this purpose, the system uses adaptive antenna groups, i.e. phased antennas, and the processing of the received signal, by means of which the mobile stations are tracked.

The use of the SDMA in connection with the CDMA provides several advantages over the prior methods, such as sectorization. If the sector beams in the sectorization are narrowed in order to increase the spectral efficiency, the number of the handovers to be performed from one sector to another also increases. This in turn increases too much the calculation capacity required in the base station controller.

In connection with the application of the SDMA, the background art is illustrated in A.F. Naguib, A. Paulraj: *Performance of CDMA Cellular Networks With Base-Station Antenna Arrays* (Proc. International Zürich Seminar on Digital Communications, pp. 87 - 100, Zürich, Switzerland, March 1994), which is incorporated herein by reference. In the SDMA a signal is thus received by means of an antenna group, and the received signal is shaped by means of digital signal processing in such a way that the directivity patterns of the antennas are suitable for the stages following the shaping in the receiver. In prior art arrangements, the received signal is shaped in order to maximize the signal-to-interference ratio of the desired signal. The received signal is thus shaped in such a way that the directivity pattern of the antenna group minimizes the interference caused by the other connections in the desired signal. In the arrangement according to the aforementioned reference, each detected signal component is subjected to individual beam shaping, i.e. the impulse response must be known before the shaping.

Experimental Studies of Space-Division-Multiple-Access Schemes for Spectral Efficient Wireless Communications by G.Xu, H.Liu, W.J.Vogel, H.P.Lin, S.S.Jeng and G.W.Torrence (IEEE Int. Conf. On Comm. ICC 1994, New Orleans, USA, IEEE 1994), which is incorporated wherein by reference, discloses a method

which applies the SDMA and in which the directivity pattern of the receiver antennas is shaped. However, the method disclosed is suitable for use only in systems where both transmission directions are on the same frequency.

When data signals, i.e. traffic channels, are transmitted to mobile stations according to the SDMA principle by using changing beams, the use of the pilot signal will be problematic in the prior art arrangements. In known methods, the pilot signal has thus been transmitted together with the traffic channels so that the pilot could be used in the mobile stations as a phase reference in order to enable coherent reception. The pilot signal has also been used in the identification of base stations and as an indicator of a need for handover. In the case of changing antenna beams, the pilot signal cannot be used for the latter purpose.

The purpose of the present invention is to realize a method for transmitting pilot channels in connection with adaptive antenna beams in such a way that the use of the pilot channels is as effective as possible. The purpose of the arrangement according to the invention is to enable the use of pilot channels both as a phase reference and to facilitate a handover.

This is achieved with a method of the type described in the preamble, characterized in that the base stations transmit at least one first pilot channel with a predetermined radiation pattern, which determines the cell coverage area, and the second pilot channels in transmission directions changing in time.

The invention also relates to a cellular radio system comprising in each cell at least one base station communicating with mobile stations located within its area, which base stations transmit information about the

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system to the mobile stations by using control channels, and which system comprises at least one base station, which transmits a data signal to the mobile stations by using radiation patterns that change in time. The cellular radio system according to the invention is characterized in that the system comprises at least one base station, which transmits at least one first pilot channel with a predetermined radiation pattern, which determines the cell coverage area, and second pilot channels in transmission directions that change in time.

In the method according to the invention, which utilizes adaptive antenna beams and thus provides considerably better spectral efficiency than the conventional cellular systems, including systems applying the CDMA method, it is thus possible to use for example the pilot signal both as a phase reference and as a base station detector. This is based on the fact that both traffic channels and second pilot signals are transmitted by using a common radiation pattern, whereupon these pilot signals and traffic channels are subjected to the same propagation conditions. Therefore, a pilot signal provides a phase reference for the detection of the desired signal. Correspondingly, a pilot transmitted by using a predetermined unchanging radiation pattern, which may be for example an omnidirectional pattern, can be used to detect the need for a handover from one base station to another.

Further, the search according to the invention for advantageous signal components in the angle-of-arrival-time domain is technically advantageous to implement.

According to the first preferred embodiment of the invention, the signal processing can be performed digitally on the base band, whereupon the antenna beams can be oriented directly to the desired directions by

means of the phasing of the received signal. In the second preferred embodiment of the invention, the signal phasing is performed analogically, thus resulting in a number of fixed antenna beams from which the beams receiving the best components of the desired signal are selected for the reception.

In the following, the invention will be described in greater detail with reference to the examples according to the accompanying drawings, in which

Figure 1 illustrates the multipath propagation of a signal between a mobile station and a base station,

Figure 2a illustrates, on a time domain, the scattering caused by the multipath propagation of a signal,

Figure 2b illustrates, on the angle-of-arrival domain, the scattering caused by the multipath propagation of a signal,

Figure 3 illustrates a possibility of orienting the beam of the base station antennas towards the mobile station,

Figure 4 shows a possible implementation of an adaptive antenna group,

Figure 5 illustrates the method according to the invention for transmitting several pilot channels,

Figure 6 is a block diagram illustrating a possible structure of a receiver according to the invention,

Figure 7 is a block diagram illustrating an example of the structure of an individual channel element,

Figure 8 is a block diagram illustrating another possible example of a receiver according to the invention,

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Figure 9 illustrates another example of the structure of an individual channel element, and

Figure 10 illustrates more closely an example of the structure of an individual channel element.

In the following, the method and receiver according to the invention will be described in greater detail using the CDMA system as an example, but not restricting the description thereto, however, since the invention is also applicable in connection with other multiple access methods, as will be evident for a person skilled in the art on the basis of the description below.

Figure 1 illustrates the typical multipath propagation of a transmitted signal in a cellular system. The figure shows a base station 100 and a mobile subscriber equipment 102 communicating with the base station. A characteristic feature of cellular radio systems is that the mobile stations are surrounded by surfaces that reflect and scatter radiowaves. Such surfaces may be for example buildings and walls formed by the nature, such as mountains and hills. Mobile stations typically transmit with an omnidirectional antenna pattern. The figure illustrates a few rays 112, 114, 116 originating from a mobile station. The surfaces 104, 108 situated close to the mobile station 102 reflect the transmitted signal, which therefore arrives at the antenna of the base station 100 along several different paths, but the delay between the different signal components is rather small, however. The reflecting surfaces situated further from the mobile station, such as larger buildings and mountains, denoted in this figure by numeral 106, produce signal components 114 which arrive at the base station 100 several, even dozens of microseconds later. There may also be obstacles 110 in the terrain that prevent a direct

connection between the mobile station and the base station.

Figure 2a illustrates, on the time domain, an example of a momentary delay of signal components caused by the multipath propagation of the signal at a base station receiver. The horizontal axis 200 of the schematic figure shows the time and the vertical axis 202 shows the power of the received signal. In the example of Figure 2a, the base station receiver has detected three groups of signal components 204, 206, 208 which have arrived at the receiver at different times and among which the component 208 is significantly more delayed than the others.

As the example of Figure 1 shows, the different signal components arrive not only at different times but also from different directions. It can thus be said that the signal scatters not only in the time domain, but also in the angular domain, which can be described by the angle of arrival (AoA) of the signal. Figure 2b illustrates an example of a momentary scattering as a function of the angle of arrival, caused by the multipath propagation of the signal, at the base station receiver. The vertical axis 202 of Figure 2b shows the power of the received signal component, and the horizontal axis 210 shows the angle of arrival. In the example of Figure 2b, the signal components 212, 214 arrive from two directions.

In large cells, so-called macrocells, wherein the base station antennas are situated high, the signal components generally arrive at the antenna with only a few different angles of arrival, which are usually at the vicinity of the direct ray between the mobile station and the base station. In small microcells where the base station antennas are usually situated below the roofs of buildings, the angles of arrival of the signal

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components are found to show far greater dispersion, since in the same way as the mobile stations, the base stations are often surrounded by several reflecting surfaces situated near by.

The multipath propagation has been described above in the uplink transmission direction. It is naturally clear that a corresponding phenomenon also occurs in the opposite downlink direction. It can also be stated that the multipath routes are mainly symmetrical in both directions, since the scattering and reflection are not greatly dependent on the frequency. However, it should be noted that fast signal fadings are mutually independent in different transmission directions. Therefore, if the base station detects a signal component that has arrived from the mobile station at the angle of arrival of α_0, transmitting a signal with the same angle α_0 guides the signal in the direction of the mobile station, except for fast fadings.

On the basis of the above, it can be stated that the multipath propagating environment typical of cellular systems leads in the base stations to the reception of a signal which is distributed in time into several components that are delayed differently and in the angular domain into components arriving from several different directions. Both distribution profiles vary in time since the subscriber equipments move, but the variation is rather slow, i.e. in the range of a few seconds, and the profiles can be synchronized with and they can be monitored.

The received signal components are thus characterized by the multidimensionality of the type described above that is illustrated above with the time-angular domain, i.e. (α, τ) domain, and that can be utilized in the base station according to the invention

for improving the detection of the signal to be received. In the method according to the invention, the best signal components of the received signal are searched for in the multidimensional signal domain, the receiver being controlled by means of the components in such a way that the detected components can be preferably combined and detected. The most simple standard for the signal quality can be the received power level, but also other standards can be used, for example the signal-to-noise ratio.

The receiver according to the invention utilizes an adaptive antenna group, which is an antenna group consisting of several different elements. Figure 4 illustrates a possible implementation of an adaptive antenna group, which can be applied in connection with the first preferred embodiment of the invention. The antenna group comprises L antenna elements 400, 402, 404, which may be for example omnidirectional antennas. Each antenna element is connected to radio-frequency parts 406, 408, 410, which convert the received signal into an intermediate frequency and sample the signal into (I,Q) components according to known technology. The obtained complex samples are then multiplied by the corresponding complex weighting coefficients w_i, wherein $i = 1,...,L$, in multipliers 412, 414, 416. The samples 422, 424, 426 that have thus been multiplied are applied via an adder 418 to other parts of the receiver.

The complex weighting coefficients w_i are selected according to an algorithm, which is usually adaptive, in such a way that an antenna pattern of the desired shape is achieved. This manner of shaping the received signal can be called digital phasing of the signal, since it is performed on a signal digitized on the base band, but due to this shaping the received signal antenna gain can be oriented in the desired

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directions. An antenna group as such may comprise either directional or omnidirectional antenna elements. Phasing the signal obtained from the different antennas and combining the phased signals produces kind of virtual antenna beams into the desired directions. A corresponding treatment can also be performed on the signal to be transmitted, whereby a desired radiation pattern can be achieved.

Figure 3 illustrates how an antenna group consisting of an evenly spaced linear group comprising four elements 300, 302, 304, 306 produces a strong directed beam 310 with the angle of arrival of α towards a mobile station 308. A group of smaller side beams 312 to 316 are also formed. This directivity can thus be implemented with the signal phasing without the antennas as such being directional.

In the arrangement according to the invention, the multiple access interference of the receiver is reduced with antenna beams that are directed in the angular domain and that are produced by means of a new type of receiver applying time-angle diversity. In the arrangement according to the invention, the angles of arrival measured from the received signal can also be used in the transmission direction, whereby the connection quality is improved in both transmission directions.

In the following, the first preferred embodiment of the invention, which relates to applying the digital phasing of the received signal in the CDMA system, will be described first.

The receiver applying time-angle diversity used at the base station comprises digital receiver means that can monitor the received signal components in the two-dimensional (α, τ) domain and demodulate the desired signal components. Before the demodulation, the received

digitized signal samples are subjected to phasing by means of which the antenna gain of the received signal is oriented in the desired signal incoming directions. In the preferred embodiment, the antenna beams produced by the phasing are beams having a predetermined shape that is determined by the weighting coefficients w_i and the antenna geometry. These coefficients can easily be calculated for each angle of the greatest gain if the shape of the antenna beam as such remains constant. Therefore, the phasing can be adjusted rapidly since it is only dependent on one parameter, i.e. the angle of arrival α.

In the method according to the invention, there is no need to apply known complicated techniques, such as MUSIC, for estimating the angle of arrival or adaptive algorithms, such as LMS and DMI. Even though these algorithms enable the calculation of the optimal beam shape for the signal to be received, so that the signal-to-noise ratio of the desired signal can be maximized by directing the zero points of the antenna pattern towards the sources of interference, this is not necessary in connection with the CDMA since, as described above, in the CDMA the interference signal is distributed to resemble noise without having any clear directions of interference source. Therefore, it is sufficient in an environment with evenly distributed interference that the angles of the greatest gain of the antenna beams having a predetermined shape are pointed in the directions from which the best signal components are received. This enables the implementation of a more simple receiver compared to the prior art.

In the method according to the invention, the receiver thus searches for the desired signal components in the (α, τ) domain. This is performed by cross-correlating the received spread-spectrum signal with the

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desired spreading code and by comparing the obtained measurement results with the threshold values given. The search can be understood as a sweep of an antenna beam over the given area, simultaneously performing the measurement of the channel impulse response and the collection of the signal energy of the terminal equipments received from each direction. The receiver thus detects the direction and code phase of the reception of the best signals and allocates a required number of demodulation means for synchronizing with and receiving these signal components. The received demodulated signal components can be preferably combined in the receiver. The search for the best signal components is performed continuously and the allocation of the demodulation means is changed, if necessary.

The receiver thus knows at all times the directions from which the best signal components from the mobile stations are received. This information can also be used in the base station equipment according to the invention in the downlink direction. This may be performed for example in such a manner that the controller of the transmitter-receiver informs the transmitter unit of the directions where significant signal components have been detected. The transmitter unit may phase the signal to be transmitted with the adaptive antenna group in such a way that the angles of the greatest gain of the antenna beams point in the desired directions. There may be one or more transmission beams and their number may also differ from the number of the receiver beams.

This method provides considerable interference cancellation also in the downlink direction. The antenna group used in the transmission may be the same as the antenna group used in the reception. It may also be a separate antenna group. The signal phasing is performed

in the same way as during the reception with the weighting coefficients.

The arrangement according to the invention may use for example prior art mobile stations, which continuously perform measurements on the connection quality from the signal they have received from the base station. This information may comprise data concerning the number, quality and relative delay of the signal components the mobile station has received. The arrangement according to the invention utilizes the results of the connection quality measurements performed by the mobile station when the beams of the transmission antennas are directed in the downlink direction.

The mobile station transmits the measurement results it has collected to the base station. On the basis of the information received from the mobile station and the measurements it has performed itself, the base station may vary the number, shape or direction of the antenna beams it uses for the transmission of the signal intended to the mobile station. These changes can be implemented gradually, so that the mobile station can follow the changing signal.

The base station may also use the connection quality information it has received from the mobile station for adjusting the transmit power of each antenna beam if the measurement results show that the aforementioned measures do not improve the signal quality in the mobile station.

One advantage of the method described above is that for example in a difficult fading situation the mobile station may transmit to the base station a request to change the parameters of the antenna beams used in the signal transmission, for example the direction, shape and number, whereby the quality of the

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signal received by the mobile station can be improved rapidly.

The prior art CDMA systems thus use a pilot signal that is transmitted by each base station and that is used in the identification of base stations, in power measurement and for enabling coherent reception in a mobile station. In known systems, a pilot signal that is a data-unmodulated spreading-coded signal is transmitted to the coverage area of the base station in the same way as the actual traffic channels.

A CDMA system implemented in the manner according to the invention applies such a method for transmitting a pilot signal that uses antenna beams changing in time in the transmission and reception of data signals. It is then possible to transmit a first pilot signal in a transmission direction that is constant in time, and second pilot signals in transmission directions that change in time and that may correspond to the transmission directions used in the transmission of the data signals.

Therefore, a pilot signal provided with transmission directions that remain constant in time can be used for the detection of a base station and for power measurements for detecting a need for a handover. Since the antenna directivity pattern used differs from the pattern of the data signals, the signal cannot be used as a reference for coherent detection. It is possible to use for this purpose a pilot signal that is transmitted with the same antenna pattern in connection with each data signal and that therefore propagates along the same path as the actual data signal and that enables coherent detection in mobile stations.

The method is illustrated in an example according to Figure 5 wherein a base station 550 communicates with two mobile stations 552 and 554. The

base station transmits a first pilot signal on a predetermined transmission direction 560 that remains constant in time and that is an omnidirectional pattern in the example of the figure. The radiation pattern of this pilot channel determines the actual coverage area of the base station where the mobile stations can establish a connection to the base station. The base station further transmits second pilot signals to the mobile stations with radiation patterns 556, 558 that correspond to the traffic channels.

The first pilot signal, which is transmitted in a predetermined transmission direction remaining constant in time, can be transmitted using a greater transmit power than the channels using the traffic channels, whereupon the greater transmit power can compensate for the weaker antenna gain, whereby the same coverage area can thus be achieved as with the directed antenna beams. Another alternative is increasing the processing gain in the subscriber terminals.

In the system according to the invention, a pilot signal can further be transmitted using a relatively narrow antenna beam, and the angle of the greatest gain of this antenna beam can be directed in such a way that the antenna beam sweeps the cell area. Thus the antenna beam comprising the pilot signal sweeps the cell like a lighthouse, and the transmission of a continuous pilot to the entire cell area can be avoided. The pilot can also be transmitted with several sweeping antenna beams, which are phased in such a way that they do not overlap. The base station informs the mobile stations on a control channel about the time when the pilot channel sweeps each area.

In the following, the structure of a receiver according to the first embodiment of the invention will be described. Figure 6 is a block diagram illustrating

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the structure of a receiver according to the invention. The receiver comprises an antenna group 500 consisting of L separate antenna elements. The antenna group may be linear, planar (two-dimensional) or omnidirectional. The antenna group 500 receives a multipath-propagated signal that is delayed in different ways from several different directions from each mobile station with each of the L elements, performs the preamplification, converts the signal into an intermediate frequency and digitizes all the L signals. The obtained L digital complex I,Q samples 514 are supplied into an input of channel elements 504, 506, 508.

Each active mobile station communicating with the base station is serviced by one channel element, which performs digital signal processing both on the received signal and on the signal to be transmitted, as will be described in greater detail below. Each channel element comprises a (α, τ) receiver and a corresponding transmitter. The digital shaping functions of the antenna beam, realized by means of the signal phasing, are performed in a channel element both in the transmission direction and in the direction of reception.

In the direction of reception, a channel element filters the signal on the angle-space domain, demodulates the received signal components and combines them in a diversity combiner and in the end decodes the signal that has been received from the mobile station and that has been combined. The obtained user data bits are supplied further to a baseband unit 510, which forwards them to other parts of the network.

In the transmission direction, the user data bits arrive from the other parts of the network to the baseband unit 510, which forwards them to the correct channel element 504 to 508 where they are encoded,

modulated by a spreading code and subjected to the phasing of the signal to be transmitted, the phasing determining the directions of the antenna beams to be transmitted. The obtained L signals are supplied to each of the L elements of the antenna group 502. In practice, the reception and transmission antenna groups 500, 502 may be either separate or implemented by means of the same physical antenna group where the directions of transmission and reception are separated with suitable duplex filtration.

In the transmission antenna group 502, the signals that have arrived from each channel element and that are intended to each antenna element are converted into analog form, transferred to a radio frequency and transmitted via the antenna elements.

In the arrangement according to the invention, the transmission and reception antenna groups may naturally comprise a different number of antenna elements, even though the description above discloses the same number L of elements in each group for the sake of simplicity. The figure also shows a control block 512, which controls the operation of the different units of the equipment, such as the allocation of the channel units to different connections according to the messages from the base station controller.

Figure 7 is a block diagram illustrating the structure of a channel element in a receiver according to the first embodiment of the invention. The channel element comprises one or several digital receiver units 600, 602 two of which are shown in the figure, one or several searcher units 604 one of which is shown in the figure, a diversity combiner 608 the input of which comprises a signal from the receiver units, a decoder 610 to the input of which a signal that is visible at the output of the diversity combiner 608 is connected,

and control means 612. The L digital complex I,Q samples 514 arriving from the antenna group are supplied to the input of all the digital receiver units 600, 602 and searcher units 604. If the arrangement according to the invention is applied in a transmitter-receiver, the transmitter-receiver according to the invention also comprises an encoder 614 and a digital transmission unit 606.

The operation of the digital searcher unit 604 is examined first with reference to Figure 7. In the same way as in a conventional rake receiver, the function of the searcher unit is to search for the desired signal components from the received signal. In the arrangement according to the invention, a new type of searcher unit continuously monitors the received signal in the (α, τ) domain and searches for useful signal components and gives their parameters, i.e. the angle of arrival (AoA) and the delay profile, to the control means 612, which in turn allocate a required number of receiver units for demodulating the best components. The receiver according to the invention can naturally also be implemented in such a way that a channel element does not comprise separate control means 612, but the searcher unit 604 forwards the information concerning the signal components to be monitored directly to the receiver branches 600, 602.

The searcher unit comprises means 634 for phasing the signal supplied from the radio-frequency parts of the antenna group, and means 636 for detecting whether the signal obtained from the output of the phasing means 634 comprises a signal component received with the given delay and for measuring the quality of this signal component. The searcher unit further comprises means 638 for controlling the aforementioned phasing means 634 and the measuring means 636 in such

a way that the incoming directions and delays of the received signal can be measured.

The means 634 for phasing the signal supplied from the radio-frequency parts of the antenna group can be implemented for example with equipment of the type described above and shown in Figure 4, the equipment comprising the multiplication of the signal with complex coefficients w_i (i=1,...,L) by means of which it is possible to determine the angle of arrival of the signal that is visible amplified in the output signal of the phasing means. Each combination of the coefficients corresponds to a certain combination of antenna beams, as described above. The phasing means (634) are controlled by the means 638 so that all the essential incoming directions of the signal can be examined.

The output of the phasing means thus shows a signal that corresponds to the signal received from a given direction on the basis of the control of the means 638. The measuring means 636 perform a measurement with different delays on a signal visible at the output of the phasing means, the purpose of the measurement being to detect the signal components that have different delays. The delay to be measured each time is set with the aforementioned means 638. In the measuring means, the signal situated at the input of the means is subjected to despreading, measurement of the complex signal energy and squaring of the energy for example over the coherence time of the channel, and comparison of the obtained measurement result with the given threshold value. The parameters of the measured signal components having a strength exceeding the given threshold value, i.e. the angle of arrival, delay and power, are provided to the control means 612 of the channel element.

The means 638 thus control the operation of the phasing means 634 and the measuring means. The means 638 correspond to a synchronization loop provided in the searcher branch of a conventional rake receiver, even though in the arrangement according to the invention the means operate in a new manner. The search for the desired signal components from the (α, τ) domain can be implemented in many ways under the control of the means 638. As stated above, the measurement of the signal power can be replaced with some other measurement of the signal quality.

The digitized signal received by the antenna group can be phased in the phasing means 634 step by step in such a way that the direction angle of the greatest gain is changed with given angle intervals. From among the possible incoming directions, one selects a representative group of angles of arrival α_j which are situated at desired angle intervals from one another, and each incoming direction is subjected to several energy measurements at different delay values, whereby a delay profile τ_k is obtained for the incoming directions.

Another way is to direct the measuring means 636 to first measure the delay profile τ_k of the received signal for example with a non-directional antenna pattern. The possible delays with which signal components are received are thus detected. The phasing means 634 are thereafter directed to sweep the different direction angles with a narrow directional beam, and the measuring means are simultaneously guided to measure with the aforementioned delay values detected in the first measurement. The incoming directions α_j of the components that have arrived with different delays are thus obtained.

The parameters of the detected signal components are thus given to the control means 612 of the channel element. The control means allocate the receiver elements 600, 602 to receive and demodulate the best detected signal components by informing the receiver element of the incoming direction and delay of the signal component. As stated above, the receiver elements can also be controlled directly by the searcher unit 604 without separate control means.

The operation of the digital receiver unit 600, 602 will be examined next with reference to Figure 7. In the same way as in a conventional rake receiver, the function of the receiver unit is to receive and demodulate a given signal component. Assume that the control means 612 of the channel element have allocated a receiver unit to receive a particular signal component the parameters of which are the angle of arrival α_j and the delay τ_k.

The receiver unit 600, 602 comprises monitoring means 624, 632 to which the control means 612 of the channel element forward the information about the phase and incoming direction of the signal component to be monitored. The monitoring means control the first phasing means of the receiver unit the input of which is the digitized signal obtained from the antenna group. The phasing means 618, 626 have a similar structure as the phasing means 634 provided in the searcher unit. On the basis of the information that concerns the angle of arrival α_j and that is received from the control unit, the monitoring means set the complex weighting coefficients w_i (i=1,..,L) in such a way that a signal arriving from the desired incoming direction is visible at the output of the phasing means. This can thus be understood as a receiver antenna beam pointing in the desired direction and having a predetermined shape.

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The receiver unit 600, 602 further comprises demodulation means 620, 628 the input of which comprises a signal obtained from the phasing means 618, 626. The monitoring means 624, 632 guide the demodulation means to synchronize with a signal component arriving with a given delay τ_k. In the demodulation means, the signal is subjected to despreading and demodulation according to known technology using the given τ_k as the code phase. The obtained symbols are supplied to the other parts of the channel element together with the delay data.

The receiver unit 600, 602 further comprises second phasing means 622, 630 the input of which comprises a digitized signal obtained from the antenna group. The output signal of the second phasing means is supplied to the monitoring means 624, 632. The monitoring means control the operation of the second phasing means by measuring with the means the environment of the current parameters (α_j, τ_k) of the signal component allocated to the receiver in order to detect possible changes in the incoming direction and delay of the received signal component. For this purpose, the second phasing means comprise complex coefficients similar to the first phasing means for phasing the signal, and means similar to the measuring means 636 situated in the searcher unit for measuring the impulse response. If the monitoring means detect, by means of the second phasing means, changes in the incoming direction α_j or delay τ_k of the desired signal component, they update this data to the first phasing means and to the demodulation means.

The prior art discloses several manners in which the monitoring means 624, 632 can be implemented in a spread spectrum system, for example Early-Late gates that can be used in the arrangement according to the invention. These circuits estimate the code timing

error by performing two energy measurements with the given time difference $\Delta\tau$, which is typically a fraction of the chip time of the spreading code in the environment of the current set point τ_k. The energy measurements are performed with the measuring means of the second phasing means 622, 630, which provide the correction data required by the nominal set point τ_k as the delay changes.

Correspondingly, changes in the angle of arrival α_j of the signal can be monitored by means of the second phasing means. It is for example possible to perform, with the given delay τ_k, two or more energy measurements with antenna beams which have been deflected by an angle $\Delta\alpha$ in both directions from the current angle of arrival α_j by means of phasing. The degree of the deflection $\Delta\alpha$ used is typically a fraction of the width of the antenna beam.

The monitoring means 624, 632 thus control the energy measurements performed by the second phasing means 622, 630, so that a signal could be received with the greatest possible energy at all times. The monitoring means update the data about the changed parameters (α_j, τ_k) to the first phasing means, to the demodulation means and also to the control means 612 of the channel element, so that the data could be used in the transmission direction, if required.

The above-described maximization of the received signal can be compared with the receiver antenna diversity used in conventional systems, wherein a signal is received with two or more antennas situated from each other at a distance having the length of several wavelengths of the received signal. In the receiver according to the invention, if a signal received with the angle of arrival α_j is caught in a deep and long fading situation, the fading can probably

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be eliminated by changing the angle of the receiver beam by a small angle $\Delta\alpha$. There is thus no need for two separate antennas situated at a given distance from each other.

The operation of the diversity combiner 608 and the decoder 610 of the channel element is similar as in the prior art diversity receivers. The combiner 608 combines the symbol sequences arriving from the different receiver elements by taking into account and compensating for their different delays τ_k and possibly by weighting the different symbol sequences according to their signal-to-noise ratios in order to obtain maximum ratio combination. The combined symbol sequence thus obtained is supplied to the decoder 610, which decodes the symbols to user data bits, usually performing the deinterleaving first. The CDMA applications generally use a strong convolutional coding for which the best method of detection is the Viterbi algorithm providing a soft decision.

It is clear that the above-described channel element can also be used for monitoring and receiving an access channel. The antenna beams used in the direction of reception have then wider antenna patterns, i.e. they can be for example 120° wide, since the exact location of the mobile stations transmitting call-set-up messages is not known.

The operation of the digital transmission unit 606 will be examined next with reference to Figure 7. The user data bits are first supplied to the encoder 614, which encodes the bits typically with a convolutional code and performs interleaving on the encoded symbols. The obtained interleaved symbols are applied to a spread spectrum modulator 642, which performs conventional modulation. All the above-

described functions can be performed according to known technology.

In the present invention, the transmission unit comprises means 644, 640, however, for controlling and phasing digitally the signal to be transmitted in response to the received signal. In the transmission unit according to the invention, the means 644 for adjusting the transmission beam receive from the control means 612 of the channel element information in their input about the incoming directions used in the different receiver units 600, 602 for receiving a signal from the mobile station. The control means 612 may also report the other incoming directions of the signal detected by the searcher unit 604, but not all the directions are necessarily used in the reception of the signal.

The means 644 of the transmission unit for adjusting the transmission beam control the phasing means 640, which calculate from predetermined beam-forming functions JxL a complex weighting coefficient w_{ij} (i=1,...L; j=1,...,J) which produces J antenna beams by means of L antenna elements. In addition to the direction and number of the antenna beams, the means 644 control the phasing means 640 by indicating the transmit power that is to be used with each beam and that the means 644 obtain from the control means 612 of the channel element.

The structure of the phasing means 640 may be similar to the phasing means 618, 626, 634 described above in the direction of reception. In the phasing means, the digitized (I,Q) samples of the outbound signal supplied from the modulation means 642 are thus multiplied by L complex weighting coefficients where L is the number of the antenna elements, as follows:

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$$v_i = \sum_{j=1}^{J} g_j w_{ij}, \quad i = 1, \ldots, L$$

whereby L complex sample sequences are obtained for the antenna group. The complex multiplication also uses a real scaling factor g_j (j=1,...,J), which is obtained from the adjusting means 644 and which can be used for the independent power adjustment of each antenna beam. The adjusting means 644 also indicate the frequency to be used, so that the weighting coefficients w_{ij} can be set correctly.

The arrangement according to the invention can also use special beam control bits that a mobile station generates on the basis of the signal it has received and that it adds to the signal it transmits to the base station. The receiver according to the invention comprises means 616 for demultiplexing and detecting these beam control bits from the received signal. The detection should be performed already before the decoder 610 in order to avoid delays. The beam control bits are forwarded to the adjusting means 644 of the transmission unit.

The means 644 for adjusting the transmission beam control the phasing means 640 on the basis of the information obtained from the control means of the channel element and the beam control bits transmitted by the mobile station. The adjustment can be performed in many ways by modifying the parameters α_j and g_j (j=1,...,J) in different ways. For example the transmit power used with some antenna beams can be independently adjusted, or the direction angle α_j of some antenna beams can be changed by a given angle $\Delta\alpha$, or the number of the antenna beams used can be altered. With these measures it is possible to compensate for the

deteriorations of signal quality, such as fadings, occurring over the radio path.

In the arrangement according to the invention, the adjusting means 644 of the transmission unit 606 can deflect the direction of one or several of the used antenna beams by small degrees $\Delta\alpha$ in the environment of the given direction angle α_j. Due to such deflection, it is possible to reduce the likelihood that the mobile station would be in a deep fading for a long time. Since the direction angle of an antenna beam continuously vibrates around a nominal direction angle α_j, a signal that has propagated over the radio path does not continuously use the same route. This method can be considered a new type of antenna diversity in the downlink direction.

Further, in the arrangement according to the invention the adjusting means 644 can control the phasing means 640 in such a way that a high-power signal having a wide antenna beam is obtained from the antenna group with the suitable adjustment of the weighting coefficients w_{ij} (i=1,...,L; j=1,...,J) and the factors g_j (j=1,...,J). The obtained antenna pattern may be for example a sector pattern or an omnidirectional pattern. For example a data-unmodulated pilot signal can thus be transmitted with a permanent antenna pattern. The same method can also be applied in the transmission of control channels.

Also in the arrangement according to the invention, the adjusting means 644 can control the phasing means 640 in such a way that with the suitable adjustment of the weighting coefficients w_{ij} (i=1,...,L; j=1,...,J) and the factors g_j (j=1,...,J), one or several signals having a rather narrow antenna beam are obtained from the antenna group, the angle of the greatest gain of the signal sweeping continuously the

cell area. The obtained antenna pattern can be used for the transmission of a data-unmodulated pilot signal.

The second preferred embodiment of the invention, wherein the analog phasing of a received signal is applied in the CDMA system, will be described below.

Figure 8 is a block diagram illustrating an example of the equipment according to the second preferred embodiment of the invention. The equipment comprises in the direction of reception a given number L of antenna elements 700 to 704 and in the transmission direction a group of antenna elements 772 to 776. In the transmitter-receiver, the transmission and reception antennas may be the same, whereby duplex filtration is used to separate the different transmission directions from one another. The figure shows different antenna elements for the different transmission directions. The group formed by the antenna elements may be linear, planar (two-dimensional) or omnidirectional. The antenna group receives a multipath-propagated signal that is delayed in different ways from several different directions with each of the L elements from each mobile station.

The antenna elements are connected to an RX matrix 706, which performs phasing on the analog signal received by the antenna elements in such a way that the matrix output 708 comprises K signal outputs each of which corresponds to a signal received by an antenna beam pointing in a predetermined signal incoming direction. The matrix can be implemented by means of prior art arrangements, such as a Butler matrix that is realized with passive 90° hybrids and phase shifters. The number K of the antenna beams produced with the matrix 706 does not necessarily correspond to the number L of the antenna elements.

The antenna beams are thus obtained in the direction of reception by phasing the signal received by the antennas and in the transmission direction by phasing the signal to be transmitted by the antennas. The antenna beams used are constant and their directions cannot be changed. The number of the antenna beams depends on the matrix 706 implementation and the beams can be set at desired angle intervals from one another and formed with a desired width.

The matrix output signals 708 are applied, if necessary, to a group of low-noise amplifiers 710, which compensate for the cable attenuations and other losses. The L signals amplified in this manner are supplied to the radio-frequency parts 712 to 716, which subject each signal to down-conversion into an intermediate frequency and to the required filtrations. The radio-frequency parts can be implemented in a manner according to known technology.

The intermediate-frequency signals are then applied to converter means 718 to 722, which convert the analog signal into digital samples. The conversion can be performed in manners according to known technology with commercially available components. Typically, complex sampling into I and Q components is performed in the means.

The output signals 724, 726, 728 of the converter means 718, 720, 722 are supplied further to a group of channel elements 738, 740, 742 via an RX switch 732, 734, 730 preceding each channel element. All the output signals 730 of the converters are applied to all the RX switches. Each RX switch thus comprises K inputs and one or several output signals that are applied to a corresponding channel element. The function of the RX switch is to guide a signal received by a desired antenna beam to a desired component of the

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channel element according to control from the channel element.

The above-described receiver structure can naturally also be implemented in such a way that one or several of the aforementioned parts (antenna elements 700-704, amplifiers 710, radio-frequency parts 712-716 and converter means 718-722) are located either integrated together or separately. In such a case, the details of the implementation vary, as it is evident for a person skilled in the art, for example in such a way that if the radio-frequency parts are situated in connection with an antenna group, there is no need for amplifiers 710.

In the following, the structure and operation of a channel element in a receiver according to the second embodiment of the invention will be described by means of the block diagram of Figure 9. The channel element comprises one or several means 804, 806, 808 for demodulating a signal, the figure showing three of the means, one or several searcher units 802 one of which is shown in the figure, a diversity combiner 608 the input of which comprises a signal from the receiver units, and a decoder 610 to the input of which a signal visible at the output of the diversity combiner 608 is connected.

The inputs In#1 to In#K of the RX switch 732 thus comprise the K signals 730 from the converter means 718 to 722. The channel element 738 thus comprises a searcher unit 802 the function of which is to perform the search for the best signal components from the multidimensional signal domain, as described in connection with the searcher unit of the first embodiment. In the present embodiment, the searcher unit 802 searches for the best signal components from the inputs of the RX switch, each of which thus corresponds

to a signal component arriving from a certain direction, by measuring the delay profile from each input of the RX switch. The measurement of the delay profile can be performed in the same manner as in the searcher branch of a conventional rake receiver. As a result of the measurement, the searcher branch thus detects the incoming directions and delays of the best signal components. The searcher unit guides the demodulation means 804, 806, 808 to synchronize with the best components by providing each demodulation means with information about the delay of the desired component and by applying the signal of this direction from the RX switch to the corresponding demodulation means.

The demodulation means 804, 806, 808 thus demodulate the given signal, monitor the changes in the delay and incoming direction of the signal, and start receiving a new antenna beam by means of the RX switch, if required. The output signals of the demodulation means are applied to a diversity combiner 608, which preferably combines the demodulated symbols and detects the information transmitted. The output signal of the diversity combiner is applied further to decoding means 610, which deinterleave the symbols and decode the information sequence.

The above-described receiver structure thus implements the arrangement according to the invention by means of analog phasing. In the reception, a number (K) of fixed antenna beams are produced by means of the phasing, the strongest signal components being selected for demodulation from the components received by the antenna beams. As the terminal equipment moves and the incoming directions of the signal change, the signal of the antenna beam providing the best signal strength is always selected for demodulation.

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The receiver structure according to the second preferred embodiment of the invention will be examined below with reference to Figure 9.

The user data bits are first supplied to an encoder 614, which encodes the bits typically with a convolutional code and performs interleaving on the encoded symbols. The obtained interleaved symbols are applied to a spread-spectrum modulator 642, which performs conventional modulation. All the above-described functions can be performed according to known technology.

In the present invention, the receiver implementation further comprises means 802 for controlling the analog phasing of the signal to be transmitted in response to the received signal. On the basis of the measurements it has performed, the searcher unit 802 knows the direction angles and the corresponding antenna beams which receive the best signal components. The searcher unit has thus allocated a group of demodulation means to receive these components. In a practical implementation, the control of the transmitting end can take place in the searcher unit or in a separate control unit. For the sake of simplicity, only the first alternative is described herein, without limiting the invention thereto, however. In any case, the idea of the invention is the same in both alternatives. As described above, in the arrangement according to the invention the detected incoming directions comprising a good signal level are used when transmitting a signal to the opposite transmission direction.

The implementation of the transmitter part will be examined below by means of Figure 8. The transmitter comprises a given number L of antenna elements 772, 774, 776, which may thus be the same as the antenna elements

in the direction of reception. The antenna elements are connected to a TX matrix 770 the function of which is to analogically phase the signal to be transmitted to different antenna elements so that the main beam of the directivity pattern points in the desired direction. The input of the TX matrix comprises K signals 756, which have been converted into analog form in D/A converters 758 to 762, converted into a radio frequency and amplified in radio-frequency parts 764 to 768. As already mentioned in connection with the description of the receiving end, the above-described components can be implemented in practice in several ways either together or separately, as it is clear for a person skilled in the art.

The TX matrix phases the K signals situated at the input in such a way that the antennas provide antenna beams to K different directions, the directions of the antenna beams being fixed and the beams covering together the desired area. The implementation of the TX matrix 770 is similar to the RX matrix 706 and it can be realized for example with a Butler matrix that is implemented with passive 90° hybrids and phase shifters. The number K of the antenna beams produced with the matrix 770 does not necessarily correspond to the number L of the antenna elements.

The modulated data signal and the control 746 from the searcher unit are supplied from each channel element 738, 740, 742 to the TX switching matrix 744, from which the signals are supplied further to adding means 754. The operation of the switching matrix 744 and the adding means 754 will be examined in greater detail by means of Figure 10.

The TX switching matrix comprises a TX switch 900, 902, 904 corresponding to each channel unit, the input of the switches consisting of both the modulated

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data signal that is to be transmitted and that arrives from the channel unit, and a control signal 746, 748, 750 from the searcher unit of the channel unit. The output of the TX switch comprises K outputs 746a to 746i, i.e. as many as there are transmission antenna beams. The function of each TX switch is to route the signal from the channel element to the correct transmission beams to be summed together with signals arriving from the other channel elements and intended to the same beam on the basis of the control from the channel element. The TX switch guides the incoming data signal into one or several outputs Txout#1 to Txout#K, depending on the control from the channel element, i.e. depending on which antenna beams the signal is intended for. Each output is a quadratic digital sample weighted with the signal level.

Each output 746a to 746i of the switch is applied to one of the K adders 906 to 910 of the adding means 745. Each adder adds digitally together the data signals arriving from different channel units and intended for a given antenna beam. The required bit number for an outbound sample is obtained with the formula 2*(log(n) + m), wherein n is the number of the inputs (channel units) of the adders, log is a two-based logarithm and m is the bit number of the samples.

Each of the outputs 756a to 756c of the TX switches is applied to a corresponding converter means 758 to 762 and further to antennas via an analog phasing matrix, as described above.

In the second preferred embodiment of the invention, it is also possible to utilize special beam control bits, which a mobile station generates on the basis of the signal that it has received and that it adds to the signal it transmits to the base station. With reference to Figure 9, the receiver according to

the invention comprises means 616 for demultiplexing and detecting these beam control bits from the received signal. The detection should be performed already before the decoder 610 in order to avoid delays. These beam control bits are forwarded to the searcher unit 802 of the channel unit.

The searcher unit 802 selects the antenna beams to be used in the transmission on the basis of the information it has measured and the beam control bits transmitted by the mobile station.

In the second preferred embodiment of the invention, a pilot signal sweeping the cell area in the form of a narrow antenna beam can be implemented in such a way that the antenna beam used in the transmission of the pilot signal is changed so that the pilot signal is transmitted by using each antenna beam in turn, whereby the pilot signal sweeps the cell area in stages.

Even though the invention is described above with reference to the examples according to the accompanying drawings, it is clear that the invention is not restricted thereto, but it can be modified in many ways within the scope of the inventive idea disclosed in the appended claims.

The alignment of the antenna beams can be used for example in both the vertical and the horizontal direction, whereby the above-described (α, τ) domain can be understood as an (α, β, τ) domain, wherein α is the vertical angle, β is the horizontal angle and τ is the delay.

One possibility is to utilize coherent, incoherent or differentially coherent modulation and demodulation methods in the channel elements. For example in order to enable coherent demodulation in a mobile station, the base station may include an additional spreading-coded signal without data

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modulation in each antenna beam as a phase reference. Alternatively, known reference symbols can be used for the same purpose.

One alternative embodiment of the invention includes positioning the digital phasing means 618 to 634 of the channel elements in one common phasing means block, which services all channel elements.

Claims:

1. A method for transmitting pilot channels in a cellular radio network, which comprises in each cell at least one base station (550) communicating with mobile stations (552, 554) located within its area, which base stations transmit a data signal in the downlink direction by using transmission directions changing in time and which transmit information about the system to the mobile stations on control channels, c h a r a c t e r i z e d in that the base stations transmit at least one first pilot channel with a predetermined radiation pattern (560), which determines the cell coverage area, and second pilot channels in transmission directions (556, 558) changing in time.

2. A method according to claim 1, c h a r a c t e r i z e d in that the data signals and the second pilot channels are transmitted using the same transmission directions (556, 558).

3. A method according to claim 1, c h a r a c t e r i z e d in that the mobile stations use the power measured from the received pilot signal that was transmitted with a predetermined radiation pattern (560) to facilitate a handover.

4. A method according to claim 1, c h a r a c t e r i z e d in that the mobile stations use the second pilot signals they have received as phase references in the coherent reception of a data signal.

5. A method according to claim 1, c h a r a c t e r i z e d in that

the base station receives a signal from a mobile station by means of an antenna group (500, 700-704) consisting of several elements, and that

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the incoming directions and delays of the signal components are searched for from the received signal, and that

when a data signal is transmitted from the base station to the mobile station, the formation of the radiation pattern used is controlled on the basis of said measurement.

6. A method according to claim 5, c h a r a c t e r i z e d in that the mobile station transmits to the base station information about the number, power level and relative delay of the data signal components received at the mobile station, and that said information is used at the base station in the formation of the radiation pattern of the data signal to be transmitted to the mobile station.

7. A method according to claim 1, c h a r a c t e r i z e d in that the predetermined radiation pattern (560) has an omnidirectional form.

8. A method according to claim 1, c h a r a c t e r i z e d in that when the predetermined radiation pattern (560) is transmitted, a higher transmit power is used than on the channels using traffic channels.

9. A method according to claim 1, c h a r a c t e r i z e d in that when the predetermined radiation pattern (560) is received, a greater processing gain is used than on the channels using traffic channels.

10. A method according to claim 1, c h a r a c t e r i z e d in that the radiation patterns used in the transmission directions changing in time have a substantially beam-like shape.

11. A cellular radio system comprising in each cell at least one base station (550) communicating with mobile stations (552, 554) located within its area, which base stations transmit information about the system to the mobile stations by using control channels,

and which system comprises at least one base station (550), which transmits a data signal to the mobile stations (552, 554) by using radiation patterns that change in time, c h a r a c t e r i z e d in that the system comprises at least one base station (550), which transmits at least one first pilot channel with a predetermined radiation pattern (560), which determines the cell coverage area, and second pilot channels in transmission directions (556, 558) that change in time.

12. A cellular radio system according to claim 11, c h a r a c t e r i z e d in that the base station (550) comprises at least one antenna group (500) consisting of several elements, a group of radio-frequency units (500) connected to the antenna group, one or several channel units (504-508) the input of which comprises a signal obtained from the radio-frequency parts (500) and which channel unit comprises means (618) for phasing the signal to be transmitted and received with the antenna group (500) so that the gain obtained from the antenna group is greatest in the desired direction, and a control unit (612) regulating the operation of the channel unit, and means (616) for separating the symbols containing information about the connection quality from the signal received from the mobile station, and which receiver further comprises a baseband unit (510) connected functionally to the output of the channel units (504-508), and that the channel unit (504-508) comprises means (604) for searching for the incoming directions and delays of the best signal components received from the mobile station, and means (606) for controlling the formation of the radiation pattern used in the transmission of a data signal intended from the base station to the mobile station on the basis of said measurement and the information

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received from the mobile station concerning the connection quality.

13. A cellular radio system according to claim 11, c h a r a c t e r i z e d in that the base station (550) comprises means (504-508) for transmitting the second pilot channels in the same transmission directions as the data signals.

14. A cellular radio system according to claim 12, c h a r a c t e r i z e d in that each channel unit (504-508) comprises means (614) for encoding the signal to be transmitted, and at least one transmission block (606) the input of which comprises a signal obtained from the encoding means (614), and at least one searcher block (604) the input of which comprises a signal obtained from the radio-frequency parts (500).

15. A cellular radio system according to claim 14, c h a r a c t e r i z e d in that the searcher block (604) comprises phasing means (634) the input of which is a signal obtained from the radio-frequency parts (500), and means (636) for detecting whether a signal obtained from the phasing means (634) and received from a certain incoming direction comprises the desired signal component having a certain delay and for measuring the power of said signal component, and measuring means (638) so that the desired incoming directions and delays of the signal to be received can be measured, and means (636) for informing the control unit (612) of the channel element of the incoming direction, delay and power of each detected signal component.

16. A cellular radio system according to claim 14, c h a r a c t e r i z e d in that the transmission block (606) comprises modulation means (642) the input of which is a signal obtained from the encoding means (614), phasing means (640) the input of which is a

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signal visible at the output of the modulation means, and means (644) for controlling the phasing means (640) in such a way that the greatest gain of the signal to be transmitted can be set in the desired direction.

17. A cellular radio system according to claim 11, c h a r a c t e r i z e d in that the base station (550) comprises at least one antenna group (700-704) consisting of several elements, means (706) connected to the antenna group (700-704) for analogically phasing the received signal so that the gain obtained from the antenna group is greatest in the desired beam-like directions, a group of radio-frequency units (712-716) the input of which comprises a phased signal, means (718-722) connected to the output of the radio-frequency units for digitizing the signal, one or several channel units (738-742) the input of which comprises a digitized signal and which channel unit comprises at least one measuring and switching means (802, 732) for searching from the received signal for the antenna beams corresponding to the incoming directions of the strongest signal component and for measuring the delays of said components, and means (802, 744) for controlling the phasing means (770) in such a way that the greatest gain of the signal to be transmitted is set in the desired direction.

18. A receiver according to claim 17, c h a r a c t e r i z e d in that the analog phasing means (706) comprise a number of outputs each of which shows a signal received by an antenna beam pointing in a certain direction.

19. A receiver according to claim 17, c h a r a c t e r i z e d in that the switching means (730-734) guide the desired signals from the digitized outputs of the analog phasing means (706) that are visible at the input of the switching means and that have been

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converted into an intermediate frequency to the desired demodulation means (804-808) under the control of the measuring means (802), and that the measuring means (802) control each demodulation means to synchronize with a signal guided thereto.

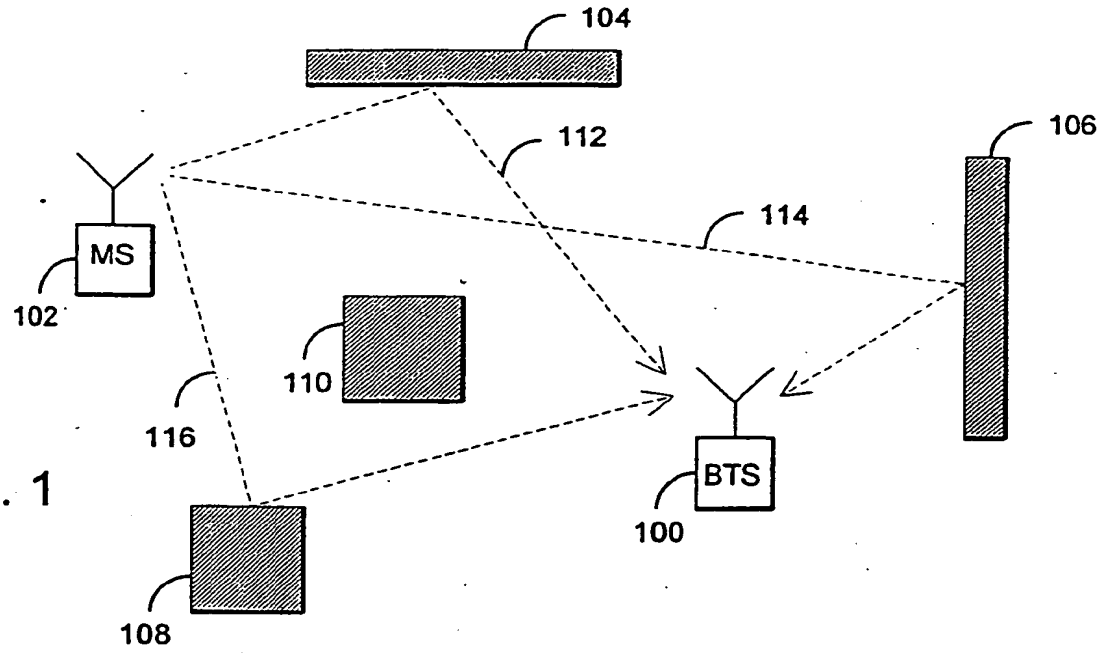


Fig. 1

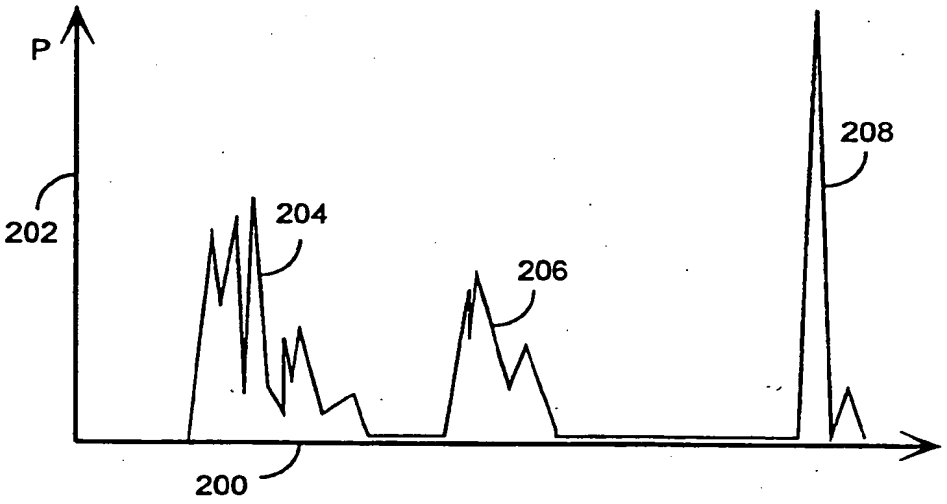


Fig. 2a

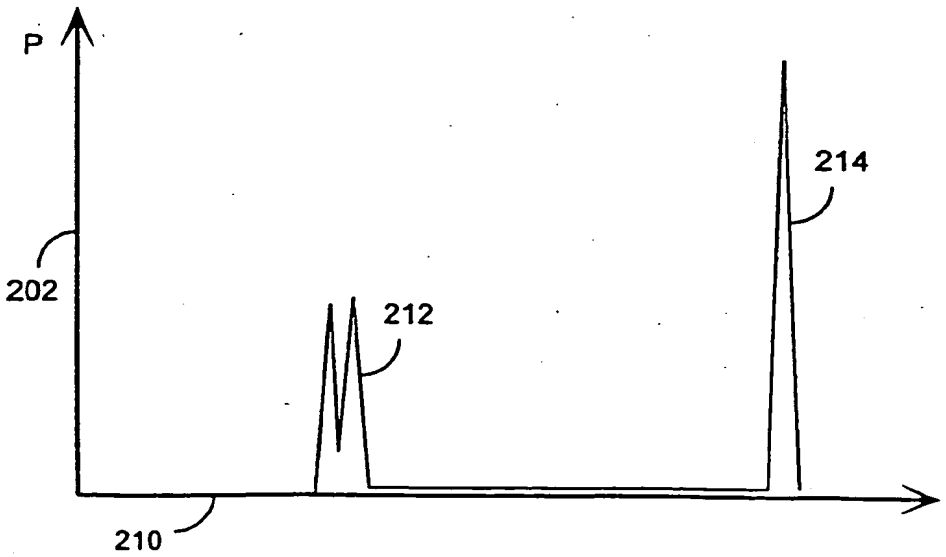


Fig. 2b

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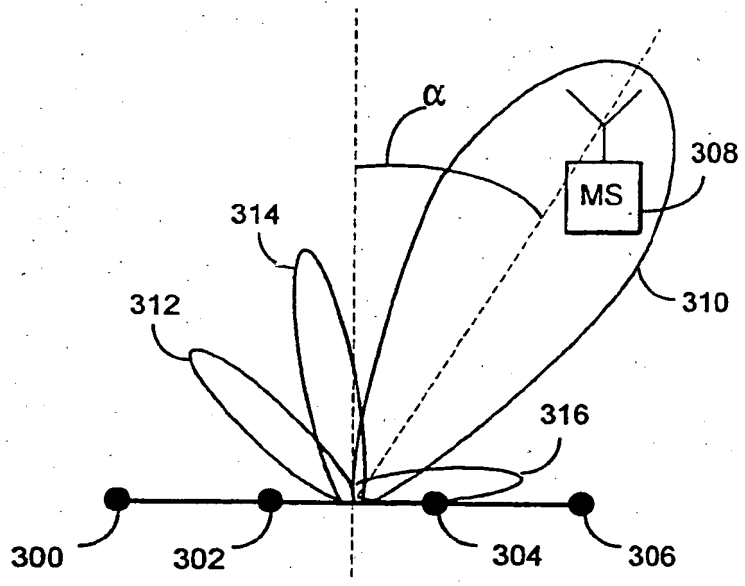

α
308
MS
314
310
312
316
300
302
304
306

Fig. 3

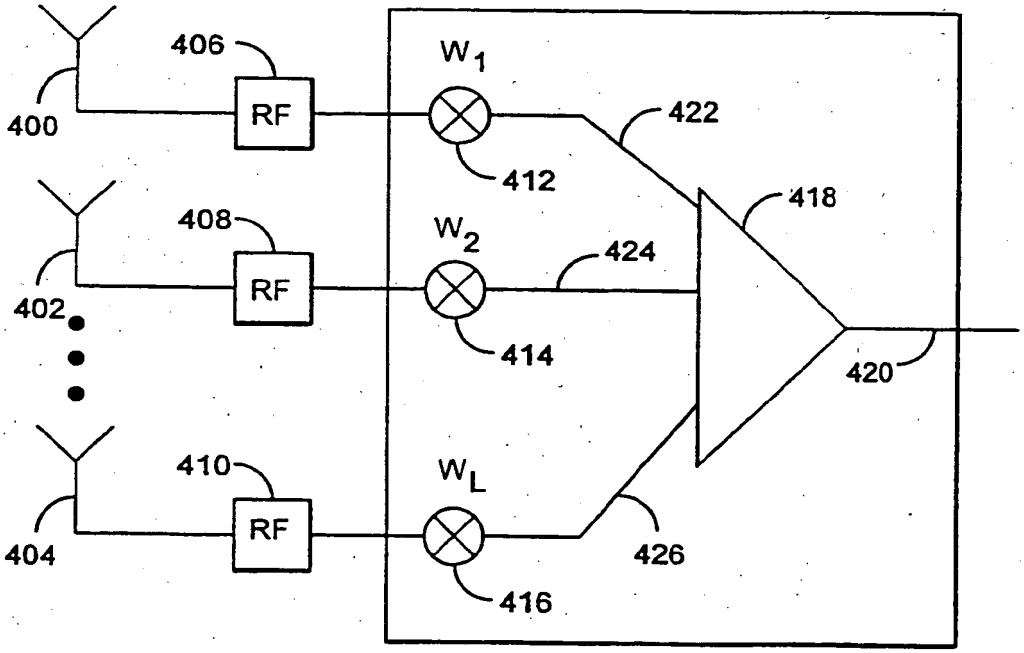

406
400
RF
W_1
422
412
418
408
W_2
424
402
RF
414
420
410
W_L
404
RF
426
416

Fig. 4

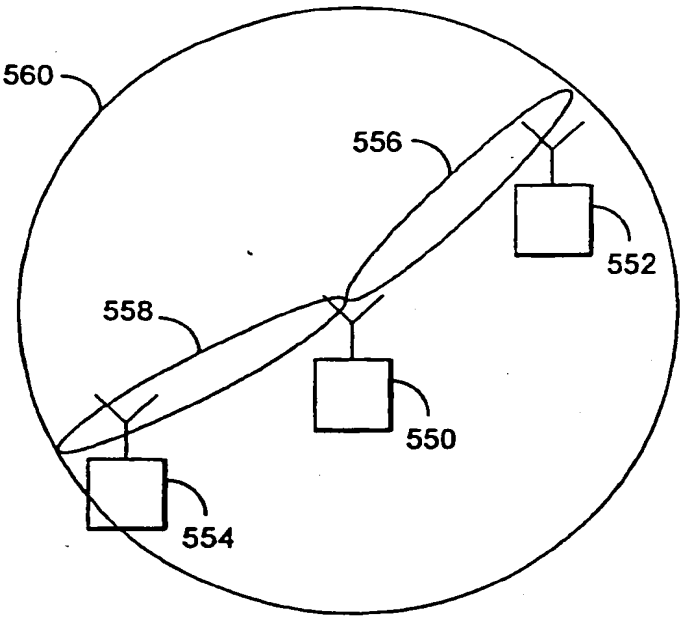

560
556
552
558
550
554

Fig. 5

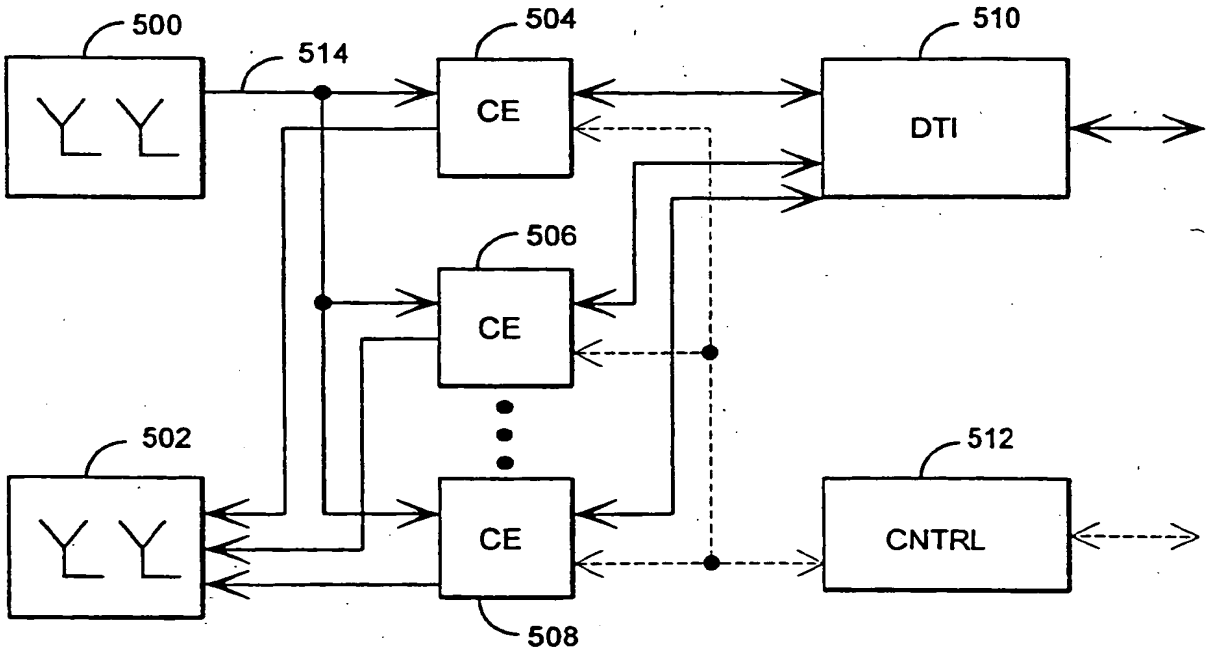

500
514
504
CE
510
DTI
506
CE
502
512
CE
CNTRL
508

Fig. 6

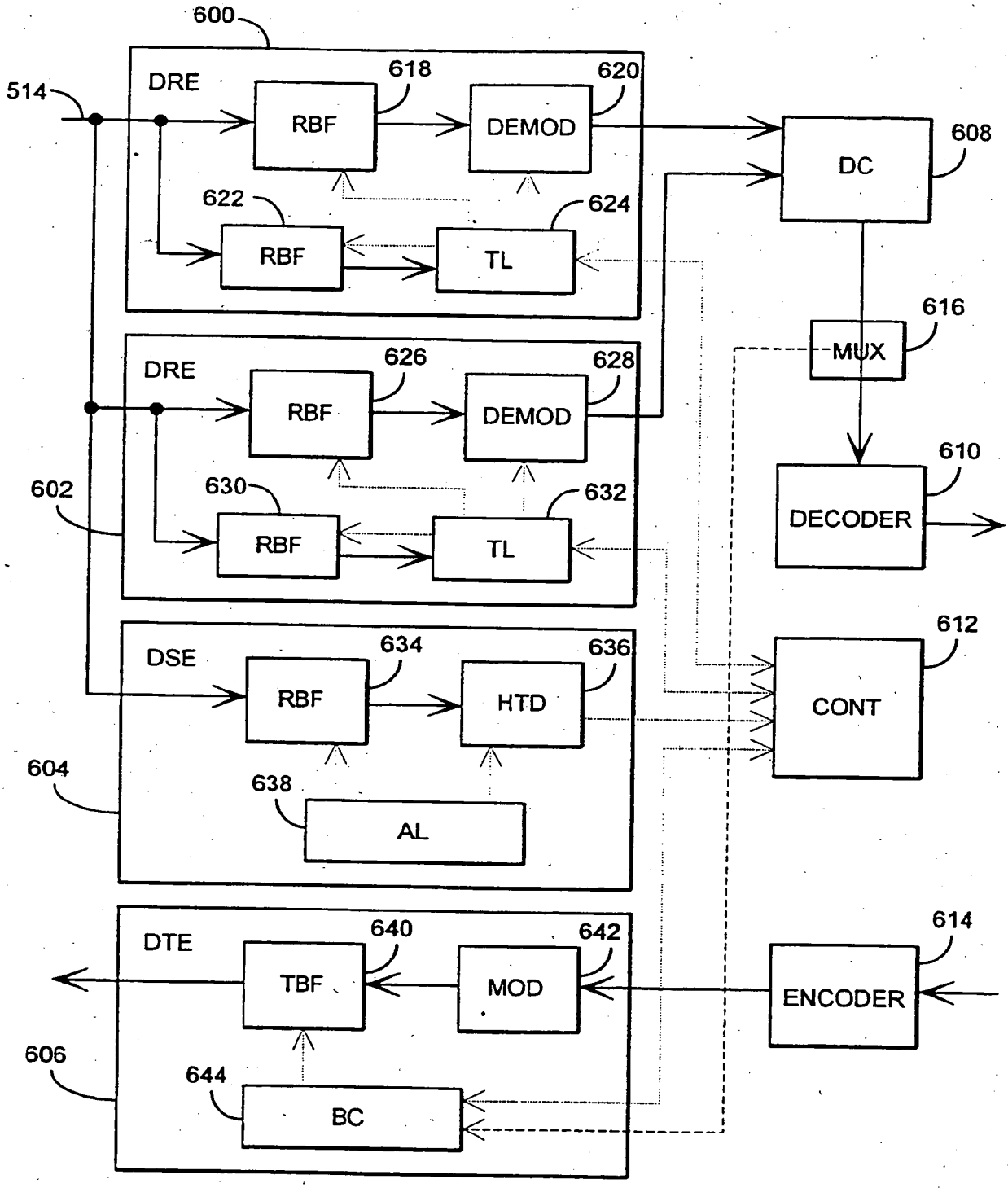

600
DRE
514
618
RBF
620
DEMOD
622
RBF
624
TL
608
DC
616
MUX
DRE
626
RBF
628
DEMOD
602
630
RBF
632
TL
610
DECODER
DSE
634
RBF
636
HTD
612
CONT
604
638
AL
DTE
640
TBF
642
MOD
614
ENCODER
606
644
BC

Fig. 7

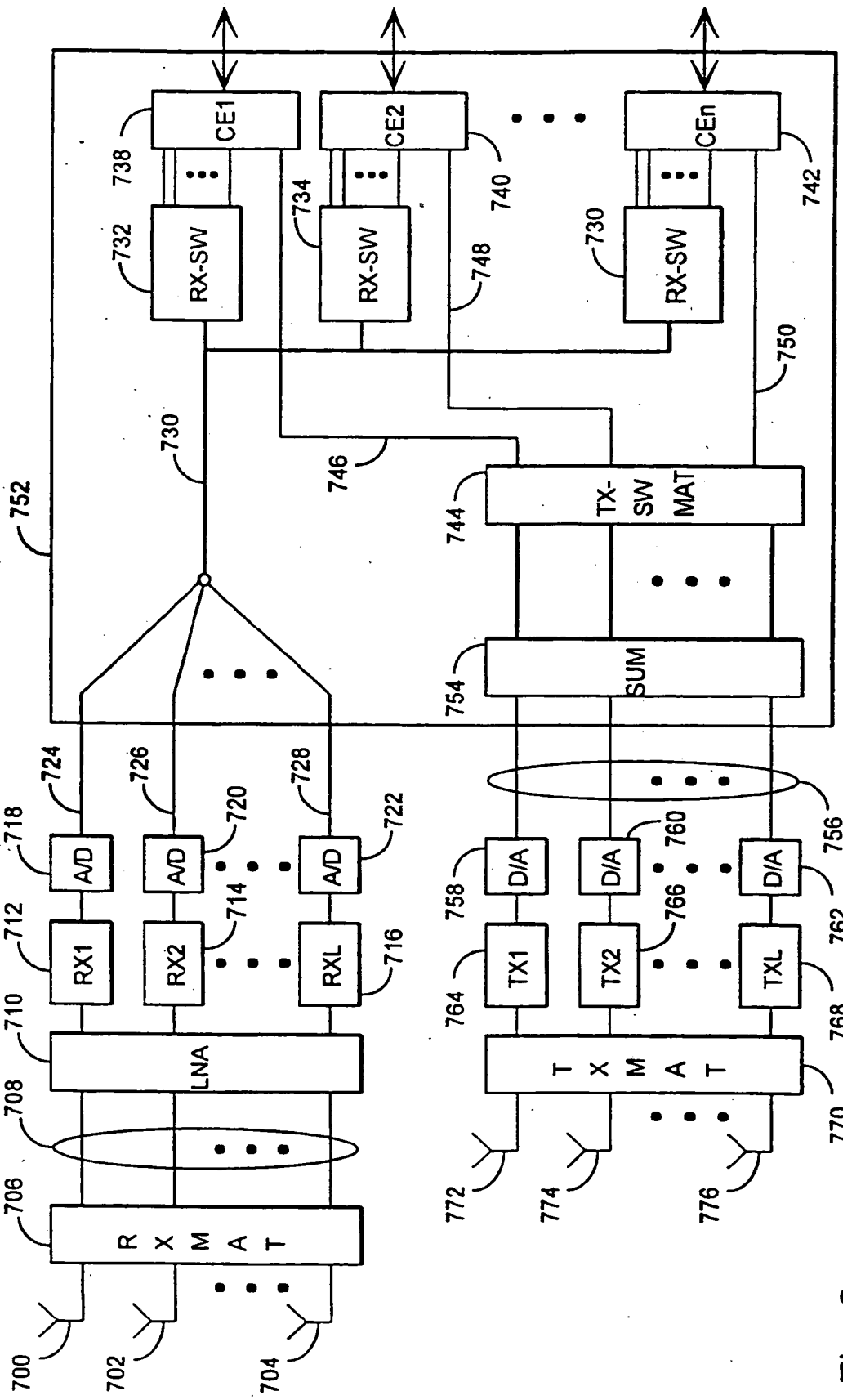


Fig. 8

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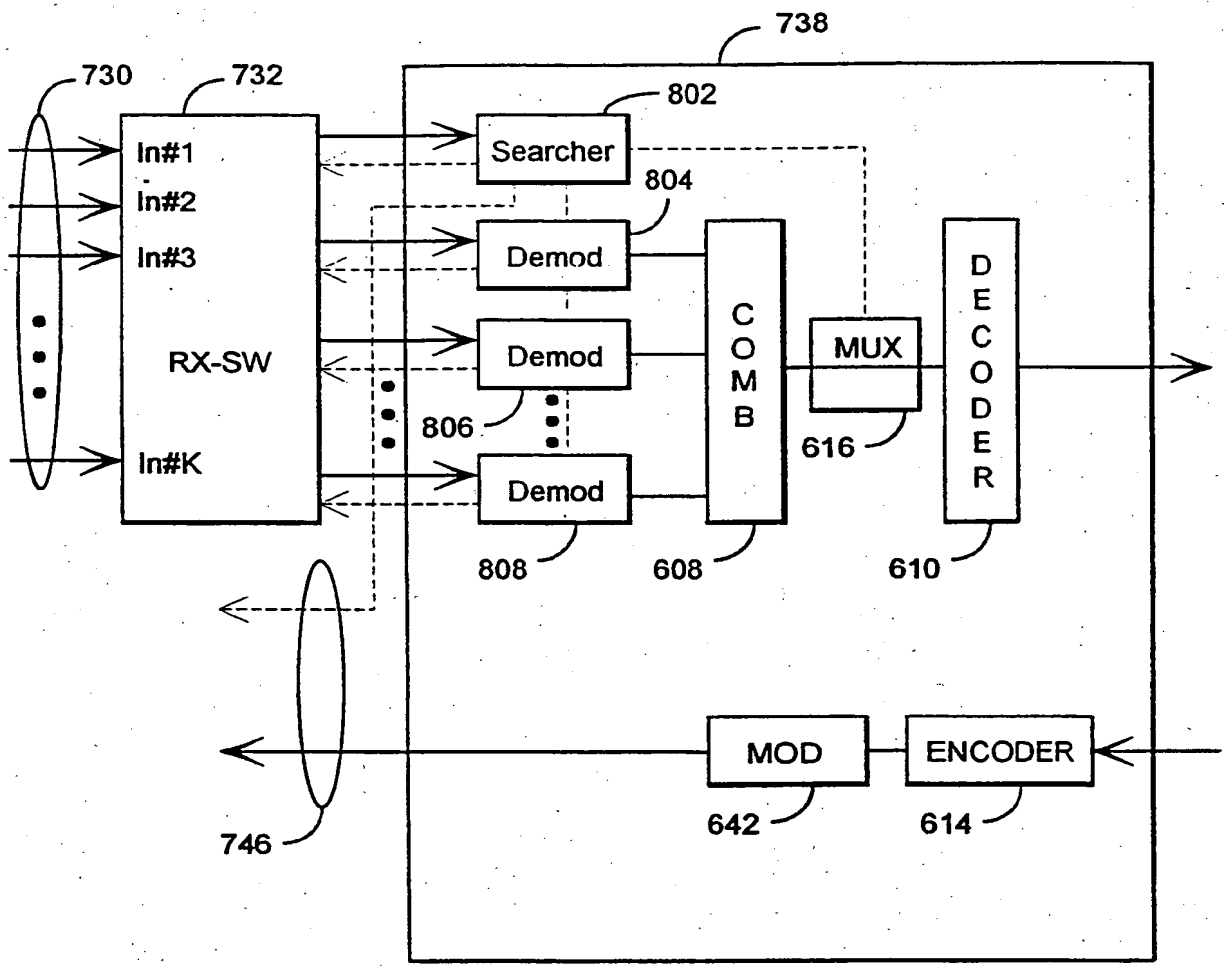

738
730
732
802
In#1
In#2
In#3
RX-SW
In#K
Searcher
804
Demod
Demod
Demod
806
808
COMB
608
MUX
616
DECODER
610
MOD
642
ENCODER
614
746

Fig. 9

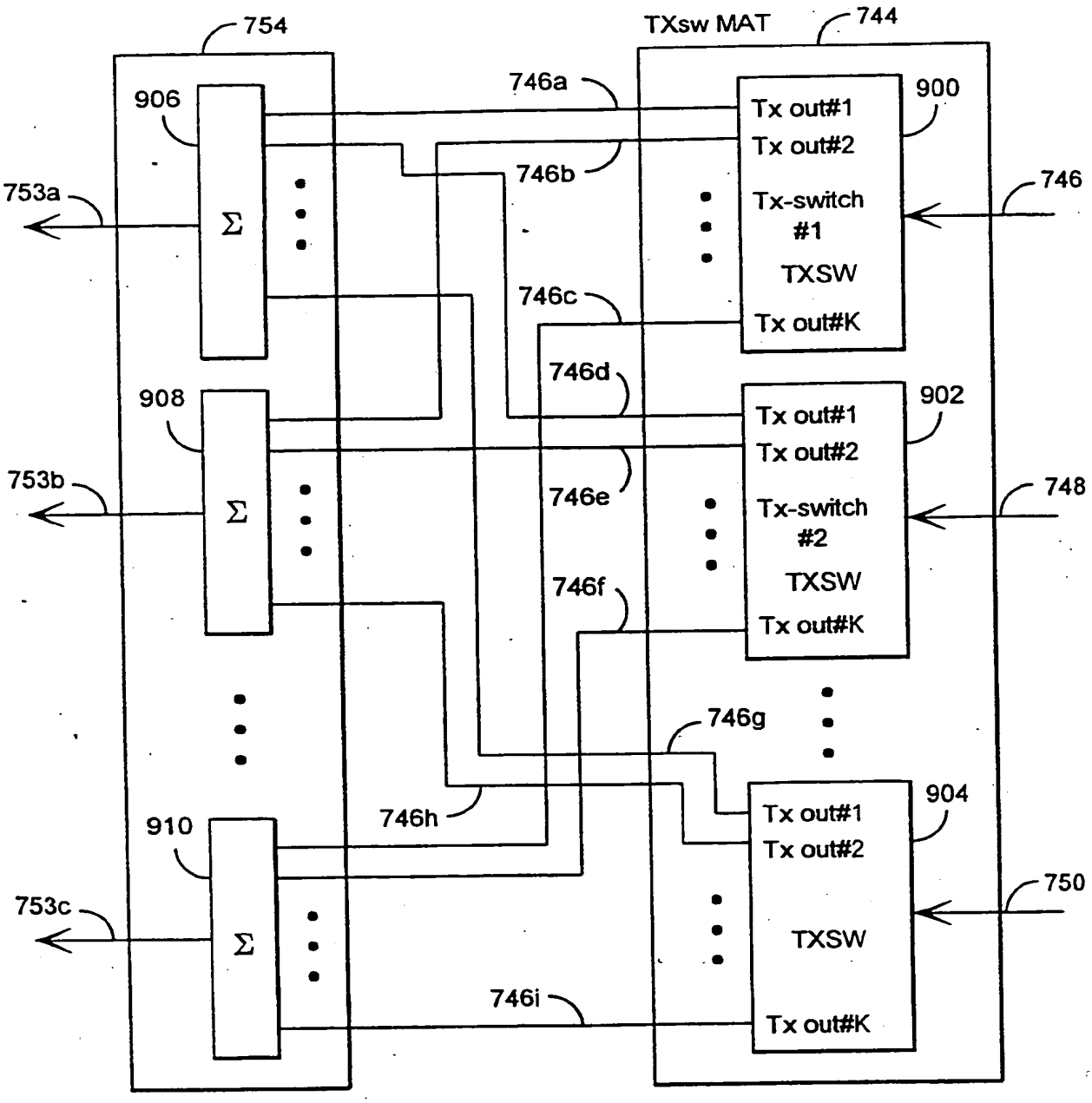


Fig. 10

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 96/00293

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04B 1/76, H04B 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B, H04Q

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9509490 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 6 April 1995 (06.04.95), figure 2(a)-2(b), abstract	1-19
A	EP 0647979 A2 (NORTHERN TELECOM LIMITED), 12 April 1995 (12.04.95), column 14, line 35 - line 57, figures 15a-15c	1-19
A	US 5109390 A (KLEIN S. GILHOUSEN ET AL), 28 April 1992 (28.04.92), column 6, line 1 - line 50	1-19

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 August 1996	29 -08- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Göran Magnusson Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 96/00293

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5267261 A (ROBERT D. BLAKENEY, II ET AL), 30 November 1993 (30.11.93), abstract -- --------	1-19

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INTERNATIONAL SEARCH REPORT

Information on patent family members

31/07/96

International application No.
PCT/FI 96/00293

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		EP-A- 0671085	13/09/95
		FI-A- 952582	26/05/95
EP-A2- 0647979	12/04/95	EP-A- 0647978	12/04/95
		EP-A- 0647980	12/04/95
		EP-A- 0647981	12/04/95
		EP-A- 0647982	12/04/95
		EP-A- 0647983	12/04/95
		EP-A- 0639035	15/02/95
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		GB-A- 2281008	15/02/95
		GB-A- 2281010	15/02/95
		GB-A- 2281009	15/02/95
		GB-A- 2281011	15/02/95
		GB-A- 2281175	22/02/95
		GB-A- 2281176	22/02/95
		GB-A- 2281012	15/02/95
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2681

DOCKET NO.: WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	PAUL F. STRUHSAKER, ET AL.
U.S. Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2681
Examiner	:	(Not yet assigned)

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

Sir:

STATUS INQUIRY

This patent application was filed in the U.S. Patent and Trademark Office on September 5, 2001. Although the official filing receipt has been received, we would appreciate receiving a status as to when we can expect to receive the first Office Action.

Respectfully submitted,

DAVIS MUNCK, P.C.

Date: 10-28-04

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NOV 01 2004
PATENT & TRADEMARK OFFICE

DOCKET NO.: WEST14-00103 **PATENT**
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Alexandria, VA 22313-1450

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Sir:

The undersigned hereby certifies that the following documents:

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relating to the above application, were deposited as "First Class Mail" with the United States Postal Service, addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on 10/28/04.

Date: 10/28/04

Kathy Cedar
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Date: 10-28-04

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1/4/6

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FEC TDD frame 1970 - 2000 Search

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Results **1** - **100** of about **141** for **FEC TDD frame**. (**0.12** seconds)

Performance Analysis of an Adaptive OFDM Packet Data System

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Orthogonal Frequency Division Multiplex transmission of H. 263 encoded video over wireless ATM ...

PJ Cherriman, T Keller, L Hanzo - 1997 - www-mobile.ecs.soton.ac.uk
... Multiple Access / Time Division Duplex (TDMA/**TDD**) frames having a ... of 170.7μs. This **frame** is split ... to avoid utilising equalisation at the **FEC**-coded sampling ...
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A wireless multimedia network on time division duplex CDMA/TDMA

K Seki, Y Sanada, Q Wang, S Kato, VK Bhargava - Communications, Computers, and Signal Processing, 1995 ... 1995 -

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S Tasaka, K Hayashi, Y Ishibashi - The 1995 IEEE International Conference on Communications. ..., 1995 - ieeexplore.ieee.org
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Adaptive Modulation/TDMA/**TDD** with Convolutionally Coded Type-II Hybrid ARQ for Wireless ...
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... agreed to base UMTS FDD component on the harmonized W-CDMA scheme, and UMTS **TDD** on TD ... **Frame** length 10 ms / 20 ms (optional) 20 ms for data and control/5 ms for ...
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Orthogonal frequency-division multiplex transmission of H. 263 encoded video over highly frequency- ...
P Cherriman, T Keller, L Hanzo - IEEE Transactions on Circuits and Systems for Video ..., 1999 - ecs.soton.ac.uk
... Multiple Access Time Division Duplex TDMA **TDD** frames having a duration of 170 : 7 s. This **frame** is split ... complex equal- isation at the **FEC**-coded sampling ...
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C Jiang, W Wenbo, Y DaCheng - Communication Technology Proceedings, 2000. WCC-ICCT 2000. ..., 2000 - ifip.or.at
... A. System Configurations In **TDD** mode, uplink and downlink occupy different time slots in one **frame**. ... length of one **TDD frame** is 10ms, including 15 time slots. ...
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K Hiramatsu, K Miya, O Kato, K Homma - IEEE VEH TECHNOL CONF, 2000 - ieeexplore.ieee.org
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Cited by 2 - Web Search - ieeexplore.ieee.org - csa.com

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... WATM system is based on TDMA/**TDD** frames having a duration of 170.7 s. This **frame** is split ... implementationally complex equalization at the **FEC**-coded sampling rate ...
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... C1 and C2 [17]), but their integrity difference was equalized using two different **FEC** codes, as seen ... Hence, it has a delay of one **TDD frame** duration or 20 ms. ...
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... In **TDD** mode, the minimum length of uplink and down- link parts is 1/8 of the **frame** length (46 ... services are protected by forward error correction (**FEC**) codes ...
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I Rhee - ACM SIGCOMM Computer Communication Review, 1998 - portal.acm.org
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... 2.4 GHz ISM-band and use a TDMA/**TDD** based MAC ... A TDMA **frame** in turn is subdivided into variable numbers of ... length of 10 bytes (8 bytes payload, 2 bytes **FEC**). ...
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WCDMA-**TDD** for Multimedia Mobile Communications

H Wu, W Li, Y Wang, J Wang - Communication Technology Proceedings, 2000. WCC-ICCT 2000. ..., 2000 - ieeexplore.ieee.org
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P Hafezi, M Beach, Y Sun, A Nix - Personal, Indoor and Mobile Radio Communications, 1998. The ..., 1998 - ieeexplore.ieee.org
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R O'Neill, L Lopes, E Swindon - Vehicular Technology Conference, 1997 IEEE 47th, 1997 - ieeexplore.ieee.org
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RM Pelz - IEEE VEH TECHNOL CONF, 1994 - ieeexplore.ieee.org
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Image transmission control over fading channel using SR-ARQ based on DCT frequency and image **frame** ...

M Yamashina, T Tanda, T TANAKA - Personal, Indoor and Mobile Radio Communications proceedings ..., 1996 - ieeexplore.ieee.org
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B Stantchev, G Fettweis - Wireless Communications and Networking Conference, 1999. ..., 1999 - ifn.et.tu-dresden.de
... in a data-aided (DA) mode making use of an embedded **frame** syn- chronization ... method can be applied to a time division duplex (**TDD**) system, eg as ... to **FEC** Ö ÑÜ ...
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I Rhee - The 1998 International Conference on Multimedia Computing ..., 1998 - ieeexplore.ieee.org
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... directions through **TDD**. ... of a single user, ie one particular time slot of the TDMA **frame**. ... The design of efficient forward error correction (**FEC**) methods should ...
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... capacit Number of users Access system Interface **Frame** length Number ... Antenna Modulation Demodulation Roll-off factor **FEC** 80Mbps 50Mbps ... 6 B-RM/B-CS TDMA-**TDD** OC-3 ...
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... For an FCH transmitted in a 20-ms **frame**, two sets of ... **FEC**: Forward Error Correction Coding. ... TDMA/**TDD**: Time Division Multiple Access/Time Division Duplexing ...
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M UESUGI, O Kato, K Homma - Wireless Communications Conference, 1997., Proceedings, 1997 - ieeexplore.ieee.org
... The combination of convolutional coder and Viterbi decoder is representative of **FEC** and ... (ADPG) is suitable for **TDD** system. ... Fig.7 shows the **frame** format. ...
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... Since retransmission always incurs delays, and **FEC** is still susceptible to burst losses, a hybrid ARQ scheme still ... The **TDD** of periodic **frame** is called ...
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JE Padgett, CG Gunther, T Hattori - IEEE Communications Magazine, 1995 - cse.buffalo.edu
... TDMA CDMA Frequency **TDD** CT2 ... In its present version, GSM supports full-rate (22.8 kb/s, eight slots/**frame**) and half-rate (11.4 kb/s, 16 slots/**frame**) operation. ...
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... timeslot 32 kbit/s (user can access up to 3 timeslots per **frame**) Base station ... sensitivity —l025 dBm (at the antenna connector, for BER <10 , pre **FEC**) RSS Tx ...
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... Division Duplex (FDD) while DECT is Time Division Duplex (**TDD**). ... duty cycle (ie most slots per **frame**.) d) For one ... in the case of cordless systems with no **FEC**. ...
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PHS with Packet Data Communications (PHS-PD) Protocol Architecture

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... I Radioaccessmethods I TDMA-**TDD** I ... The **frame** structure of PHS is shown in Fig. ... PHS-PD does not adopt **FEC** because the fade duration is W-TLa+l@ & jQ ...
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... In the HIPERLAN/2 system owing to the **TDD** mode of ... is calculated for each slot of the MAC **frame** with all ... our simulations a Reed–Solomon (65,55) **FEC** (for- ward ...
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... physical layer, the forward error correction (**FEC**) with error ... has shorter mean delay for successful **frame** transmission ... Jeong and WS Jeon, "CDMA/**TDD** system for ...
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IE Dravopoulos - Communications, 1999. ICC'99. 1999 IEEE International ..., 1999 - ieeexplore.ieee.org
... A Time Division Multiple Access / Time Division Duplex (TDMA/**TDD**) scheme is ... JME **FRAME** STRUCI'URE ... need is more on information integrity, and use **FEC** on real ...
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High-Quality and High-Speed Wireless Multimedia Transmission Technology for Personal Handy Phone ...
H TAKANASHI, T TANAKA, T OONO, H MATSUKI, T ... - Wireless Personal Communications, 1998 - kluweronline.com
... 1.9 GHz Access method TDMA – **TDD** Traffic channels ... repeat request (ARQ) and forward error collection (**FEC**). ... may be redundant, however, ARQ **frame** numbering is ...
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M Umehira, A Ohta, O Kagami, H Hojo, T Kobayashi - IEEE VEH TECHNOL CONF, 2000 - ieeexplore.ieee.org
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P Hafezi, M Beach, A Nix, Y Sun - Antennas and Propagation for Future Mobile Communications (..., 1998 - ieeexplore.ieee.org
... This interface provides a data rate of 70 Mbit/s(in **TDD**). Figure I also includes certain nominal power levels ... Two types of Reed-Solomon **FEC** code ... Each **frame** ...
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... pre-prototype **frame** format is a TDMA-**TDD** (Time Division ... The **frame** duration is 2 ms [3}. Each time slot carries 8 ATM cells with Forward Error Correction (**FEC**). ...
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L Nenonen, J Mikkonen, NM Phones - MOBICOM, 1996 - portal.acm.org
... Wireless ATIUMAC Description References MDR Multiservice Dynamic [3], [I41 Reservation; based on dynamic TDMA!**TDD**; design by NEC ... **Frame** length 2ms **FEC** ...
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Emerging wireless broadband networks
J Mikkonen, C Corrado, C Evci, M Progler - IEEE Communications Magazine, 1998 - ieeexplore.ieee.org
... function is to handle data **frame** and packet ... air interface, and efficient error con- **FEC** Complementary Reed ... TDMAT1DD TDMA,IDD TDMNFDD TDMA/**TDD** independent code ...
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GM Stamatelos, VN Koukoulidis - IEEE/ACM Transactions on Networking, 1997 - ieeexplore.ieee.org
... S WITCHED -A NTENNA D IVERSITY AND **FEC** C ODING ... duration in the control portion of the **frame** (see also [23]). Subsequent transmission in a TDM/**TDD** mode based on ...
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... The problem is that a **FEC** decoder will produce burst ... depending on the degree of compression for each **frame**. ... TDMA with time division duplex (**TDD**) and contention ...
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J Jiang, TH Lai - Personal, Indoor and Mobile Radio Communications, 1998. The ..., 1998 - ieeexplore.ieee.org
... receiving state to transmit- ting state), **TDD** provides better ... We also assume forward error control (**FEC**) is used in ... The time **frame** structure in our protocol is ...
Web Search - ieeexplore.ieee.org

IP Optimized Broadband Wireless Access

T Ojanpera, J Makinen - Personal, Indoor and Mobile Radio Communications, 2000. ..., 2000 - ieeexplore.ieee.org
... HiperAccess proposal 1 millisecond DL: **TDD**/FDD ... El, T1, n*64 kbiVs, ATM, Ethernet, **Frame** Relay, Ipv4 ... proposed MAC when carrying IP traffic, including **FEC** and all ...
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... FDD c **TDD** ... In its prcsent version, GSM supports full-rate (22.8 kbis, eightslots/**frame**) and hall-rate (I 1.4 kh/s. Ih slotsiframe) opcration. ...
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Impact of wireless access on traffic management in ATM networks

R Sigle, T Renger - Computer Networks, 1999 - ikr.uni-stuttgart.de
... While **FEC** (adopted to a single data packet) doesn ... wireless ATM MAC operation using TDMA/**TDD** access is ... informs the mobile stations through a **frame** control packet ...
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Bandwidth-efficient wireless multimedia communications

L Hanzo - Proceedings of the IEEE, 1998 - ieeexplore.ieee.org
... FDMA Frequency division multiple access. **FEC** Forward error correction. ... MV Motion vector, a vector to estimate the motion in a **frame**. ...
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E Ayanoglu, KY Eng, MJ Karol, L Technologies - IEEE Personal Communications, 1996 - cs.cmu.edu
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... approach abandons the concept of a **frame** reference altogether ... The problem is that a **FEC** decoder will produce ... TDMA with time division duplex (**TDD**) and contention ...
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U Bilstrup, PA Wiberg - Proceedings of the 2000 IEEE International Workshop on ..., 2000 - ieeexplore.ieee.org
... one piconet because of the Time Division Duplex (**TDD**) scheme, but ... HV3, DH1, DH3 and DH5 packets use no **FEC** at all ... made out of plaster tiles with a **frame** of wood ...
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Techniques for channel estimation, DC-offset compensation, and link quality control in Bluetooth ...

CH Park, JH Paik, YH You, MC Ju, JW Cho - IEEE TRANS CONSUM ELECTRON, 2000 - ieeexplore.ieee.org
... system adopts a slotted time division duplex (**TDD**) scheme for ... is 625 ps length and two slots form one **frame**. ... Also, **FEC** and ARQ are used as error correc- tion ...
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Radio Link Configurations of Broad-band Wireless Access System

K Koga, Y Fujimoto, S Tejima - Personal Wireless Communication, 1999 IEEE International ..., 1999 - ieeexplore.ieee.org
... random access time slot in a TDMA **frame** on a ... 6] have been being developed with TDM/TDMA/**TDD** configuration because of ... This can easily be made in **FEC** decoder by ...
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S Choi, KG Shin - MOBILE NETWORKS APPL, 1998 - portal.acm.org
... usually a half) of each time **frame** is al ... But, dynamic **TDD** allows for more efficient

link utilization in the ... We use an **FEC** (Forward Error Correction) scheme for ...
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... speech eodees and with their new **FEC** codees will ... 12 channels but instead of using FDD it employs **TDD**. ... than continuous, and that a time **frame** structure prevails ...
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... Partnership Project) [I]. In its **TDD** mode, the IMT ... details of the burst and **frame** structures applied ... scheme chip impulse filter [12] convolutional encoder (**FEC**) ...
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M Weckerle, T Weber, PW Baier, J Oster - Communication Technology Proceedings, 2000. WCC-ICCT 2000. ..., 2000 - ieeexplore.ieee.org
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NC Ericsson, A Ahlen, S Falahati, A Svensson - IEEE VEH TECHNOL CONF, 2000 - signal.uu.se
... **frame**. The queues are emptied in a bit-by-bit manner, indepen- dently of the individual packet boundaries. The bit-stream is passed to the link-layer **FEC**/ARQ ...
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N Metzner, F David, HJ Eul, I Introduction, IIF ... - IEEE VEH TECHNOL CONF, 1994 - ieeexplore.ieee.org
... requires that this service mainly relies on **FEC** techniques ... up to 72 slots per 1'DMA **frame** (pico cells ... is designed to support both FDD and **TDD** functionality in ...
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Multipriority video transmission for third-generation wireless communication systems
H Gharavi, SM Alamouti - Proceedings of the IEEE, 1999 - ieeexplore.ieee.org
... schemes are the frequency- division-duplex (FDD) mode, the time-division duplex (**TDD**) mode, and ... The **frame** length is 10 ms, which corresponds to 40 960 chips. ...
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Burst-by-burst adaptive wideband wireless video telephony
L Hanzo, CH Wong, P Cherriman - IEEE Signal Processing Mag, 2000 - www-mobile.ecs.soton.ac.uk
... **Frame** Rate (fr/s) 10 10 10 10 10 10 C1 **FEC** BCH(127,71,9) BCH(127,50,13) BCH(127,71,9) BCH(127,50,13) BCH(127,50,13) BCH(127,71,9) ...
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... bursty Rayleigh channels an even stronger **FEC** code would ... at both ends of the transmitted **frame**, which also ... conversations in Time Divi- sion Duplex (**TDD**) mode. ...
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An overview of broad-band access technologies
M Gagnaire - Proceedings of the IEEE, 1997 - ieeexplore.ieee.org
... EC Echo cancellation. **FEC** Forward error correction. ... For instance, 512 kb/s or

2 Mb/s rates are necessary for access to **frame** relay networks. ...
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Robust and scalable matching pursuits video transmission using the Bluetooth air interface standard
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... MODEL Bluetooth is a time division duplex (**TDD**) system that ... can be protected using a rate 2/3 **FEC** code. ... displaced **frame** difference (DFD) signal over a basis of ...
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Bluetooth-based wireless connectivity in an automotive environment
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ADSL, VDSL, and multicarrier modulation
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GA Awater - Personal, Indoor and Mobile Radio Communications, 1997.' ..., 1997 - ieeexplore.ieee.org
... Drawbacks of **TDD** include lower two-way throughput and ... made available within the project's time **frame**, a 2 ... are that they allow selective (per VC) **FEC** (Forward ...
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YK Kwok, VKN Lau - 2000 International Conference on Network Protocols, 2000 - ieeexplore.ieee.org
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S Torres-Guijarro, R Sanchez-Perez, FJ Casajus- ... - Vehicular Technology Conference, 1998. VTC 98. 48th IEEE, 1998 - ieeexplore.ieee.org
... rate is recommended (for example in the next **frame** is over ... is performed at the base station, the **FEC** code has ... Click Noise Detection Scheme for TDMA-**TDD** Systems ...
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The Influence of Segmentation Mismatch on Quality of Audio-Video Transmission by Bluetooth
H OKURA, K Masami, S TASAKA - IEICE TRANS. COMMUN, 1999 - inl.elcom.nitech.ac.jp
... is based on a time division duplex (**TDD**) polling scheme ... we focus on the RFCOMM Maximum **Frame** Size and ... ACL packets User Asymmetric Type payload **FEC** ARQ maximum ...
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Call Admission Control for QoS Provisioning in Multimedia Wireless ATM Networks
DS EOM, M SUGANO, M MURATA, H Miyahara - IEICE Transactions on Communications, VE-82B, no, 1999 - final.korea.ac.kr
... 1, TDMA/**TDD** protocol can divide a fixed length **frame** into uplink (from terminal to base station) and down- link dynamically, so that it is applicable to the ...
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H Matsuoka, S Sampei, N Morinaga, Y Kamio - IEICE Transactions on Communications, 1996 - ieeexplore.ieee.org
... 1) consist S symbols. In this system. the burst length is 1.26 msec aimd the **frame** length is 10.08 1155CC because of employing 4 channel TDMA/**TDD**. Fig. ...
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TK Fong, PS Henry, KK Leung, X Qiu, NK ... - IEEE Trans. Commun, 1998 - ieeexplore.ieee.org
... of subframe 1 and the following subframe 2. (Note that the figure just shows the **frame** structure for a downlink or an uplink, excluding the **TDD** between the two ...

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... time division duplex (**TDD**). ... needs, by allocating more or fewer time slots per time **frame**. ... may be a combination of For- ward Error Correction (**FEC**) or Automatic ...
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FEC TDD frame Search

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Scholar

Results **101** - **141** of **141** for **FEC TDD frame**. (**0.08** seconds)

A Novel Antenna Solution for Bluetooth Access Point
P Salonen, L Sydaenheimo, M Keskilammi, M ... - IEEE Wireless Communication and Networking Conference, ..., 2000 - ieeexplore.ieee.org
... element two-dimensional X-array, and its coordinate **frame**. ... type type load payload length slots **FEC** [bytes] [PSI ... Hence a time division duplex (**TDD**) scheme is ...
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Speech Codecs for Personal Communications
AS Tale - IEEE Communications Magazine, 1993 - ieeexplore.ieee.org
... tion in the recovered speech, due to each hit in every **frame** being erroneously ... combined low bit rate codec and the forward error correction (**FEC**) codec yield ...
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S Mangold, I Forkel - The Second International Conference on ATM (ICATM99), Colmar ..., 1999 - ieeexplore.ieee.org
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PR Chang, CF Lin - Proceedings of the IEEE, 1999 - ieeexplore.ieee.org
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C Standards - IEEE Communications Magazine, 1992 - dectweb.com
... Bits per TDMA Timeslot (speech/data+embedded control) Timeslot duration (including guard time) TDMA **frame** period Modulation Technique ... 33/34 kb/s **TDD** ...
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P MLSHRA, MANB SRIVASTAVA, JINA TROTTER - IEEE Personal Communications, 1996 - ieeexplore.ieee.org
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... Forward error correction (**FEC**) codes and interleaving techniques (to ... In **TDD** operations, both the uplink and downlink of a ... The **frame** delay in PACS is about 5 ms ...
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Low-tier wireless local loop radio systems* Part 1: Introduction
CC Yu, D Morton, C Stumpf, RG White, JE Wilkes, M ... - IEEE Communications Magazine, 1997 - ieeexplore.ieee.org
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Toward wireless multimedia communications. Current standards and future directions
C Sinner, R Sigle - INT J WIRELESS INF NETWORKS, 1998 - kluweronline.com
... access (TDMA) and time-division duplex (**TDD**) for transmission ... **frame** relay service

with throughput of up to ... combination of forward error correction (**FEC**) and lim ...
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... By increasing the number of slots used in a **frame**, source bit rates up to 64
kb/s ... the micro and pico cells can be used in both FDD, as shown, or **TDD**, with 2 x ...
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... ATM MAC MDR Multiservice Dynamic Reservation; based on dy- namic TDMA/**TDD**; design
by NEC [3,14] ... **Frame** length 2 ms 1 ms **FEC** – 31/26 CRC per packet 16 bits – ...
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TDD TDD FDD ... Spacing UsersICarrier Access Method Modulation **FEC** Coding Rate ...
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T Fujii, M NAKAGAWA - Vehicular Technology Conference, 1999. VTC 1999-Fall. IEEE ..., 1999 - ee.psu.ac.th
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error correction (**FEC**). ... the assignment status information of the next **frame**. ...
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R Steele - Antennas and Propagation, 1991. ICAP 91., Seventh ..., 1991 - ieeexplore.ieee.org
... on one FSK carrier with a **frame** having the BS ... cordless telecommunications (DECT)
system [4]. Again **TDD** is used ... certainly require ARQ, as well as **FEC** coding and ...
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... As a TDMA/**TDD** (time division duplexing) system, WATMnet ... the uplink M–B control sub-
frame slots are ... be obtained by using Forward Error Control (**FEC**) coding. ...
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S Choi, KG Shin - IEEE/ACM Transactions on Networking, 1999 - portal.acm.org
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correction (**FEC**) scheme is used ... on the uplink and downlink **frame** formats, which ...
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P Agrawal, E Hyden, P Krzyzanowski, P Mishra, MB ... - IEEE Personal Communications, 1996 - mnlab.cs.depaul.edu
... multiple ATM cells on the same VC into a variable sized MAC **frame**, and share ... on the
basis of the specified rate, (ii) link level error control using **FEC** and/or ...
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An adaptive data link layer protocol for wireless ATM networks
S Jagannath - 1997 - ittc.ku.edu
... for data applications, **FEC** operates in conjunction with ... within a dynamic TDMA/**TDD**
framework for ... rate acknowledgement and **frame** control overhead fields for each ...
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R ENVIRONMENTS - IEEE Communications Magazine, 1999 - ieeexplore.ieee.org
... these dif- ferent service needs are supported in a spectrum-efficient way by a combi
is a tin is of trcq mien cy— and time—division dci plex (I?DD and **TDD** ...
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Z Ye, GJ Saulnier, KS Vastola, MJ Medley - IEEE International Conference on Communications, 1999 - networks.ecse.rpi.edu
... DATA: Actual TX DATA (Variable processing gain) **FEC**: Error Correcting Code for
Rate Indicator SYNC Figure 2. Signal **frame** format for the adaptive OFDM-SS ...
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Performance Analysis of Multi-Antenna TD-CDMA Receivers with Estimation and Consideration of the ...
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TD-CDMA ... impulse ® Iter [18] GMSK convolutional encoder (**FEC**) constraint length ...
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A Lozano - PhD Theses, Stanford University, 1998 - wireless.stanford.edu
... branch antenna selection diversity, =10 dB, s =50 m and a 5-ms **frame** with 8 time
slots. . . . . s =50 m and a 5-ms **frame** with 8 time slots. . . . .
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K Czajkowski - ELECTRONICS & COMMUNICATION ENGINEERING JOURNAL, 1999 - ieeexplore.ieee.org
... FCC FDD **FEC** FEXT FFT FIR FSAN FITB FITC FTTCab ... **TDD** Tv UAWG UN1 UTP VDSL VoD xDSL ...
terminating equipment = long wave = main distribution **frame** = Motion Picture ...
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P Stavroulakis - International Journal of Communication Systems, 2000 - doi.wiley.com
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see Fixed Subscriber Unit Forward Error Correction (**FEC**) 13 Frequency ...
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A unified wireless LAN architecture for real-time and non-real-time communication services
S Choi, KG Shin - IEEE/ACM Transactions on Networking, 2000 - ieeexplore.ieee.org
... a portion (usually a half) of each time **frame** is allocated ... way traffic (eg, web
browsing), D-**TDD** is a ... a hybrid of forward-error correction (**FEC**) and automatic ...
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A PROPOSED ARCHITECTURE FOR A HIGH-DATA RATE MOBILE LMDS NETWORK
KR Reece, C Bostian, N Davis IV, T Pratt, J Reed, ... - 1999 - scholar.lib.vt.edu
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A Dornan - 2000 - print.google.com
... 43 Cells 45 Page 8. Handoff 47 Effect of Frequency 49 Duplexing 49 FDD 49 **TDD** 50
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S Baatz, M Frank, R Goepffarth, D Kassatkine, P ... - CONF LOCAL COMPUT NETWORKS. pp. 143-154. 2000, 2000 - cchen2.et.ntust.edu.tw
... fast ARQ (Automatic Repeat Request), CRC (Cyclic Redundancy Check) and **FEC** (Forward
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Y Ishibashi, S Tasaka, T Inoue - Global Telecommunications Conference, 1998. GLOBECOM 98. The ..., 1998 - ieeexplore.ieee.org
... both retransmission—ba.sed and forward error correc- tion (**FEC**)—hased error control for ... Note that a video **frame** in MPEG is either aim Intra—coded (I). P ...
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Z Ye, GJ Saulnier, A Seyedi, MJ Medley - AIAA Space Technology Conference & Exposition, Albuquerque, ..., 1999 - pdf.aiaa.org

... the satellite in the earth centered inertial (ECI) **frame**, angular velocity ... These include adaptive modulation, adaptive **FEC** coding and spread spectrum systems ...
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JV Evans - IEEE Antennas and Propagation Magazine, 1997 - ieeexplore.ieee.org
... Minimum channel spacing (lcHz) 50 20 10 5 Users/carrier 1 1 1 1 Access method FDMA FDMA FDMA FDMA Modulation Companded FM O-QPSK O-QPSK O-QPSK **FEC** coding rate N ...
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K Pahlavan, AH Levesque - Proceedings of the IEEE, 1994 - ieeexplore.ieee.org
... Channel Coding: **Frame** Duration (ms): ... FDD **TDD** 1250 1728 BPSW GFSK QPSK 200 mW 250 mW1 10 mW Dynamic YeS No YeS No QCELP ADPCM 1-8 (var.) 32 12 ...
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... a portion (usually a half) of each time **frame** is allocated ... way traffic (eg, web browsing), D-**TDD** is a ... a hybrid of forward-error correction (**FEC**) and automatic ...
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F Berens, A Worm, H Michel, N Wehn - IEEE VEH TECHNOL CONF, 1999 - ieeexplore.ieee.org
... Exploration The forward error correction control (**FEC**) has to ... Turbo- Codes in the UTRA-**TDD**-Mode. ... Turbo-Code Decoders Applied to Short **Frame** Transmission Systems ...
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[BOOK] Wireless technician's handbook
A Miceli - 2000 - print.google.com
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SG Glisic, S Gilsic, PA Leppanen - 1997 - print.google.com
... In Time Division Multiple Access (TDMA), within a given time **frame** a particular user is ... merged into three CDMAIFDD (Core A, B and C) and into one **TDD** proposal. ...
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AW Tranceivers, L Hanzo, CH Wong, MS Yee - IEEE Transactions on Vehicular Technology, 1993 - doi.wiley.com
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A Helal, B Haskell, JL Carter, R Brice, D Woelk, M ... - 1999 - print.google.com
Page 1. ANY TIME, ANYWHERE COMPUTING Mobile Computing Concepts and Technology ..
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Distributed resource allocation for DS-CDMA-based multimedia ad hoc wireless LAN's
S Lal, ES Sousa - IEEE J. Select Areas Commun, 1999 - ieeexplore.ieee.org
... is assumed that some form of forward error correction (**FEC**) is used ... forms of duplexing, frequency division duplexing (FDD) and time division duplexing (**TDD**). ...
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Adaptive Antenna Arrays for Satellite Personal Communication Systems
KJ Lian, T Pratt, C Bostian, B Woerner, V ... - 1997 - wwwgssr.uah.es
... The IRIDIUM system is fully digital and utilizes high-quality vocoded messages at 4.8 kbps with Forward Error Correction (**FEC**) coding. ...
View as HTML - Web Search - scholar.lib.vt.edu - scholar.lib.vt.edu - antennas.ee.duth.gr - all 5 versions »

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FEC TDD frame Search

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Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	8	TDD same uplink same modulation same FEC	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 15:17
L2	131	TDD same uplink same modulation	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 15:18
L3	0	TDD same frmae same uplink same modulation	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 15:19
L4	81	TDD same frame same uplink same modulation	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 15:19
S1	2	"6785278".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 07:40
S2	2	"6859655".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 07:44
S3	2	"6891810".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 07:44
S4	9	("5638371" | "5684791" | "5694424" | "5809086" | "5991292" | "6188873" | "6470057" | "6549759" | "6748021").PN. OR ("6891810").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:30
S5	1	"6804527".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:36

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S6	1	"6128331".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:37
S7	1	"5950124".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:38
S8	1	"5923651".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:38
S9	34	("3949404" | "4495619" | "5130983" | "5297144" | "5420851" | "5444698" | "5511082" | "5517503" | "5615212" | "5638371" | "5638374" | "5663990" | "5675573" | "5751708" | "5768254" | "5828695" | "5859619" | "5890055" | "5909469" | "6006069" | "6016311" | "6016313" | "6038455" | "6049566" | "6094421" | "6112080" | "6170061" | "6363241" | "6434189" | "6470005").PN. OR ("6549759"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:58
S10	11	(("3949404" | "4495619" | "5130983" | "5297144" | "5420851" | "5444698" | "5511082" | "5517503" | "5615212" | "5638371" | "5638374" | "5663990" | "5675573" | "5751708" | "5768254" | "5828695" | "5859619" | "5890055" | "5909469" | "6006069" | "6016311" | "6016313" | "6038455" | "6049566" | "6094421" | "6112080" | "6170061" | "6363241" | "6434189" | "6470005").PN. OR ("6549759"). URPN.) and TDD	US-PGPUB; USPAT; USOCR	OR	ON	2006/01/05 08:58

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Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L5	1	(wireless and access and network and (base adj station) and bidirectional and time and division and duplex and transceiver and transmit and path and circuitry and beam and signal and broadcast and downlink).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/01/05 16:19

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Inventor Name Search Result

Your Search was:

Last Name = STRUHSAKER
First Name = PAUL

Application#	Patent#	Status	Date Filed	Title	Inventor Name
60263097	Not Issued	159	01/19/2001	Redundant telecommunication system using memory equalization apparatus and method of operation	STRUHSAKER, PAUL F
60263101	Not Issued	159	01/19/2001	System for coordination of TDD transmission bursts within and between cells in a wireless access system and method of operation	STRUHSAKER, PAUL F
09520156	6668174	150	03/07/2000	METHOD AND SYSTEM FOR A MICRO-CHANNEL BANK FOR PROVIDING VOICE, DATA AND MUTIMEDIA SERVICES IN A WIRELESS LOCAL LOOP SYSTEM	STRUHSAKER, PAUL F.
09579349	6381211	150	05/25/2000	PROCESSING DATA TRANSMITTED AND RECEIVED OVER A WIRELESS LINK CONNECTING A CENTRAL TERMINAL AND A SUBSCRIBER TERMINAL OF A WIRELESS TELECOMMUNICATIONS SYSTEM	STRUHSAKER, PAUL F.
09641289	6434185	150	08/17/2000	CORRELATION SYSTEM FOR USE IN WIRELESS DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS	STRUHSAKER, PAUL F.
09838810	Not Issued	80	04/20/2001	Wireless communication system using block filtering and fast equalization-demodulation and method of operation	STRUHSAKER, PAUL F.
09838910	6564051	150	04/20/2001	SYSTEM AND METHOD FOR INTERFACE BETWEEN A SUBSCRIBER MODEM AND SUBSCRIBER PREMISES INTERFACES	STRUHSAKER, PAUL F.
09838924	Not Issued	71	04/20/2001	Apparatus for establishing a priority call in a fixed wireless access communication system	STRUHSAKER, PAUL F.
09839075	6859655	150	04/20/2001	TDD FDD AIR INTERFACE	STRUHSAKER, PAUL F.
09839259	Not Issued	71	04/20/2001	Redundant telecommunication system using memory equalization apparatus and method of operation	STRUHSAKER, PAUL F.
09839456	6891810	150	04/20/2001	WIRELESS ACCESS SYSTEM AND ASSOCIATED METHOD USING	STRUHSAKER, PAUL F.

				MULTIPLE MODULATION FORMATS IN TDD FRAMES ACCORDING TO SUBSCRIBER SERVICE TYPE	
09839457	Not Issued	94	04/20/2001	WIRELESS ACCESS SYSTEM FOR ALLOCATING AND SYNCHRONIZING UPLINK AND DOWNLINK OF TDD FRAMES AND METHOD OF OPERATION	STRUHSAKER, PAUL F.
09839458	Not Issued	71	04/20/2001	Wireless access system using multiple modulation formats in TDD frames and method of operation	STRUHSAKER, PAUL F.
09839499	Not Issued	71	04/20/2001	Apparatus, and an associated method, for providing WLAN service in a fixed wireless access communication system	STRUHSAKER, PAUL F.
09839509	Not Issued	120	04/20/2001	Backplane architecture for use in wireless and wireline access systems	STRUHSAKER, PAUL F.
09839512	6804527	150	04/20/2001	SYSTEM FOR COORDINATION OF TDD TRANSMISSION BURSTS WITHIN AND BETWEEN CELLS IN A WIRELESS ACCESS SYSTEM AND METHOD OF OPERATION	STRUHSAKER, PAUL F.
09839513	6925516	150	04/20/2001	SYSTEM AND METHOD FOR PROVIDING AN IMPROVED COMMON CONTROL BUS FOR USE IN ON-LINE INSERTION OF LINE REPLACEABLE UNITS IN WIRELESS AND WIRELINE ACCESS SYSTEMS	STRUHSAKER, PAUL F.
09839514	Not Issued	41	04/20/2001	System and method for on-line insertion of line replaceable units in wireless and wireline access systems	STRUHSAKER, PAUL F.
09839719	6947477	150	04/20/2001	APPARATUS AND METHOD FOR CREATING SIGNAL AND PROFILES AT A RECEIVING STATION	STRUHSAKER, PAUL F.
09839726	Not Issued	41	04/20/2001	Apparatus and associated method for operating upon data signals received at a receiving station of a fixed wireless access communication system	STRUHSAKER, PAUL F.
09839727	Not Issued	93	04/20/2001	APPARATUS FOR REALLOCATING COMMUNICATION RESOURCES TO ESTABLISH A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM	STRUHSAKER, PAUL F.
09839729	Not Issued	41	04/20/2001	Apparatus and method for operating a subscriber interface in a fixed wireless system	STRUHSAKER, PAUL F.
09839734	Not Issued	94	04/20/2001	METHOD FOR ESTABLISHING A PRIORITY CALL IN A FIXED WIRELESS ACCESS COMMUNICATION SYSTEM	STRUHSAKER, PAUL F.
09948059	Not Issued	30	09/05/2001	Wireless access system using selectively adaptable beam forming in TDD frames	STRUHSAKER, PAUL F.

				and method of operation	
10042705	Not Issued	71	11/15/2000	Subscriber integrated access device for use in wireless and wireline access systems	STRUHSAKER, PAUL F.
10722681	Not Issued	30	11/25/2003	Dual platform communication controller, method of controlling a dual platform communication and wireless communication system employing the same	STRUHSAKER, PAUL F.
60262698	Not Issued	159	01/19/2001	Apparatus and method for operating a subscriber interface in a fixed wireless system	STRUHSAKER, PAUL F.
60262708	Not Issued	159	01/19/2001	Apparatus, and an associated method, for providing WLAN service in a fixed wireless access communication system	STRUHSAKER, PAUL F.
60262712	Not Issued	159	01/19/2001	Wireless communication system using block filtering and fast equalization-demodulation and method of operation	STRUHSAKER, PAUL F.
60262824	Not Issued	159	01/19/2001	System and method for on-line insertion of line replaceable units in wireless and wireline access systems	STRUHSAKER, PAUL F.
60262825	Not Issued	159	01/19/2001	Apparatus and associated method for operating upon data signals received at a receiving station of a fixed wireless access communication system	STRUHSAKER, PAUL F.
60262826	Not Issued	159	01/19/2001	System and method for interface between a subscriber modem and subscriber premises interface	STRUHSAKER, PAUL F.
60262827	Not Issued	159	01/19/2001	Apparatus and method for creating signal and profiles at a receiving station	STRUHSAKER, PAUL F.
60262951	Not Issued	159	01/19/2001	Backplane architecture for use in wireless and wireline access systems	STRUHSAKER, PAUL F.
60262955	Not Issued	159	01/19/2001	TDD FDD air interface	STRUHSAKER, PAUL F.
60270378	Not Issued	159	02/21/2001	Apparatus for establishing a priority call in a fixed wireless access communication system	STRUHSAKER, PAUL F.
60270385	Not Issued	159	02/21/2001	Apparatus for reallocating communication resources to establish a priority call in a fixed wireless access communication system	STRUHSAKER, PAUL F.
60270430	Not Issued	159	02/21/2001	Method for establishing a priority call in a fixed wireless access communication system	STRUHSAKER, PAUL F.
60273579	Not Issued	159	03/05/2001	Wireless access system for allocating and synchronizing uplink and downlink of TDD frames and method of operation	STRUHSAKER, PAUL F.
60273689	Not Issued	159	03/05/2001	Wireless access system using multiple modulation formats in TDD frames and method of operation	STRUHSAKER, PAUL F.
60273757	Not	159	03/05/2001	Wireless access system and associated	STRUHSAKER, PAUL F.

	Issued			method using multiple modulation formats in TDD frames according to subscriber service type	
60434094	Not Issued	159	12/17/2002	Mechanism for bluetooth and IEEE 802.11 coexistence	STRUHSAKER, PAUL F.
08335328	6128331	150	11/07/1994	CORRELATION SYSTEM FOR USE IN WIRELESS DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS	STRUHSAKER, PAUL F.
08496768	Not Issued	161	06/29/1995	DIRECT SEQUENCE SPREAD SPECTRUM COMMUNICATION SYSTEM WITH DYNAMICALLY OPTIMIZED PERFORMANCE CAPABILITIES	STRUHSAKER, PAUL F.
08523942	Not Issued	161	09/06/1995	CELLULAR COMMUNICATION SYSTEM WITH DYNAMICALLY MODIFIED DATA TRANSMISSION PARAMETERS	STRUHSAKER, PAUL F.
08566502	5950124	150	12/04/1995	CELLULAR COMMUNICATION SYTEM WITH DYNAMICALLY MODIFIED DATA TRANSMISSION PARAMETERS	STRUHSAKER, PAUL F.
08768814	5966411	150	12/18/1996	MULTIPATH EQUALIZATION USING TAPS DERIVED FROM A PARALLEL CORRELATOR	STRUHSAKER, PAUL F.
08780055	5923651	150	12/23/1996	INCREASING DATA THROUGHPUT IN A WIRELESS TELECOMMUNICATIONS ENVIRONMENT	STRUHSAKER, PAUL F.
08866342	6052408	150	05/30/1997	CELLULAR COMMUNICATION SYSTEM WITH DYNAMICALLY MODIFIED DATA TRANSMISSION PARAMETERS	STRUHSAKER, PAUL F.
08978970	6222819	150	11/26/1997	PROCESSING DATA TRANSMITTED AND RECEIVED OVER A WIRELESS LINK CONNECTING A CENTRAL TERMINAL AND A SUBSCRIBER TERMINAL OF A WIRELESS TELECOMMUNICATIONS SYSTEM	STRUHSAKER, PAUL F.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

7590 01/10/2006

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EXAMINER	
AHMED, SALMAN	

ART UNIT	PAPER NUMBER
2666	

DATE MAILED: 01/10/2006

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

Office Action Summary	Application No.	Applicant(s)	
	09/948,059	STRUHSAKER, PAUL F.	
	Examiner	Art Unit	
	Salman Ahmed	2666	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 September 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,10-16 and 19-25* is/are rejected.

7)☒ Claim(s) *8,9,17,18,26,27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *1/10/02,9/5/01* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 102

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

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1, 10 and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Scott (US PAT 6094421).

In regards to claims 1 and 10 Scott anticipates for using in a wireless access network (Figure 3a element 301, a cellular environment for a communication system), comprising a plurality of base stations (figure 3a, element 304), each of plurality of base stations capable of bidirectional time division duplex (TDD) communication (column 5 lines 62-65, user stations 302 and base stations 304 may communicate using time

division duplex communication techniques) with wireless access devices (figure 3a element 302) disposed at a plurality of subscriber premises in an associated cell site (figure 3a, cells associated with user stations 302) of wireless access network, a transceiver (column 16 lines 51-52, a transmitter 807, a receiver 809 and fig 8A) associated with a first of plurality of base stations comprising:

transmit path circuitry (column 16 lines 51-52, a transmitter 807 and fig 8A) associated with a beam forming network capable of transmitting directed scanning beam signals (figure 3a and column 22 line 61, directional antenna) in a sector of a cell site associated with first base station, wherein transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal (column 20 lines 25-33, In each transmit time slot 574, rather than sending a message directed to a single user station 302, the base station 304 sends an interleaved message 578 containing a sub-message 589, for each of the user stations 302 (or a sub-message 589 for general polling or other functions if the receive time slot is unoccupied)) comprising a start of frame field (figure 11a, element 1102, preamble) capable of synchronizing (column 5 lines 1-5, The base station may precede their main data transmissions with a preamble, such as, for example, where desired for synchronization of spread spectrum communication signals or for conducting power control) and subsequently transmits downlink data traffic in a downlink portion (figure 507 element 502) of TDD frame (figure 5b, element 551) to at least one of wireless access devices using at least one directed scanning beam signal (figure 3a and column 22 line 61, directional antenna).

In regards to claims 2, 11 and 20 broadcast beam signal further comprising a first beam map (column 10 lines 55-64, a brief header 550) containing scanning beam information (column 10 lines 55-64, indicating whether or not the particular slot pair 510, 511 is available) usable by said at least one wireless access device to detect least one directed scanning beam signal is anticipated by (column 10 lines 55-64) by the steps of during facilitation of initial communication between a base station 304 and a user station 302, each base transmission during a transmit time slot 510 may have a brief header 550 preceding a data link message 551 indicating whether or not the particular slot pair 510, 511 is available. If a slot pair 510, 511 is available, a user station 302 desiring to establish communication with the base station 304 responds with a brief reply message 562 in the receive time slot 511 of the slot pair 510, 511.

In regards to claims 3, 12 and 21 scanning beam information identifying a downlink time slot in downlink portion (column 10 lines 55-64, by the steps of during facilitation of initial communication between a base station 304 and a user station 302, each base transmission during a transmit time slot 510 may have a brief header 550 preceding a data link message 551 indicating whether or not the particular slot pair 510, 511 is available) during which at least one directed scanning beam signal transmits downlink data traffic is anticipated by (column 10 lines 55-64) a slot pair 510, 511 if being available, a user station 302 desiring to establish communication with the base station 304 responds with a brief reply message 562 in the receive time slot 511 of the slot pair 510, 511.

In regards to claims 6, 15, 24, receive path circuitry (column 16 lines 51-52, a receiver 809 and Fig 8A) associated with said beam forming network capable of receiving uplink data traffic transmitted by at least one wireless access device in an uplink portion of said TDD frame (figure 7 element 504, Reception).

In regards to claims 7, 16 and 25 Scott anticipates, first beam map further contains uplink transmission information identifying an uplink time slot (column 8 lines 61-67, receive time slot 511) in uplink portion (figure 7 element 504) during which said at least one wireless access device transmits said uplink data traffic (column 8 lines 61-67) is anticipated by the user station 302 receiving a base transmission from the first transmit time slot 510 is the first to send a responsive user transmission in the first receive time slot 511, the user station 302 receiving the base transmission from the second transmit time slot 510 is the second to send a responsive user transmission in the second receive time slot 511, and so on. In this manner, the base station 304 sends a series of consecutive base transmissions, each directed to a separate user station 302, and receives a series of consecutive user transmissions in matching return order.

Claim Rejections - 35 USC § 103

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

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 4, 5, 13, 14, 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Scott in view of Baum et al. (Performance analysis of an adaptive OFDM packet data system; Broadband Communications, 2000. Proceedings. 2000 International Zurich Seminar on 15-17 Feb. 2000 Page(s):237 – 243), hereinafter referred to as Baum.

In regards to claims 4, 5, 13, 14, 22 and 23, Scott teaches using TDD for data communication between base stations and user units as described in the rejections of claims 1, 10 and 19 above.

In regards to claims 4, 5, 13, 14, 22 and 23, Scott does not explicitly teach scanning beam information identifies at least one modulation format and one forward error correction code level associated with at least one directed scanning beam signal.

In regards to claims 4, 13 and 22, Baum teaches (page 238, column 1, second paragraph) before transmission, fragments are FEC encoded with a 64-state rate-compatible punctured convolution (RCPC) code, interleaved, and mapped to a modulation scheme.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Scott's teaching by incorporating the inclusion of modulation scheme as taught by Baum. The motivation is that (as suggested by Baum, page 237, column 2, System Overview, first paragraph) a portion of the downlink interval contains control information that assigns the downlink and uplink resources to a

specific combination of subscriber units in the current frame. This provides a true "bandwidth on demand" capability in the system.

Allowable Subject Matter

5. Claim8, 9, 17, 18, 26 and 27 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. Prior art pertinent to the application but not used in office action:

- US 6470057 B1 USPAT Method for timing recovery and compensation in time-division-duplex wireless communications Hui; Liu et al.

- Wireless in-building network architecture and protocols Buchholz, D.; Odlyzko, P.; Taylor, M.; White, R.; Communications, 1992. ICC 92, Conference record, SUPERCOMM/ICC '92, Discovering a New World of Communications. IEEE International Conference on 14-18 June 1992 Page(s):1025 - 1031 vol.2

- Integrated video and data transmission in the TDD ALOHA-reservation wireless LAN Tasaka, S.; Hayashi, K.; Ishihashi, Y.; Communications, 1995. ICC 95 Seattle, Gateway to Globalization, 1995 IEEE International Conference on Volume 3, 18-22 June 1995 Page(s):1387 - 1393 vol.3.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salman Ahmed whose telephone number is (571)272-8307. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Seema Rao can be reached on (571)272-3174. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Salman Ahmed
Examiner
Art Unit 2666

SA

Seema S. Rao
SEEMA S. RAO 1/6/06
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

OIPE JC71
FEB 06 2003
PATENT & TRADEMARK OFFICE

PTO/SB/08A (10-01)
Approved for use through 10/31/2002. OMB 0551-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Art Unit	2681
Examiner Name	Not yet assigned
Attorney Docket Number	WEST14-00103

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
SA	AA	US- 6,181,955	01/30/2001	Dartois	
		US-			
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
SA	AB	WO 96/37970	11/28/1996	Nokia Telecommunications OY		

Examiner Signature		Date Considered	1/7/06

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

[1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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PTO/SB/08B (10-01)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449B/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 2 of 2

Complete if Known	
Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Group Art Unit	2681
Examiner Name	Not yet assigned
Attorney Docket Number	WEST14-00103

OTHER PRIOR ART -- NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
SA	AC	BENYAMIN-SEEYAR, Anader, et al; "DRAFT DOCUMENT FOR SC-FDE PHY LAYER SYSTEM FOR SUB 11 GHz BWA"; XP-002224912; IEEE 802.16.3c01-58r2; IEEE 802.16 Broadband Wireless Access Working Group, 'Online!; May 17, 2001; pages 0-87;	
SA	AD	LEIBA, Yigal, et al.; "MAC AND PHY SUPPORT FOR AAS"; XP-002224913; IEEE C802.16a-02/49; IEEE 802.16 Broadband Wireless Access Working Group, 'Oneline!; May 10, 2002, pages 1-10	

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FEB 11 2003
Technology Center 2600

Examiner Signature		Date Considered	1.7.06

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

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Notice of References Cited	Application/Control No. 09/948,059	Applicant(s)/Patent Under Reexamination STRUHSAKER, PAUL F.	
	Examiner Salman Ahmed	Art Unit 2666	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,094,421	07-2000	Scott, Logan	370/280
*	B	US-6,470,057	10-2002	Hui et al.	375/294
	C	US-			
	D	US-			
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Baum et al. (Performance analysis of an adaptive OFDM packet data system; Broadband Communications, 2000. Proceedings. 2000 International Zurich Seminar on 15-17 Feb. 2000 Page(s):237 – 243)
	V	·Wireless in-building network architecture and protocols Buchholz, D.; Odlyzko, P.; Taylor, M.; White, R.; Communications, 1992. ICC 92, Conference record, SUPERCOMM/ICC '92, Discovering a New World of Communications. IEEE International Conference on 14-1
	W	·Integrated video and data transmission in the TDD ALOHA-reservation wireless LAN Tasaka, S.; Hayashi, K.; Ishihashi, Y.; Communications, 1995. ICC 95 Seattle, Gateway to Globalization, 1995 IEEE International Conference on Volume 3, 18-22 June 1995 Page
	X	

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

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

Bib Data Sheet

CONFIRMATION NO. 5591

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/948,059	09/05/2001 RULE	455	2681	WEST14-00103

APPLICANTS

Paul F. Struhsaker, Plano, TX;

(VERIFIED)

** CONTINUING DATA **********

THIS APPLN CLAIMS BENEFIT OF 60/262,712 01/19/2001
AND CLAIMS BENEFIT OF 60/262,825 01/19/2001
AND CLAIMS BENEFIT OF 60/262,698 01/19/2001
AND CLAIMS BENEFIT OF 60/262,827 01/19/2001
AND CLAIMS BENEFIT OF 60/262,826 01/19/2001
AND CLAIMS BENEFIT OF 60/262,951 01/19/2001
AND CLAIMS BENEFIT OF 60/262,824 01/19/2001
AND CLAIMS BENEFIT OF 60/263,101 01/19/2001
AND CLAIMS BENEFIT OF 60/263,097 01/19/2001
AND CLAIMS BENEFIT OF 60/273,579 03/05/2001
AND CLAIMS BENEFIT OF 60/262,955 01/19/2001
AND CLAIMS BENEFIT OF 60/262,708 01/19/2001
AND CLAIMS BENEFIT OF 60/273,689 03/05/2001
AND CLAIMS BENEFIT OF 60/273,757 03/05/2001
AND CLAIMS BENEFIT OF 60/270,378 02/21/2001
AND CLAIMS BENEFIT OF 60/270,385 02/21/2001
AND CLAIMS BENEFIT OF 60/270,430 02/21/2001

1.7.06

** FOREIGN APPLICATIONS ********** (NONE)

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
**10/06/2001

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☒ no	TX	14	27	3
35 USC 119 (a-d) conditions met	☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged	Examiner's Signature / Initials SA				

ADDRESS

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS , TX 75240

TITLE

Wireless access system using selectively adaptable beam forming in TDD frames and method of operation

☐ All Fees

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
09/948,059	STRUHSAKER, PAUL F.
Examiner	**Art Unit**
Salman Ahmed	2666

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
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Claim		Date								
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/948,059	STRUHSAKER, PAUL F.	
	Examiner	Art Unit	
	Salman Ahmed	2666	

SEARCHED			
Class	Subclass	Date	Examiner
370	280	1/4/2006	SA
370	347	1/4/2006	SA
370	252	1/4/2006	SA
370	350	1/4/2006	SA
370	347-348	1/4/2006	SA

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
See interference search		1/4/2006	SA

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
See attached search history	1/4/2006	SA
IEEE, google and inventorship search	1/4/2006	SA

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PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103
Customer No. 23990

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2666
Examiner	:	Salman Ahmed

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT AND RESPONSE TO OFFICE ACTION

A two month extension of time is believed to be required. An appropriate petition and fee are enclosed. A fee of $50.00 for two additional dependent claims.

No further fees are believed to be necessary; however, in the event that any additional fees are required for the prosecution of this application, please charge any necessary fees to Deposit Account No. 50-0208. No further extension of time is believed to be necessary. If, however, an additional extension of time is needed, the extension is requested and please charge the fee for this extension to Deposit Account No. 50-0208.

05/19/2006 FFANAEIA 00000042 09948059
02 FC:2202 50.00 OP

In response to the Office Action dated January 10, 2006, please amend the above-identified application as follows:

PETITIONER VERIZON
EX. 1012
P. 246

AMENDMENTS TO THE CLAIMS:

Please amend the claims as follows, substituting any amended claim(s) for the corresponding pending claim(s):

1. (Currently Amended) For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the boradcast beam signal comprising a start of frame field, and

subsequently transmits, in a downlink portion of said TDD frame, first downlink data traffic to substantially only ~~at least one of said~~ wireless access devices within one of said sectors using ~~at least~~ one of said directed scanning beam signals.

PETITIONER VERIZON
EX. 1012
P. 247

2. (Currently Amended) The transceiver as set forth in Claim 1 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said ~~at least one~~ wireless access devices to detect said ~~least one~~ directed scanning beam signals.

3. (Currently Amended) The transceiver as set forth in Claim 2 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said ~~at least~~ one of said directed scanning beam signals transmits said downlink data traffic.

4. (Currently Amended) The transceiver as set forth in Claim 3 wherein said scanning beam information identifies at least one modulation format associated with said ~~at least~~ one of said directed scanning beam signals.

5. (Currently Amended) The transceiver as set forth in Claim 3 wherein said scanning beam information identifies at least one forward error correction code level associated with said ~~at least~~ one of said directed scanning beam signals.

6. (Currently Amended) The transceiver as set forth in Claim 2 further comprising receive path circuitry associated with said beam forming network capable of receiving uplink data traffic transmitted by ~~said~~ at least one wireless access device in an uplink portion of said TDD frame.

PETITIONER VERIZON
EX. 1012
P. 248

7. (Original) The transceiver as set forth in Claim 6 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

8. (Original) The transceiver as set forth in Claim 7 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

9. (Original) The transceiver as set forth in Claim 8 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

PETITIONER VERIZON
EX. 1012
P. 249

10. (Currently Amended) A fixed wireless access network comprising:

a plurality of base stations, each of said base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in a cell site associated with said each base station, wherein said each base station comprises:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the boradcast beam signal comprising a start of frame field, and

subsequently transmits, in a downlink portion of said TDD frame, first downlink data traffic to substantially only ~~at least one of said~~ wireless access devices within one of said sectors using ~~at least~~ one of said directed scanning beam signals.

11. (Currently Amended) The fixed wireless access network as set forth in Claim 10 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said ~~at least one~~ wireless access devices to detect said ~~least one~~ directed scanning beam signals.

12. (Currently Amended) The fixed wireless access network as set forth in Claim 11 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said ~~at least~~ one of said directed scanning beam signals transmits said downlink data traffic.

13. (Currently Amended) The fixed wireless access network as set forth in Claim 12 wherein said scanning beam information identifies at least one modulation format associated with said ~~at least~~ one of said directed scanning beam signals.

14. (Currently Amended) The fixed wireless access network as set forth in Claim 12 wherein said scanning beam information identifies at least one forward error correction code level associated with said ~~at least~~ one of said directed scanning beam signals.

PETITIONER VERIZON
EX. 1012
P. 251

15. (Currently Amended) The fixed wireless access network as set forth in Claim 11 wherein said each base station further comprises receive path circuitry associated with said beam forming network capable of receiving uplink data traffic transmitted by ~~said~~ at least one wireless access device in an uplink portion of said TDD frame.

16. (Original) The fixed wireless access network as set forth in Claim 15 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

17. (Original) The fixed wireless access network as set forth in Claim 16 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

18. (Original) The fixed wireless access network as set forth in Claim 17 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

PETITIONER VERIZON
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19. (Currently Amended) For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a method of communicating with a first of said plurality of base stations comprising the steps of:

transmitting, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of a plurality of sectors within said associated cell site, the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and

transmitting, ~~downlink data traffic~~ in a downlink portion of said TDD frame, first downlink data traffic to ~~at least one of said~~ substantially only wireless access devices in a first of said sectors ~~of a cell site associated with said first base station~~ using ~~at least one~~ a first directed scanning beam signal.

20. (Currently Amended) The method as set forth in Claim 19 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said ~~at least one~~ wireless access devices to receive said ~~least one~~ first directed scanning beam signal.

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21. (Currently Amended) The method as set forth in Claim 20 wherein said scanning beam information identifies a downlink time slot in said downlink portion during which said ~~at least one~~ first directed scanning beam signal transmits said downlink data traffic.

22. (Currently Amended) The method as set forth in Claim 21 wherein said scanning beam information identifies at least one modulation format associated with said ~~at least one~~ first directed scanning beam signal.

23. (Currently Amended) The method as set forth in Claim 21 wherein said scanning beam information identifies at least one forward error correction code level associated with said ~~at least one~~ directed scanning beam signal.

24. (Currently Amended) The method as set forth in Claim 20 further the step of receiving uplink data traffic transmitted by ~~said~~ at least one wireless access device in an uplink portion of said TDD frame.

25. (Original) The method as set forth in Claim 24 wherein said first beam map further contains uplink transmission information identifying an uplink time slot in said uplink portion during which said at least one wireless access device transmits said uplink data traffic.

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26. (Original) The method as set forth in Claim 25 wherein said uplink transmission information further identifies at least one modulation format used by said at least one wireless access device to transmit said uplink data traffic.

27. (Original) The method as set forth in Claim 26 wherein said uplink transmission information further identifies at least one at least one forward error correction code level used by said at least one wireless access device to transmit said uplink data traffic.

Please add the following new claims:

28. (Newly Added) The transceiver as set forth in Claim 1 wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.

29. (Newly Added) The method as set forth in Claim 19, further comprising:

transmitting, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of said sectors using a second directed scanning beam signal..

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REMARKS

Claims 1–27 are pending in the present application.

Claims 1–6, 10–15 and 19–24 have been amended herein. Claims 28–29 were added.

Claims 8–9, 17–18 and 26–27 were objected to as being dependent upon a rejected base claim, but were indicated to be allowable if rewritten in independent form including all limitations of the base claim(s) and any intervening claims. Because the Applicants believe that the remaining claims in this application are still allowable, the Applicants have not rewritten those claims in independent form.

Reconsideration of the claims is respectfully requested.

35 U.S.C. § 102 (Anticipation)

Claims 1, 10 and 19 were rejected under 35 U.S.C. § 102(e) as being unpatentable over U.S. Patent No. 6,094,421 to *Scott*. This rejection is respectfully traversed.

A claim is anticipated only if each and every element is found, either expressly or inherently described, in a single prior art reference. The identical invention must be shown in as complete detail as is contained in the claim. MPEP § 2131 at p. 2100-76 (8th ed. rev. 4 October 2005).

Claims 1, 10 and 19 each recite that first downlink data traffic transmitted during a downlink portion of the TDD frame is transmitted to substantially only wireless access devices within one of the cell sectors using one of the directed scanning beam signals. Such a feature is not found in the

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cited reference. The cited portion of *Scott* merely teaches that directional antennas may optionally be employed and, if so employed, may be accommodated by an adjustment interval within a frame:

> The antenna adjustment interval 1017 may be of sufficient duration to allow transmission of a data symbol indicating selection of a particular antenna beam or permitting minor adjustments to the angle of a directional antenna at the base station 302, or permitting selection of one or more antennas if the base station 302 is so equipped.

Scott, column 22, lines 57–63. Nothing in the cited portion of *Scott* suggests using a directional antenna to transmit download traffic to substantially only devices within one cell sector.

Therefore, the rejection of claims 1, 10 and 19 under 35 U.S.C. § 102 has been overcome.

35 U.S.C. § 103 (Obviousness)

Claims 4–5, 13–14 and 22–23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Scott* in view of Baum et al, "Performance Analysis of An Adaptive OFDM Packet Data System." This rejection is respectfully traversed.

In *ex parte* examination of patent applications, the Patent Office bears the burden of establishing a *prima facie* case of obviousness. MPEP § 2142, p. 2100-133 (8th ed. rev. 4 October 2005). Absent such a *prima facie* case, the applicant is under no obligation to produce evidence of nonobviousness. *Id.*

To establish a *prima facie* case of obviousness, three basic criteria must be met: First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference

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teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *Id.*

As noted above, independent claims 1, 10 and 19 and each recite features not found in *Scott*. Such features are also not found in *Baum et al.*

Therefore, the rejection of claims 4–5, 13–14 and 22–23 under 35 U.S.C. § 103 has been overcome.

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If any issues arise, or if the Examiner has any suggestions for expediting allowance of this Application, the Applicant respectfully invites the Examiner to contact the undersigned at the telephone number indicated below or at ***dvenglarik@munckbutrus.com***.

The Commissioner is hereby authorized to charge any additional fees connected with this communication or credit any overpayment to Deposit Account No. 50-0208.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 5-15-06

Daniel E. Venglarik
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OIPE
MAY 18 2006
PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103
Customer No. 23990

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2666
Examiner	:	Salman Ahmed

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

PETITION FOR EXTENSION OF TIME

Applicant respectfully requests a two (2) month extension of time for filing a response to the Office Action mailed January 10, 2006. The response period is presently set to expire on April 10, 2006, and if this Petition for Extension of Time is granted, the new response date will be June 10, 2006.

A check in the amount of $275.00 is enclosed for two additional dependent claims ($50.00) and the two-month extension fee ($225.00). The Commissioner is hereby authorized to charge any

05/19/2006 FFANAEIA 00000042 09948059
01 FC:2252 225.00 OP

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additional fees which may be required, or credit any overpayment to Davis Munck Deposit Account No. 50-0208.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 5-15-06

Daniel E. Venglarik
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OIPE
MAY 18 2006
PATENT & TRADEMARK OFFICE
IAP18

DOCKET NO. WEST14-00103
Customer No. 23990

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2666
Examiner	:	Salman Ahmed

MAIL STOP AMENDMENT
Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT TRANSMITTAL LETTER

Transmitted herewith is an Amendment and Response to Office Action in the above-identified application. The fee has been calculated as shown below.

CLAIMS AS AMENDED					SMALL ENTITY	
(1)	(2) CLAIMS REMAINING AFTER AMENDMENT	(3)	(4) HIGHEST NUMBER PREVIOUSLY PAID FOR	(5) NUMBER OF EXTRA CLAIMS PRESENT	(6) RATE	(7) ADDITIONAL FEE
TOTAL CLAIMS	29	-	27	2	X 25.00 =	$50.00
IND. CLAIMS	3	-	3	-0-	X 100.00 =	$-0-
			TOTAL ADDITIONAL FEE FOR THIS AMENDMENT			$50.00

✔ A check in the amount of $275.00 is enclosed for two additional dependent claims ($50.00) and two-month extension fee ($225.00).

____ A check in the amount of $_____ for a _____-month extension of time is attached.

✔ Please charge any additional fees or credit any overpayment to the Davis Munck Deposit Account No. 50-0208.

A DUPLICATE COPY OF THIS SHEET IS ENCLOSED.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 5-15-06

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OIPE
MAY 18 2006
PATENT & TRADEMARK OFFICE

TFW 2666

DOCKET NO. WEST14-00105 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2666
Examiner	:	Salman Ahmed

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

Sir:

The undersigned hereby certifies that the following documents:

1. Amendment Transmittal Letter (in duplicate);
2. Amendment and Response to Office Action;
3. Petition for Extension of Time - two months (in duplicate);
4. Check in the amount of $225.00 for two additional dependent claims ($50.00) and two-month extension fee ($225.00); and
5. A postcard receipt

relating to the above application, were deposited as "First Class Mail" with the United States Postal Service, addressed to MAIL STOP AMENDMENT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on May 15, 2006.

Date: 5/15/06 Kathy Ceder
Mailer

Date: 5-15-2006 Daniel E. Venglarik
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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	"6094421".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/31 09:27
L2	136	("3795864" | "3838221" | "4189677" | "4217563" | "4222115" | "4291410" | "4301530" | "4324001" | "4355411" | "4418393" | "4432089" | "4481640" | "4484028" | "4494211" | "4506372" | "4513416" | "4525835" | "4587662" | "4612637" | "4621365" | "4672658" | "4675863" | "4688210" | "4696051" | "4701904" | "4703474" | "4724435" | "4736371" | "4742512" | "4754453" | "4765753" | "4797947" | "4807222" | "4901307" | "4905221" | "4953197" | "4979170" | "4984247" | "4995083" | "5016255" | "5018165" | "5022046" | "5022047" | "5025452" | "5029184" | "5042050" | "5042082" | "5056109" | "5073900" | "5093840" | "5097484" | "5101501" | "5103459" | "5107225" | "5109393" | "5111535" | "5117423" | "5166929" | "5170412" | "5177765" | "5177766" | "5200956" | "5210771" | "5257283" | "5263045" | "5263047" | "5265119" | "5267262" | "5274665" | "5278835" | "5289497" | "5291516" | "5299198" | "5303287" | "5313457" | "5353303" | "5361277" | "5363368" | "5363373" | "5383219" | "5392287" | "5398247" | "5402413" | "5410568" | "5414796" | "5420851" | "5430760" | "5434859" | "5444696" | "5446727" | "5454028" | "5455822" | "5471649" | "5481533" | "5483676" | "5506837" | "5528597" | "5689502" | "5715521" | "5745484" | "5828659").PN. OR ("6094421"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2006/05/31 12:00

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EAST Search Hist ry

L3	14	TDD same frame same uplink same modulation same (cell or sector)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/05/31 12:01
L4	0	("2005/0075125").URPN.	USPAT	OR	ON	2006/05/31 12:01
L5	5	("2002/0141355").URPN.	USPAT	OR	ON	2006/05/31 12:01
L6	5	("2002/0136170").URPN.	USPAT	OR	ON	2006/05/31 12:02
L7	0	("2002/0122395").URPN.	USPAT	OR	ON	2006/05/31 12:02
L8	11	("20030002495" | "5793753" | "5832365" | "5978650" | "6222858" | "6230326" | "6320903" | "6345071" | "6590872" | "6636490" | "6654384").PN. OR ("6947477"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2006/05/31 12:02

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

7590 06/07/2006

NOVAKOV DAVIS & MUNCK
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13155 NOEL ROAD
DALLAS, TX 75240

EXAMINER	
AHMED, SALMAN	

ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 06/07/2006

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

Office Action Summary	Application No.	Applicant(s)	
	09/948,059	STRUHSAKER, PAUL F.	
	Examiner	Art Unit	
	Salman Ahmed	2616	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5/18/2006(Amendments)*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,10-16,19-25,28 and 29* is/are rejected.

7)☒ Claim(s) *8,9,17,18,26 and 27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *1/10/02,9/5/01* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

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DETAILED ACTION

Claims 1-29 are pending.

Claims 1-7, 10-16, 19-25, 28 and 29 are rejected.

Claims 8, 9, 17, 18, 26 and 27 are objected to.

Claim Rejections - 35 USC § 102

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

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1-3, 6, 7, 10-12, 15, 16, 19-21, 24, 25, 28 and 29 are rejected under 35 U.S.C. 102(e) as being anticipated by Scott (US PAT 6094421).

In regards to claims 1, 10 and 19 Scott anticipates for using in a wireless access

network (Figure 3a element 301, a cellular environment for a communication system), comprising a plurality of base stations (figure 3a, element 304), each of plurality of base stations capable of bidirectional time division duplex (TDD) communication (column 5 lines 62-65, user stations 302 and base stations 304 may communicate using time division duplex communication techniques) with wireless access devices (figure 3a element 302) disposed at a plurality of subscriber premises in an associated cell site (figure 3a, cells associated with user stations 302) of wireless access network, a transceiver (column 16 lines 51-52, a transmitter 807, a receiver 809 and fig 8A) associated with a first of plurality of base stations comprising:

transmit path circuitry (column 16 lines 51-52, a transmitter 807 and fig 8A) associated with a beam forming network capable of transmitting directed scanning beam signals (figure 3a and column 22 line 61, directional antenna) each directed to substantially only wireless access devices within a different one of a plurality of sectors (figure 3a, cells associated with user stations 302) in a sector of a cell site associated with first base station, wherein transmit path circuitry transmits at a start of a TDD frame a broadcast beam signal (column 20 lines 25-33, In each transmit time slot 574, rather than sending a message directed to a single user station 302, the base station 304 sends an interleaved message 578 containing a sub-message 589, for each of the user stations 302 (or a sub-message 589 for general polling or other functions if the receive time slot is unoccupied)) to wireless access devices within more than one of sectors (figure 3a, cells associated with user stations 302) the broadcast beam signal comprising a start of frame field (figure 11a, element 1102, preamble) capable of

synchronizing (column 5 lines 1-5, The base station may precede their main data transmissions with a preamble, such as, for example, where desired for synchronization of spread spectrum communication signals or for conducting power control) subsequently transmits in a downlink portion (figure 507 element 502) of TDD frame (figure 5b, element 551) first downlink data traffic (figure 507 element 502) to substantially only wireless access devices within one of sectors (figure 3a, cells associated with user stations 302) using one of directed scanning beam signals (figure 3a and column 22 line 61, directional antenna).

In regards to claims 2, 11 and 20 broadcast beam signal further comprising a first beam map (column 10 lines 55-64, a brief header 550) containing scanning beam information (column 10 lines 55-64, indicating whether or not the particular slot pair 510, 511 is available) usable by said wireless access device to detect directed scanning beam signal is anticipated by (column 10 lines 55-64) by the steps of during facilitation of initial communication between a base station 304 and a user station 302, each base transmission during a transmit time slot 510 may have a brief header 550 preceding a data link message 551 indicating whether or not the particular slot pair 510, 511 is available. If a slot pair 510, 511 is available, a user station 302 desiring to establish communication with the base station 304 responds with a brief reply message 562 in the receive time slot 511 of the slot pair 510, 511.

In regards to claims 3, 12 and 21 scanning beam information identifying a downlink time slot in downlink portion (column 10 lines 55-64, by the steps of during facilitation of initial communication between a base station 304 and a user station 302,

each base transmission during a transmit time slot 510 may have a brief header 550 preceding a data link message 551 indicating whether or not the particular slot pair 510, 511 is available) during which one of directed scanning beam signal transmits downlink data traffic is anticipated by (column 10 lines 55-64) a slot pair 510, 511 if being available, a user station 302 desiring to establish communication with the base station 304 responds with a brief reply message 562 in the receive time slot 511 of the slot pair 510, 511.

In regards to claims 6, 15, 24, receive path circuitry (column 16 lines 51-52, a receiver 809 and Fig 8A) associated with said beam forming network capable of receiving uplink data traffic transmitted by one wireless access device in an uplink portion of said TDD frame (figure 7 element 504, Reception).

In regards to claims 7, 16 and 25 Scott anticipates, first beam map further contains uplink transmission information identifying an uplink time slot (column 8 lines 61-67, receive time slot 511) in uplink portion (figure 7 element 504) during which said at least one wireless access device transmits said uplink data traffic (column 8 lines 61-67) is anticipated by the user station 302 receiving a base transmission from the first transmit time slot 510 is the first to send a responsive user transmission in the first receive time slot 511, the user station 302 receiving the base transmission from the second transmit time slot 510 is the second to send a responsive user transmission in the second receive time slot 511, and so on. In this manner, the base station 304 sends a series of consecutive base transmissions, each directed to a separate user station 302, and receives a series of consecutive user transmissions in matching return order.

In regards to claims 28 and 29, Scott anticipates transmit path circuitry (column 16 lines 51-52, a transmitter 807 and fig 8A) transmits, in downlink portion (figure 507 element 502) of TDD frame (figure 5b, element 551), second downlink data traffic to substantially only wireless access devices within an other of sectors (column 2 lines 5-10, the base station may transmit to a first user station, await a response, and, after receiving a response from the first user station, transmit to a second user station, and so on, until the base station has communicated with all user stations sequentially over a particular time frame) using an other of directed scanning (figure 3a and column 22 line 61, directional antenna) beam signals (column 20 lines 25-33, In each transmit time slot 574, rather than sending a message directed to a single user station 302, the base station 304 sends an interleaved message 578 containing a sub-message 589, for each of the user stations 302 (or a sub-message 589 for general polling or other functions if the receive time slot is unoccupied))

Claim Rejections - 35 USC § 103

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

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 4, 5, 13, 14, 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Scott in view of Baum et al. (Performance analysis of an adaptive

OFDM packet data system; Broadband Communications, 2000. Proceedings. 2000 International Zurich Seminar on 15-17 Feb. 2000 Page(s):237 – 243), hereinafter referred to as Baum.

In regards to claims 4, 5, 13, 14, 22 and 23, Scott teaches using TDD for data communication between base stations and user units as described in the rejections of claims 1, 10 and 19 above.

Scott does not explicitly teach scanning beam information identifies at least one modulation format and one forward error correction code level associated with one of directed scanning beam signal.

Baum in the same field of endeavor teaches (page 238, column 1, second paragraph) before transmission, fragments are FEC encoded with a 64-state rate-compatible punctured convolution (RCPC) code, interleaved, and mapped to a modulation scheme.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Scott's teaching by incorporating the inclusion of modulation scheme as taught by Baum. The motivation is that (as suggested by Baum, page 237, column 2, System Overview, first paragraph) a portion of the downlink interval contains control information that assigns the downlink and uplink resources to a specific combination of subscriber units in the current frame. This provides a true "bandwidth on demand" capability in the system, thus making the system efficient.

Allowable Subject Matter

5. Claims 8, 9, 17, 18, 26 and 27 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

6. Applicant's arguments see pages 12-14 of the Remarks section, filed 5/18/2006, with respect to rejections of claims 1-7. 10-16 and 19-25 have been fully considered and are not persuasive.

In regards to claims 1, 10 and 19, the Applicant argues (See page 12 last paragraph and page 13 paragraph 3) that Scott reference does not teach *first downlink data traffic transmitted during a downlink portion of the TDD frame is transmitted to substantially only wireless access devices within one of the cell sectors using one of the directed scanning beam signals* and further argues that *nothing in the cited portion of Scott suggests using a directional antenna to transmit download traffic to substantially only devices within one cell sector.* However, Examiner respectfully disagrees with this assertion. The present claim language is broad and in view of the broadest reasonable interpretation of this language, Scott does in fact disclose the cited limitations. Specifically Scott teaches transmit path circuitry (column 16 lines 51-52, a transmitter 807 and fig 8A) associated with a beam forming network capable of transmitting directed scanning beam signals (figure 3a and column 22 line 61, directional antenna) each directed to substantially only wireless access devices within a different one of a

plurality of sectors (figure 3a, cells associated with user stations 302) in a sector of a cell site associated with first base station. To further clarify, Scott teaches (column 2 lines 19-27) user stations are often mobile and can move anywhere within the radius of the cell covered by a base station. Scott teaches In FIG. 3A, a communication system 301 for communication among a plurality of user stations 302 includes a plurality of cells 303, each with a base station 304, typically located at the center of the cell 303. Each station (both the base stations 304 and the user stations 302) generally comprises a receiver and a transmitter. The user stations 302 and base stations 304 may communicate using time division duplex or any of the other communication techniques disclosed (column 6 lines 57-65).

In regards to claims 4, 5, 13, 14, 22 and 23 the Applicant argues (see page 13 last paragraph and page 14 first paragraph) that *to establish a prima-facie case of obviousness, three basic criteria must be met: First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. Id.* However, in response Examiner respectfully states that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed

invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art at the time the invention was made. See In re Keller 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Prior art pertinent to the application but not used in office action:

- US 6470057 B1 USPAT Method for timing recovery and compensation in time-division-duplex wireless communications Hui; Liu et al.
- Wireless in-building network architecture and protocols Buchholz, D.; Odlyzko, P.; Taylor, M.; White, R.; Communications, 1992. ICC 92, Conference record, SUPERCOMM/ICC '92, Discovering a New World of

Communications. IEEE International Conference on 14-18 June 1992 Page(s):1025 - 1031 vol.2

- Integrated video and data transmission in the TDD ALOHA-reservation wireless LAN Tasaka, S.; Hayashi, K.; Ishihashi, Y.; Communications, 1995. ICC 95 Seattle, Gateway to Globalization, 1995 IEEE International Conference on Volume 3, 18-22 June 1995 Page(s):1387 - 1393 vol.3.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salman Ahmed whose telephone number is (571)272-8307. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hassan Kizou can be reached on (571) 272-3088. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

Art Unit 2616

SA
05/31/2006

HASSAN KIZOU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Notice of References Cited	Application/Control No. 09/948,059	Applicant(s)/Patent Under Reexamination STRUHSAKER, PAUL F.	
	Examiner Salman Ahmed	Art Unit 2666	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,094,421	07-2000	Scott, Logan	370/280
*	B	US-6,470,057	10-2002	Hui et al.	375/294
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Baum et al. (Performance analysis of an adaptive OFDM packet data system; Broadband Communications, 2000. Proceedings. 2000 International Zurich Seminar on 15-17 Feb. 2000 Page(s):237 – 243)
	V	·Wireless in-building network architecture and protocols Buchholz, D.; Odlyzko, P.; Taylor, M.; White, R.; Communications, 1992. ICC 92, Conference record, SUPERCOMM/ICC '92, Discovering a New World of Communications. IEEE International Conference on 14-1
	W	·Integrated video and data transmission in the TDD ALOHA-reservation wireless LAN Tasaka, S.; Hayashi, K.; Ishihashi, Y.; Communications, 1995. ICC 95 Seattle, Gateway to Globalization, 1995 IEEE International Conference on Volume 3, 18-22 June 1995 Page
	X	

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

Index of Claims

Applicati n/Contr I N .	Applicant(s)/Patent under Reexamination
09948059	STRUHSAKER, PAUL F.
Examiner	**Art Unit**
Ahmed, Salman	2616

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

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

CLAIM		DATE								
Final	Original	5/31/2006								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	O								
	9	O								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	O								
	18	O								
	19	✓								
	20	✓								
	21	✓								
	22	✓								
	23	✓								
	24	✓								
	25	✓								
	26	O								
	27	O								
	28	✓								
	29	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	09948059	STRUHSAKER, PAUL F.
	Examiner Ahmed, Salman	Art Unit 2616

Notes	Date	Examiner
Updated Search	5/31/2006	SA

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Searched	Application/Control No.	Applicant(s)/Patent Under Reexamination
	09948059	STRUHSAKER, PAUL F.
	Examiner Ahmed, Salman	Art Unit 2616

Class	SubClass	Date	Examiner
Updated Search	Updated Search	5/31/2006	SA

U.S. Patent and Trademark Office	Part of Paper No.:

OIPE
OCT 13 2006
PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2616
Examiner	:	Salman Ahmed

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Applicant requests review of the final rejection in the above-identified application. No amendments are being filed with this request.

This request is being filed with a notice of appeal. The review is requested for the reason(s) stated in the arguments below, demonstrating the clear legal and factual deficiency of the rejections of some or all claims.

Claims 1–3, 6–7, 10–12, 15–16, 19–21, 24–25 and 28–29 were rejected under 35 U.S.C. § 102(e) as being unpatentable over U.S. Patent No. 6,094,421 to *Scott*. Independent claims 1, 10 and

19 each recite a beam forming network transmitting directed scanning beam signals each directed substantially only to wireless access devices within a different one of a plurality of sectors, the network transmitting the same start of frame field for a TDD frame to all wireless access devices within more than one of the sectors, then subsequently transmitting first downlink data traffic to only wireless access devices within one of said sectors in a downlink portion of the TDD frame. Such a feature is not found in the cited reference. The cited portion of *Scott* merely teaches that directional antennas may optionally be employed and, if so employed, may be accommodated by an adjustment interval within a frame:

> The antenna adjustment interval 1017 may be of sufficient duration to allow transmission of a data symbol indicating selection of a particular antenna beam or permitting minor adjustments to the angle of a directional antenna at the base station 302, or permitting selection of one or more antennas if the base station 302 is so equipped.

Scott, column 22, lines 57–63. Nothing in the cited portion of *Scott* suggests using directional antennae to transmit a start of frame to all devices within all sectors, but transmit certain download traffic to substantially only devices within one cell sector.

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EX. 1012
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If any issues arise, or if the Examiner has any suggestions for expediting allowance of this Application, the Applicant respectfully invites the Examiner to contact the undersigned at the telephone number indicated below or at ***dvenglarik@munckbutrus.com***.

The Commissioner is hereby authorized to charge any additional fees connected with this communication or credit any overpayment to Deposit Account No. 50-0208.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 10-10-2006

Daniel E. Venglarik
Registration No. 39,409

P.O. Drawer 800889
Dallas, Texas 75380
(972) 628-3621 (direct dial)
(972) 628-3600 (main number)
(972) 628-3616 (fax)
E-mail: *dvenglarik@munckbutrus.com*

OIPE 4512
OCT 13 2006
PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2616
Examiner	:	Salman Ahmed

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

NOTICE OF APPEAL

Applicant hereby appeals to the Board of Appeals from the decision dated June 7, 2006, of the Primary Examiner finally rejecting Claims 1-29.

Applicant respectfully requests a one (1) month extension of time for filing a Notice of Appeal in response to the final Office Action dated June 7, 2006. The response period is presently set to expire on September 7, 2006, and if this Request for Extension of Time is granted, the new response date will be October 7, 2006 (Saturday). Since Monday, October 9, 2006 is a Federal Holiday (Columbus Day), the response is extended to Tuesday, October 10, 2006.

10/13/2006 CNGUYEN 00000028 09948059
02 FC:2401 250.00 OP

PETITIONER VERIZON
EX. 1012
P. 287

A check in the amount of $310.00 is enclosed in payment of the Notice of Appeal filing fee ($250.00) and one-month extension fee ($60.00). The Commissioner is hereby authorized to charge any additional fees connected with this communication or credit any overpayment to Munck Butrus Deposit Account No. 50-0208.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 10-10-2006

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OIPE IAP12
OCT 13 2006
PATENT & TRADEMARK OFFICE

AF

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2616
Examiner	:	Salman Ahmed

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

PETITION FOR EXTENSION OF TIME

Applicant respectfully requests a one (1) month extension of time for filing a Notice of Appeal in response to the final Office Action mailed June 7, 2006. The response period is presently set to expire on September 7, 2006, and if this Petition for Extension of Time is granted, the new response date will be October 7, 2006 (Saturday). Since Monday, October 9, 2006 is a Federal Holiday (Columbus Day), the response is extended to Tuesday, October 10, 2006.

10/13/2006 CNGUYEN 00000028 09948059
01 FC:2251 60.00 OP

PETITIONER VERIZON
EX. 1012
P. 289

A check in the amount of $310.00 is enclosed for the Notice of Appeal filing fee ($250.00) and one-month extension fee ($60.00). The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Munck ButrusDeposit Account No. 50-0208.

Respectfully submitted,

MUNCK BUTRUS, P.C.

Date: 10-10-2006

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PETITIONER VERIZON
EX. 1012
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OIPE IAP12
OCT 13 2006
PATENT & TRADEMARK OFFICE

DOCKET NO. WEST14-00103 **PATENT**
Customer No. 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Serial No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Group No.	:	2616
Examiner	:	Salman Ahmed

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

Sir:

The undersigned hereby certifies that the following documents:

1. Notice of Appeal;
2. Pre-Appeal Brief Request for Review;
3. Petition for Extension of Time - one month (in duplicate);
4. Check in the amount of $310.00 for the Notice of Appeal filing fee ($250.00) and one-month extension fee ($60.00); and
5. A postcard receipt

relating to the above application, were deposited as "First Class Mail" with the United States Postal Service, addressed to MAIL STOP AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 10, 2006.

Date: 10/10/06

Mailer

Date: 10-10-2006

Daniel E. Venglarik
Reg. No. 39,409

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Fax: (972) 628-3616
E-mail: *dvenglarik@munckbutrus.com*

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	58057	Frame same direct$5 same (beam or signal) and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 13:50
L2	488	Frame same direct$5 same broadcast same (beam or signal) and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 13:50
L3	488	(Frame same direct$5 same broadcast same (beam or signal)) and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 13:51
L4	214	(Frame same direct$5 same broadcast same (beam or signal) same (data or payload)) and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 13:52
L5	11	(Frame same direct$5 same broadcast same (beam or signal) same (data or payload)) and TDD and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 13:59
L6	17	(Frame same direct$5 same omni) and TDD and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 14:10
L7	211	(Frame same direct$5 same omni) and (@rlad<"20010119" or @ad<"20010119")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/04 14:11

PETITIONER VERIZON
EX. 1012
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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	718	((base adj station) or basestation) and (TDD or (time adj division adj duplex)).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/05 08:46
L2	422	(((base adj station) or basestation) and (TDD or (time adj division adj duplex))).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/05 08:47
L3	90	(((base adj station) or basestation) and (TDD or (time adj division adj duplex$3)) and direct$3 and (signal or beam)).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/05 08:50
L4	32	(((base adj station) or basestation) and (TDD or (time adj division adj duplex$3)) and direct$3 and (signal or beam) and frame).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/05 08:57
L5	4	(((base adj station) or basestation) and (TDD or (time adj division adj duplex$3)) and direct$3 and (signal or beam) and frame and (header or preamble)).clm.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2006/12/05 08:58

PETITIONER VERIZON
EX. 1012
P. 293

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

7590 12/06/2006

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

EXAMINER	
AHMED, SALMAN	

ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 12/06/2006

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

Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/948,059	STRUHSAKER, PAUL F.	
	Hassan Kizou	Art Unit 2616	

Document Code - AP.PRE.DEC

Notice of Panel Decision from Pre-Appeal Brief Review

This is in response to the Pre-Appeal Brief Request for Review filed 10/13/06.

1. ☐ **Improper Request** – The Request is improper and a conference will not be held for the following reason(s):

☐ The Notice of Appeal has not been filed concurrent with the Pre-Appeal Brief Request.
☐ The request does not include reasons why a review is appropriate.
☐ A proposed amendment is included with the Pre-Appeal Brief request.
☐ Other:

The time period for filing a response continues to run from the receipt date of the Notice of Appeal or from the mail date of the last Office communication, if no Notice of Appeal has been received.

2. ☐ **Proceed to Board of Patent Appeals and Interferences** – A Pre-Appeal Brief conference has been held. The application remains under appeal because there is at least one actual issue for appeal. Applicant is required to submit an appeal brief in accordance with 37 CFR 41.37. The time period for filing an appeal brief will be reset to be one month from mailing this decision, or the balance of the two-month time period running from the receipt of the notice of appeal, whichever is greater. Further, the time period for filing of the appeal brief is extendible under 37 CFR 1.136 based upon the mail date of this decision or the receipt date of the notice of appeal, as applicable.

☐ The panel has determined the status of the claim(s) is as follows:
Claim(s) allowed: _____.
Claim(s) objected to: _____.
Claim(s) rejected: _____.
Claim(s) withdrawn from consideration: _____.

3. ☒ **Allowable application** – A conference has been held. The rejection is withdrawn and a Notice of Allowance will be mailed. Prosecution on the merits remains closed. No further action is required by applicant at this time.

4. ☐ **Reopen Prosecution** – A conference has been held. The rejection is withdrawn and a new Office action will be mailed. No further action is required by applicant at this time.

All participants:

(1) *Hassan Kizou*. HK (3)_____.

(2) *Salman Ahmed*. SA (4)_____.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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NOTICE OF ALLOWANCE AND FEE(S) DUE

7590 01/22/2007

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

EXAMINER	
AHMED, SALMAN	
ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 01/22/2007

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

TITLE OF INVENTION: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$700	$300	$0	$1000	04/23/2007

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

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

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

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

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

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

PETITIONER VERIZON
EX. 1012
P. 296

PART B - FEE(S) TRANSMITTAL

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

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

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

7590 01/22/2007

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

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

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

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

TITLE OF INVENTION: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$700	$300	$0	$1000	04/23/2007

EXAMINER	ART UNIT	CLASS-SUBCLASS
AHMED, SALMAN	2616	370-280000

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

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

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

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

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

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

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

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

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

7590 01/22/2007

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A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

EXAMINER	
AHMED, SALMAN	
ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 01/22/2007

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

The Patent Term Adjustment to date is 1088 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 1088 day(s).

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

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

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

PTOL-85 (Rev. 07/06) Approved for use through 04/30/2007.

PETITIONER VERIZON
EX. 1012
P. 298

Notice of Allowability	Application No.	Applicant(s)	
	09/948,059	STRUHSAKER, PAUL F.	
	Examiner	Art Unit	
	Salman Ahmed	2616	

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

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

1. ☒ This communication is responsive to *Pre-Brief Conference Request*.

2. ☒ The allowed claim(s) is/are *1-29*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

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

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

EXAMINER'S AMENDMENT

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

The application has been amended as follows:

Claim 1 line 11 "boradcast" has been changed to –broadcast--.

Claim 10 line 11 "boradcast" has been changed to –broadcast--.

Allowable Subject Matter

1. Claims 1-29 are allowed.

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

The prior arts of record do not teach the following:

In regards to claims 1, 10 and 19 the prior arts do not teach transmitting at a start of a TDD frame a broadcast beam signal to wireless access devices within more than one of the sectors, the broadcast beam signal comprising a start of frame field and subsequently transmitting in a downlink portion of the TDD frame, first downlink data traffic to substantially only wireless access devices within one of the sectors using one of the directed scanning beam signal(s).

The prior arts alone or in combination fail to jointly suggest or teach the claimed combination of features as taught by the instant application. Therefore claims 1-29 are to be deemed allowable over prior art.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salman Ahmed whose telephone number is (571)272-8307. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hassan Kizou can be reached on (571) 272-3088. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

Art Unit 2616

SA
12/4/2006

HASSAN KIZOU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

Notice of References Cited	Application/Control No. 09/948,059	Applicant(s)/Patent Under Reexamination STRUHSAKER, PAUL F.	
	Examiner Salman Ahmed	Art Unit 2666	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,094,421	07-2000	Scott, Logan	370/280
*	B	US-6,470,057	10-2002	Hui et al.	375/294
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Baum et al. (Performance analysis of an adaptive OFDM packet data system; Broadband Communications, 2000. Proceedings. 2000 International Zurich Seminar on 15-17 Feb. 2000 Page(s):237 – 243)
	V	·Wireless in-building network architecture and protocols Buchholz, D.; Odlyzko, P.; Taylor, M.; White, R.; Communications, 1992. ICC 92, Conference record, SUPERCOMM/ICC '92, Discovering a New World of Communications. IEEE International Conference on 14-1
	W	·Integrated video and data transmission in the TDD ALOHA-reservation wireless LAN Tasaka, S.; Hayashi, K.; Ishihashi, Y.; Communications, 1995. ICC 95 Seattle, Gateway to Globalization, 1995 IEEE International Conference on Volume 3, 18-22 June 1995 Page
	X	

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

PETITIONER VERIZON
EX. 1012
P. 303

OIPE JC71
FEB 06 2003
PATENT & TRADEMARK OFFICE

PTO/SB/08A (10-01)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 2

Complete If Known	
Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Art Unit	2681
Examiner Name	Not yet assigned
Attorney Docket Number	WEST14-00103

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
SR	AA	US- 6,181,955	01/30/2001	Dartois	
		US-			
		US-			
		US-			
		US-			
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
SR	AB	WO 96/37970	11/28/1996	Nokia Telecommunications OY		

Examiner Signature		Date Considered	1/7/06

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

[1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 9/948059

CLAIMS AS FILED - PART I

	(Column 1)		(Column 2)
TOTAL CLAIMS	27		
FOR	NUMBER FILED		NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	27	minus 20=	* 7
INDEPENDENT CLAIMS	3	minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT			☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=	63	OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL	$418	OR	TOTAL	

5/18/06

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 29	Minus	** 27	= 2
Independent	* 3	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
~~X$ 9=~~ 25	50	OR	X$18=	
~~X40=~~ 100		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE	$50	OR	TOTAL ADDIT. FEE	

1/19/07

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 29	Minus	** 29	=
Independent	* 3	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Issue Classification	Application/Control No. 09/948,059	Applicant(s)/Patent under Reexamination STRUHSAKER, PAUL F.
	Examiner Salman Ahmed	Art Unit 2616

ISSUE CLASSIFICATION

ORIGINAL		INTERNATIONAL CLASSIFICATION											
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED						
370	280	H	04	J	03	/00					/		
CROSS REFERENCES													
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					/					/		
370	294					/					/		
						/					/		
						/					/		
						/					/		
						/					/		

Salman Ahmed 12/4/2006
(Assistant Examiner) (Date)

(Legal Instruments Examiner) (Date)

HASSAN KIZOU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600
(Primary Examiner) (Date)

Total Claims Allowed: 29

O.G. Print Claim(s)	O.G. Print Fig.
1	14

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

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91		121		151		181
	2		32		62		92		122		152		182
	3		33		63		93		123		153		183
	4		34		64		94		124		154		184
	5		35		65		95		125		155		185
	6		36		66		96		126		156		186
	7		37		67		97		127		157		187
	8		38		68		98		128		158		188
	9		39		69		99		129		159		189
	10		40		70		100		130		160		190
	11		41		71		101		131		161		191
	12		42		72		102		132		162		192
	13		43		73		103		133		163		193
	14		44		74		104		134		164		194
	15		45		75		105		135		165		195
	16		46		76		106		136		166		196
	17		47		77		107		137		167		197
	18		48		78		108		138		168		198
	19		49		79		109		139		169		199
	20		50		80		110		140		170		200
	21		51		81		111		141		171		201
	22		52		82		112		142		172		202
	23		53		83		113		143		173		203
	24		54		84		114		144		174		204
	25		55		85		115		145		175		205
	26		56		86		116		146		176		206
	27		57		87		117		147		177		207
	28		58		88		118		148		178		208
	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination
	09/948,059	STRUHSAKER, PAUL F.
	Examiner	Art Unit
	Salman Ahmed	2616

SEARCHED			
Class	Subclass	Date	Examiner
Updated	Search	12/4/2006	SA

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
See interference search		12/5/2006	SA

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
Updated search	12/4/2006	SA

04-20-07

USPTO APR 19 2007 PATENT & TRADEMARK OFFICE

PART B - FEE(S) TRANSMITTAL

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

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

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

7590 01/22/2007

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
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DALLAS, TX 75240

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

Certificate of Mailing or Transmission

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

Nancy J. Lauterbach	(Depositor's name)
Nancy J. Lauterbach	(Signature)
4-19-07	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

TITLE OF INVENTION: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$700	$300	$0	$1000	04/23/2007

04/20/2007 TBESHAH2 00000070 09948059

01 FC:2501 700.00 OP
02 FC:1504 300.00 OP
03 FC:1051 15.00 OP

EXAMINER	ART UNIT	CLASS-SUBCLASS
AHMED, SALMAN	2616	370-280000

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

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

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

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

(A) NAME OF ASSIGNEE: Raze Technologies, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Plano, Texas

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

4a. The following fee(s) are submitted:
☑ Issue Fee
☑ Publication Fee (No small entity discount permitted)
☑ Advance Order - # of Copies 5

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☑ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-0208 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature William A. Munck Date Apr. 19 2007

Typed or printed name William A. Munck Registration No. 39,308

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

USPTO
APR 19 2007
PATENT & TRADEMARK OFFICE

PART B - FEE(S) TRANSMITTAL DUPLICATE

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

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

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

7590 01/22/2007

NOVAKOV DAVIS & MUNCK
A PROFFESSIONAL CORPORATION
900 THREE GALLERIA TOWER
13155 NOEL ROAD
DALLAS, TX 75240

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

Certificate of Mailing or Transmission

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

Nancy J. Lambertini	(Depositor's name)
Nancy J. Lambertini	(Signature)
4-19-07	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103	5591

TITLE OF INVENTION: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$700	$300	$0	$1000	04/23/2007

EXAMINER	ART UNIT	CLASS-SUBCLASS
AHMED, SALMAN	2616	370-280000

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

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

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

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

(A) NAME OF ASSIGNEE: Raze Technologies, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Plano, Texas

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

4a. The following fee(s) are submitted:
☑ Issue Fee
☑ Publication Fee (No small entity discount permitted)
☑ Advance Order - # of Copies 5

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☑ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-0208 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature William A. Munck Date Apr. 19 2007

Typed or printed name William A. Munck Registration No. 39,308

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DOCKET NO.: WEST14-00103 **PATENT**
Customer No.: 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	Paul F. Struhsaker
Application No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Art Unit	:	2616
Examiner	:	Salman Ahmed

USPTO IAP78 APR 19 2007 PATENT & TRADEMARK OFFICE

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CERTIFICATE OF MAILING BY EXPRESS MAIL

The undersigned hereby certifies that the following documents:

1) Part B Issue Fee Transmittal (in duplicate);
2) Check in the amount of $1,015.00 for issue fee ($700.00), publication fee ($300.00) and soft copies of patent ($15.00);
3) Fee Transmittal for FY 2006 (in duplicate);
4) Change of Correspondence Address; and
5) A Postcard receipt

relating to the above application, were deposited as "Express Mail", Label No. EV863464611US with the United States Postal Service, addressed to Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on April 19, 2007.

Date: 4-19-07

Mailer

Date: Apr. 19, 2007

William A. Munck
Reg. No. 39,308

P.O. Drawer 800889
Dallas, Texas 75380
Phone: (972) 628-3600
Fax: (972) 628-3616
E-mail: *wmunck@munckbutrus.com*

OIPE LAP78 APR 19 2007 PATENT & TRADEMARK OFFICE

PTO/SB/17 (12-04)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2006

☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 1,015.00

Complete if Known	
Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Examiner Name	Salman Ahmed
Art Unit	2616
Attorney Docket No.	WEST14-00103

METHOD OF PAYMENT (check all that apply)

☑ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☑ Deposit Account Deposit Account Number: 50-0208 Deposit Account Name: Munck Butrus P.C.

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☑ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☑ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES Fee ($)	FILING FEES Small Entity Fee ($)	SEARCH FEES Fee ($)	SEARCH FEES Small Entity Fee ($)	EXAMINATION FEES Fee ($)	EXAMINATION FEES Small Entity Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 or, for Reissues, each claim over 20 and more than in the original patent	50	25
Each independent claim over 3 or, for Reissues, each independent claim more than in the original patent	200	100
Multiple dependent claims	360	180

Total Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 20 or HP =	_____ x	_____ =	_____

HP = highest number of total claims paid for, if greater than 20

Indep. Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 3 or HP =	_____ x	_____ =	_____

HP = highest number of independent claims paid for, if greater than 3

Multiple Dependent Claims Fee ($)	Fee Paid ($)
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee ($)	Fee Paid ($)
_____ - 100 =	_____ / 50 =	_____ (round **up** to a whole number) x	_____ =	_____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	
Other: Issue Fee ($700), Publication Fee ($300) and copies of patent ($15)	$1,015.00

SUBMITTED BY

Signature	William C Munck	Registration No. (Attorney/Agent) 39,308	Telephone 972-628-3600
Name (Print/Type)	William A. Munck		Date Apr. 19, 2007

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

USPTO IAP78
APR 19 2007
PATENT & TRADEMARK OFFICE

PTO/SB/122 (09-03)
Approved for use through 11/30/2005. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

CHANGE OF CORRESPONDENCE ADDRESS
Application

Address to:
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450.

Application Number	09/948,059
Filing Date	September 5, 2001
First Named Inventor	Paul F. Struhsaker
Art Unit	2616
Examiner Name	Salman Ahmed
Attorney Docket Number	WEST14-00103

Please change the Correspondence Address for the above-identified patent application to:

☑ Customer Number : 23990

OR

☐ **Firm or Individual Name**					
Address					
Address					
City		**State**		**Zip**	
Country					
Telephone		**Fax**			

This form cannot be used to change the data associated with a Customer Number. To change the data associated with an existing Customer Number use "Request for Customer Number Data Change" (PTO/SB/124).

I am the:

☐ Applicant/Inventor

☐ Assignee of record of the entire interest.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☑ Attorney or Agent of record. Registration Number 39,308.

☐ Registered practitioner named in the application transmittal letter in an application without an executed oath or declaration. See 37 CFR 1.33(a)(1). Registration Number_____.

Typed or Printed Name	William A. Munck
Signature	William C Munck
Date	Apr. 19, 2007
Telephone	972-628-3600

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____forms are submitted.

This collection of information is required by 37 CFR 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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UNITED STATES PATENT AND TRADEMARK OFFICE

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

BIBDATASHEET

Bib Data Sheet

CONFIRMATION NO. 5591

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/948,059	09/05/2001 RULE	370	2616	WEST14-00103

APPLICANTS

Paul F. Struhsaker, Plano, TX;

**** CONTINUING DATA ***************************

This appln claims benefit of 60/262,712 01/19/2001
and claims benefit of 60/262,825 01/19/2001
and claims benefit of 60/262,698 01/19/2001
and claims benefit of 60/262,827 01/19/2001
and claims benefit of 60/262,826 01/19/2001
and claims benefit of 60/262,951 01/19/2001
and claims benefit of 60/262,824 01/19/2001
and claims benefit of 60/263,101 01/19/2001
and claims benefit of 60/263,097 01/19/2001
and claims benefit of 60/273,579 03/05/2001
and claims benefit of 60/262,955 01/19/2001
and claims benefit of 60/262,708 01/19/2001
and claims benefit of 60/273,689 03/05/2001
and claims benefit of 60/273,757 03/05/2001
and claims benefit of 60/270,378 02/21/2001
and claims benefit of 60/270,385 02/21/2001
and claims benefit of 60/270,430 02/21/2001

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

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 10/06/2001

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☐ no	TX	14	27	3
35 USC 119 (a-d) conditions met	☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged	Examiner's Signature Initials				

ADDRESS
23990

TITLE
WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

FILING FEE RECEIVED	FEES: Authority has been given in Paper	☐ All Fees
848	No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time)

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	06/12/2007	7230931	WEST14-00103	5591

23990 7590 05/23/2007

DOCKET CLERK
P.O. DRAWER 800889
DALLAS, TX 75380

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 1088 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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

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

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

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

Paul F. Struhsaker, Plano, TX;

DOCKET NO.: WEST14-00103 **PATENT**
Customer No.: 23990

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	Paul F. Struhsaker
U.S. Patent No.	:	7,230,931
Issued	:	June 12, 2007
Application No.	:	09/948,059
Filed	:	September 5, 2001
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
Art Unit	:	2616
Examiner	:	Salman Ahmed
Confirmation No.	:	5591

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT AND CHANGE OF CORRESPONDENCE ADDRESS

The undersigned attorney, on behalf of and including the attorneys/agents associated with Customer No. 23990, hereby withdraw as attorneys or agents in connection with the above-identified matter.

The reasons for withdrawal are that the Owner/Applicant (1) has effectively discharged the practitioners by failing to respond and communicate with practitioners to

PETITIONER VERIZON
EX. 1012
P. 315

reasonable requests concerning representation and/or (2) has failed to pay one or more bills rendered by the practitioners for an unreasonable period of time and/or has knowingly and freely assented to termination of the employment.

Accordingly, the practitioners believe that no further action on the part of the practitioners is necessary for withdrawal. However, as a precautionary matter, the practitioners have taken reasonable steps to avoid any foreseeable prejudice to the rights of the Owner/Applicant, including having performed the following:

- Given due notice to the Owner/Applicant that the practitioners are withdrawing from representation in this matter and have filed, or will be filing, the necessary papers with the Patent & Trademark Office,
- Delivered to the Owner/Applicant all papers and property to which the Owner/Applicant is entitled, or requesting instructions from the Owner/Applicant regarding disposition of the Owner/Applicant's files; and
- Notified the Owner/Applicant of any responses that may be due and the time frame within which Owner/Applicant must respond.

Please address all future correspondence to:

Mr. Michael S. Hynek
17519 Muirfield Drive
Dallas, Texas 75287

Respectfully submitted,

MUNCK CARTER, P.C.

Date: 11 Dec. 2008

John T. Mockler
Reg. No. 39,775

Docket Clerk
P.O. Drawer 800889
Dallas, Texas 75380
Phone: (972) 628-3600
Fax: (972) 628-3616
Email: *jmockler@munckcarter.com*

Doc Code: PET.POA.WDRW
Document Description: Petition to withdraw attorney or agent (SB83)

PTO/SB/83 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT AND CHANGE OF CORRESPONDENCE ADDRESS

Patent Number	7,230,931
Issue Date	June 12, 2007
First Named Inventor	Paul F. Struhsaker
Art Unit	2616
Examiner Name	Salman Ahmed
Attorney Docket Number	WEST14-00103

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Please withdraw me as attorney or agent for the above identified patent application, and

☐ all the practitioners of record;

☐ the practitioners (with registration numbers) of record listed on the attached paper(s); or

☑ the practitioners of record associated with Customer Number: 23990

NOTE: The immediately preceding box should only be marked when the practitioners were appointed using the listed Customer Number.

The reason(s) for this request are those described in 37 CFR :

☐ 10.40(b)(1)	☐ 10.40(b)(2)	☐ 10.40(b)(3)	☐ 10.40(b)(4)
☐ 10.40(c)(1)(i)	☐ 10.40(c)(1)(ii)	☐ 10.40(c)(1)(iii)	☐ 10.40(c)(1)(iv)
☐ 10.40(c)(1)(v)	☑ 10.40(c)(1)(vi)	☐ 10.40(c)(2)	☐ 10.40(c)(3)
☐ 10.40(c)(4)	☐ 10.40(c)(5)	☐ 10.40(c)(6) Please explain below:	

Certifications

Check each box below that is factually correct. WARNING: If a box is left unchecked, the request will likely not be approved.

1. ☑ I/We have given reasonable notice to the client, prior to the expiration of the response period, that the practitioner(s) intend to withdraw from employment.

2. ☑ I/We have delivered to the client or a duly authorized representative of the client all papers and property (including funds) to which the client is entitled.

3. ☑ I/We have notified the client of any responses that may be due and the time frame within which the client must respond.

Please provide an explanation, if necessary:

Please see attachment.

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/SB/83 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
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REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT AND CHANGE OF CORRESPONDENCE ADDRESS

Complete the following section only when the correspondence address will change. *Changes of address will only be accepted to an inventor or an assignee that has properly made itself of record pursuant to 37 CFR 3.71.*

Change the correspondence address and direct all future correspondence to:

A. ☐ The address of the inventor or assignee associated with Customer Number: _____

OR

B. ☑ Inventor or Assignee name	Michael S. Hynek			
Address 17519 Muirfield Drive				
City Dallas	State Texas	Zip 75287	Country USA	
Telephone		Email		

I am authorized to sign on behalf of myself and all withdrawing practitioners.

Signature	John T. Mockler		
Name	John T. Mockler	Registration No. 39,775	
Address 600 Banner Place, 12770 Coit Road			
City Dallas	State Texas	Zip 75251	Country USA
Date	11 Dec. 2008	Telephone No. 972-628-3600	

NOTE: ***Withdrawal is effective when approved rather than when received.***

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Electronic Acknowledgement Receipt

EFS ID:	4442186
Application Number:	09948059
International Application Number:	
Confirmation Number:	5591
Title of Invention:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
First Named Inventor/Applicant Name:	Paul F. Struhsaker
Customer Number:	23990
Filer:	John Mockler/Keith Woods
Filer Authorized By:	John Mockler
Attorney Docket Number:	WEST14-00103
Receipt Date:	11-DEC-2008
Filing Date:	05-SEP-2001
Time Stamp:	19:57:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition to withdraw attorney or agent (SB83)	WithdrawalAsAttorney.pdf	301990 6e94fa71930d4e2958cf6b22654c03bcfbbc11ce	no	5

Warnings:	
Information:	

Total Files Size (in bytes):	301990

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PTO/SB/81A (12-08)
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PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Patent Number	7,230,931
Issue Date	6/12/07
First Named Inventor	Struhsaker
Title	Wireless Access System Using Selectively Adaptable Beam Forming...
Attorney Docket Number	9030101.147-US1

I hereby revoke all previous powers of attorney given in the above-identified patent.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 70763

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

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

I am the:

☐ Inventor, having ownership of the patent.

OR

☒ Patent owner.

Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Inventor or Patent Owner

Signature	Michael S. Hynek	Date	7-8-10
Name	Michael S. Hynek	Telephone	
Title and Company	Manager, Access Solutions, Ltd.		

NOTE: Signatures of all the inventors or patent owners of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/SB/96 (07-09)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Access Solutions, Ltd.

Application No./Patent No.: 7,230,931 Filed/Issue Date: 6/12/07

Titled: Wireless Access System Using Selectively Adaptable Beam Forming in TDD Frames and Method of Operation

Access Solutions, Ltd. (Name of Assignee), a Texas limited partnership (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. [X] the assignee of the entire right, title, and interest in;

2. [ ] an assignee of less than the entire right, title, and interest in (The extent (by percentage) of its ownership interest is _____ %); or

3. [ ] the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

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

OR

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

1. From: P. Struhsaker To: Raze Technologies, Inc.

The document was recorded in the United States Patent and Trademark Office at Reel 12467, Frame 0944, or for which a copy thereof is attached.

2. From: Raze Technologies, Inc. To: Access Solutions, Ltd.

The document was recorded in the United States Patent and Trademark Office at Reel 012449, Frame 0730, or for which a copy thereof is attached.

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

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

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

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

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

Michael S. Hynek — Signature

7-8-10 — Date

Michael S. Hynek — Printed or Typed Name

Manager — Title

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt

EFS ID:	7990110
Application Number:	09948059
International Application Number:	
Confirmation Number:	5591
Title of Invention:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
First Named Inventor/Applicant Name:	Paul F. Struhsaker
Customer Number:	23990
Filer:	Matthew T. Byrne
Filer Authorized By:	
Attorney Docket Number:	WEST14-00103
Receipt Date:	11-JUL-2010
Filing Date:	05-SEP-2001
Time Stamp:	12:08:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	9030101_147_US1_POA.pdf	118626 b8a306601439e2c81a0be63f235918abc813cf0e	no	2

Warnings:	
Information:	

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Total Files Size (in bytes):	118626

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/948,059	09/05/2001	Paul F. Struhsaker	9030101.147-US1

CONFIRMATION NO. 5591

POA ACCEPTANCE LETTER

70763
Byrne Poh LLP
11 Broadway, Ste 865
New York, NY 10004

OC000000042600139

Date Mailed: 07/16/2010

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/11/2010.

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

/skiflemariam/

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

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UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/948,059	09/05/2001	Paul F. Struhsaker	WEST14-00103

CONFIRMATION NO. 5591

POWER OF ATTORNEY NOTICE

23990
DOCKET CLERK
P.O. DRAWER 800889
DALLAS, TX 75380

OC000000042600128

Date Mailed: 07/16/2010

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/11/2010.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/skiflemariam/

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

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P. 327

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT for the Eastern District of Texas
PLAINTIFF GENERAL ACCESS SOLUTIONS, LTD.		DEFENDANT SPRINT CORPORATION, VIRGIN MOBILE USA, L.P. and BOOST MOBILE LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 6,891,810 B2	5/10/2005	General Access Solutions, Ltd.
2	US 7,173,916 B2	2/6/2007	General Access Solutions, Ltd.
3	US 7,230,931 B2	6/12/2007	General Access Solutions, Ltd.
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

Trials@uspto.gov
571.272.7822

Paper 5
Entered: March 9, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.,
Petitioner,

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Patent Owner.

Case IPR2017-01889
Patent 7,230,931 B2

Before KALYAN K. DESHPANDE, DAVID M. KOHUT, and MELISSA A. HAAPALA, *Administrative Patent Judges*.

HAAPALA, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

Sprint Spectrum L.P. ("Petitioner") filed a Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–29 of U.S. Patent No. 7,230,931 B2 ("the '931 patent"). Paper 1 ("Pet."). General Access Solutions, Ltd. ("Patent Owner") did not file a Preliminary Response. Applying the standard set forth in 35 U.S.C. § 314(a), which requires demonstration of a reasonable likelihood that Petitioner would prevail with respect to at least one challenged claim, we grant Petitioner's request to institute an *inter partes* review of claims 1, 3–10, 12–19, and 21–29. We decline to institute a review of claims 2, 11, and 20.

I. BACKGROUND

A. The '931 Patent (Ex. 1001)

The '931 patent describes a burst packet transmission media access system using selectively adaptable beam forming in a fixed wireless access network. Ex. 1001, 3:28–31. Figure 1 of the '931 patent is reproduced below:

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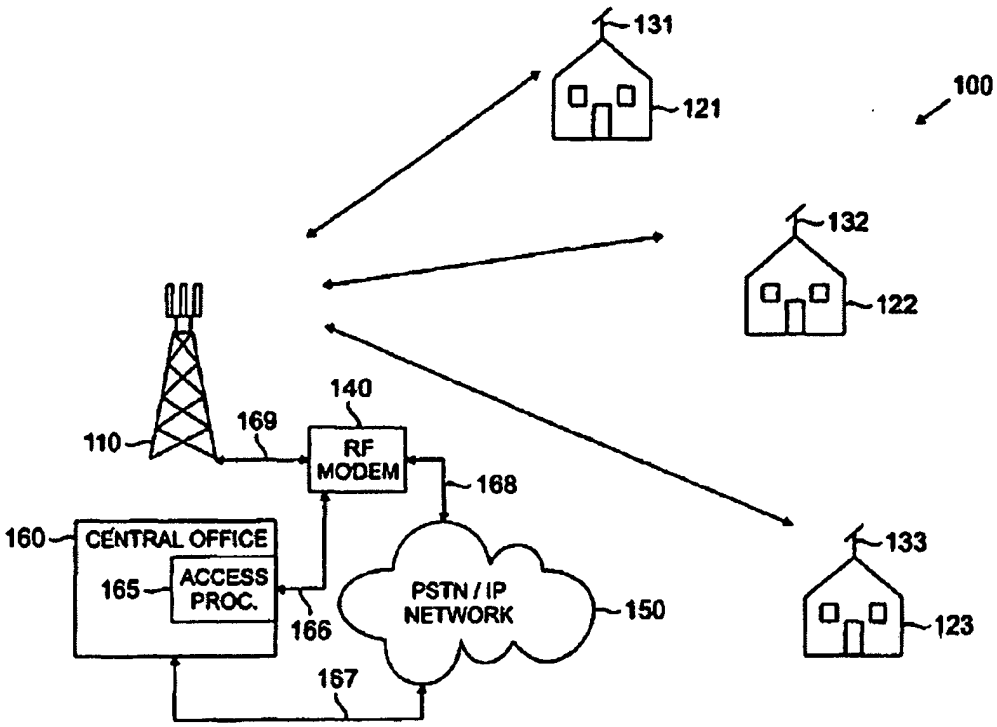


FIG. 1

Figure 1 illustrates exemplary fixed wireless access network 100. *Id.* at 11:55–56. Fixed wireless network 100 comprises a plurality of transceiver base stations, including transceiver base station 110, that transmit forward channel (downlink or downstream) broadband signals to subscriber premises 121, 122, 123 and receive reverse channel (uplink or upstream) broadband signals from subscriber premises 121-123. *Id.* at 11:57–64. Subscriber premises 121-123 transmit and receive via fixed, externally-mounted antennas 131-133, respectively. *Id.* at 11:64–66. Transceiver base station 110 receives the forward channel (downlink) signals from external network 150 and transmits the reverse channel (uplink) signals to external network 150. *Id.* at 12:5–8. External network may be the public switched telephone network (PTSN) or one or more data networks, including the Internet or

proprietary wide area networks (WANs) and local area networks (LANs). *Id.* at 12:8–13.

Transceiver base station 110 is coupled to RF modem shelf 140, which up-converts baseband data traffic received from external network 150 to radio frequency (RF) signals transmitted in the forward channel to subscriber premises 121-123 and down-converts RF signals received in the reverse channel from subscriber premises 121-123 to baseband data traffic that is transmitted to external network 150. *Id.* at 12:13–20. RF modem shelf 140 comprises a plurality of RF modems capable of modulating the baseband data traffic and demodulating the reverse channel RF signals. *Id.* at 12:21–24. Each of the transceiver base stations may cover a cell site that is divided into a plurality of sectors and each RF modem may be assigned to modulate and demodulate signals in a particular sector of each cell site. *Id.* at 12:25–30. Each RF modem uses an individual antenna to transmit and to receive in its assigned sector. *Id.* at 16:11–13.

Pre-programmed sets of directed beam patterns are used to cover a cell in an angular fashion, which is referred to as "beam scanning." *Id.* at 28:1–3. The base station establishes a set of beams to cover the cell and based on physical location in the sector, a specific beam is used to communicate with one or more subscribers that lie in that sector. *Id.* at 28:9–12.

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Figure 14 of the '931 patent is depicted below:

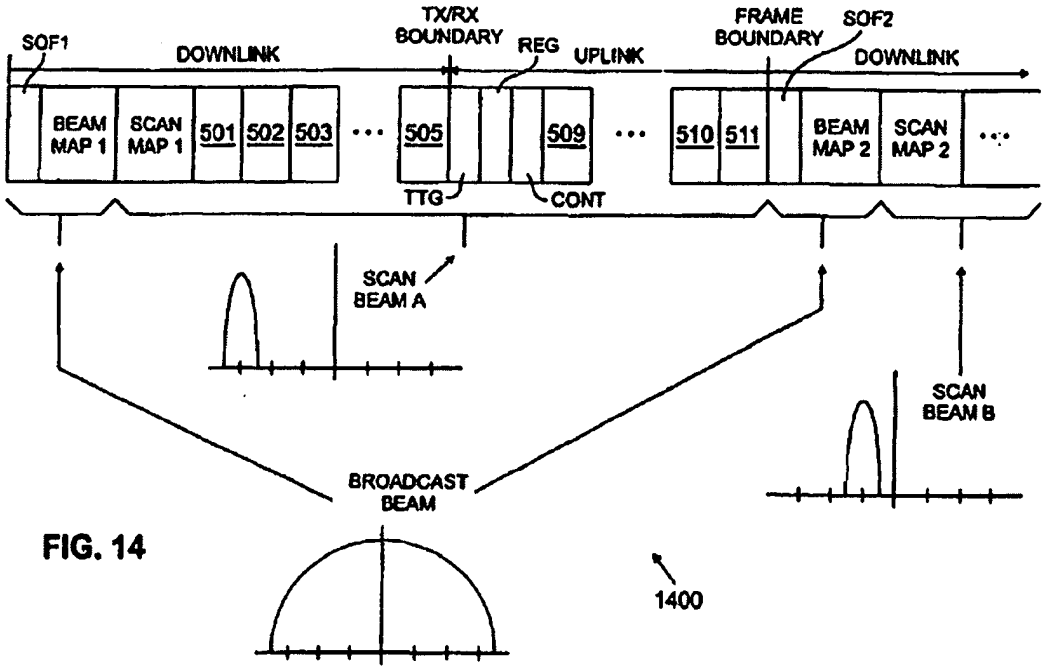


FIG. 14

Figure 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) signal 1400. *Id.* at 29:3–5. TDD signal 1400 comprises a first TDD frame having a downlink portion comprising a first start-of-frame field (SOF1), a first beam map field (Beam Map 1), and a first scan map field (Scan Map 1). *Id.* at 29:6–10. The first TDD frame is followed by a second TDD frame, which comprises a second start-of-frame field (SOF2), a second beam map field (Beam Map 2), and a second scan map field (Scan Map 2). *Id.* at 29:21–25. A spread spectrum Broadcast Beam is used to transmit start-of-frame fields SOF1, SOF2 and beam map fields Beam Map 1, Beam Map 2 in each TDD frame. *Id.* at 29:26–30. Distinct scan beams (Scan Beam A and Scan Beam B) are used to transmit the scan map fields (Scan Map 1 and Scan Map 2) and the remainder of the uplink and downlink portions of each TDD frame. *Id.* at 29:30–33.

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Broadcast Beam Maps 1, 2 provide data indicating which scanning beam (or beams) are used at which time for the frame and also transmits a synchronization field so that all subscribers can maintain synchronization. *Id.* at 29:34–36, 29:47–50. Scanning Beam Maps A, B provides the uplink and downlink map, which state at which time in the frame, using the scanning beam described in the associated Broadcast Beam Map, the downlink modulation groups and specific uplink slots are allocated for the frame using the specific scanning beam. *Id.* at 29:38–43.

B. Illustrative Claim

Claims 1, 10, and 19 are independent claims. Claim 1 is illustrative of the subject matter at issue:

> 1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communications with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:
>
> transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry
>
> transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and
>
> subsequently transmits in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.

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C. References

Petitioner relies on the following references:

1. Vornefeld, Ulrich et al., *SDMA Techniques for Wireless ATM*, IEEE Communications Magazine (Nov. 1999) ("Vornefeld") (Ex. 1004).
3. U.S. Patent No. 6,470,177, issued Oct. 22, 2002 ("Andersson") (Ex. 1005).
4. U.S. Patent No. 7,366,133, issued Apr. 29, 2008 ("Ahy") (Ex. 1006).[1]
5. U.S. Patent No. 5,684,491, issued Nov. 4, 1997 ("Newman") (Ex. 1007).

Petitioner further relies on testimony of its witness, Mr. James A. Proctor, Jr. (Ex. 1003).

D. Grounds Asserted

Petitioner challenges the patentability of the claims of the '931 patent under 35 U.S.C. §§ 102(b) and 103(a) over the following combinations of references:

Reference(s)	Basis	Claims
Vornefeld	35 U.S.C. § 102(b)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Vornefeld and Andersson	35 U.S.C. § 103(a)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld, Andersson, and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Newman, Ahy, and Andersson	35 U.S.C. § 103(a)	1–29

[1] We note the first named inventor of U.S. Patent 7,366,133 is Majidi-Ahy. Ex. 1006, 1. However, as Petitioner refers to this reference as "Ahy" (*see e.g.*, Pet. 17), we use the same shortened form for consistency and to avoid confusion.

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E. Related Proceedings

Petitioner and Patent Owner identify the following district court litigation involving the '931 patent: *General Access Sol., Ltd. V. Sprint Spectrum L.P.*, Case No. 2:16-cv-465-RWS (E.D. Tx.). Pet. 2; Paper 3, 1.

F. Real Parties in Interest

Petitioner identifies the following additional real parties in interest: Virgin Mobile USA, L.P.; Boost Mobile, LLC; Clearwire Corporation; Clearwire Communications LLC; and Clear Wireless LLC. Pet. 1. Petitioner further identifies Sprint Corporation as a real party in interest only for purposes of this proceeding and only to the extent Patent Owner contends the separate legal entity should be named a real party in interest in this proceeding. *Id.* Patent Owner does not identify any additional real parties in interest. *See* Paper 3, 1.

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claims of an unexpired patent are interpreted using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under that standard, claim terms are generally given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Petitioner proposes constructions for "sector" and "directed scanning beam signal(s)," both terms which appear in all challenged claims. Pet. 10–13. In view of our analysis, we do not find it necessary to construe any terms for purposes of this Decision. *See Vivid Techs., Inc. v. Am. Sci. &*

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Eng'g, Inc., 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

B. Anticipation by Vornefeld and Obviousness over Vornefeld and Ahy

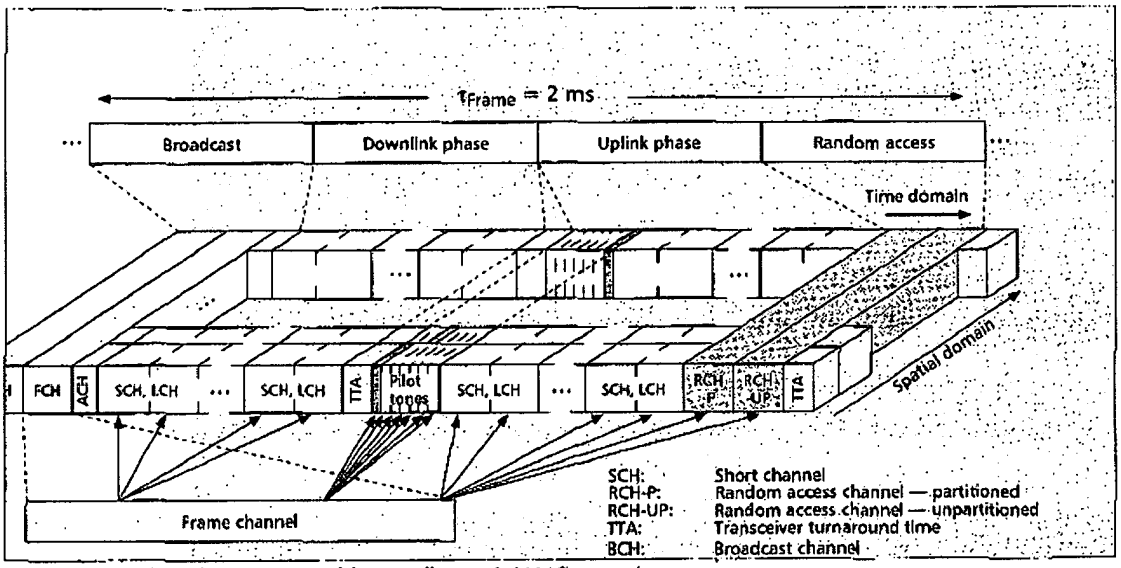
Petitioner contends that claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 are unpatentable as anticipated under 35 U.S.C. § 102(b) by Vornefeld. Pet. 19–35. Petitioner further contends that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 are unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld and Ahy. Pet. 35–44. For the reasons that follow, Petitioner fails to demonstrate a reasonable likelihood of prevailing on these grounds.

1. Overview of Vornefeld

Vornefeld describes space-division multiple access (SDMA) techniques in the context of the HIPERLAN/2 system, which provides wireless network broadband services with guaranteed quality of service. Ex. 1004, 52. The system deploys a smart array antenna with several antenna systems, which provides the ability to set up multiple antenna beams that can be directed adaptively to the mobile terminal (MT) locations and allows different users to be served on the same frequency channel at the same time. *Id.* Depending on the number of antenna elements and the applied beamforming algorithm, array antennas are able to simultaneously direct several beams conveying individual user signals to different positions. *Id.* at Fig. 2, 53. The system uses a Medium Access Control (MAC) protocol to coordinate the access of MTs to the shared radio channel. *Id.* at 54.

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Figure 3 of Vornefeld is depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

Figure 3 illustrates the basic MAC frame structure of the spatially extended MAC protocol. *Id.* at Fig. 3. MAC frame starts with broadcast channel (BCH), followed by frame channel (FCH), then a downlink phase, an uplink phase, and random access channels (partitioned, RCH-P, and unpartitioned, RCH-UP). *Id.* at 54. BCH conveys signaling information concerning the whole radio cell in the downlink direction and announces the location of the FCH and RCH within the actual MAC frame. *Id.* FCH is broadcast in the downlink direction and transmits information about the structure of the MAC frame for the up-and downlink phases; it contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive. *Id.* Short Channel (SCH) conveys data link control information and Long Channel (LCH) serves to transmit user data bidirectionally on the up- and downlink. *Id.* RCH-P and RCH-UP are contention channels. *Id.* As depicted in Figure 3, a number of MAC frames can be transmitted concurrently by extension into the space domain using the

smart antenna system. *See id.* at Fig. 3, 53, 55. A space-time scheduler is used to determine the temporal transmission sequence of MAC PDUs (protocol data unit) as well as the MTs that can simultaneously be addressed or allowed to concurrently transmit their bursts. *Id.* at 55.

2. Overview of Ahy

Ahy describes adaptive point to multipoint wireless communications. Ex. 1006, 1:65–66. A base station controller (BSC) maintains a set of physical (PHY) parameters and media-access-control (MAC) parameters, each of which is adaptively modified by the BSC for communication with a plurality of customer premises equipment (CPE). *Id.* at 2:15–21, 7:18–20. The BSC adjusts communication with each CPE individually and adaptively in response to changes in communication characteristics. *Id.* at 2:21–23. Control of each parameter by the BSC is independent and individual with regard to each CPE. *Id.* at 7:20–22. Each parameter actually has two values: a first value for transmission by the BSC and a second value for transmission by the CPE. *Id.* at 7:65–8:1. The communication parameters that can be adapted include: antenna selection to choose the antenna to be used at the BSC and the CPE; modulation type to determine the bit per symbol rate to use to exchange information; and error code type to choose the error detection and correction technique. *See id.* at 8:50–59, 10:38–48, 11:40–45.

Communications between the BSC and each CPE is conducted using a TDD technique in which time durations are divided into individual frames, each of which includes a "downstream" and "upstream" portion. *Id.* at 7:1–5. The BSC controls transmission for both upstream and downstream directions without specific requests from CPEs. *Id.* at 7:5–9. The TDD frame includes a sequence of parameter setting values for the BSC to use to

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inform each selected CPE of the PHY and MAC parameters the BSC is using to send messages to that selected CPE, and the PHY and MAC parameters the selected CPE should use to send messages to the BSC during its allocated part of the upstream portion. *Id.* at 15:11–20.

3. Claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29

Independent claim 1 recites "transmit path circuitry transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors" ("broadcast beam signal" limitation). Petitioner contends that Vornefeld discloses this limitation through its description that each MAC frame starts with two broadcast channels, the broadcast channel (BCH) and the frame channel (FCH), and that the BCH contains signaling information concerning the whole radio cell in the downlink direction. Pet. 23. Petitioner asserts that because the signal concerns "the whole radio cell" it would have to cover multiple sectors and that the information is broadcast to inform all the terminals about their individual transmission and reception schedules for the next MAC frame. *Id.* at 23–24.

We have reviewed the cited evidence and we are not persuaded by Petitioner's contention that Vornefeld discloses the "broadcast beam signal" limitation. We agree with Petitioner that Vornefeld describes that the BCH and FCH are included in each MAC frame and that the BCH conveys information concerning the whole radio cell (i.e., more than one sector). *See* 1004, 52. But the cited sections of Vornefeld do not describe that a MAC frame (with the BCH information) is transmitted via a broadcast *beam* signal to devices in more than one sector. Rather, Vornefeld describes transmission of MAC frames using directive beams to devices in one sector. *See id.* at Fig. 2, 52–53. Although the devices may receive the same

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information, Petitioner does not support adequately its contention that Vornefeld discloses transmittal of a broadcast beam signal to wireless access devices within more than one sector.

We, therefore, determine Petitioner has not established a reasonable likelihood that the "broadcast beam signal" limitation recited in claim 1 (and its dependent claims 2, 3, 6, 7, and 28) is anticipated by Vornefeld. Independent claims 10 and 19 (and their dependent claims 11, 12, 15, 16, 20, 21, 24, 25, and 29) each set forth a similar limitation as the "broadcast beam signal" limitation. Petitioner cites to its analysis of claim 1 to support its contention that Vornefeld discloses these limitations. *See* Pet. 29–31. Thus, its analysis for these claims contains the same deficiencies as its analysis of claim 1.

For the foregoing reasons, we conclude Petitioner has not demonstrated a reasonable likelihood of prevailing in establishing that claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 are anticipated by Vornefeld.

4. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27

Petitioner relies on its analysis of claim 1 to meet the "broadcast beam signal" limitation (or substantially similar limitation) recited in these claims by virtue of their dependency from one of claims 1, 10, and 19. Petitioner does not set forth any analysis or argument why this limitation would have been obvious to one of ordinary skill in the art in view of the teachings of Ahy. Therefore, Petitioner fails to cure the deficiencies in Vornefeld discussed above and has not demonstrated a reasonable likelihood of prevailing in establishing claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 would have been obvious over the combination of Vornefeld and Ahy.

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C. Obviousness over Vornefeld and Andersson, and Obviousness over Vornefeld, Andersson, and Ahy

Petitioner contends that claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 are unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld and Andersson. Pet. 44–50. Petitioner further contends that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 are unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy. Pet. 50–51. For the reasons that follow, Petitioner has demonstrated a reasonable likelihood of prevailing on its challenges as to claims 1, 3–10, 12–19, and 21–29. Petitioner fails to establish a reasonable likelihood of prevailing in establishing claims 2, 11, and 20 would have been obvious over the combination of Vornefeld and Andersson.

1. Overview of Andersson

Andersson describes adaptive sectorization to solve problems associated with sectorization of cells in cellular communication systems. Ex. 1005, 3:37–40, 4:31–34. A transceiver structure located at a base station is connected to a set of sector antennas and each sector antenna is used to cover a sector of the cell. *Id.* at 4:42–44; *see also* Fig. 2 (depicting an antenna configuration with six sectors). The beacon carrier is also connected to an omni-directional antenna, which provides the same coverage area as all of the sector antennas together. *Id.* at 4:58–60.

2. Claims 1, 3–10, 12–19, and 21–29

Petitioner contends the combination of Vornefeld and Andersson teaches the limitations recited in independent claim 1. Pet. 44–50 (citing *id.* at 19–25 for the analysis of the majority of the limitations of claim 1). In particular, Petitioner asserts Vornefeld discloses all of the limitations in claim 1. *Id.* at 19–25. Petitioner further asserts that to the extent Vornefeld

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does not disclose "a transceiver associated with a first of said plurality of base stations" and "[wherein said transmit circuitry] transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors," these limitations are taught by Andersson. *Id.* at 44–50.

We determine that Petitioner demonstrates a reasonable likelihood of prevailing on its challenge based on the combination of Vornefeld and Andersson. Petitioner provides sufficient evidence that Vornefeld is a printed publication that qualifies as prior art. See Pet. 3–4; Ex. 1009, ¶¶ 26–27. Petitioner identifies adequately that Vornefeld teaches "a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network" through its description of a broadband wireless access system with base stations having multiple antenna beams electronically connected to MT locations and that the radio system operates on a TDD channel. *Id.* at 20. Petitioner supports adequately its assertion that one of ordinary skill in the art would understand Vornefeld's uniform linear array (ULA) antennas to be part of a transceiver through testimony of its witness, Mr. Proctor, which we credit. *Id.* at 20–21 (citing *e.g.*, Ex. 1003 ¶¶ 116–117). Additionally, Petitioner establishes sufficiently that Andersson also discloses the recited transceiver. *Id.* at 44–45. Although for the reasons discussed previously, we are not persuaded Vornefeld discloses the "broadcast beam signal limitation," Petitioner adequately shows the combination of Vornefeld and Andersson meets this limitation through Vornefeld's description of the broadcast BCH and FCH channels combined with Anderson's description of

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a broadcast beam signal used to transmit to more than one sector. *See id.* at 23–24, 45–47. Petitioner also sufficiently establishes that Vornefeld teaches the transmit path circuitry capable of transmitting directed scanning beam signals and the transmits, in a downlink portion of said TDD frame limitations set forth in claim 1. *See id.* at 21–26.

Additionally, Petitioner provides a sufficient rationale at this stage, and on the current record, to support its contention that one of ordinary skill in the art would have combined Vornefeld and Andersson. Petitioner asserts combining Andersson's method of beacon signal transmission to transmit Vornefeld's broadcast signals and the use of Andersson's sector based beamforming to transmit Vornefeld's downlink phase would have amounted to nothing more than the use of known techniques to improve similar methods in the same way and that the combination was obvious to try. *See id.* at 47–48 (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007)). Petitioner supports its assertions with testimony of Mr. Proctor, which we credit. *See* Pet. 47–48 (citing Ex. 1003).

With respect to independent claims 10 and 19, and dependent claims 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 (which depend from claim 1, 10, or 19), we have reviewed Petitioner's analysis and determine, for purposes of this Decision and on the current record, that Petitioner establishes a reasonable likelihood it will prevail in demonstrating that the combination of Vornefeld and Andersson teaches the limitations recited in these claims. *See* Pet. 50 (citing *id.* at 25–35 for the analysis of the dependent claims). Petitioner establishes a reasonable likelihood it will prevail in demonstrating that the combination of Vornefeld, Andersson, and Ahy teaches the limitations recited in dependent claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 (which depend from claim 1, 10, or 19), and provides

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sufficient reasoning, on the current record, why one of ordinary skill in the art would have combined Ahy with Vornefeld and Andersson. *See* Pet. 50–51 (citing *id.* at 35–44 for the analysis of these claims).

For the foregoing reasons, we are persuaded Petitioner has demonstrated a reasonable likelihood of prevailing in establishing that claims 1, 3, 6, 7, 10, 12, 15, 16, 19, 21, 24, 25, 28, and 29 would have been obvious over the combination of Vornefeld and Andersson. We are further persuaded Petitioner has demonstrated a reasonable likelihood of prevailing in establishing that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 would have been obvious over the combination of Vornefeld, Andersson, and Ahy.

3. Claims 2, 11, and 20

Claim 2 recites the broadcast beam signal further comprises "a first beam map containing scanning beam information usable by said wireless access device to detect said directed scanning beam signals." Claims 11 and 20 set forth similar limitations. Petitioner contends Vornefeld discloses this limitation. Pet. 26; *see also id.* at 50 (citing to the analysis of "Ground 1" to support the assertion claims 2, 11, and 20 are obvious over Vornefeld and Andersson). In particular, Petitioner identifies the FCH described in Vornefeld as equivalent to the claimed "first beam map" because Vornefeld describes the FCH is broadcast in the downlink direction and contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive. *Id.* at 26.

We have reviewed Petitioner's analysis and cited evidence and find Petitioner does not establish a reasonable likelihood that Vornefeld discloses the recited "first beam map" usable to detect directed scanning beam signals. Vornefeld describes the FCH is used to transmit information about the structure of the MAC frame. Ex. 1004, 54. We agree with Petitioner the

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FCH includes announcements and reservations of the long and short transport channels for the individual MTs to transmit/receive. *See id.* at 54. However, we find Vornefeld describes the long channels (LCH) and short channels (SCH) as being channel slots in a MAC frame. *See id.* at Fig. 2, 54. Petitioner does not provide sufficient analysis to explain why one of ordinary skill in the art would understand the broadcast timeslot reservations of the LCH and SCH to be a *beam map* usable to *detect directed scanning beam signals*. Because Petitioner fails to provide an adequate analysis, we determine Petitioner has not demonstrated a reasonable likelihood of prevailing in establishing claims 2, 11, and 20 would have been obvious over Vornefeld and Andersson.

D. Obviousness over Newman, Andersson, and Ahy

Petitioner contends that claims 1–29 are unpatentable as obvious under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson. Pet. 51–63. For the reasons that follow, Petitioner has demonstrated a reasonable likelihood of prevailing on this grounds as to claims 1, 3–10, 12–18, and 28. Petitioner fails to establish a reasonable likelihood of prevailing on this ground as to claims 2, 11, 19–27, and 29.

1. Overview of Newman

Newman describes a multi-beam antenna system for communicating with mobile users. *Id.* at 1:4–6. The multi-beam communication system includes a sector antenna having a beamwidth providing sector coverage and a transmitter and a receiver system for receiving user signals from a user located in the sector. Ex. 1007, 2:10–14; *see also id.* at 4:5–6. A sector antenna has a beamwidth effective to provide coverage of a 120 degree azimuth sector. *Id.* at 4:12–15. The antenna system further includes a multi-beam antenna, which may comprise four side-by-side vertical arrays of

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dipoles or other radiating element arrangements suitable for providing four antenna beams, each having a beam width narrower than the 120 degree sector and aligned so that the four beams collectively cover at least a portion of the sector. *Id.* at 4:35–42. The beams may be provided with the inclusion of a suitable beam forming network. *Id.* at 4:47–50. Access to the four beams of the multi-beam antenna is provided by operation of the beam forming network, which may be included as part of the multi-beam antenna. *Id.* at 10:35–38. With this arrangement, communication with a particular user can be enhanced by a significant increase in transmitted signal strength, for example, by transmitting to the user via a narrow beam instead of the sector beam. *Id.* at 38–42.

2. Claims 1, 3–10, 12–18, and 28

Petitioner contends the combination of Newman, Ahy, and Andersson teaches the limitations set forth in claim 1. Pet. 51–58. In particular, Petitioner relies on Newman to teach the transmit circuitry capable of transmitting directed scanning beam signals limitation. *Id.* at 53–55. Petitioner relies on the combination of Newman and Ahy to meet the preamble and the transmits downlink data traffic using one of the directed scanning beam limitations. *See id.* at 51–53, 57–58. Petitioner asserts combining the teachings of Ahy and Newman with Andersson's description of a broadcast beam signal used to transmit to more than one sector teaches the "broadcast beam signal" limitation. *Id.* at 56–57.

We determine that Petitioner establishes a reasonable likelihood that the combination of Newman, Ahy, and Andersson teaches the limitations recited in claim 1. For example, Petitioner adequately shows the combination of Newman's multi-beam antenna system with Ahy's disclosure of a BSC communicating with CPEs using TDD frames teaches

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the preamble limitation. *See id.* at 51–53. Petitioner shows sufficiently that Newman's description of a multi-beam antenna in a beam forming network for transmission and reception of signals to and from users discloses "transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site." *Id.* at 53–55. Petitioner also establishes sufficiently that the remaining limitations are taught by claim 1. *See id.* at 55–58. Additionally, we determine Petitioner's stated reason for combining Newman, Ahy, and Andersson—use of known techniques to improve a similar device in a similar way to yield predictable results (predictable modification)—is sufficient rationale on the current record and at this stage of the proceeding. *See id.* at 52–53, 56–57. In reaching our determination, we credit the testimony of Petitioner's witness, Mr. Proctor. *See* Ex. 1003 ¶¶ 124, 139–140, 142–143.

With respect to independent claim 10 and dependent claims 3–9, 12–18, and 28 (which depend from claim 1 or 10), we have reviewed Petitioner's analysis and determine, for purposes of this Decision and on the current record, that Petitioner supports sufficiently its contentions that the combination of Newman, Andersson, and Ahy teaches the limitations recited in these claims. *See* Pet. 58–63.

For the foregoing reasons, we are persuaded Petitioner has demonstrated a reasonable likelihood of prevailing in establishing that claims 1, 3–10, 12–18, and 28 would have been obvious over the combination of Newman, Andersson, and Ahy.

3. Claims 19–27 and 29

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Petitioner contends claim 19 is obvious over the combination of Newman, Ahy, and Anderson for the same reasons given with respect to claim 1. *Id.* at 63. However, claim 19 recites "the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices," a limitation which does not appear in claim 1. Petitioner does not explain in its analysis of claim 1 how the cited references teach a start of frame field capable of synchronizing receivers in said wireless access devices.[2] *See* Pet. 51–58. Accordingly, Petitioner fails to establish a reasonable likelihood of prevailing in establishing claim 19, and its dependent claims 20–27 and 29, would have been obvious over the combination of Newman, Ahy, and Andersson.

4. Claims 2 and 11

Petitioner relies on Ahy to disclose "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals," as recited in claims 2 and 11. Pet. 58; *see also id.* at 63 (relying on the analysis of claim 2 for the limitations set forth in claim 11). In particular, Petitioner points to Ahy's description that the start of each TDD frame includes a first parameter value for transmission by the BSC and a second parameter value for transmission by the CPE, which allows the BSC and the CPE to transmit using different sets of parameters. *Id.* at 58. Petitioner further points to Ahy's disclosure that the first part of the frame includes a value for the length for subsequent downstream payload elements for each CPE. *Id.* But Petitioner does not

[2] Petitioner does identify Ahy's description of a TDD frame including a time-synchronization portion as disclosing the "start of frame field" recited in claim 1, but does not assert this field is capable of synchronizing receivers in wireless devices as recited in claim 19. *See* Pet. 55–56.

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provide sufficient analysis to explain why one of ordinary skill in the art would understand the transmission of parameter values and the length of the downstream payload element to disclose a *beam map* usable to *detect directed scanning beam signals*. Accordingly, we conclude Petitioner has not demonstrated a reasonable likelihood of prevailing in establishing claims 2 and 11 would have been obvious over Newman, Andersson, and Ahy.

III. CONCLUSION

Petitioner has demonstrated a reasonable likelihood of prevailing on its challenges to claims 1, 3–10, 12–19, and 21–29 of the '931 patent as set forth above. Petitioner has not demonstrated a reasonable likelihood of prevailing on its challenges to claims 2, 11, and 20.

At this stage of the proceeding, we have not made a final determination as to the patentability of any of these challenged claims or the construction of any claim term.

IV. ORDER

It is

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review is hereby instituted on the following grounds:

(1) Obviousness of claims 1, 3, 6, 7, 10, 12, 15, 16, 19, 21, 24, 25, 28, and 29 over Vornefeld and Andersson;

(2) Obviousness of claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 over Vornefeld, Andersson, and Ahy;

(3) Obviousness of claims 1, 3–10, 12–18, and 28 over Newman, Ahy, and Andersson;

FURTHER ORDERED that no review is instituted based on any other grounds of unpatentability; and

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FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial commencing on the entry date of this decision.

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Paper 43
Entered: March 7, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.,
Petitioner,

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Patent Owner.

Case IPR2017-01889
Patent 7,230,931 B2

Before MELISSA A. HAAPALA, *Acting Vice Chief Administrative Patent Judge,* and KALYAN K. DESHPANDE and DAVID M. KOHUT, *Administrative Patent Judges.*

HAAPALA, *Acting Vice Chief Administrative Patent Judge.*

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

Sprint Spectrum L.P. ("Petitioner") filed a Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–29 of U.S. Patent No. 7,230,931 B2 ("the '931 patent"). Paper 1 ("Pet."). General Access Solutions, Ltd. ("Patent Owner") did not file a Preliminary Response. Applying the standard set forth in 35 U.S.C. § 314(a), we granted Petitioner's request to institute an *inter partes* review of all challenged claims. Papers 5 ("Dec") (instituting on claims 1, 3–10, 12–19, and 21–29); Paper 8 (instituting on remaining challenged claims 2, 11, and 20 and modifying our initial institution decision to include all of the grounds presented in the Petition).

During the trial, Patent Owner timely filed a Response (Paper 25, "PO Resp."), to which Petitioner timely filed a Reply (Paper 29, "Reply"). Patent Owner further submitted a Sur-Reply (Paper 34, "Sur-Reply") to Petitioner's Reply. An oral hearing was held on December 6, 2018, and a copy of the transcript was entered into the record. Paper 41 ("Tr.").

Following the oral hearing and pursuant to our authorization (Paper 37), both parties each submitted claim construction briefs (Papers 38, 39); each party also submitted a reply to the other party's brief (Papers 40, 41).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the claims on which we instituted trial. For the reasons that follow, we enter adverse judgement against Patent Owner with respect to independent claims 1, 10, and 19 of the '931 patent and we determine that Petitioner has not shown that dependent claims 2–9, 11–18, and 20–29 are unpatentable.

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I. BACKGROUND

A. The '931 Patent (Ex. 1001)

The '931 patent describes a burst packet transmission media access system using selectively adaptable beam forming in a fixed wireless access network. Ex. 1001, 3:28–31. The fixed wireless network may comprise a plurality of transceiver base stations that transmit forward channel (downlink or downstream) broadband signals to subscriber premises and receive reverse channel (uplink or upstream) broadband signals from subscriber premises. *Id.* at Fig. 1, 11:57–64. Each of the transceiver base stations may cover a cell site that is divided into a plurality of sectors. *Id.* at Fig. 2, 12:25–27. Pre-programmed sets of directed beam patterns are used to cover a cell in an angular fashion, which is referred to as "beam scanning." *Id.* at 28:1–3. The base station establishes a set of beams to cover the cell and based on physical location in the sector, a specific beam is used to communicate with one or more subscribers that lie in that sector. *Id.* at 28:9–12.

Figure 14 of the '931 patent is depicted below:

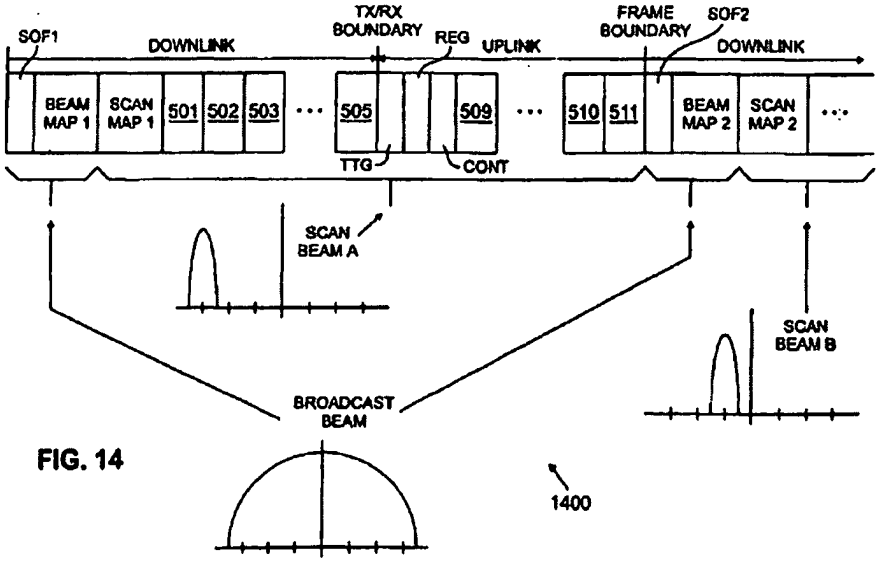


FIG. 14

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Figure 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) signal 1400. *Id.* at 29:3–5. TDD signal 1400 comprises a first TDD frame having a downlink portion comprising a first start-of-frame field (SOF1), a first beam map field (Beam Map 1), and a first scan map field (Scan Map 1). *Id.* at 29:6–10. The first TDD frame is followed by a second TDD frame, which comprises a second start-of-frame field (SOF2), a second beam map field (Beam Map 2), and a second scan map field (Scan Map 2). *Id.* at 29:21–25. A spread spectrum Broadcast Beam is used to transmit start-of-frame fields SOF1, SOF2 and beam map fields Beam Map 1, Beam Map 2 in each TDD frame. *Id.* at 29:26–30. Distinct scan beams (Scan Beam A and Scan Beam B) are used to transmit the scan map fields (Scan Map 1 and Scan Map 2) and the remainder of the uplink and downlink portions of each TDD frame. *Id.* at 29:30–33.

Broadcast Beam Maps 1, 2 provide data indicating which scanning beam (or beams) are used at which time for the frame and also transmits a synchronization field so that all subscribers can maintain synchronization. *Id.* at 29:34–36, 29:47–50. Scanning Beam Maps A, B provides the uplink and downlink map, which state at which time in the frame, using the scanning beam described in the associated Broadcast Beam Map, the downlink modulation groups and specific uplink slots are allocated for the frame using the specific scanning beam. *Id.* at 29:38–43.

B. Illustrative Claims

Claims 1, 10, and 19 are independent claims. Claims 1 and 2 are illustrative of the subject matter at issue:

> 1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations

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capable of bidirectional time division duplex (TDD) communications with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and

subsequently transmits in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.

2. The transceiver as set forth in claim 1 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals.

C. Instituted Grounds of Unpatentability

Petitioner relies on the following references:

1. U. Vornefeld, et al., *SDMA Techniques for Wireless ATM*, IEEE Communications Magazine (Nov. 1999) ("Vornefeld") (Ex. 1004).
2. U.S. Patent No. 6,470,177 B1, issued Oct. 22, 2002 ("Andersson") (Ex. 1005).
3. U.S. Patent No. 7,366,133 B1, issued Apr. 29, 2008 ("Ahy") (Ex. 1006).[1]

[1] We note the first named inventor of U.S. Patent 7,366,133 is Majidi-Ahy. Ex. 1006, 1. However, as both parties refer to this reference as "Ahy" (*see e.g.*, Pet. 17; PO Resp. 18), we use the same shortened form for consistency and to avoid confusion.

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4. U.S. Patent No. 5,684,491, issued Nov. 4, 1997 ("Newman") (Ex. 1007).

We instituted trial under 35 U.S.C. §§ 102(b) and 103(a) over the following combinations of references:

Reference(s)	Basis	Claims
Vornefeld	35 U.S.C. § 102(b)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Vornefeld and Andersson	35 U.S.C. § 103(a)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld, Andersson, and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Newman, Ahy, and Andersson	35 U.S.C. § 103(a)	1–29

In support of its contentions, Petitioner submitted a declaration by its witness, Mr. James A. Proctor, Jr. Ex. 1003. In response, Patent Owner submitted a declaration by its witness, Kurt D. Humphrey. Ex. 2001. Both witnesses were cross-examined during the trial, and transcripts of their depositions are in the record. Ex. 1011 (Proctor deposition); Ex. 1012 (Humphrey deposition).

D. Related Proceedings

Petitioner and Patent Owner identify the following district court litigation involving the '931 patent: *General Access Sol., Ltd. V. Sprint Spectrum L.P.*, Case No. 2:16-cv-465-RWS (E.D. Tx.). Pet. 2; Paper 3, 1.

E. Real Parties in Interest

Petitioner identifies the following additional real parties in interest: Virgin Mobile USA, L.P.; Boost Mobile, LLC; Clearwire Corporation;

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Clearwire Communications LLC; and Clear Wireless LLC. Pet. 1. Petitioner further identifies Sprint Corporation as a real party in interest only for purposes of this proceeding and only to the extent Patent Owner contends the separate legal entity should be named a real party in interest in this proceeding. *Id.* Patent Owner does not identify any additional real parties in interest. *See* Paper 3, 1.

II. ADVERSE JUDGEMENT

Both in its Response and at the oral hearing, Patent Owner conceded the unpatentability of independent claims 1, 10, and 19. PO Resp. 2 n.2 ("Patent Owner does not herein dispute the patentability of the independent claims 1, 10, and 19 of the '931 patent."); Tr. 56:19–57:9 ("[Vornefeld] knocks out our independent claims. We concede that."). A concession of unpatentability is construed as a request for entry of adverse judgement. 37 C.F.R. § 42.73(b)(3). The request is granted.

III. ANALYSIS

A. Legal Principles

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *See Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). Although the elements must be arranged or combined in the same way as in the claim, "the reference need not satisfy an *ipsissimis verbis* test," i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter as a whole would have been obvious at the time the invention was made to a

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person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness, i.e., secondary considerations such as commercial success, long felt but unsolved needs, and failure of others.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). The obviousness inquiry further requires an analysis of "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring "articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")).

B. Level of Ordinary Skill in the Art

Petitioner asserts a person of ordinary skill in the art at the time of the filing date of the '931 patent would have had at least a Bachelor of Science in Computer Science, Computer Engineering, Electrical Engineering, or an equivalent field, and at least two years of academic or industry experience in any type of wireless networking field. Pet. 9–10. Patent Owner asserts a person or ordinary skill would have been a telecommunications engineer or technologist working in the wireless networking sector and have a least a bachelor's degree in engineering and relevant work experience, including at

[2] The record does not include arguments or evidence regarding objective indicia of non-obviousness.

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least two years of academic, practical, or industry experience in the wireless networking and/or telecommunications field. PO Resp. 6.

Our decision does not turn on the minor differences between the definitions. Both Petitioner and Patent Owner advocate a similar level of experience and both agree that a person of ordinary skill would have a bachelor's degree in engineering. We accept the level of skill advocated by Petitioner as the identified undergraduate academic degrees are consistent with the prior art of record.

C. Claim Construction

In an *inter partes* review, based on a petition filed before November 13, 2018, claims of an unexpired patent are interpreted using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b) (2017);[3] *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under that standard, "words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification and prosecution history." *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016).

1. "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals"

This limitation is recited by dependent claims 2, 11, and 20. After review of the parties' briefing and based on arguments made at the oral hearing, we determined the meaning of the recited "beam map" is at issue in

[3] A recent amendment to this rule does not apply here because the Petition was filed before November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018).

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this proceeding. Because neither party had set forth an explicit construction for this term, during the oral hearing we authorized each party to file an additional brief setting forth the party's proposed construction and also authorized each party to file a response brief to the other party's proposed construction. Paper 37. Both parties submitted the additional briefs and response briefs. *See* Papers 39, 40 (Petitioner's briefs); Papers 38, 41 (Patent Owner's briefs).

Petitioner asserts we should construe "a first beam map" as "scheduling information for one or more beams." Paper 39, 1. In support of its construction, Petitioner asserts the beam map is part of the broadcast beam shown in Figure 14 and the description of a beam map in the corresponding portion of the specification references scheduling information associated with the beam map. *Id.* at 2 (citing Ex. 1001, 29:34–36). Petitioner asserts the scheduling information that forms a beam map comprises information about one or more beams that are transmitted in the frame and that the beam maps "provide data indicating which beam (or beams) are used at which time." *Id.* at 3 (citing Ex. 1001, 29:34–36).

Patent Owner initially proposes we construe "a first beam map" as "scanning beam information contained in the broadcast beam signal that enables wireless access devices to detect a particular directed scanning beam signal." Paper 38, 1. In its Opposition, Patent Owner states it does not disagree with Petitioner's proposed construction and that it is suitable for the claimed "beam map." Paper 41, 1. Patent Owner further asserts that the "first beam map" at issue in claims 2, 11, and 20 is significantly narrower, and requires that the beam map enable devices to detect a particular scanning beam. *Id.*

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Petitioner does not dispute that claims 2, 11, and 20 require the elements of Patent Owner's proposed construction because those elements are already found in the claims. Paper 40, 1. Petitioner asserts the problem with Patent Owner's initial construction is that it is redundant and renders the remaining terms of the claims superfluous. *Id.*

The '931 patent describes two different types of beam maps: broadcast beam maps and scanning beam maps. Ex. 1001, 29:26–43. A broadcast beam is used to transmit the broadcast beam map (Beam Map 1 and Beam Map 2) and distinct scan beams are used to transmit the scan map fields (Scan Beam A, Scan Beam B). *Id.* at Fig. 14, 29:26–33. Both parties assert that the "first beam map" recited in claims 2, 11, and 20 refers to the broadcast beam map. *See* Paper 38, 2 (Patent Owner's assertion that the first beam map "clearly means the Broadcast Beam Map portion of the definition of a generic "beam map."); Paper 39, 2 (Petitioner's assertion that the beam map "is a part of the broadcast beam (see Fig. 14), and the description of a beam map in the corresponding portion of the specification also references the scheduling information associated with the beam map."). Because claims 2, 11, and 20 all set forth the "first beam map" is a component of the "broadcast beam signal," we agree with the parties that the "first beam map" refers to a broadcast beam map.

We are persuaded that Petitioner's proposed construction of a "first beam map" is consistent with the plain meaning of a broadcast beam map in the context of the disclosure of the '931 patent. The '931 patent describes transmission of map information for beam scheduling via a spread spectrum broadcast beam. *See* Ex. 1001, 28:56; 29:34–35. Patent Owner agrees that Petitioner's proposed construction for "a first beam map" is a suitable

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definition. Paper 41, 1. Accordingly, we construe "first beam map" as "scheduling information for one or more beams."

As noted by both parties, claims 2, 11, and 20 further require that the "first beam map" contain "scanning beam information usable by said wireless access device to detect said directed scanning beam." *See* Papers 40, 2; 41, 1. Petitioner argues the scanning beam information

> may include information that 'identifies a downlink time slot during which one of said directed scanning beam signals transmits said downlink data traffic,' (claim 3), information that 'identifies at least one modulation format associated with one of said directed scanning beam signals' (claim 4), or information that 'identifies at least one forward error correction code level associated with one of said directed scanning beam signals' (claim 5).

Paper 40, 2–3. Petitioner asserts that Patent Owner's arguments limit "beam map" to a specific embodiment (such as the "Frame Beam map and Super-Frame Beam Map embodiment) and this provides reason to reject Patent Owner's construction. *Id.* at 3; *see also* Reply 9–11 (similarly asserting that Patent Owner's arguments that a first beam map necessary includes information about what scanning beam will be used improperly confine the claim to a specific embodiment). Petitioner argues that the '931 patent includes description of another embodiment in which the scanning beam information identifies a downlink time slot in the downlink portion during which the at least one directed scanning beam transmits the downlink traffic. Reply 11 (citing Ex. 1001, 9:40–44).

Patent Owner asserts that scanning beam detection information is different from scanning beam uplink/downlink/modulation information. *Id.* Patent Owner cites to several examples in the disclosure that provide data to enable a device to detect a particular scanning beam signal. Paper 38, 3

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(citing Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2). Patent Owner argues that information about which scanning beam will be used to cover the sector and when it will be used is necessary for a signal to serve as a beam map. PO Resp. 21, 24 (citing Ex. 2001 ¶ 44). Patent Owner argues that timeslot reservations do not constitute beam map information including the specific beam(s) and their precise start times in the frames which are useable by the wireless access devices to detect the directed scanning beam signals. *Id.* at 25 (citing Ex. 2001 ¶ 45).

We are not persuaded by Petitioner's arguments that the embodiment in which the scanning beam information identifies a downlink portion for transmission relates to the claimed scanning beam information useable to *detect* said directed scanning beam. Rather, the '931 patent discloses explicitly that the embodiment in which the scanning beam information identifies a downlink time slot is "another embodiment" than the embodiment set forth in claims 2, 9, and 11 in which the beam map contains scanning beam information usable to detect the directed scanning beam. *See* Ex. 1001, 9:35–44 (first describing the embodiment recited in claims 2, 9, and 11, and then describing "another embodiment" in which the scanning beam information identifies a downlink time slot). Thus, although as set forth in claim 3 (by virtue of its dependency from claim 2) the scanning beam information can include both types of information (information usable to detect directed scanning beam signals and identification of a downlink time slot), the disclosure of the '931 patent makes clear the information that identifies a downlink time slot is different than the information usable to detect directed scanning beam signals.

Furthermore, we determine Patent Owner's arguments—that the scanning beam information usable to detect the scanning beam signals must

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include information about which scanning beam will be used—are not an improper attempt to limit the claim language to a specific embodiment. As explained above and undisputed by the parties, the "first beam map" is a broadcast beam map. The '931 patent describes the information contained in the broadcast beam map as "data indicating which scanning beam (or beams) are used at which time." *See* Ex. 1001, 29:34–36. Petitioner cites to the same disclosure in support of its construction that a beam map is scheduling information for one or more beams. *See* Paper 39, 3 (citing Ex. 1001, 29:34–36). The other sections in the '931 patent describing the broadcast beam map all explain that the map contains information that informs the subscriber (wireless access) device which scanning beam is used and when (frame time) in which each beam starts. *See* Ex. 1001, 29:51–55, 29:66–30:2. We agree with Patent Owner that this information is what enables a device to detect a particular scanning beam. *See* Paper 38, 3.

We are mindful that claims must be interpreted in view of the specification without importing limitations from the specification unnecessarily. *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1369 (Fed. Cir. 2003). However, the disclosure of the '931 patent consistently describes that the broadcast beam map is scheduling information that indicates which scanning beam is used at which time. *See* Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2. The correct inquiry in giving a claim term its broadest reasonable interpretation in light of the specification is an interpretation that corresponds with what and how the inventor describes his invention in the specification. *In re Smith Int'l*, 871 F.3d 1375, 1382–83 (Fed. Cir. 2017). Consistent with the description set forth in the '931 patent, our complete construction of "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed

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scanning beam signals" is "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

2. Other Terms

Petitioner proposes constructions for "sector" and "directed scanning beam signal(s)," both terms which appear in independent claims 1, 10, and 19. Pet. 10–13. Patent Owner asserts that the meaning of these terms do not appear to be in dispute and construction of these terms would not resolve any controversy. PO Resp. 15.

We agree with Patent Owner that these terms are not in controversy and, accordingly, determine that we need not explicitly construe these terms to resolve the issues before us. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

D. Anticipation by Vornefeld and Obviousness over Vornefeld and Andersson

Petitioner challenges claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 as anticipated under 35 U.S.C. § 102(b) by Vornefeld. Pet. 19–35. Petitioner further challenges these claims as obvious under 35 U.S.C. § 103(a) over Vornefeld and Andersson. *Id.* at 44–50.

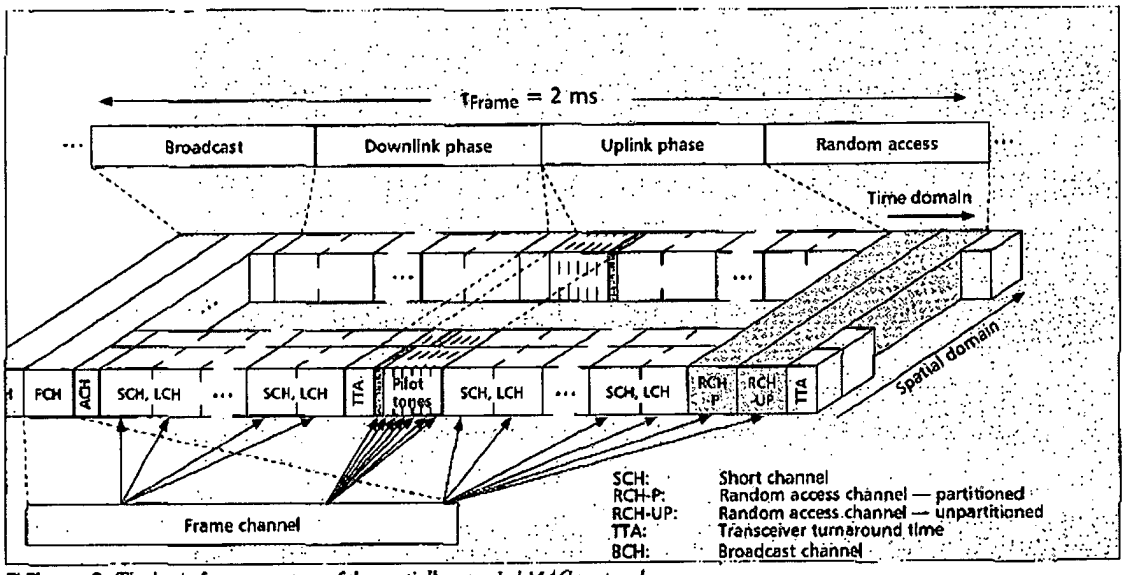
1. Scope and Content of Vornefeld

Vornefeld describes space-division multiple access (SDMA) techniques in the context of the HIPERLAN/2 system, which provides wireless network broadband services with guaranteed quality of service. Ex. 1004, 52. The system deploys a smart array antenna with several antenna systems that provides the ability to set up multiple antenna beams, which can be directed adaptively to the mobile terminal (MT) locations and

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allows different users to be served on the same frequency channel at the same time. *Id.* Depending on the number of antenna elements and the applied beamforming algorithm, array antennas are able to simultaneously direct several beams conveying individual user signals to different positions. *Id.* at Fig. 2, 53. The system uses a Medium Access Control (MAC) protocol to coordinate the access of MTs to the shared radio channel. *Id.* at 54.

Figure 3 of Vornefeld is depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

Figure 3 illustrates the basic MAC frame structure of the spatially extended MAC protocol. *Id.* at Fig. 3. MAC frame starts with broadcast channel (BCH), followed by frame channel (FCH), then a downlink phase, an uplink phase, and random access channels (partitioned, RCH-P, and unpartitioned, RCH-UP). *Id.* at 54. BCH conveys signaling information concerning the whole radio cell in the downlink direction and announces the location of the FCH and RCH within the actual MAC frame. *Id.* FCH is broadcast in the downlink direction and transmits information about the structure of the

MAC frame for the up- and downlink phases; it contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive. *Id.* Short Channel (SCH) conveys data link control information and Long Channel (LCH) serves to transmit user data bi-directionally on the up- and downlink. *Id.* RCH-P and RCH-UP are contention channels. *Id.* As depicted in Figure 3, a number of MAC frames can be transmitted concurrently by extension into the space domain using the smart antenna system. *See id.* at Fig. 3, 53, 55. A space-time scheduler is used to determine the temporal transmission sequence of MAC PDUs (protocol data unit) as well as the MTs that can simultaneously be addressed or allowed to concurrently transmit their bursts. *Id.* at 55.

2. Scope and Content of Andersson

Andersson describes adaptive sectorization to solve problems associated with sectorization of cells in cellular communication systems. Ex. 1005, 3:37–40, 4:31–34. A transceiver structure located at a base station is connected to a set of sector antennas and each sector antenna is used to cover a sector of the cell. *Id.* at 4:42–44; *see also* Fig. 2 (depicting an antenna configuration with six sectors). The beacon carrier is also connected to an omni-directional antenna, which provides the same coverage area as all of the sector antennas together. *Id.* at 4:58–60.

3. Claims 2, 11, and 20

Claim 2 depends from claim 1 and recites "wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals." Claims 11 and 20 depend from claims 10 and 19, respectively, and recite the same limitation set forth in claim 2.

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Petitioner contends "Vornefeld discloses that the broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signal." Pet. 26 (citing Ex. 1003 ¶¶ 151–152); *see also id.* at 50 (citing to the analysis of "Ground 1" to support the assertion that claims 2, 11, and 20 are obvious over Vornefeld and Andersson). Specifically, Petitioner asserts the frame channel (FCH) described in Vornefeld is equivalent to the claimed 'first beam map" because Vornefeld discloses the FCH is broadcast in the downlink direction, transmits information about the structure of the MAC frame for the up-and downlink phases and contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in. *Id.* at 26 (citing Ex. 1004, 54–55; Ex. 1003 ¶ 152).

Petitioner further asserts that because each of the SCH and LCH portions of the frame are transmitted in different signals (or directed beams) in the spatial domain, the base station must inform each subscriber unit when it should listen for its specific directive beam signal. Reply 5 (citing Ex. 1011, 29:12–30:3 (testimony of Mr. Proctor)). Mr. Proctor testifies that the FCH, which is broadcast to all users, will have a map in it that describes which time slots particular mobile terminals should decode on the downlink phase. Ex 1011, 30:15–19. Mr. Proctor further testifies that this information sent in Vornefeld would be sufficient to demodulate or detect the downlink signal and that downlink is a directed beam signal. *See id* at 47:18–48:2; *see also* Tr. 31 (Petitioner's assertion that the FCH includes information sufficient to allow the subscriber units to detect the directed scanning beam signal that is sent out). Petitioner further asserts, citing the testimony of Mr. Proctor, that one would not need to include information about the beams

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themselves to be a beam map as the claim only requires information be usable to demodulate a directed signal. Reply 12–13 (citing Ex. 1011, 47:2–11).

Patent Owner contends that Vornefeld does not disclose a beam map containing scanning beam information and asserts that the FCH signal cited by Petitioner is not "equivalent" to the recited "first beam map." PO Resp. 20–21. Patent Owner asserts the FCH signal includes only information about the structure of the frame (when the base station will be sending and receiving information) and does not include information about what scanning beam signal will be used to cover the sector, or when it will be used. *Id.* at 21. Patent Owner further asserts that Vornefeld accomplishes beam forming with the use of algorithms and says nothing about using beam maps in a broadcast beam signal. *Id.* at 21–22 (citing Ex. 1004, 53; Ex. 2001 ¶ 43); *see also* Tr. 61:2–4 (asserting the reason Vornefeld does not disclose a beam map is because Vornefeld discloses an algorithm for determining where beams would be directed and it does not need to send maps). Patent Owner asserts that Vornefeld also does not inherently disclose the recited beam map because a beam forming station may inform each subscriber unit when it should listen for its specific directive beam signal in any number of ways. Sur-Reply 4. Mr. Humphrey testifies that one of ordinary skill in the art would not assume that the start of frame information would include beam map information because beam maps are unnecessary in schemes that broadcast with beams cycled in round robin rotation as noted in the '931 patent or using various multiple antenna diversity techniques. *See* Ex. 2001 ¶¶ 46–47.

In our Institution Decision, we were not persuaded Petitioner established a reasonable likelihood that Vornefeld discloses the recited first

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beam map usable to detect directed scanning beam signals. Dec. 17. In particular, we were not persuaded that Petitioner provided sufficient analysis to establish that one of ordinary skill in the art would understand Vornefeld's description of transmitting broadcast timeslot reservations for long and short transport channels (channel slots in a MAC frame) to be a beam map usable to detect directed scanning beam signals. *Id.* at 17–18. After consideration of the entire record, we remain unpersuaded that Vornefeld discloses a first beam map containing scanning beam information useable to detect said directed scanning beam signals.

Vornefeld discloses its FCH is "[u]sed to transmit the information about the structure of the MAC frame for the up- and downlink phases." Ex. 1004, 54. The FCH "contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in." *Id.* We agree with Petitioner and Mr. Proctor that this information may be used by an MT to demodulate the downlink signal. *See* Reply 6; Ex. 1011, 47:18–23.

But, we are not persuaded by Petitioner's assertions, or the testimony of Mr. Proctor, that this demodulation information is what the claim requires. *See* Reply 12–13; Ex. 1011, 47:2–11. As discussed in our claim construction analysis above, the disclosure of the '931 patent makes clear that information that identifies a downlink time slot (demodulation information) is different than the information usable to detect directed scanning beam signals. *See* Ex. 1001, 9:35–44.

We are also not persuaded that the FCH demodulation information disclosed by Vornefeld meets our construction of the limitation set forth in claims 2, 11, and 20, namely "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

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Rather, we agree with Patent Owner that the FCH described in Vornefeld does not include information about which scanning beam signal will be used or when it will be used. PO Resp. 21; *see* Ex. 1004, 54. We are persuaded by Mr. Humphrey's testimony that Vornefeld discloses beam forming is accomplished with the use of algorithms and not a beam map.[4] *See* Ex. 2001 ¶ 43; Ex. 1004, 53 (describing the use of a beam forming algorithm to adjust the phases at the antenna elements to steer towards the desired MT). Thus, we determine that Petitioner fails to establish, by a preponderance of the evidence, that Vornefeld discloses a first beam map containing scanning beam information usable by the wireless access devices to detect the directed scanning beam signals.

We conclude Petitioner has not demonstrated that claims 2, 11, and 20 are anticipated by Vornefeld. Petitioner does not assert Andersson meets the limitation set forth in these claims, but rather relies on its anticipation analysis discussed above. *See* Pet. 50. Accordingly, Petitioner has also not demonstrated that claims 2, 11, and 20 would have been obvious over Vornefeld and Andersson.

4. Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25

Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 depend from claim 2, 11, or 20. In its analysis of these claims, Petitioner does not cure its failure to demonstrate Vornefeld discloses the "first beam map" limitation recited in

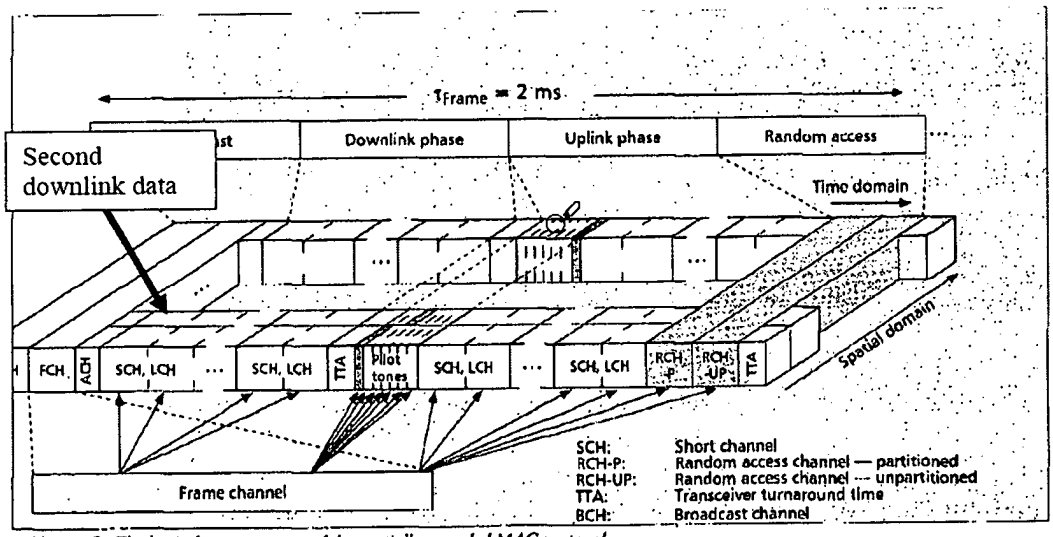
[4] Petitioner asserts Mr. Humphrey does not qualify as a person of ordinary skill in the art because he did not obtain his experience prior to 2001. *See* Reply 16. We agree with Patent Owner that Petitioner's assertion is immaterial as it is not necessary for an expert to obtain the relevant experience by the time of the filing of the patent. *See* Sur-Reply 11. We are persuaded Mr. Humphrey has sufficient qualifications to credit his testimony. *See* Ex. 2001 ¶ 7; Ex. 2002.

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these claims by virtue of their dependency. *See* Pet. 27–31, 33–34, 50. Accordingly, we conclude Petitioner has not demonstrated that claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 are anticipated by Vornefeld. Petitioner has also not demonstrated that these claims would have been obvious over Vornefeld and Andersson.

5. Claims 28 and 29

Claim 28 depends from claim 1 and recites "wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals." Petitioner contends Vornefeld discloses that its array antennas are able to simultaneously direct several beams to different positions conveying individual user signals. Pet. 34 (citing Ex. 1004, Fig. 2, 53); Reply 15. Petitioner asserts Figure 3 of Vornefeld clearly shows "second downlink data traffic" being transmitted in the downlink portion of the frame using a different directed scanning beam signal. *Id.* Petitioner provides an annotated version of Figure 3, depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

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Figure 3, as annotated by Petitioner, illustrates Petitioner's assertions that Vornefeld discloses second downlink data in its spatially extended MAC protocol. Pet. 35. Petitioner further asserts Figure 3 of Vornefeld shows a single frame with multiple channels being transmitted in parallel in the spatial domain and that each channel represents a different directive scanning beam. Reply 15. Petitioner asserts a person of ordinary skill in the art would understand that the ULAs in Vornefeld transmit downlink data to different sectors using different directive scanning beams. *Id.* at 15–16.

Patent Owner contends Vornefeld does not disclose using a different directed scanning beam signal within a TDD frame. PO Resp. 26. Patent Owner asserts the second downlink data identified by Petitioner is in a different, spatially-separated, simultaneous TDD frame. *Id.* Patent Owner asserts Vornefeld does not disclose using different or multiple beams in the same TDD frame. *Id.*

Petitioner has not met its burden to establish claim 28 is anticipated by, or would have been obvious over, Vornefeld. Claim 28 requires the transmit circuitry to transmit second downlink data traffic in the same (said) downlink portion of the same (said) TDD frame recited in claim 1. The block that Petitioner relies on for the second downlink data traffic is depicted as a different (spatially separated) TDD frame that is simultaneously transmitted with the other frames. *See* Pet. 35; *see also* Ex. 1004, 54 (describing concurrent transmission of MAC PDUs in the spatial domain). We agree with Patent Owner that Petitioner does not establish Vornefeld discloses using different beams in the same TDD frame (i.e., second downlink data traffic, transmitted in "said downlink portion of said TDD frame") to transmit to devices within a different sector.

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We conclude Petitioner has not demonstrated that claim 28 is anticipated by Vornefeld. Petitioner relies on its analysis of claim 28 to support its assertion that claim 29, which recites similar limitations as claim 28, is anticipated by Vornefeld. *See* Pet. 35. Accordingly, Petitioner has also not demonstrated that claim 29 is anticipated by Vornefeld.

Petitioner does not assert Andersson meets the limitations set forth in claims 28 and 29. *See id.* at 50. Therefore, we conclude Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Vornefeld and Andersson.

E. Obviousness over Vornefeld and Ahy, and Obviousness over Vornefeld, Andersson, and Ahy

Petitioner challenges claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld and Ahy. Pet. 35–44. Petitioner further challenges these claims as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy. *Id.* at 50–51.

1. Scope and Content of Ahy

Ahy describes adaptive point to multipoint wireless communications. Ex. 1006, 1:65–66. A base station controller (BSC) maintains a set of physical (PHY) parameters and media-access-control (MAC) parameters, each of which is adaptively modified by the BSC for communication with a plurality of customer premises equipment (CPE). *Id.* at 2:15–21, 7:18–20. The BSC adjusts communication with each CPE individually and adaptively in response to changes in communication characteristics. *Id.* at 2:21–23. Control of each parameter by the BSC is independent and individual with regard to each CPE. *Id.* at 7:20–22. Each parameter actually has two values: a first value for transmission by the BSC and a second value for

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transmission by the CPE. *Id.* at 7:65–8:1. The communication parameters that can be adapted include: antenna selection to choose the antenna to be used at the BSC and the CPE; modulation type to determine the bit per symbol rate to use to exchange information; and error code type to choose the error detection and correction technique. *See id.* at 8:50–59, 10:38–48, 11:40–45.

Communications between the BSC and each CPE are conducted using a TDD technique in which time durations are divided into individual frames, each of which includes a "downstream" and "upstream" portion. *Id.* at 7:1–5. The BSC controls transmission for both upstream and downstream directions without specific requests from CPEs. *Id.* at 7:5–9. The TDD frame includes a sequence of parameter setting values for the BSC to use to inform each selected CPE of the PHY and MAC parameters the BSC is using to send messages to that selected CPE, and the PHY and MAC parameters the selected CPE should use to send messages to the BSC during its allocated part of the upstream portion. *Id.* at 15:11–20.

2. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27

In its challenges based on Vornefeld, Petitioner relies on Vornefeld to disclose the "first beam map" limitation set forth in these claims by virtue of their dependency from one of claims 2, 11, and 20.[5] Pet. 35–44, 50–51. Therefore, Petitioner fails to cure the deficiencies in Vornefeld discussed above and has not demonstrated that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 are obvious over Vornefeld and Ahy. Petitioner also fails to

[5] Petitioner relies on Ahy to disclose the "first beam map" limitation only in its challenge based on Newman. *See* Pet. 58. Accordingly, we address Petitioner's assertions about Ahy in the Newman ground discussed below.

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demonstrate that these claims are obvious over Vornefeld, Andersson, and Ahy.

F. Obviousness over Newman, Andersson, and Ahy

Petitioner challenges claims 1–29 as obvious under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson. Pet. 51–63.

1. Scope and Content of Newman

Newman describes a multi-beam antenna system for communicating with mobile users. *Id.* at 1:4–6. The multi-beam communication system includes a sector antenna having a beamwidth providing sector coverage and a transmitter and a receiver system for receiving user signals from a user located in the sector. Ex. 1007, 2:10–14; *see also id.* at 4:5–6. A sector antenna has a beamwidth effective to provide coverage of a 120 degree azimuth sector. *Id.* at 4:12–15. The antenna system further includes a multi-beam antenna, which may comprise four side-by-side vertical arrays of dipoles or other radiating element arrangements suitable for providing four antenna beams, each having a beam width narrower than the 120 degree sector and aligned so that the four beams collectively cover at least a portion of the sector. *Id.* at 4:35–42. The beams may be provided with the inclusion of a suitable beam forming network. *Id.* at 4:47–50. Access to the four beams of the multi-beam antenna is provided by operation of the beam forming network, which may be included as part of the multi-beam antenna. *Id.* at 10:35–38. With this arrangement, communication with a particular user can be enhanced by a significant increase in transmitted signal strength, for example, by transmitting to the user via a narrow beam instead of the sector beam. *Id.* at 38–42.

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2. Claims 2–9, 11–18, and 20–27

Petitioner contends Ahy discloses "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals," as recited in claims 2, 11, and 20. Pet. 58; *see also id.* at 63 (asserting claims 11 and 20 are obvious for the same reasons given with respect to claim 2). In particular, Petitioner asserts Ahy teaches that the start of each TDD frame includes a first parameter value for transmission by the BSC and a second parameter value for transmission by the CPE, which allows the BSC and the CPE to transmit using different sets of parameters. *Id.* at 58 (citing Ex. 1006, 7:67–8:3). Petitioner asserts Ahy also discloses that the first part of the frame includes a value for the length for subsequent downstream payload elements for each CPE. *Id.* (citing Ex. 1006, 15:25–30). Thus, Petitioner asserts Ahy teaches providing information usable by CPEs (wireless access devices) to detect directed scanning beam signals. *Id.* (citing Ex. 1003 ¶ 153). Petitioner further asserts it would have been obvious to incorporate the TDD frame structure in Ahy into the beam forming network disclosed in Newman for the reasons described with respect to claim 1. *Id.*; *see also id.* at 52–53, 57 (asserting incorporating Ahy's TDD frame structure in Newman is nothing more than the use of known techniques to improve similar methods in the same way to yield predictable results).

Additionally, Petitioner asserts that, during Mr. Proctor's deposition, Mr. Proctor further explained why Ahy discloses the "beam map" and pointed to the "antenna selection" parameter in Ahy that includes a choice of antenna at the BSC 120 and choice of antenna at each CPE 130. Reply 7–8 (citing Ex. 1006, 8:54–59; Ex. 1011, 45:21–46:3). Petitioner asserts the antenna selection parameter in Ahy identifies the specific beam used to

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transmit the signal to the CPE. *Id.* at 8, 14. Petitioner asserts the value of the length of the subsequent downstream payload elements for each CPE informs the CPE when it should listen. *Id.* at 8 (citing Ex. 1006, 15:25–30; Ex. 1003 ¶ 153). Petitioner asserts this "scanning beam information" is usable by the CPE to detect directed scanning beam signals, and therefore meets the "beam map" limitations of claims 2, 11, and 20. *Id.* Petitioner also asserts that the antenna selection parameter (along with the timeslot reservation) clearly identifies the specific beams and their precise start times, which are usable by the CPE to detect the directed scanning beam signal. *Id.* at 14.

Patent Owner asserts that Ahy says nothing about directed scanning beam signals and nothing about sending a beam map containing scanning beam information that would allow the CPEs to detect directed scanning beam signals. PO Resp. 23. Patent Owner asserts Ahy's start of frame signal does not include information about which scanning beam will be used to cover the sector, or when it will be used. *Id.* at 23–24. Patent Owner asserts that Petitioner has not explained or provided supporting facts or evidence showing how or why the frame disclosed in Ahy would require a beam map containing scanning information. Sur-Reply 8.

We determine Petitioner fails to establish Ahy discloses "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time," based on our construction of the beam map limitation set forth above. Ahy discloses

> [e]ach of the following parameters actually has two values: a first value for transmission by the BSC 120 and a second value for transmission by the CPE 130. Thus, the BSC 120 can transmit using a first set of parameters while the CPE 130 is instructed to transmit using a second set of parameters.

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Ex. 1006, 7:65–8:3(bolding omitted). Petitioner relies on this passage, along with Ahy's disclosure that the BSC sends the length of each downstream payload element in the time synchronization portion, to meet the beam map limitation. *See* Pet. 58 (citing Ex. 1006, 7:67–8:3; 15:25–30). But, Petitioner does not provide sufficient analysis in its Petition to explain why one of ordinary skill in the art would understand Ahy's description that the BSC and CPE can transmit using different values, in combination with its description that the length of the downstream payload elements is also transmitted in the time synchronization portion, discloses scheduling information for one or more beams indicating which scanning beam is used at which time.[6]

We are also not persuaded that Ahy's description of the BSC transmitting the length of each of the downstream payload elements discloses a start time of the beam. *See* Ex. 1006, 15:25–30. Petitioner does not provide sufficient reasoning to explain why the length of a payload informs the CPE the time it should listen. *See* Reply 8, 14. Mr. Proctor's testimony does not support Petitioner's assertion that the payload length indicates a start time; rather, Mr. Proctor merely states that Ahy discloses the

[6] In its Reply, Petitioner newly cites to Ahy's disclosure of an antenna selection parameter (which includes a choice of antenna at the BSC 120 and antenna at CPE 130) to support its assertion that Ahy discloses identification of the specific beam used to transmit the signal. *See* Reply 7–8 (citing Ex. 1006, 8:54–59). Mr. Proctor also newly relies on the antenna selection parameter to support his testimony that Ahy informs the CPE which antenna the BSC would be transmitting on. *See* Ex. 1011, 45:15–46:3. We decline to consider Petitioner's new assertions because they raise a new issue and exceeds the scope of a proper reply. *See* 37 C.F.R. § 42.23(b); *see also* Office Practice Trial Guide, 77 Fed. Reg. 48,765, 48,767 (Aug. 14, 2012) (a reply that raises a new issue will not be considered).

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first part of the frame "includes a value of the length for subsequent downstream payload elements for each CPE" (without further explanation of the relevance of this disclosure) and that this, in conjunction with the ability for the BSC and CPE to transmit using different sets of parameters teaches "providing information usable by CPEs (e.g., wireless access devices) to detect directed scanning beam signals. Ex. 1003 ¶ 153.

Finally, we observe that Petitioner relies on Newman, and not Ahy, to disclose the multi-beam antenna system and the "said directed scanning beam signals" recited in claims 2, 11, and 20. *See* Pet. 53–55. Petitioner relies on a combination argument—incorporation of the TDD frame structure in Ahy into the beam forming network disclosed in Newman—to meet the beam map limitation. *See* Pet. 58. However, Petitioner only provides reasoning why one of ordinary skill in the art would incorporate the capability of communicating using TDD into the communications system in Newman. *Id.* at 52–53, 58. This reasoning is insufficient to explain why one of ordinary skill would have incorporated Ahy's disclosure of BSC and CPE parameters and transmission of payload length into Newman.

For the reasons stated above, Petitioner fails to establish the Newman-Ahy-Andersson combination discloses the beam map limitation recited in claims 2, 11, and 20. Claims 3–9, 12–18, and 21–27 depend from claim 2, 11, and 20, respectively. Petitioner's analysis of these claims does not cure the deficiency. *See* Pet. 59–63.

We conclude Petitioner has not demonstrated that claims 2–9, 11–18, and 20–27 would have been obvious over Newman, Ahy, and Andersson.

5. Claims 28 and 29

Petitioner contends that claims 28 and 29 are obvious over the combination of Newman, Ahy, and Andersson for the same reasons given

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with respect to claims 2–9. However, claims 28 and 29 recite limitations that do not appear in claims 2–9. Petitioner fails to explain how the cited references teach transmit circuitry that "transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals," as recited in claim 28. Petitioner also fails to explain how the references teach the substantially similar limitation that appears in claim 29. Accordingly, Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Newman, Ahy, and Andersson.

III. CONCLUSION

For the reasons stated above, we enter adverse judgement against Patent Owner with respect to claims 1, 10, and 19 of the '931 patent. We further determine

A. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 102(b) as anticipated by Vornefeld;

B. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Andersson;

C. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Ahy;

D. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy; and

E. Claims 2–9, 11–18, and 20–29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson.

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IV. ORDER

It is

ORDERED that that adverse judgement is entered against Patent Owner as to claims 1, 10, and 19 of U.S. Patent No. 7,230,931 B2; and

FURTHER ORDERED that claims 2–9, 11–18, and 21–29 of U.S. Patent No. 7,230,931 B2 have not shown to be unpatentable.

This is a final written decision of the Board under 35 U.S.C. § 318(a), and, therefore, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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FORM 5. Petition for Review or Notice of Appeal of an Order or Decision of an AGENCY, BOARD, COMMISSION, OFFICE OR BUREAU

Form 5
Rev. 03/16

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Sprint Spectrum L.P. , Petitioner or Appellant,

v.

PETITION FOR REVIEW

General Access Solutions, Ltd. , Respondent or Appellee.

Sprint Spectrum L.P. (name all parties* bringing the petition or appeal) hereby petition/appeal the court for review of the Final Written Decision (describe the order or decision and include decision number) of the Patent Trial and Appeal Board (name the agency, board, office or bureau) entered on March 7, 2019 (date). The order or decision was received on March 7, 2019 (date).

Date: May 8, 2019

/s/ Brian D. Schmalzbach

(Signature of petitioner, appellant or attorney)

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*See Fed. R. App. P. 15 (a) (2) for permissible ways of identifying petitioners.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.
Petitioner

v.

GENERAL ACCESS SOLUTIONS, LTD.
Patent Owner

Inter Partes Review Case No. 2017-01889

Patent No. 7,230,931

PETITIONER'S NOTICE OF APPEAL

Please take notice that under 35 U.S.C. §§ 141(c), 142, 319; 37 C.F.R. §§ 90.2(a), 90.3(a), and Federal Rules of Appellate Procedure/Federal Circuit Rule 4(3)(a), Petitioner Sprint Spectrum L.P. ("Sprint") hereby appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered on March 7, 2019 (Paper 43), and all rulings leading up to those decisions. A copy of the Final Written Decision is attached as Exhibit A.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Sprint's issues on appeal include at least: (i) the Board's construction of certain terms, including the term "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals"; (ii) the Board's determination that Petitioner failed to show by a preponderance of the evidence that claims 28 and 29 are unpatentable under 35 U.S.C. §§ 102(b) or 103(a); (iii) the Board's refusal to consider evidence that allegedly raised a new issue and exceeded the scope of a proper reply; and (iv) any findings or determinations supporting or related to the aforementioned issues as well as all other issues decided adversely to Sprint in any orders, decisions, rulings, and opinions.

Simultaneously with this submission, Sprint is filing a copy of this Notice of Appeal with the Director of the United States Patent and Trademark Office and a copy of the same, along with the required docketing fee, with the Clerk of the United States Court of Appeals for the Federal Circuit as set forth in the accompanying

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Certificate of Service.

Dated: May 9, 2019

Respectfully submitted,

By: */s/ Robert C. Hilton*

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 1.903, the undersigned certifies that on May 8, 2019, a copy of this Notice was served in the manner shown below, to the following:

Via Federal Express

The Office of the General Counsel
U.S. Patent and Trademark Office
Madison Building East, 10B20
600 Dulany Street
Alexandria, VA 22313-1450

Patent Trial and Appeal Board
U.S. Patent and Trademark Office
Madison Building East, 10B20
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I further certify that on this 8th day of May, 2019, an electronic copy of the foregoing **Petitioner's Notice Of Appeal**, along with the required docketing fee, is

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being submitted electronically with the United States Court of Appeals for the Federal Circuit via CM/ECF. In addition, I further certify that on this 8th day of May, 2019, a copy of the foregoing **Petitioner's Notice Of Appeal** is being sent to the Clerk's Office of the United States Court of Appeals for the Federal Circuit via Federal Express.

By: */Robert C. Hilton/*

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Attorney for Petitioner

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Exhibit A

Trials@uspto.gov
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Paper 43
Entered: March 7, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.,
Petitioner,

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Patent Owner.

Case IPR2017-01889
Patent 7,230,931 B2

Before MELISSA A. HAAPALA, *Acting Vice Chief Administrative Patent Judge,* and KALYAN K. DESHPANDE and DAVID M. KOHUT, *Administrative Patent Judges*.

HAAPALA, *Acting Vice Chief Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

Sprint Spectrum L.P. ("Petitioner") filed a Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–29 of U.S. Patent No. 7,230,931 B2 ("the '931 patent"). Paper 1 ("Pet."). General Access Solutions, Ltd. ("Patent Owner") did not file a Preliminary Response. Applying the standard set forth in 35 U.S.C. § 314(a), we granted Petitioner's request to institute an *inter partes* review of all challenged claims. Papers 5 ("Dec") (instituting on claims 1, 3–10, 12–19, and 21–29); Paper 8 (instituting on remaining challenged claims 2, 11, and 20 and modifying our initial institution decision to include all of the grounds presented in the Petition).

During the trial, Patent Owner timely filed a Response (Paper 25, "PO Resp."), to which Petitioner timely filed a Reply (Paper 29, "Reply"). Patent Owner further submitted a Sur-Reply (Paper 34, "Sur-Reply") to Petitioner's Reply. An oral hearing was held on December 6, 2018, and a copy of the transcript was entered into the record. Paper 41 ("Tr.").

Following the oral hearing and pursuant to our authorization (Paper 37), both parties each submitted claim construction briefs (Papers 38, 39); each party also submitted a reply to the other party's brief (Papers 40, 41).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the claims on which we instituted trial. For the reasons that follow, we enter adverse judgement against Patent Owner with respect to independent claims 1, 10, and 19 of the '931 patent and we determine that Petitioner has not shown that dependent claims 2–9, 11–18, and 20–29 are unpatentable.

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I. BACKGROUND

A. The '931 Patent (Ex. 1001)

The '931 patent describes a burst packet transmission media access system using selectively adaptable beam forming in a fixed wireless access network. Ex. 1001, 3:28–31. The fixed wireless network may comprise a plurality of transceiver base stations that transmit forward channel (downlink or downstream) broadband signals to subscriber premises and receive reverse channel (uplink or upstream) broadband signals from subscriber premises. *Id.* at Fig. 1, 11:57–64. Each of the transceiver base stations may cover a cell site that is divided into a plurality of sectors. *Id.* at Fig. 2, 12:25–27. Pre-programmed sets of directed beam patterns are used to cover a cell in an angular fashion, which is referred to as "beam scanning." *Id.* at 28:1–3. The base station establishes a set of beams to cover the cell and based on physical location in the sector, a specific beam is used to communicate with one or more subscribers that lie in that sector. *Id.* at 28:9–12.

Figure 14 of the '931 patent is depicted below:

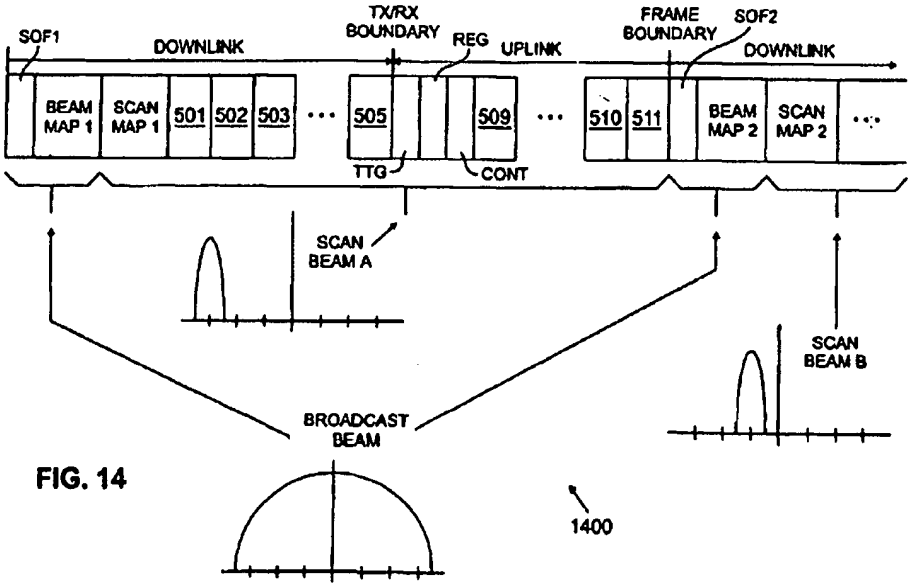


FIG. 14

Figure 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) signal 1400. *Id.* at 29:3–5. TDD signal 1400 comprises a first TDD frame having a downlink portion comprising a first start-of-frame field (SOF1), a first beam map field (Beam Map 1), and a first scan map field (Scan Map 1). *Id.* at 29:6–10. The first TDD frame is followed by a second TDD frame, which comprises a second start-of-frame field (SOF2), a second beam map field (Beam Map 2), and a second scan map field (Scan Map 2). *Id.* at 29:21–25. A spread spectrum Broadcast Beam is used to transmit start-of-frame fields SOF1, SOF2 and beam map fields Beam Map 1, Beam Map 2 in each TDD frame. *Id.* at 29:26–30. Distinct scan beams (Scan Beam A and Scan Beam B) are used to transmit the scan map fields (Scan Map 1 and Scan Map 2) and the remainder of the uplink and downlink portions of each TDD frame. *Id.* at 29:30–33.

Broadcast Beam Maps 1, 2 provide data indicating which scanning beam (or beams) are used at which time for the frame and also transmits a synchronization field so that all subscribers can maintain synchronization. *Id.* at 29:34–36, 29:47–50. Scanning Beam Maps A, B provides the uplink and downlink map, which state at which time in the frame, using the scanning beam described in the associated Broadcast Beam Map, the downlink modulation groups and specific uplink slots are allocated for the frame using the specific scanning beam. *Id.* at 29:38–43.

B. Illustrative Claims

Claims 1, 10, and 19 are independent claims. Claims 1 and 2 are illustrative of the subject matter at issue:

> 1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations

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capable of bidirectional time division duplex (TDD) communications with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and

subsequently transmits in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.

2. The transceiver as set forth in claim 1 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals.

C. Instituted Grounds of Unpatentability

Petitioner relies on the following references:

1. U. Vornefeld, et al., *SDMA Techniques for Wireless ATM*, IEEE Communications Magazine (Nov. 1999) ("Vornefeld") (Ex. 1004).
2. U.S. Patent No. 6,470,177 B1, issued Oct. 22, 2002 ("Andersson") (Ex. 1005).
3. U.S. Patent No. 7,366,133 B1, issued Apr. 29, 2008 ("Ahy") (Ex. 1006).[1]

[1] We note the first named inventor of U.S. Patent 7,366,133 is Majidi-Ahy. Ex. 1006, 1. However, as both parties refer to this reference as "Ahy" (*see e.g.*, Pet. 17; PO Resp. 18), we use the same shortened form for consistency and to avoid confusion.

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4. U.S. Patent No. 5,684,491, issued Nov. 4, 1997 ("Newman") (Ex. 1007).

We instituted trial under 35 U.S.C. §§ 102(b) and 103(a) over the following combinations of references:

Reference(s)	Basis	Claims
Vornefeld	35 U.S.C. § 102(b)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Vornefeld and Andersson	35 U.S.C. § 103(a)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld, Andersson, and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Newman, Ahy, and Andersson	35 U.S.C. § 103(a)	1–29

In support of its contentions, Petitioner submitted a declaration by its witness, Mr. James A. Proctor, Jr. Ex. 1003. In response, Patent Owner submitted a declaration by its witness, Kurt D. Humphrey. Ex. 2001. Both witnesses were cross-examined during the trial, and transcripts of their depositions are in the record. Ex. 1011 (Proctor deposition); Ex. 1012 (Humphrey deposition).

D. Related Proceedings

Petitioner and Patent Owner identify the following district court litigation involving the '931 patent: *General Access Sol., Ltd. V. Sprint Spectrum L.P.*, Case No. 2:16-cv-465-RWS (E.D. Tx.). Pet. 2; Paper 3, 1.

E. Real Parties in Interest

Petitioner identifies the following additional real parties in interest: Virgin Mobile USA, L.P.; Boost Mobile, LLC; Clearwire Corporation;

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Clearwire Communications LLC; and Clear Wireless LLC. Pet. 1. Petitioner further identifies Sprint Corporation as a real party in interest only for purposes of this proceeding and only to the extent Patent Owner contends the separate legal entity should be named a real party in interest in this proceeding. *Id.* Patent Owner does not identify any additional real parties in interest. *See* Paper 3, 1.

II. ADVERSE JUDGEMENT

Both in its Response and at the oral hearing, Patent Owner conceded the unpatentability of independent claims 1, 10, and 19. PO Resp. 2 n.2 ("Patent Owner does not herein dispute the patentability of the independent claims 1, 10, and 19 of the '931 patent."); Tr. 56:19–57:9 ("[Vornefeld] knocks out our independent claims. We concede that."). A concession of unpatentability is construed as a request for entry of adverse judgement. 37 C.F.R. § 42.73(b)(3). The request is granted.

III. ANALYSIS

A. Legal Principles

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *See Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). Although the elements must be arranged or combined in the same way as in the claim, "the reference need not satisfy an *ipsissimis verbis* test," i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter as a whole would have been obvious at the time the invention was made to a

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person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness, i.e., secondary considerations such as commercial success, long felt but unsolved needs, and failure of others.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). The obviousness inquiry further requires an analysis of "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring "articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")).

B. Level of Ordinary Skill in the Art

Petitioner asserts a person of ordinary skill in the art at the time of the filing date of the '931 patent would have had at least a Bachelor of Science in Computer Science, Computer Engineering, Electrical Engineering, or an equivalent field, and at least two years of academic or industry experience in any type of wireless networking field. Pet. 9–10. Patent Owner asserts a person or ordinary skill would have been a telecommunications engineer or technologist working in the wireless networking sector and have a least a bachelor's degree in engineering and relevant work experience, including at

[2] The record does not include arguments or evidence regarding objective indicia of non-obviousness.

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least two years of academic, practical, or industry experience in the wireless networking and/or telecommunications field. PO Resp. 6.

Our decision does not turn on the minor differences between the definitions. Both Petitioner and Patent Owner advocate a similar level of experience and both agree that a person of ordinary skill would have a bachelor's degree in engineering. We accept the level of skill advocated by Petitioner as the identified undergraduate academic degrees are consistent with the prior art of record.

C. Claim Construction

In an *inter partes* review, based on a petition filed before November 13, 2018, claims of an unexpired patent are interpreted using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b) (2017);[3] *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under that standard, "words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification and prosecution history." *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016).

1. "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals"

This limitation is recited by dependent claims 2, 11, and 20. After review of the parties' briefing and based on arguments made at the oral hearing, we determined the meaning of the recited "beam map" is at issue in

[3] A recent amendment to this rule does not apply here because the Petition was filed before November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018).

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this proceeding. Because neither party had set forth an explicit construction for this term, during the oral hearing we authorized each party to file an additional brief setting forth the party's proposed construction and also authorized each party to file a response brief to the other party's proposed construction. Paper 37. Both parties submitted the additional briefs and response briefs. *See* Papers 39, 40 (Petitioner's briefs); Papers 38, 41 (Patent Owner's briefs).

Petitioner asserts we should construe "a first beam map" as "scheduling information for one or more beams." Paper 39, 1. In support of its construction, Petitioner asserts the beam map is part of the broadcast beam shown in Figure 14 and the description of a beam map in the corresponding portion of the specification references scheduling information associated with the beam map. *Id.* at 2 (citing Ex. 1001, 29:34–36). Petitioner asserts the scheduling information that forms a beam map comprises information about one or more beams that are transmitted in the frame and that the beam maps "provide data indicating which beam (or beams) are used at which time." *Id.* at 3 (citing Ex. 1001, 29:34–36).

Patent Owner initially proposes we construe "a first beam map" as "scanning beam information contained in the broadcast beam signal that enables wireless access devices to detect a particular directed scanning beam signal." Paper 38, 1. In its Opposition, Patent Owner states it does not disagree with Petitioner's proposed construction and that it is suitable for the claimed "beam map." Paper 41, 1. Patent Owner further asserts that the "first beam map" at issue in claims 2, 11, and 20 is significantly narrower, and requires that the beam map enable devices to detect a particular scanning beam. *Id.*

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Petitioner does not dispute that claims 2, 11, and 20 require the elements of Patent Owner's proposed construction because those elements are already found in the claims. Paper 40, 1. Petitioner asserts the problem with Patent Owner's initial construction is that it is redundant and renders the remaining terms of the claims superfluous. *Id.*

The '931 patent describes two different types of beam maps: broadcast beam maps and scanning beam maps. Ex. 1001, 29:26–43. A broadcast beam is used to transmit the broadcast beam map (Beam Map 1 and Beam Map 2) and distinct scan beams are used to transmit the scan map fields (Scan Beam A, Scan Beam B). *Id.* at Fig. 14, 29:26–33. Both parties assert that the "first beam map" recited in claims 2, 11, and 20 refers to the broadcast beam map. *See* Paper 38, 2 (Patent Owner's assertion that the first beam map "clearly means the Broadcast Beam Map portion of the definition of a generic "beam map."); Paper 39, 2 (Petitioner's assertion that the beam map "is a part of the broadcast beam (see Fig. 14), and the description of a beam map in the corresponding portion of the specification also references the scheduling information associated with the beam map."). Because claims 2, 11, and 20 all set forth the "first beam map" is a component of the "broadcast beam signal," we agree with the parties that the "first beam map" refers to a broadcast beam map.

We are persuaded that Petitioner's proposed construction of a "first beam map" is consistent with the plain meaning of a broadcast beam map in the context of the disclosure of the '931 patent. The '931 patent describes transmission of map information for beam scheduling via a spread spectrum broadcast beam. *See* Ex. 1001, 28:56; 29:34–35. Patent Owner agrees that Petitioner's proposed construction for "a first beam map" is a suitable

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definition. Paper 41, 1. Accordingly, we construe "first beam map" as "scheduling information for one or more beams."

As noted by both parties, claims 2, 11, and 20 further require that the "first beam map" contain "scanning beam information usable by said wireless access device to detect said directed scanning beam." *See* Papers 40, 2; 41, 1. Petitioner argues the scanning beam information

> may include information that 'identifies a downlink time slot during which one of said directed scanning beam signals transmits said downlink data traffic,' (claim 3), information that 'identifies at least one modulation format associated with one of said directed scanning beam signals' (claim 4), or information that 'identifies at least one forward error correction code level associated with one of said directed scanning beam signals' (claim 5).

Paper 40, 2–3. Petitioner asserts that Patent Owner's arguments limit "beam map" to a specific embodiment (such as the "Frame Beam map and Super-Frame Beam Map embodiment) and this provides reason to reject Patent Owner's construction. *Id.* at 3; *see also* Reply 9–11 (similarly asserting that Patent Owner's arguments that a first beam map necessary includes information about what scanning beam will be used improperly confine the claim to a specific embodiment). Petitioner argues that the '931 patent includes description of another embodiment in which the scanning beam information identifies a downlink time slot in the downlink portion during which the at least one directed scanning beam transmits the downlink traffic. Reply 11 (citing Ex. 1001, 9:40–44).

Patent Owner asserts that scanning beam detection information is different from scanning beam uplink/downlink/modulation information. *Id.* Patent Owner cites to several examples in the disclosure that provide data to enable a device to detect a particular scanning beam signal. Paper 38, 3

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(citing Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2). Patent Owner argues that information about which scanning beam will be used to cover the sector and when it will be used is necessary for a signal to serve as a beam map. PO Resp. 21, 24 (citing Ex. 2001 ¶ 44). Patent Owner argues that timeslot reservations do not constitute beam map information including the specific beam(s) and their precise start times in the frames which are useable by the wireless access devices to detect the directed scanning beam signals. *Id.* at 25 (citing Ex. 2001 ¶ 45).

We are not persuaded by Petitioner's arguments that the embodiment in which the scanning beam information identifies a downlink portion for transmission relates to the claimed scanning beam information useable to *detect* said directed scanning beam. Rather, the '931 patent discloses explicitly that the embodiment in which the scanning beam information identifies a downlink time slot is "another embodiment" than the embodiment set forth in claims 2, 9, and 11 in which the beam map contains scanning beam information usable to detect the directed scanning beam. *See* Ex. 1001, 9:35–44 (first describing the embodiment recited in claims 2, 9, and 11, and then describing "another embodiment" in which the scanning beam information identifies a downlink time slot). Thus, although as set forth in claim 3 (by virtue of its dependency from claim 2) the scanning beam information can include both types of information (information usable to detect directed scanning beam signals and identification of a downlink time slot), the disclosure of the '931 patent makes clear the information that identifies a downlink time slot is different than the information usable to detect directed scanning beam signals.

Furthermore, we determine Patent Owner's arguments—that the scanning beam information usable to detect the scanning beam signals must

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include information about which scanning beam will be used—are not an improper attempt to limit the claim language to a specific embodiment. As explained above and undisputed by the parties, the "first beam map" is a broadcast beam map. The '931 patent describes the information contained in the broadcast beam map as "data indicating which scanning beam (or beams) are used at which time." *See* Ex. 1001, 29:34–36. Petitioner cites to the same disclosure in support of its construction that a beam map is scheduling information for one or more beams. *See* Paper 39, 3 (citing Ex. 1001, 29:34–36). The other sections in the '931 patent describing the broadcast beam map all explain that the map contains information that informs the subscriber (wireless access) device which scanning beam is used and when (frame time) in which each beam starts. *See* Ex. 1001, 29:51–55, 29:66–30:2. We agree with Patent Owner that this information is what enables a device to detect a particular scanning beam. *See* Paper 38, 3.

We are mindful that claims must be interpreted in view of the specification without importing limitations from the specification unnecessarily. *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1369 (Fed. Cir. 2003). However, the disclosure of the '931 patent consistently describes that the broadcast beam map is scheduling information that indicates which scanning beam is used at which time. *See* Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2. The correct inquiry in giving a claim term its broadest reasonable interpretation in light of the specification is an interpretation that corresponds with what and how the inventor describes his invention in the specification. *In re Smith Int'l*, 871 F.3d 1375, 1382–83 (Fed. Cir. 2017). Consistent with the description set forth in the '931 patent, our complete construction of "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed

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scanning beam signals" is "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

2. Other Terms

Petitioner proposes constructions for "sector" and "directed scanning beam signal(s)," both terms which appear in independent claims 1, 10, and 19. Pet. 10–13. Patent Owner asserts that the meaning of these terms do not appear to be in dispute and construction of these terms would not resolve any controversy. PO Resp. 15.

We agree with Patent Owner that these terms are not in controversy and, accordingly, determine that we need not explicitly construe these terms to resolve the issues before us. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

D. Anticipation by Vornefeld and Obviousness over Vornefeld and Andersson

Petitioner challenges claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 as anticipated under 35 U.S.C. § 102(b) by Vornefeld. Pet. 19–35. Petitioner further challenges these claims as obvious under 35 U.S.C. § 103(a) over Vornefeld and Andersson. *Id.* at 44–50.

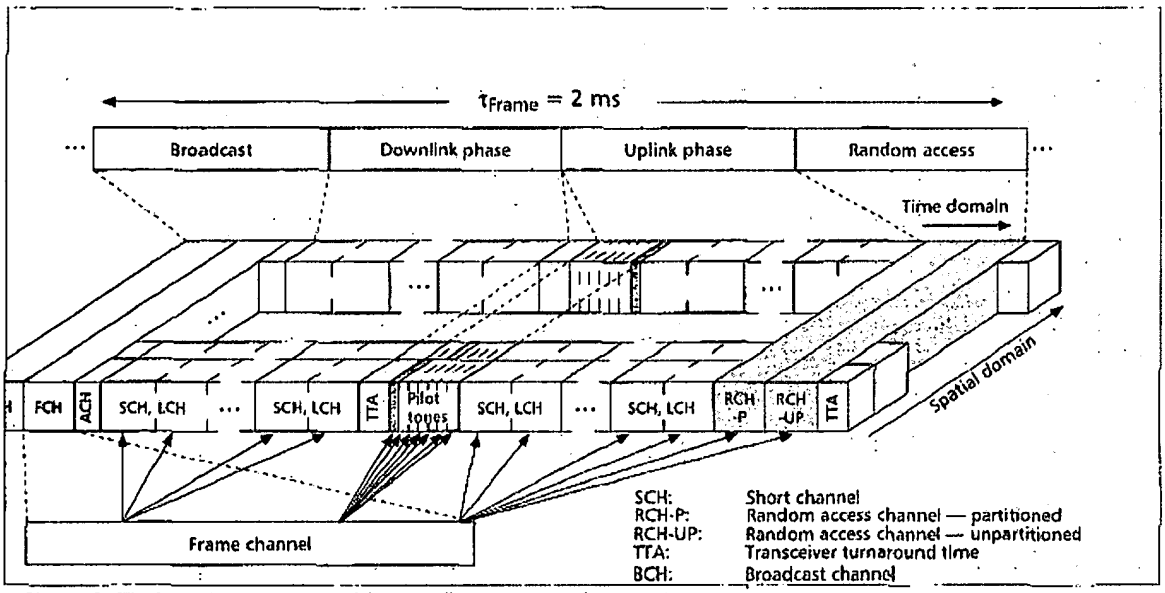
1. Scope and Content of Vornefeld

Vornefeld describes space-division multiple access (SDMA) techniques in the context of the HIPERLAN/2 system, which provides wireless network broadband services with guaranteed quality of service. Ex. 1004, 52. The system deploys a smart array antenna with several antenna systems that provides the ability to set up multiple antenna beams, which can be directed adaptively to the mobile terminal (MT) locations and

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allows different users to be served on the same frequency channel at the same time. *Id.* Depending on the number of antenna elements and the applied beamforming algorithm, array antennas are able to simultaneously direct several beams conveying individual user signals to different positions. *Id.* at Fig. 2, 53. The system uses a Medium Access Control (MAC) protocol to coordinate the access of MTs to the shared radio channel. *Id.* at 54.

Figure 3 of Vornefeld is depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

Figure 3 illustrates the basic MAC frame structure of the spatially extended MAC protocol. *Id.* at Fig. 3. MAC frame starts with broadcast channel (BCH), followed by frame channel (FCH), then a downlink phase, an uplink phase, and random access channels (partitioned, RCH-P, and unpartitioned, RCH-UP). *Id.* at 54. BCH conveys signaling information concerning the whole radio cell in the downlink direction and announces the location of the FCH and RCH within the actual MAC frame. *Id.* FCH is broadcast in the downlink direction and transmits information about the structure of the

MAC frame for the up- and downlink phases; it contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive. *Id.* Short Channel (SCH) conveys data link control information and Long Channel (LCH) serves to transmit user data bi-directionally on the up- and downlink. *Id.* RCH-P and RCH-UP are contention channels. *Id.* As depicted in Figure 3, a number of MAC frames can be transmitted concurrently by extension into the space domain using the smart antenna system. *See id.* at Fig. 3, 53, 55. A space-time scheduler is used to determine the temporal transmission sequence of MAC PDUs (protocol data unit) as well as the MTs that can simultaneously be addressed or allowed to concurrently transmit their bursts. *Id.* at 55.

2. Scope and Content of Andersson

Andersson describes adaptive sectorization to solve problems associated with sectorization of cells in cellular communication systems. Ex. 1005, 3:37–40, 4:31–34. A transceiver structure located at a base station is connected to a set of sector antennas and each sector antenna is used to cover a sector of the cell. *Id.* at 4:42–44; *see also* Fig. 2 (depicting an antenna configuration with six sectors). The beacon carrier is also connected to an omni-directional antenna, which provides the same coverage area as all of the sector antennas together. *Id.* at 4:58–60.

3. Claims 2, 11, and 20

Claim 2 depends from claim 1 and recites "wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals." Claims 11 and 20 depend from claims 10 and 19, respectively, and recite the same limitation set forth in claim 2.

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Petitioner contends "Vornefeld discloses that the broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signal." Pet. 26 (citing Ex. 1003 ¶¶ 151–152); *see also id.* at 50 (citing to the analysis of "Ground 1" to support the assertion that claims 2, 11, and 20 are obvious over Vornefeld and Andersson). Specifically, Petitioner asserts the frame channel (FCH) described in Vornefeld is equivalent to the claimed 'first beam map" because Vornefeld discloses the FCH is broadcast in the downlink direction, transmits information about the structure of the MAC frame for the up-and downlink phases and contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in. *Id.* at 26 (citing Ex. 1004, 54–55; Ex. 1003 ¶ 152).

Petitioner further asserts that because each of the SCH and LCH portions of the frame are transmitted in different signals (or directed beams) in the spatial domain, the base station must inform each subscriber unit when it should listen for its specific directive beam signal. Reply 5 (citing Ex. 1011, 29:12–30:3 (testimony of Mr. Proctor)). Mr. Proctor testifies that the FCH, which is broadcast to all users, will have a map in it that describes which time slots particular mobile terminals should decode on the downlink phase. Ex 1011, 30:15–19. Mr. Proctor further testifies that this information sent in Vornefeld would be sufficient to demodulate or detect the downlink signal and that downlink is a directed beam signal. *See id* at 47:18–48:2; *see also* Tr. 31 (Petitioner's assertion that the FCH includes information sufficient to allow the subscriber units to detect the directed scanning beam signal that is sent out). Petitioner further asserts, citing the testimony of Mr. Proctor, that one would not need to include information about the beams

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themselves to be a beam map as the claim only requires information be usable to demodulate a directed signal. Reply 12–13 (citing Ex. 1011, 47:2–11).

Patent Owner contends that Vornefeld does not disclose a beam map containing scanning beam information and asserts that the FCH signal cited by Petitioner is not "equivalent" to the recited "first beam map." PO Resp. 20–21. Patent Owner asserts the FCH signal includes only information about the structure of the frame (when the base station will be sending and receiving information) and does not include information about what scanning beam signal will be used to cover the sector, or when it will be used. *Id.* at 21. Patent Owner further asserts that Vornefeld accomplishes beam forming with the use of algorithms and says nothing about using beam maps in a broadcast beam signal. *Id.* at 21–22 (citing Ex. 1004, 53; Ex. 2001 ¶ 43); *see also* Tr. 61:2–4 (asserting the reason Vornefeld does not disclose a beam map is because Vornefeld discloses an algorithm for determining where beams would be directed and it does not need to send maps). Patent Owner asserts that Vornefeld also does not inherently disclose the recited beam map because a beam forming station may inform each subscriber unit when it should listen for its specific directive beam signal in any number of ways. Sur-Reply 4. Mr. Humphrey testifies that one of ordinary skill in the art would not assume that the start of frame information would include beam map information because beam maps are unnecessary in schemes that broadcast with beams cycled in round robin rotation as noted in the '931 patent or using various multiple antenna diversity techniques. *See* Ex. 2001 ¶¶ 46–47.

In our Institution Decision, we were not persuaded Petitioner established a reasonable likelihood that Vornefeld discloses the recited first

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beam map usable to detect directed scanning beam signals. Dec. 17. In particular, we were not persuaded that Petitioner provided sufficient analysis to establish that one of ordinary skill in the art would understand Vornefeld's description of transmitting broadcast timeslot reservations for long and short transport channels (channel slots in a MAC frame) to be a beam map usable to detect directed scanning beam signals. *Id.* at 17–18. After consideration of the entire record, we remain unpersuaded that Vornefeld discloses a first beam map containing scanning beam information useable to detect said directed scanning beam signals.

Vornefeld discloses its FCH is "[u]sed to transmit the information about the structure of the MAC frame for the up- and downlink phases." Ex. 1004, 54. The FCH "contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in." *Id.* We agree with Petitioner and Mr. Proctor that this information may be used by an MT to demodulate the downlink signal. *See* Reply 6; Ex. 1011, 47:18–23.

But, we are not persuaded by Petitioner's assertions, or the testimony of Mr. Proctor, that this demodulation information is what the claim requires. *See* Reply 12–13; Ex. 1011, 47:2–11. As discussed in our claim construction analysis above, the disclosure of the '931 patent makes clear that information that identifies a downlink time slot (demodulation information) is different than the information usable to detect directed scanning beam signals. *See* Ex. 1001, 9:35–44.

We are also not persuaded that the FCH demodulation information disclosed by Vornefeld meets our construction of the limitation set forth in claims 2, 11, and 20, namely "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

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Rather, we agree with Patent Owner that the FCH described in Vornefeld does not include information about which scanning beam signal will be used or when it will be used. PO Resp. 21; *see* Ex. 1004, 54. We are persuaded by Mr. Humphrey's testimony that Vornefeld discloses beam forming is accomplished with the use of algorithms and not a beam map.[4] *See* Ex. 2001 ¶ 43; Ex. 1004, 53 (describing the use of a beam forming algorithm to adjust the phases at the antenna elements to steer towards the desired MT). Thus, we determine that Petitioner fails to establish, by a preponderance of the evidence, that Vornefeld discloses a first beam map containing scanning beam information usable by the wireless access devices to detect the directed scanning beam signals.

We conclude Petitioner has not demonstrated that claims 2, 11, and 20 are anticipated by Vornefeld. Petitioner does not assert Andersson meets the limitation set forth in these claims, but rather relies on its anticipation analysis discussed above. *See* Pet. 50. Accordingly, Petitioner has also not demonstrated that claims 2, 11, and 20 would have been obvious over Vornefeld and Andersson.

4. Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25

Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 depend from claim 2, 11, or 20. In its analysis of these claims, Petitioner does not cure its failure to demonstrate Vornefeld discloses the "first beam map" limitation recited in

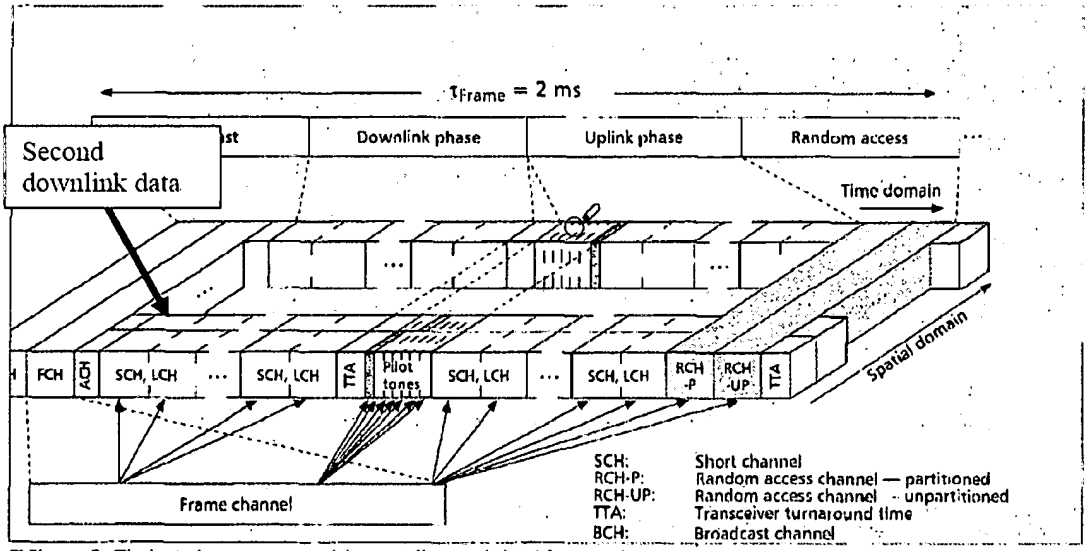
[4] Petitioner asserts Mr. Humphrey does not qualify as a person of ordinary skill in the art because he did not obtain his experience prior to 2001. *See* Reply 16. We agree with Patent Owner that Petitioner's assertion is immaterial as it is not necessary for an expert to obtain the relevant experience by the time of the filing of the patent. *See* Sur-Reply 11. We are persuaded Mr. Humphrey has sufficient qualifications to credit his testimony. *See* Ex. 2001 ¶ 7; Ex. 2002.

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these claims by virtue of their dependency. *See* Pet. 27–31, 33–34, 50. Accordingly, we conclude Petitioner has not demonstrated that claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 are anticipated by Vornefeld. Petitioner has also not demonstrated that these claims would have been obvious over Vornefeld and Andersson.

5. Claims 28 and 29

Claim 28 depends from claim 1 and recites "wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals." Petitioner contends Vornefeld discloses that its array antennas are able to simultaneously direct several beams to different positions conveying individual user signals. Pet. 34 (citing Ex. 1004, Fig. 2, 53); Reply 15. Petitioner asserts Figure 3 of Vornefeld clearly shows "second downlink data traffic" being transmitted in the downlink portion of the frame using a different directed scanning beam signal. *Id.* Petitioner provides an annotated version of Figure 3, depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

Figure 3, as annotated by Petitioner, illustrates Petitioner's assertions that Vornefeld discloses second downlink data in its spatially extended MAC protocol. Pet. 35. Petitioner further asserts Figure 3 of Vornefeld shows a single frame with multiple channels being transmitted in parallel in the spatial domain and that each channel represents a different directive scanning beam. Reply 15. Petitioner asserts a person of ordinary skill in the art would understand that the ULAs in Vornefeld transmit downlink data to different sectors using different directive scanning beams. *Id.* at 15–16.

Patent Owner contends Vornefeld does not disclose using a different directed scanning beam signal within a TDD frame. PO Resp. 26. Patent Owner asserts the second downlink data identified by Petitioner is in a different, spatially-separated, simultaneous TDD frame. *Id.* Patent Owner asserts Vornefeld does not disclose using different or multiple beams in the same TDD frame. *Id.*

Petitioner has not met its burden to establish claim 28 is anticipated by, or would have been obvious over, Vornefeld. Claim 28 requires the transmit circuitry to transmit second downlink data traffic in the same (said) downlink portion of the same (said) TDD frame recited in claim 1. The block that Petitioner relies on for the second downlink data traffic is depicted as a different (spatially separated) TDD frame that is simultaneously transmitted with the other frames. *See* Pet. 35; *see also* Ex 1004, 54 (describing concurrent transmission of MAC PDUs in the spatial domain). We agree with Patent Owner that Petitioner does not establish Vornefeld discloses using different beams in the same TDD frame (i.e., second downlink data traffic, transmitted in "said downlink portion of said TDD frame") to transmit to devices within a different sector.

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We conclude Petitioner has not demonstrated that claim 28 is anticipated by Vornefeld. Petitioner relies on its analysis of claim 28 to support its assertion that claim 29, which recites similar limitations as claim 28, is anticipated by Vornefeld. *See* Pet. 35. Accordingly, Petitioner has also not demonstrated that claim 29 is anticipated by Vornefeld.

Petitioner does not assert Andersson meets the limitations set forth in claims 28 and 29. *See id.* at 50. Therefore, we conclude Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Vornefeld and Andersson.

E. Obviousness over Vornefeld and Ahy, and Obviousness over Vornefeld, Andersson, and Ahy

Petitioner challenges claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld and Ahy. Pet. 35–44. Petitioner further challenges these claims as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy. *Id.* at 50–51.

1. Scope and Content of Ahy

Ahy describes adaptive point to multipoint wireless communications. Ex. 1006, 1:65–66. A base station controller (BSC) maintains a set of physical (PHY) parameters and media-access-control (MAC) parameters, each of which is adaptively modified by the BSC for communication with a plurality of customer premises equipment (CPE). *Id.* at 2:15–21, 7:18–20. The BSC adjusts communication with each CPE individually and adaptively in response to changes in communication characteristics. *Id.* at 2:21–23. Control of each parameter by the BSC is independent and individual with regard to each CPE. *Id.* at 7:20–22. Each parameter actually has two values: a first value for transmission by the BSC and a second value for

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transmission by the CPE. *Id.* at 7:65–8:1. The communication parameters that can be adapted include: antenna selection to choose the antenna to be used at the BSC and the CPE; modulation type to determine the bit per symbol rate to use to exchange information; and error code type to choose the error detection and correction technique. *See id.* at 8:50–59, 10:38–48, 11:40–45.

Communications between the BSC and each CPE are conducted using a TDD technique in which time durations are divided into individual frames, each of which includes a "downstream" and "upstream" portion. *Id.* at 7:1–5. The BSC controls transmission for both upstream and downstream directions without specific requests from CPEs. *Id.* at 7:5–9. The TDD frame includes a sequence of parameter setting values for the BSC to use to inform each selected CPE of the PHY and MAC parameters the BSC is using to send messages to that selected CPE, and the PHY and MAC parameters the selected CPE should use to send messages to the BSC during its allocated part of the upstream portion. *Id.* at 15:11–20.

2. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27

In its challenges based on Vornefeld, Petitioner relies on Vornefeld to disclose the "first beam map" limitation set forth in these claims by virtue of their dependency from one of claims 2, 11, and 20.[5] Pet. 35–44, 50–51. Therefore, Petitioner fails to cure the deficiencies in Vornefeld discussed above and has not demonstrated that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 are obvious over Vornefeld and Ahy. Petitioner also fails to

[5] Petitioner relies on Ahy to disclose the "first beam map" limitation only in its challenge based on Newman. *See* Pet. 58. Accordingly, we address Petitioner's assertions about Ahy in the Newman ground discussed below.

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demonstrate that these claims are obvious over Vornefeld, Andersson, and Ahy.

F. Obviousness over Newman, Andersson, and Ahy

Petitioner challenges claims 1–29 as obvious under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson. Pet. 51–63.

1. Scope and Content of Newman

Newman describes a multi-beam antenna system for communicating with mobile users. *Id.* at 1:4–6. The multi-beam communication system includes a sector antenna having a beamwidth providing sector coverage and a transmitter and a receiver system for receiving user signals from a user located in the sector. Ex. 1007, 2:10–14; *see also id.* at 4:5–6. A sector antenna has a beamwidth effective to provide coverage of a 120 degree azimuth sector. *Id.* at 4:12–15. The antenna system further includes a multi-beam antenna, which may comprise four side-by-side vertical arrays of dipoles or other radiating element arrangements suitable for providing four antenna beams, each having a beam width narrower than the 120 degree sector and aligned so that the four beams collectively cover at least a portion of the sector. *Id.* at 4:35–42. The beams may be provided with the inclusion of a suitable beam forming network. *Id.* at 4:47–50. Access to the four beams of the multi-beam antenna is provided by operation of the beam forming network, which may be included as part of the multi-beam antenna. *Id.* at 10:35–38. With this arrangement, communication with a particular user can be enhanced by a significant increase in transmitted signal strength, for example, by transmitting to the user via a narrow beam instead of the sector beam. *Id.* at 38–42.

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2. Claims 2–9, 11–18, and 20–27

Petitioner contends Ahy discloses "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals," as recited in claims 2, 11, and 20. Pet. 58; *see also id.* at 63 (asserting claims 11 and 20 are obvious for the same reasons given with respect to claim 2). In particular, Petitioner asserts Ahy teaches that the start of each TDD frame includes a first parameter value for transmission by the BSC and a second parameter value for transmission by the CPE, which allows the BSC and the CPE to transmit using different sets of parameters. *Id.* at 58 (citing Ex. 1006, 7:67–8:3). Petitioner asserts Ahy also discloses that the first part of the frame includes a value for the length for subsequent downstream payload elements for each CPE. *Id.* (citing Ex. 1006, 15:25–30). Thus, Petitioner asserts Ahy teaches providing information usable by CPEs (wireless access devices) to detect directed scanning beam signals. *Id.* (citing Ex. 1003 ¶ 153). Petitioner further asserts it would have been obvious to incorporate the TDD frame structure in Ahy into the beam forming network disclosed in Newman for the reasons described with respect to claim 1. *Id.*; *see also id.* at 52–53, 57 (asserting incorporating Ahy's TDD frame structure in Newman is nothing more than the use of known techniques to improve similar methods in the same way to yield predictable results).

Additionally, Petitioner asserts that, during Mr. Proctor's deposition, Mr. Proctor further explained why Ahy discloses the "beam map" and pointed to the "antenna selection" parameter in Ahy that includes a choice of antenna at the BSC 120 and choice of antenna at each CPE 130. Reply 7–8 (citing Ex. 1006, 8:54–59; Ex. 1011, 45:21–46:3). Petitioner asserts the antenna selection parameter in Ahy identifies the specific beam used to

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transmit the signal to the CPE. *Id.* at 8, 14. Petitioner asserts the value of the length of the subsequent downstream payload elements for each CPE informs the CPE when it should listen. *Id.* at 8 (citing Ex. 1006, 15:25–30; Ex. 1003 ¶ 153). Petitioner asserts this "scanning beam information" is usable by the CPE to detect directed scanning beam signals, and therefore meets the "beam map" limitations of claims 2, 11, and 20. *Id.* Petitioner also asserts that the antenna selection parameter (along with the timeslot reservation) clearly identifies the specific beams and their precise start times, which are usable by the CPE to detect the directed scanning beam signal. *Id.* at 14.

Patent Owner asserts that Ahy says nothing about directed scanning beam signals and nothing about sending a beam map containing scanning beam information that would allow the CPEs to detect directed scanning beam signals. PO Resp. 23. Patent Owner asserts Ahy's start of frame signal does not include information about which scanning beam will be used to cover the sector, or when it will be used. *Id.* at 23–24. Patent Owner asserts that Petitioner has not explained or provided supporting facts or evidence showing how or why the frame disclosed in Ahy would require a beam map containing scanning information. Sur-Reply 8.

We determine Petitioner fails to establish Ahy discloses "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time," based on our construction of the beam map limitation set forth above. Ahy discloses

> [e]ach of the following parameters actually has two values: a first value for transmission by the BSC 120 and a second value for transmission by the CPE 130. Thus, the BSC 120 can transmit using a first set of parameters while the CPE 130 is instructed to transmit using a second set of parameters.

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Ex. 1006, 7:65–8:3(bolding omitted). Petitioner relies on this passage, along with Ahy's disclosure that the BSC sends the length of each downstream payload element in the time synchronization portion, to meet the beam map limitation. *See* Pet. 58 (citing Ex. 1006, 7:67–8:3; 15:25–30). But, Petitioner does not provide sufficient analysis in its Petition to explain why one of ordinary skill in the art would understand Ahy's description that the BSC and CPE can transmit using different values, in combination with its description that the length of the downstream payload elements is also transmitted in the time synchronization portion, discloses scheduling information for one or more beams indicating which scanning beam is used at which time.[6]

We are also not persuaded that Ahy's description of the BSC transmitting the length of each of the downstream payload elements discloses a start time of the beam. *See* Ex. 1006, 15:25–30. Petitioner does not provide sufficient reasoning to explain why the length of a payload informs the CPE the time it should listen. *See* Reply 8, 14. Mr. Proctor's testimony does not support Petitioner's assertion that the payload length indicates a start time; rather, Mr. Proctor merely states that Ahy discloses the

[6] In its Reply, Petitioner newly cites to Ahy's disclosure of an antenna selection parameter (which includes a choice of antenna at the BSC 120 and antenna at CPE 130) to support its assertion that Ahy discloses identification of the specific beam used to transmit the signal. *See* Reply 7–8 (citing Ex. 1006, 8:54–59). Mr. Proctor also newly relies on the antenna selection parameter to support his testimony that Ahy informs the CPE which antenna the BSC would be transmitting on. *See* Ex. 1011, 45:15–46:3. We decline to consider Petitioner's new assertions because they raise a new issue and exceeds the scope of a proper reply. *See* 37 C.F.R. § 42.23(b); *see also* Office Practice Trial Guide, 77 Fed. Reg. 48,765, 48,767 (Aug. 14, 2012) (a reply that raises a new issue will not be considered).

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first part of the frame "includes a value of the length for subsequent downstream payload elements for each CPE" (without further explanation of the relevance of this disclosure) and that this, in conjunction with the ability for the BSC and CPE to transmit using different sets of parameters teaches "providing information usable by CPEs (e.g., wireless access devices) to detect directed scanning beam signals. Ex. 1003 ¶ 153.

Finally, we observe that Petitioner relies on Newman, and not Ahy, to disclose the multi-beam antenna system and the "said directed scanning beam signals" recited in claims 2, 11, and 20. *See* Pet. 53–55. Petitioner relies on a combination argument—incorporation of the TDD frame structure in Ahy into the beam forming network disclosed in Newman—to meet the beam map limitation. *See* Pet. 58. However, Petitioner only provides reasoning why one of ordinary skill in the art would incorporate the capability of communicating using TDD into the communications system in Newman. *Id.* at 52–53, 58. This reasoning is insufficient to explain why one of ordinary skill would have incorporated Ahy's disclosure of BSC and CPE parameters and transmission of payload length into Newman.

For the reasons stated above, Petitioner fails to establish the Newman-Ahy-Andersson combination discloses the beam map limitation recited in claims 2, 11, and 20. Claims 3–9, 12–18, and 21–27 depend from claim 2, 11, and 20, respectively. Petitioner's analysis of these claims does not cure the deficiency. *See* Pet. 59–63.

We conclude Petitioner has not demonstrated that claims 2–9, 11–18, and 20–27 would have been obvious over Newman, Ahy, and Andersson.

5. Claims 28 and 29

Petitioner contends that claims 28 and 29 are obvious over the combination of Newman, Ahy, and Andersson for the same reasons given

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with respect to claims 2–9. However, claims 28 and 29 recite limitations that do not appear in claims 2–9. Petitioner fails to explain how the cited references teach transmit circuitry that "transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals," as recited in claim 28. Petitioner also fails to explain how the references teach the substantially similar limitation that appears in claim 29. Accordingly, Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Newman, Ahy, and Andersson.

III. CONCLUSION

For the reasons stated above, we enter adverse judgement against Patent Owner with respect to claims 1, 10, and 19 of the '931 patent. We further determine

A. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 102(b) as anticipated by Vornefeld;

B. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Andersson;

C. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Ahy;

D. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy; and

E. Claims 2–9, 11–18, and 20–29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson.

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IV. ORDER

It is

ORDERED that that adverse judgement is entered against Patent Owner as to claims 1, 10, and 19 of U.S. Patent No. 7,230,931 B2; and

FURTHER ORDERED that claims 2–9, 11–18, and 21–29 of U.S. Patent No. 7,230,931 B2 have not shown to be unpatentable.

This is a final written decision of the Board under 35 U.S.C. § 318(a), and, therefore, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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MAY 0 9 2019
PATENT & TRADEMARK OFFICE

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.
Petitioner

v.

GENERAL ACCESS SOLUTIONS, LTD.
Patent Owner

Inter Partes Review Case No. 2017-01889

Patent No. 7,230,931

PETITIONER'S NOTICE OF APPEAL

OFFICE OF THE GENERAL COUNSEL
2019 MAY 13 PM 12: 22
US PATENT AND
TRADEMARK OFFICE

PETITIONER VERIZON
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UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Sprint Spectrum L.P. , Petitioner or Appellant,

v.

PETITION FOR REVIEW

General Access Solutions, Ltd. , Respondent or Appellee.

Sprint Spectrum L.P. (name all parties* bringing the petition or appeal) hereby petition/appeal the court for review of the Final Written Decision (describe the order or decision and include decision number) of the Patent Trial and Appeal Board (name the agency, board, office or bureau) entered on March 7, 2019 (date). The order or decision was received on March 7, 2019 (date).

Date: May 8, 2019

/s/ Brian D. Schmalzbach

(Signature of petitioner, appellant or attorney)

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*See Fed. R. App. P. 15 (a) (2) for permissible ways of identifying petitioners.

Please take notice that under 35 U.S.C. §§ 141(c), 142, 319; 37 C.F.R. §§ 90.2(a), 90.3(a), and Federal Rules of Appellate Procedure/Federal Circuit Rule 4(3)(a), Petitioner Sprint Spectrum L.P. ("Sprint") hereby appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered on March 7, 2019 (Paper 43), and all rulings leading up to those decisions. A copy of the Final Written Decision is attached as Exhibit A.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Sprint's issues on appeal include at least: (i) the Board's construction of certain terms, including the term "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals"; (ii) the Board's determination that Petitioner failed to show by a preponderance of the evidence that claims 28 and 29 are unpatentable under 35 U.S.C. §§ 102(b) or 103(a); (iii) the Board's refusal to consider evidence that allegedly raised a new issue and exceeded the scope of a proper reply; and (iv) any findings or determinations supporting or related to the aforementioned issues as well as all other issues decided adversely to Sprint in any orders, decisions, rulings, and opinions.

Simultaneously with this submission, Sprint is filing a copy of this Notice of Appeal with the Director of the United States Patent and Trademark Office and a copy of the same, along with the required docketing fee, with the Clerk of the United States Court of Appeals for the Federal Circuit as set forth in the accompanying

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Certificate of Service.

Dated: May 9, 2019

Respectfully submitted,

By: */s/ Robert C. Hilton*

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 1.903, the undersigned certifies that on May 8, 2019, a copy of this Notice was served in the manner shown below, to the following:

Via Federal Express

The Office of the General Counsel
U.S. Patent and Trademark Office
Madison Building East, 10B20
600 Dulany Street
Alexandria, VA 22313-1450

Patent Trial and Appeal Board
U.S. Patent and Trademark Office
Madison Building East, 10B20
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I further certify that on this 8th day of May, 2019, an electronic copy of the foregoing **Petitioner's Notice Of Appeal**, along with the required docketing fee, is

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being submitted electronically with the United States Court of Appeals for the Federal Circuit via CM/ECF. In addition, I further certify that on this 8th day of May, 2019, a copy of the foregoing **Petitioner's Notice Of Appeal** is being sent to the Clerk's Office of the United States Court of Appeals for the Federal Circuit via Federal Express.

By: */Robert C. Hilton/*

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Attorney for Petitioner

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Exhibit A

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Paper 43
Entered: March 7, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P.,
Petitioner,

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Patent Owner.

Case IPR2017-01889
Patent 7,230,931 B2

Before MELISSA A. HAAPALA, *Acting Vice Chief Administrative Patent Judge,* and KALYAN K. DESHPANDE and DAVID M. KOHUT, *Administrative Patent Judges.*

HAAPALA, *Acting Vice Chief Administrative Patent Judge.*

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

Sprint Spectrum L.P. ("Petitioner") filed a Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–29 of U.S. Patent No. 7,230,931 B2 ("the '931 patent"). Paper 1 ("Pet."). General Access Solutions, Ltd. ("Patent Owner") did not file a Preliminary Response. Applying the standard set forth in 35 U.S.C. § 314(a), we granted Petitioner's request to institute an *inter partes* review of all challenged claims. Papers 5 ("Dec") (instituting on claims 1, 3–10, 12–19, and 21–29); Paper 8 (instituting on remaining challenged claims 2, 11, and 20 and modifying our initial institution decision to include all of the grounds presented in the Petition).

During the trial, Patent Owner timely filed a Response (Paper 25, "PO Resp."), to which Petitioner timely filed a Reply (Paper 29, "Reply"). Patent Owner further submitted a Sur-Reply (Paper 34, "Sur-Reply") to Petitioner's Reply. An oral hearing was held on December 6, 2018, and a copy of the transcript was entered into the record. Paper 41 ("Tr.").

Following the oral hearing and pursuant to our authorization (Paper 37), both parties each submitted claim construction briefs (Papers 38, 39); each party also submitted a reply to the other party's brief (Papers 40, 41).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the claims on which we instituted trial. For the reasons that follow, we enter adverse judgement against Patent Owner with respect to independent claims 1, 10, and 19 of the '931 patent and we determine that Petitioner has not shown that dependent claims 2–9, 11–18, and 20–29 are unpatentable.

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I. BACKGROUND

A. The '931 Patent (Ex. 1001)

The '931 patent describes a burst packet transmission media access system using selectively adaptable beam forming in a fixed wireless access network. Ex. 1001, 3:28–31. The fixed wireless network may comprise a plurality of transceiver base stations that transmit forward channel (downlink or downstream) broadband signals to subscriber premises and receive reverse channel (uplink or upstream) broadband signals from subscriber premises. *Id.* at Fig. 1, 11:57–64. Each of the transceiver base stations may cover a cell site that is divided into a plurality of sectors. *Id.* at Fig. 2, 12:25–27. Pre-programmed sets of directed beam patterns are used to cover a cell in an angular fashion, which is referred to as "beam scanning." *Id.* at 28:1–3. The base station establishes a set of beams to cover the cell and based on physical location in the sector, a specific beam is used to communicate with one or more subscribers that lie in that sector. *Id.* at 28:9–12.

Figure 14 of the '931 patent is depicted below:

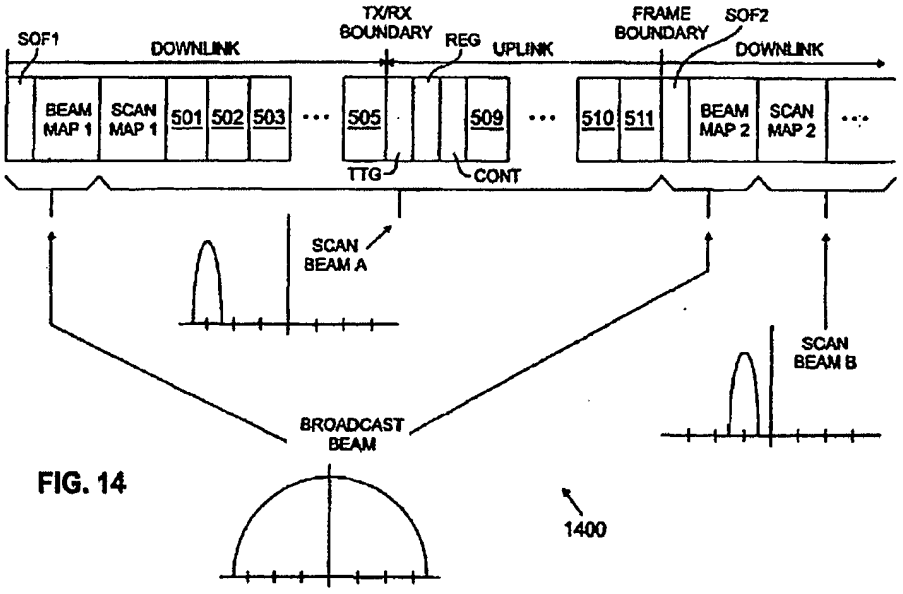


FIG. 14

Figure 14 illustrates the use of broadcast beams and scanning beams in exemplary time division duplex (TDD) signal 1400. *Id.* at 29:3–5. TDD signal 1400 comprises a first TDD frame having a downlink portion comprising a first start-of-frame field (SOF1), a first beam map field (Beam Map 1), and a first scan map field (Scan Map 1). *Id.* at 29:6–10. The first TDD frame is followed by a second TDD frame, which comprises a second start-of-frame field (SOF2), a second beam map field (Beam Map 2), and a second scan map field (Scan Map 2). *Id.* at 29:21–25. A spread spectrum Broadcast Beam is used to transmit start-of-frame fields SOF1, SOF2 and beam map fields Beam Map 1, Beam Map 2 in each TDD frame. *Id.* at 29:26–30. Distinct scan beams (Scan Beam A and Scan Beam B) are used to transmit the scan map fields (Scan Map 1 and Scan Map 2) and the remainder of the uplink and downlink portions of each TDD frame. *Id.* at 29:30–33.

Broadcast Beam Maps 1, 2 provide data indicating which scanning beam (or beams) are used at which time for the frame and also transmits a synchronization field so that all subscribers can maintain synchronization. *Id.* at 29:34–36, 29:47–50. Scanning Beam Maps A, B provides the uplink and downlink map, which state at which time in the frame, using the scanning beam described in the associated Broadcast Beam Map, the downlink modulation groups and specific uplink slots are allocated for the frame using the specific scanning beam. *Id.* at 29:38–43.

B. Illustrative Claims

Claims 1, 10, and 19 are independent claims. Claims 1 and 2 are illustrative of the subject matter at issue:

> 1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations

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capable of bidirectional time division duplex (TDD) communications with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and

subsequently transmits in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.

2. The transceiver as set forth in claim 1 wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals.

C. Instituted Grounds of Unpatentability

Petitioner relies on the following references:

1. U. Vornefeld, et al., *SDMA Techniques for Wireless ATM*, IEEE Communications Magazine (Nov. 1999) ("Vornefeld") (Ex. 1004).
2. U.S. Patent No. 6,470,177 B1, issued Oct. 22, 2002 ("Andersson") (Ex. 1005).
3. U.S. Patent No. 7,366,133 B1, issued Apr. 29, 2008 ("Ahy") (Ex. 1006).[1]

[1] We note the first named inventor of U.S. Patent 7,366,133 is Majidi-Ahy. Ex. 1006, 1. However, as both parties refer to this reference as "Ahy" (*see e.g.*, Pet. 17; PO Resp. 18), we use the same shortened form for consistency and to avoid confusion.

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4. U.S. Patent No. 5,684,491, issued Nov. 4, 1997 ("Newman") (Ex. 1007).

We instituted trial under 35 U.S.C. §§ 102(b) and 103(a) over the following combinations of references:

Reference(s)	Basis	Claims
Vornefeld	35 U.S.C. § 102(b)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Vornefeld and Andersson	35 U.S.C. § 103(a)	1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, 29
Vornefeld, Andersson, and Ahy	35 U.S.C. § 103(a)	4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, 27
Newman, Ahy, and Andersson	35 U.S.C. § 103(a)	1–29

In support of its contentions, Petitioner submitted a declaration by its witness, Mr. James A. Proctor, Jr. Ex. 1003. In response, Patent Owner submitted a declaration by its witness, Kurt D. Humphrey. Ex. 2001. Both witnesses were cross-examined during the trial, and transcripts of their depositions are in the record. Ex. 1011 (Proctor deposition); Ex. 1012 (Humphrey deposition).

D. Related Proceedings

Petitioner and Patent Owner identify the following district court litigation involving the '931 patent: *General Access Sol., Ltd. V. Sprint Spectrum L.P.*, Case No. 2:16-cv-465-RWS (E.D. Tx.). Pet. 2; Paper 3, 1.

E. Real Parties in Interest

Petitioner identifies the following additional real parties in interest: Virgin Mobile USA, L.P.; Boost Mobile, LLC; Clearwire Corporation;

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Clearwire Communications LLC; and Clear Wireless LLC. Pet. 1. Petitioner further identifies Sprint Corporation as a real party in interest only for purposes of this proceeding and only to the extent Patent Owner contends the separate legal entity should be named a real party in interest in this proceeding. *Id.* Patent Owner does not identify any additional real parties in interest. *See* Paper 3, 1.

II. ADVERSE JUDGEMENT

Both in its Response and at the oral hearing, Patent Owner conceded the unpatentability of independent claims 1, 10, and 19. PO Resp. 2 n.2 ("Patent Owner does not herein dispute the patentability of the independent claims 1, 10, and 19 of the '931 patent."); Tr. 56:19–57:9 ("[Vornefeld] knocks out our independent claims. We concede that."). A concession of unpatentability is construed as a request for entry of adverse judgement. 37 C.F.R. § 42.73(b)(3). The request is granted.

III. ANALYSIS

A. Legal Principles

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *See Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). Although the elements must be arranged or combined in the same way as in the claim, "the reference need not satisfy an *ipsissimis verbis* test," i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter as a whole would have been obvious at the time the invention was made to a

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person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness, i.e., secondary considerations such as commercial success, long felt but unsolved needs, and failure of others.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). The obviousness inquiry further requires an analysis of "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring "articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")).

B. Level of Ordinary Skill in the Art

Petitioner asserts a person of ordinary skill in the art at the time of the filing date of the '931 patent would have had at least a Bachelor of Science in Computer Science, Computer Engineering, Electrical Engineering, or an equivalent field, and at least two years of academic or industry experience in any type of wireless networking field. Pet. 9–10. Patent Owner asserts a person or ordinary skill would have been a telecommunications engineer or technologist working in the wireless networking sector and have a least a bachelor's degree in engineering and relevant work experience, including at

[2] The record does not include arguments or evidence regarding objective indicia of non-obviousness.

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least two years of academic, practical, or industry experience in the wireless networking and/or telecommunications field. PO Resp. 6.

Our decision does not turn on the minor differences between the definitions. Both Petitioner and Patent Owner advocate a similar level of experience and both agree that a person of ordinary skill would have a bachelor's degree in engineering. We accept the level of skill advocated by Petitioner as the identified undergraduate academic degrees are consistent with the prior art of record.

C. Claim Construction

In an *inter partes* review, based on a petition filed before November 13, 2018, claims of an unexpired patent are interpreted using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b) (2017);[3] *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under that standard, "words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification and prosecution history." *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016).

1. "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals"

This limitation is recited by dependent claims 2, 11, and 20. After review of the parties' briefing and based on arguments made at the oral hearing, we determined the meaning of the recited "beam map" is at issue in

[3] A recent amendment to this rule does not apply here because the Petition was filed before November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018).

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this proceeding. Because neither party had set forth an explicit construction for this term, during the oral hearing we authorized each party to file an additional brief setting forth the party's proposed construction and also authorized each party to file a response brief to the other party's proposed construction. Paper 37. Both parties submitted the additional briefs and response briefs. *See* Papers 39, 40 (Petitioner's briefs); Papers 38, 41 (Patent Owner's briefs).

Petitioner asserts we should construe "a first beam map" as "scheduling information for one or more beams." Paper 39, 1. In support of its construction, Petitioner asserts the beam map is part of the broadcast beam shown in Figure 14 and the description of a beam map in the corresponding portion of the specification references scheduling information associated with the beam map. *Id.* at 2 (citing Ex. 1001, 29:34–36). Petitioner asserts the scheduling information that forms a beam map comprises information about one or more beams that are transmitted in the frame and that the beam maps "provide data indicating which beam (or beams) are used at which time." *Id.* at 3 (citing Ex. 1001, 29:34–36).

Patent Owner initially proposes we construe "a first beam map" as "scanning beam information contained in the broadcast beam signal that enables wireless access devices to detect a particular directed scanning beam signal." Paper 38, 1. In its Opposition, Patent Owner states it does not disagree with Petitioner's proposed construction and that it is suitable for the claimed "beam map." Paper 41, 1. Patent Owner further asserts that the "first beam map" at issue in claims 2, 11, and 20 is significantly narrower, and requires that the beam map enable devices to detect a particular scanning beam. *Id.*

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Petitioner does not dispute that claims 2, 11, and 20 require the elements of Patent Owner's proposed construction because those elements are already found in the claims. Paper 40, 1. Petitioner asserts the problem with Patent Owner's initial construction is that it is redundant and renders the remaining terms of the claims superfluous. *Id.*

The '931 patent describes two different types of beam maps: broadcast beam maps and scanning beam maps. Ex. 1001, 29:26–43. A broadcast beam is used to transmit the broadcast beam map (Beam Map 1 and Beam Map 2) and distinct scan beams are used to transmit the scan map fields (Scan Beam A, Scan Beam B). *Id.* at Fig. 14, 29:26–33. Both parties assert that the "first beam map" recited in claims 2, 11, and 20 refers to the broadcast beam map. *See* Paper 38, 2 (Patent Owner's assertion that the first beam map "clearly means the Broadcast Beam Map portion of the definition of a generic "beam map."); Paper 39, 2 (Petitioner's assertion that the beam map "is a part of the broadcast beam (see Fig. 14), and the description of a beam map in the corresponding portion of the specification also references the scheduling information associated with the beam map."). Because claims 2, 11, and 20 all set forth the "first beam map" is a component of the "broadcast beam signal," we agree with the parties that the "first beam map" refers to a broadcast beam map.

We are persuaded that Petitioner's proposed construction of a "first beam map" is consistent with the plain meaning of a broadcast beam map in the context of the disclosure of the '931 patent. The '931 patent describes transmission of map information for beam scheduling via a spread spectrum broadcast beam. *See* Ex. 1001, 28:56; 29:34–35. Patent Owner agrees that Petitioner's proposed construction for "a first beam map" is a suitable

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definition. Paper 41, 1. Accordingly, we construe "first beam map" as "scheduling information for one or more beams."

As noted by both parties, claims 2, 11, and 20 further require that the "first beam map" contain "scanning beam information usable by said wireless access device to detect said directed scanning beam." *See* Papers 40, 2; 41, 1. Petitioner argues the scanning beam information

> may include information that 'identifies a downlink time slot during which one of said directed scanning beam signals transmits said downlink data traffic,' (claim 3), information that 'identifies at least one modulation format associated with one of said directed scanning beam signals' (claim 4), or information that 'identifies at least one forward error correction code level associated with one of said directed scanning beam signals' (claim 5).

Paper 40, 2–3. Petitioner asserts that Patent Owner's arguments limit "beam map" to a specific embodiment (such as the "Frame Beam map and Super-Frame Beam Map embodiment) and this provides reason to reject Patent Owner's construction. *Id.* at 3; *see also* Reply 9–11 (similarly asserting that Patent Owner's arguments that a first beam map necessary includes information about what scanning beam will be used improperly confine the claim to a specific embodiment). Petitioner argues that the '931 patent includes description of another embodiment in which the scanning beam information identifies a downlink time slot in the downlink portion during which the at least one directed scanning beam transmits the downlink traffic. Reply 11 (citing Ex. 1001, 9:40–44).

Patent Owner asserts that scanning beam detection information is different from scanning beam uplink/downlink/modulation information. *Id.* Patent Owner cites to several examples in the disclosure that provide data to enable a device to detect a particular scanning beam signal. Paper 38, 3

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(citing Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2). Patent Owner argues that information about which scanning beam will be used to cover the sector and when it will be used is necessary for a signal to serve as a beam map. PO Resp. 21, 24 (citing Ex. 2001 ¶ 44). Patent Owner argues that timeslot reservations do not constitute beam map information including the specific beam(s) and their precise start times in the frames which are useable by the wireless access devices to detect the directed scanning beam signals. *Id.* at 25 (citing Ex. 2001 ¶ 45).

We are not persuaded by Petitioner's arguments that the embodiment in which the scanning beam information identifies a downlink portion for transmission relates to the claimed scanning beam information useable to *detect* said directed scanning beam. Rather, the '931 patent discloses explicitly that the embodiment in which the scanning beam information identifies a downlink time slot is "another embodiment" than the embodiment set forth in claims 2, 9, and 11 in which the beam map contains scanning beam information usable to detect the directed scanning beam. *See* Ex. 1001, 9:35–44 (first describing the embodiment recited in claims 2, 9, and 11, and then describing "another embodiment" in which the scanning beam information identifies a downlink time slot). Thus, although as set forth in claim 3 (by virtue of its dependency from claim 2) the scanning beam information can include both types of information (information usable to detect directed scanning beam signals and identification of a downlink time slot), the disclosure of the '931 patent makes clear the information that identifies a downlink time slot is different than the information usable to detect directed scanning beam signals.

Furthermore, we determine Patent Owner's arguments—that the scanning beam information usable to detect the scanning beam signals must

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include information about which scanning beam will be used—are not an improper attempt to limit the claim language to a specific embodiment. As explained above and undisputed by the parties, the "first beam map" is a broadcast beam map. The '931 patent describes the information contained in the broadcast beam map as "data indicating which scanning beam (or beams) are used at which time." *See* Ex. 1001, 29:34–36. Petitioner cites to the same disclosure in support of its construction that a beam map is scheduling information for one or more beams. *See* Paper 39, 3 (citing Ex. 1001, 29:34–36). The other sections in the '931 patent describing the broadcast beam map all explain that the map contains information that informs the subscriber (wireless access) device which scanning beam is used and when (frame time) in which each beam starts. *See* Ex. 1001, 29:51–55, 29:66–30:2. We agree with Patent Owner that this information is what enables a device to detect a particular scanning beam. *See* Paper 38, 3.

We are mindful that claims must be interpreted in view of the specification without importing limitations from the specification unnecessarily. *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1369 (Fed. Cir. 2003). However, the disclosure of the '931 patent consistently describes that the broadcast beam map is scheduling information that indicates which scanning beam is used at which time. *See* Ex. 1001, 29:34–36, 29:51–55, 29:66–30:2. The correct inquiry in giving a claim term its broadest reasonable interpretation in light of the specification is an interpretation that corresponds with what and how the inventor describes his invention in the specification. *In re Smith Int'l*, 871 F.3d 1375, 1382–83 (Fed. Cir. 2017). Consistent with the description set forth in the '931 patent, our complete construction of "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed

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scanning beam signals" is "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

2. Other Terms

Petitioner proposes constructions for "sector" and "directed scanning beam signal(s)," both terms which appear in independent claims 1, 10, and 19. Pet. 10–13. Patent Owner asserts that the meaning of these terms do not appear to be in dispute and construction of these terms would not resolve any controversy. PO Resp. 15.

We agree with Patent Owner that these terms are not in controversy and, accordingly, determine that we need not explicitly construe these terms to resolve the issues before us. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

D. Anticipation by Vornefeld and Obviousness over Vornefeld and Andersson

Petitioner challenges claims 1–3, 6, 7, 10–12, 15, 16, 19–21, 24, 25, 28, and 29 as anticipated under 35 U.S.C. § 102(b) by Vornefeld. Pet. 19–35. Petitioner further challenges these claims as obvious under 35 U.S.C. § 103(a) over Vornefeld and Andersson. *Id.* at 44–50.

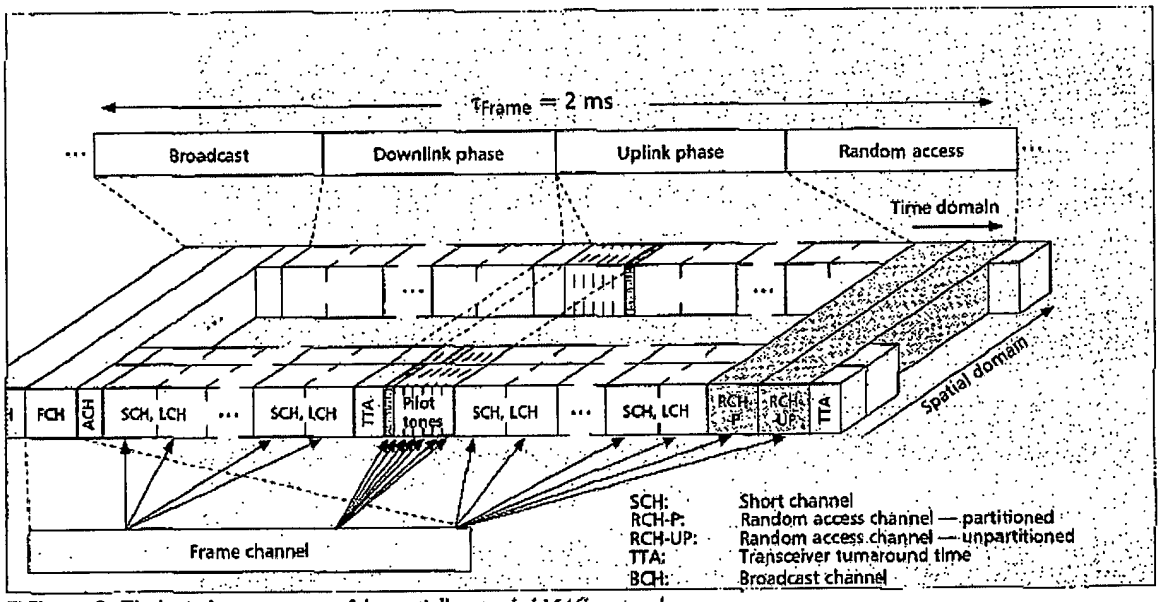
1. Scope and Content of Vornefeld

Vornefeld describes space-division multiple access (SDMA) techniques in the context of the HIPERLAN/2 system, which provides wireless network broadband services with guaranteed quality of service. Ex. 1004, 52. The system deploys a smart array antenna with several antenna systems that provides the ability to set up multiple antenna beams, which can be directed adaptively to the mobile terminal (MT) locations and

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allows different users to be served on the same frequency channel at the same time. *Id.* Depending on the number of antenna elements and the applied beamforming algorithm, array antennas are able to simultaneously direct several beams conveying individual user signals to different positions. *Id.* at Fig. 2, 53. The system uses a Medium Access Control (MAC) protocol to coordinate the access of MTs to the shared radio channel. *Id.* at 54.

Figure 3 of Vornefeld is depicted below:



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

Figure 3 illustrates the basic MAC frame structure of the spatially extended MAC protocol. *Id.* at Fig. 3. MAC frame starts with broadcast channel (BCH), followed by frame channel (FCH), then a downlink phase, an uplink phase, and random access channels (partitioned, RCH-P, and unpartitioned, RCH-UP). *Id.* at 54. BCH conveys signaling information concerning the whole radio cell in the downlink direction and announces the location of the FCH and RCH within the actual MAC frame. *Id.* FCH is broadcast in the downlink direction and transmits information about the structure of the

MAC frame for the up- and downlink phases; it contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive. *Id.* Short Channel (SCH) conveys data link control information and Long Channel (LCH) serves to transmit user data bi-directionally on the up- and downlink. *Id.* RCH-P and RCH-UP are contention channels. *Id.* As depicted in Figure 3, a number of MAC frames can be transmitted concurrently by extension into the space domain using the smart antenna system. *See id.* at Fig. 3, 53, 55. A space-time scheduler is used to determine the temporal transmission sequence of MAC PDUs (protocol data unit) as well as the MTs that can simultaneously be addressed or allowed to concurrently transmit their bursts. *Id.* at 55.

2. Scope and Content of Andersson

Andersson describes adaptive sectorization to solve problems associated with sectorization of cells in cellular communication systems. Ex. 1005, 3:37–40, 4:31–34. A transceiver structure located at a base station is connected to a set of sector antennas and each sector antenna is used to cover a sector of the cell. *Id.* at 4:42–44; *see also* Fig. 2 (depicting an antenna configuration with six sectors). The beacon carrier is also connected to an omni-directional antenna, which provides the same coverage area as all of the sector antennas together. *Id.* at 4:58–60.

3. Claims 2, 11, and 20

Claim 2 depends from claim 1 and recites "wherein said broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals." Claims 11 and 20 depend from claims 10 and 19, respectively, and recite the same limitation set forth in claim 2.

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Petitioner contends "Vornefeld discloses that the broadcast beam signal further comprises a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signal." Pet. 26 (citing Ex. 1003 ¶¶ 151–152); *see also id.* at 50 (citing to the analysis of "Ground 1" to support the assertion that claims 2, 11, and 20 are obvious over Vornefeld and Andersson). Specifically, Petitioner asserts the frame channel (FCH) described in Vornefeld is equivalent to the claimed 'first beam map" because Vornefeld discloses the FCH is broadcast in the downlink direction, transmits information about the structure of the MAC frame for the up-and downlink phases and contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in. *Id.* at 26 (citing Ex. 1004, 54–55; Ex. 1003 ¶ 152).

Petitioner further asserts that because each of the SCH and LCH portions of the frame are transmitted in different signals (or directed beams) in the spatial domain, the base station must inform each subscriber unit when it should listen for its specific directive beam signal. Reply 5 (citing Ex. 1011, 29:12–30:3 (testimony of Mr. Proctor)). Mr. Proctor testifies that the FCH, which is broadcast to all users, will have a map in it that describes which time slots particular mobile terminals should decode on the downlink phase. Ex 1011, 30:15–19. Mr. Proctor further testifies that this information sent in Vornefeld would be sufficient to demodulate or detect the downlink signal and that downlink is a directed beam signal. *See id* at 47:18–48:2; *see also* Tr. 31 (Petitioner's assertion that the FCH includes information sufficient to allow the subscriber units to detect the directed scanning beam signal that is sent out). Petitioner further asserts, citing the testimony of Mr. Proctor, that one would not need to include information about the beams

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themselves to be a beam map as the claim only requires information be usable to demodulate a directed signal. Reply 12–13 (citing Ex. 1011, 47:2–11).

Patent Owner contends that Vornefeld does not disclose a beam map containing scanning beam information and asserts that the FCH signal cited by Petitioner is not "equivalent" to the recited "first beam map." PO Resp. 20–21. Patent Owner asserts the FCH signal includes only information about the structure of the frame (when the base station will be sending and receiving information) and does not include information about what scanning beam signal will be used to cover the sector, or when it will be used. *Id.* at 21. Patent Owner further asserts that Vornefeld accomplishes beam forming with the use of algorithms and says nothing about using beam maps in a broadcast beam signal. *Id.* at 21–22 (citing Ex. 1004, 53; Ex. 2001 ¶ 43); *see also* Tr. 61:2–4 (asserting the reason Vornefeld does not disclose a beam map is because Vornefeld discloses an algorithm for determining where beams would be directed and it does not need to send maps). Patent Owner asserts that Vornefeld also does not inherently disclose the recited beam map because a beam forming station may inform each subscriber unit when it should listen for its specific directive beam signal in any number of ways. Sur-Reply 4. Mr. Humphrey testifies that one of ordinary skill in the art would not assume that the start of frame information would include beam map information because beam maps are unnecessary in schemes that broadcast with beams cycled in round robin rotation as noted in the '931 patent or using various multiple antenna diversity techniques. *See* Ex. 2001 ¶¶ 46–47.

In our Institution Decision, we were not persuaded Petitioner established a reasonable likelihood that Vornefeld discloses the recited first

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beam map usable to detect directed scanning beam signals. Dec. 17. In particular, we were not persuaded that Petitioner provided sufficient analysis to establish that one of ordinary skill in the art would understand Vornefeld's description of transmitting broadcast timeslot reservations for long and short transport channels (channel slots in a MAC frame) to be a beam map usable to detect directed scanning beam signals. *Id.* at 17–18. After consideration of the entire record, we remain unpersuaded that Vornefeld discloses a first beam map containing scanning beam information useable to detect said directed scanning beam signals.

Vornefeld discloses its FCH is "[u]sed to transmit the information about the structure of the MAC frame for the up- and downlink phases." Ex. 1004, 54. The FCH "contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in." *Id.* We agree with Petitioner and Mr. Proctor that this information may be used by an MT to demodulate the downlink signal. *See* Reply 6; Ex. 1011, 47:18–23.

But, we are not persuaded by Petitioner's assertions, or the testimony of Mr. Proctor, that this demodulation information is what the claim requires. *See* Reply 12–13; Ex. 1011, 47:2–11. As discussed in our claim construction analysis above, the disclosure of the '931 patent makes clear that information that identifies a downlink time slot (demodulation information) is different than the information usable to detect directed scanning beam signals. *See* Ex. 1001, 9:35–44.

We are also not persuaded that the FCH demodulation information disclosed by Vornefeld meets our construction of the limitation set forth in claims 2, 11, and 20, namely "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time."

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Rather, we agree with Patent Owner that the FCH described in Vornefeld does not include information about which scanning beam signal will be used or when it will be used. PO Resp. 21; *see* Ex. 1004, 54. We are persuaded by Mr. Humphrey's testimony that Vornefeld discloses beam forming is accomplished with the use of algorithms and not a beam map.[4] *See* Ex. 2001 ¶ 43; Ex. 1004, 53 (describing the use of a beam forming algorithm to adjust the phases at the antenna elements to steer towards the desired MT). Thus, we determine that Petitioner fails to establish, by a preponderance of the evidence, that Vornefeld discloses a first beam map containing scanning beam information usable by the wireless access devices to detect the directed scanning beam signals.

We conclude Petitioner has not demonstrated that claims 2, 11, and 20 are anticipated by Vornefeld. Petitioner does not assert Andersson meets the limitation set forth in these claims, but rather relies on its anticipation analysis discussed above. *See* Pet. 50. Accordingly, Petitioner has also not demonstrated that claims 2, 11, and 20 would have been obvious over Vornefeld and Andersson.

4. Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25

Claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 depend from claim 2, 11, or 20. In its analysis of these claims, Petitioner does not cure its failure to demonstrate Vornefeld discloses the "first beam map" limitation recited in

[4] Petitioner asserts Mr. Humphrey does not qualify as a person of ordinary skill in the art because he did not obtain his experience prior to 2001. *See* Reply 16. We agree with Patent Owner that Petitioner's assertion is immaterial as it is not necessary for an expert to obtain the relevant experience by the time of the filing of the patent. *See* Sur-Reply 11. We are persuaded Mr. Humphrey has sufficient qualifications to credit his testimony. *See* Ex. 2001 ¶ 7; Ex. 2002.

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these claims by virtue of their dependency. *See* Pet. 27–31, 33–34, 50. Accordingly, we conclude Petitioner has not demonstrated that claims 3, 6, 7, 12, 15, 16, 21, 24, and 25 are anticipated by Vornefeld. Petitioner has also not demonstrated that these claims would have been obvious over Vornefeld and Andersson.

5. Claims 28 and 29

Claim 28 depends from claim 1 and recites "wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals." Petitioner contends Vornefeld discloses that its array antennas are able to simultaneously direct several beams to different positions conveying individual user signals. Pet. 34 (citing Ex. 1004, Fig. 2, 53); Reply 15. Petitioner asserts Figure 3 of Vornefeld clearly shows "second downlink data traffic" being transmitted in the downlink portion of the frame using a different directed scanning beam signal. *Id.* Petitioner provides an annotated version of Figure 3, depicted below:

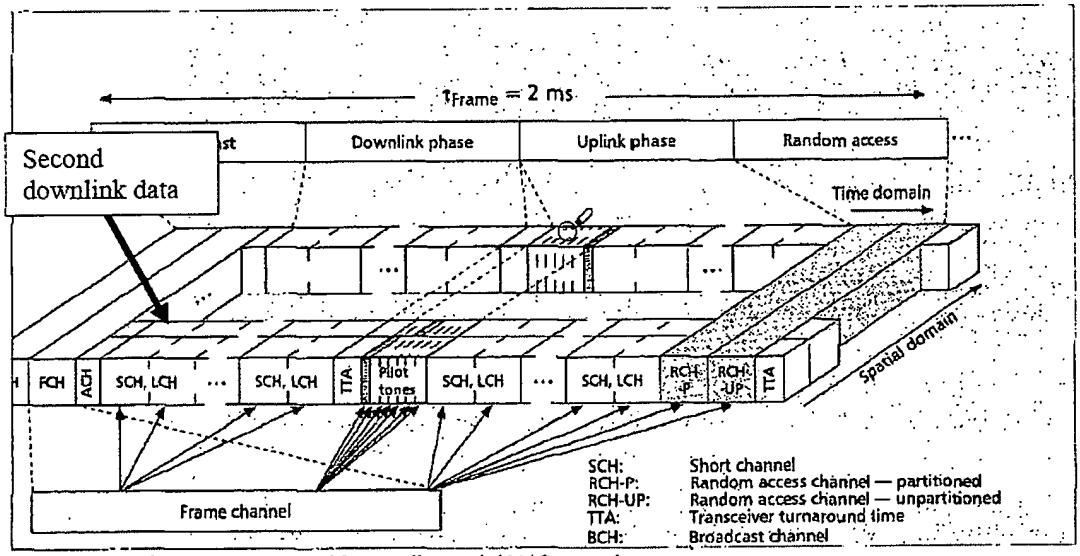


Figure 3. *The basic frame structure of the spatially extended MAC protocol.*

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Figure 3, as annotated by Petitioner, illustrates Petitioner's assertions that Vornefeld discloses second downlink data in its spatially extended MAC protocol. Pet. 35. Petitioner further asserts Figure 3 of Vornefeld shows a single frame with multiple channels being transmitted in parallel in the spatial domain and that each channel represents a different directive scanning beam. Reply 15. Petitioner asserts a person of ordinary skill in the art would understand that the ULAs in Vornefeld transmit downlink data to different sectors using different directive scanning beams. *Id.* at 15–16.

Patent Owner contends Vornefeld does not disclose using a different directed scanning beam signal within a TDD frame. PO Resp. 26. Patent Owner asserts the second downlink data identified by Petitioner is in a different, spatially-separated, simultaneous TDD frame. *Id.* Patent Owner asserts Vornefeld does not disclose using different or multiple beams in the same TDD frame. *Id.*

Petitioner has not met its burden to establish claim 28 is anticipated by, or would have been obvious over, Vornefeld. Claim 28 requires the transmit circuitry to transmit second downlink data traffic in the same (said) downlink portion of the same (said) TDD frame recited in claim 1. The block that Petitioner relies on for the second downlink data traffic is depicted as a different (spatially separated) TDD frame that is simultaneously transmitted with the other frames. *See* Pet. 35; *see also* Ex 1004, 54 (describing concurrent transmission of MAC PDUs in the spatial domain). We agree with Patent Owner that Petitioner does not establish Vornefeld discloses using different beams in the same TDD frame (i.e., second downlink data traffic, transmitted in "said downlink portion of said TDD frame") to transmit to devices within a different sector.

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We conclude Petitioner has not demonstrated that claim 28 is anticipated by Vornefeld. Petitioner relies on its analysis of claim 28 to support its assertion that claim 29, which recites similar limitations as claim 28, is anticipated by Vornefeld. *See* Pet. 35. Accordingly, Petitioner has also not demonstrated that claim 29 is anticipated by Vornefeld.

Petitioner does not assert Andersson meets the limitations set forth in claims 28 and 29. *See id.* at 50. Therefore, we conclude Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Vornefeld and Andersson.

E. Obviousness over Vornefeld and Ahy, and Obviousness over Vornefeld, Andersson, and Ahy

Petitioner challenges claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld and Ahy. Pet. 35–44. Petitioner further challenges these claims as unpatentable as obvious under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy. *Id.* at 50–51.

1. Scope and Content of Ahy

Ahy describes adaptive point to multipoint wireless communications. Ex. 1006, 1:65–66. A base station controller (BSC) maintains a set of physical (PHY) parameters and media-access-control (MAC) parameters, each of which is adaptively modified by the BSC for communication with a plurality of customer premises equipment (CPE). *Id.* at 2:15–21, 7:18–20. The BSC adjusts communication with each CPE individually and adaptively in response to changes in communication characteristics. *Id.* at 2:21–23. Control of each parameter by the BSC is independent and individual with regard to each CPE. *Id.* at 7:20–22. Each parameter actually has two values: a first value for transmission by the BSC and a second value for

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transmission by the CPE. *Id.* at 7:65–8:1. The communication parameters that can be adapted include: antenna selection to choose the antenna to be used at the BSC and the CPE; modulation type to determine the bit per symbol rate to use to exchange information; and error code type to choose the error detection and correction technique. *See id.* at 8:50–59, 10:38–48, 11:40–45.

Communications between the BSC and each CPE are conducted using a TDD technique in which time durations are divided into individual frames, each of which includes a "downstream" and "upstream" portion. *Id.* at 7:1–5. The BSC controls transmission for both upstream and downstream directions without specific requests from CPEs. *Id.* at 7:5–9. The TDD frame includes a sequence of parameter setting values for the BSC to use to inform each selected CPE of the PHY and MAC parameters the BSC is using to send messages to that selected CPE, and the PHY and MAC parameters the selected CPE should use to send messages to the BSC during its allocated part of the upstream portion. *Id.* at 15:11–20.

2. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27

In its challenges based on Vornefeld, Petitioner relies on Vornefeld to disclose the "first beam map" limitation set forth in these claims by virtue of their dependency from one of claims 2, 11, and 20.[5] Pet. 35–44, 50–51. Therefore, Petitioner fails to cure the deficiencies in Vornefeld discussed above and has not demonstrated that claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 are obvious over Vornefeld and Ahy. Petitioner also fails to

[5] Petitioner relies on Ahy to disclose the "first beam map" limitation only in its challenge based on Newman. *See* Pet. 58. Accordingly, we address Petitioner's assertions about Ahy in the Newman ground discussed below.

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demonstrate that these claims are obvious over Vornefeld, Andersson, and Ahy.

F. Obviousness over Newman, Andersson, and Ahy

Petitioner challenges claims 1–29 as obvious under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson. Pet. 51–63.

1. Scope and Content of Newman

Newman describes a multi-beam antenna system for communicating with mobile users. *Id.* at 1:4–6. The multi-beam communication system includes a sector antenna having a beamwidth providing sector coverage and a transmitter and a receiver system for receiving user signals from a user located in the sector. Ex. 1007, 2:10–14; *see also id.* at 4:5–6. A sector antenna has a beamwidth effective to provide coverage of a 120 degree azimuth sector. *Id.* at 4:12–15. The antenna system further includes a multi-beam antenna, which may comprise four side-by-side vertical arrays of dipoles or other radiating element arrangements suitable for providing four antenna beams, each having a beam width narrower than the 120 degree sector and aligned so that the four beams collectively cover at least a portion of the sector. *Id.* at 4:35–42. The beams may be provided with the inclusion of a suitable beam forming network. *Id.* at 4:47–50. Access to the four beams of the multi-beam antenna is provided by operation of the beam forming network, which may be included as part of the multi-beam antenna. *Id.* at 10:35–38. With this arrangement, communication with a particular user can be enhanced by a significant increase in transmitted signal strength, for example, by transmitting to the user via a narrow beam instead of the sector beam. *Id.* at 38–42.

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2. Claims 2–9, 11–18, and 20–27

Petitioner contends Ahy discloses "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals," as recited in claims 2, 11, and 20. Pet. 58; *see also id.* at 63 (asserting claims 11 and 20 are obvious for the same reasons given with respect to claim 2). In particular, Petitioner asserts Ahy teaches that the start of each TDD frame includes a first parameter value for transmission by the BSC and a second parameter value for transmission by the CPE, which allows the BSC and the CPE to transmit using different sets of parameters. *Id.* at 58 (citing Ex. 1006, 7:67–8:3). Petitioner asserts Ahy also discloses that the first part of the frame includes a value for the length for subsequent downstream payload elements for each CPE. *Id.* (citing Ex. 1006, 15:25–30). Thus, Petitioner asserts Ahy teaches providing information usable by CPEs (wireless access devices) to detect directed scanning beam signals. *Id.* (citing Ex. 1003 ¶ 153). Petitioner further asserts it would have been obvious to incorporate the TDD frame structure in Ahy into the beam forming network disclosed in Newman for the reasons described with respect to claim 1. *Id.*; *see also id.* at 52–53, 57 (asserting incorporating Ahy's TDD frame structure in Newman is nothing more than the use of known techniques to improve similar methods in the same way to yield predictable results).

Additionally, Petitioner asserts that, during Mr. Proctor's deposition, Mr. Proctor further explained why Ahy discloses the "beam map" and pointed to the "antenna selection" parameter in Ahy that includes a choice of antenna at the BSC 120 and choice of antenna at each CPE 130. Reply 7–8 (citing Ex. 1006, 8:54–59; Ex. 1011, 45:21–46:3). Petitioner asserts the antenna selection parameter in Ahy identifies the specific beam used to

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transmit the signal to the CPE. *Id.* at 8, 14. Petitioner asserts the value of the length of the subsequent downstream payload elements for each CPE informs the CPE when it should listen. *Id.* at 8 (citing Ex. 1006, 15:25–30; Ex. 1003 ¶ 153). Petitioner asserts this "scanning beam information" is usable by the CPE to detect directed scanning beam signals, and therefore meets the "beam map" limitations of claims 2, 11, and 20. *Id.* Petitioner also asserts that the antenna selection parameter (along with the timeslot reservation) clearly identifies the specific beams and their precise start times, which are usable by the CPE to detect the directed scanning beam signal. *Id.* at 14.

Patent Owner asserts that Ahy says nothing about directed scanning beam signals and nothing about sending a beam map containing scanning beam information that would allow the CPEs to detect directed scanning beam signals. PO Resp. 23. Patent Owner asserts Ahy's start of frame signal does not include information about which scanning beam will be used to cover the sector, or when it will be used. *Id.* at 23–24. Patent Owner asserts that Petitioner has not explained or provided supporting facts or evidence showing how or why the frame disclosed in Ahy would require a beam map containing scanning information. Sur-Reply 8.

We determine Petitioner fails to establish Ahy discloses "scheduling information for one or more beams that provides data indicating which scanning beam is used at which time," based on our construction of the beam map limitation set forth above. Ahy discloses

> [e]ach of the following parameters actually has two values: a first value for transmission by the BSC 120 and a second value for transmission by the CPE 130. Thus, the BSC 120 can transmit using a first set of parameters while the CPE 130 is instructed to transmit using a second set of parameters.

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Ex. 1006, 7:65–8:3(bolding omitted). Petitioner relies on this passage, along with Ahy's disclosure that the BSC sends the length of each downstream payload element in the time synchronization portion, to meet the beam map limitation. *See* Pet. 58 (citing Ex. 1006, 7:67–8:3; 15:25–30). But, Petitioner does not provide sufficient analysis in its Petition to explain why one of ordinary skill in the art would understand Ahy's description that the BSC and CPE can transmit using different values, in combination with its description that the length of the downstream payload elements is also transmitted in the time synchronization portion, discloses scheduling information for one or more beams indicating which scanning beam is used at which time.[6]

We are also not persuaded that Ahy's description of the BSC transmitting the length of each of the downstream payload elements discloses a start time of the beam. *See* Ex. 1006, 15:25–30. Petitioner does not provide sufficient reasoning to explain why the length of a payload informs the CPE the time it should listen. *See* Reply 8, 14. Mr. Proctor's testimony does not support Petitioner's assertion that the payload length indicates a start time; rather, Mr. Proctor merely states that Ahy discloses the

[6] In its Reply, Petitioner newly cites to Ahy's disclosure of an antenna selection parameter (which includes a choice of antenna at the BSC 120 and antenna at CPE 130) to support its assertion that Ahy discloses identification of the specific beam used to transmit the signal. *See* Reply 7–8 (citing Ex. 1006, 8:54–59). Mr. Proctor also newly relies on the antenna selection parameter to support his testimony that Ahy informs the CPE which antenna the BSC would be transmitting on. *See* Ex. 1011, 45:15–46:3. We decline to consider Petitioner's new assertions because they raise a new issue and exceeds the scope of a proper reply. *See* 37 C.F.R. § 42.23(b); *see also* Office Practice Trial Guide, 77 Fed. Reg. 48,765, 48,767 (Aug. 14, 2012) (a reply that raises a new issue will not be considered).

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first part of the frame "includes a value of the length for subsequent downstream payload elements for each CPE" (without further explanation of the relevance of this disclosure) and that this, in conjunction with the ability for the BSC and CPE to transmit using different sets of parameters teaches "providing information usable by CPEs (e.g., wireless access devices) to detect directed scanning beam signals. Ex. 1003 ¶ 153.

Finally, we observe that Petitioner relies on Newman, and not Ahy, to disclose the multi-beam antenna system and the "said directed scanning beam signals" recited in claims 2, 11, and 20. *See* Pet. 53–55. Petitioner relies on a combination argument—incorporation of the TDD frame structure in Ahy into the beam forming network disclosed in Newman—to meet the beam map limitation. *See* Pet. 58. However, Petitioner only provides reasoning why one of ordinary skill in the art would incorporate the capability of communicating using TDD into the communications system in Newman. *Id.* at 52–53, 58. This reasoning is insufficient to explain why one of ordinary skill would have incorporated Ahy's disclosure of BSC and CPE parameters and transmission of payload length into Newman.

For the reasons stated above, Petitioner fails to establish the Newman-Ahy-Andersson combination discloses the beam map limitation recited in claims 2, 11, and 20. Claims 3–9, 12–18, and 21–27 depend from claim 2, 11, and 20, respectively. Petitioner's analysis of these claims does not cure the deficiency. *See* Pet. 59–63.

We conclude Petitioner has not demonstrated that claims 2–9, 11–18, and 20–27 would have been obvious over Newman, Ahy, and Andersson.

5. Claims 28 and 29

Petitioner contends that claims 28 and 29 are obvious over the combination of Newman, Ahy, and Andersson for the same reasons given

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with respect to claims 2–9. However, claims 28 and 29 recite limitations that do not appear in claims 2–9. Petitioner fails to explain how the cited references teach transmit circuitry that "transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals," as recited in claim 28. Petitioner also fails to explain how the references teach the substantially similar limitation that appears in claim 29. Accordingly, Petitioner has not demonstrated that claims 28 and 29 would have been obvious over Newman, Ahy, and Andersson.

III. CONCLUSION

For the reasons stated above, we enter adverse judgement against Patent Owner with respect to claims 1, 10, and 19 of the '931 patent. We further determine

A. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 102(b) as anticipated by Vornefeld;

B. Claims 2, 3, 6, 7, 11, 12, 15, 16, 20, 21, 24, 25, 28, and 29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Andersson;

C. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld and Ahy;

D. Claims 4, 5, 8, 9, 13, 14, 17, 18, 22, 23, 26, and 27 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Vornefeld, Andersson, and Ahy; and

E. Claims 2–9, 11–18, and 20–29 have not been shown to be unpatentable under 35 U.S.C. § 103(a) over Newman, Ahy, and Andersson.

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IV. ORDER

It is

ORDERED that that adverse judgement is entered against Patent Owner as to claims 1, 10, and 19 of U.S. Patent No. 7,230,931 B2; and

FURTHER ORDERED that claims 2–9, 11–18, and 21–29 of U.S. Patent No. 7,230,931 B2 have not shown to be unpatentable.

This is a final written decision of the Board under 35 U.S.C. § 318(a), and, therefore, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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PTO/SB/80 (11-08)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

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

I hereby appoint:

☑ Practitioners associated with the Customer Number: 164543

OR

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

Name	Registration Number	Name	Registration Number

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

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

☑ The address associated with Customer Number: 164543

OR

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

Assignee Name and Address:

General Access Solutions, Ltd.
3400 Welborn St., #216
Dallas, TX 75219

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

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

Signature	/Michael S. Hynek/	Date	September 23, 2019
Name	Michael S. Hynek	Telephone	
Title	Manager of General Access, LLC which is GP of General Access I, Ltd., GP of Applicant		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

SCHEDULE A

Docket No.:	**000189-0028-101**	**Conf. No.:**	**5591**
Application No.:	**09/948,059**	**Patent No.:**	**7,230,931**

Total Assignments: 3

Application #: 09948059 Filing Dt: 09/05/2001 Patent #: 7230931 Issue Dt: 06/12/2007

PCT #: NONE Intl Reg #: Publication #: US20020136170 Pub Dt: 09/26/2002

Inventor: Paul F. Struhsaker

Title: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

Assignment: 1

Reel/Frame: 012467 / 0944 Received: 01/18/2002 Recorded: 01/10/2002 Mailed: 03/12/2002 Pages: 3

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: STRUHSAKER, PAUL F. Exec Dt: 12/07/2001

Assignee: RAZE TECHNOLOGIES, INC.
2540 EAST PLANO PARKWAY, SUITE 188
PLANO, TEXAS 75074

Assignment: 2

Reel/Frame: 012449 / 0730 Received: 01/15/2002 Recorded: 01/10/2002 Mailed: 03/06/2002 Pages: 8

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: RAZE TECHNOLOGIES, INC. Exec Dt: 12/20/2001

Assignee: ACCESS SOLUTIONS, LTD.
17519 MUIRFIELD
DALLAS, TEXAS 75287

Assignment:

Reel/Frame: 050326 / 0971 **Received:** 09/10/2019 **Recorded:** 09/10/2019 **Mailed:** 09/11/2019 **Pages:** 8

Conveyance: CHANGE OF NAME (SEE DOCUMENT FOR DETAILS).

Assignor: ACCESS SOLUTIONS, LTD. **Exec Dt:** 08/15/2011

Assignee: GENERAL ACCESS SOLUTIONS, LTD.
3400 WELBORN ST., #216
DALLAS, TEXAS 75219

PTO/SB/96 (07-09)
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: GENERAL ACCESS SOLUTIONS, LTD.

Application No./Patent No.: See Schedule A Filed/Issue Date: See Schedule A

Titled: See Schedule A

GENERAL ACCESS SOLUTIONS, LTD. (Name of Assignee) , Corporation (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. [x] the assignee of the entire right, title, and interest in;

2. [ ] an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. [ ] an assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made) the patent application/patent identified above by virtue of either:

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

OR

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

1. From: See Schedule A To: See Schedule A
The document was recorded in the United States Patent and Trademark Office at
Reel See Schedule A, Frame See Schedule A, or for which a copy thereof is attached.

2. From: See Schedule A To: See Schedule A
The document was recorded in the United States Patent and Trademark Office at
Reel See Schedule A, Frame See Schedule A, or for which a copy thereof is attached.

3. From: See Schedule A To: See Schedule A
The document was recorded in the United States Patent and Trademark Office at
Reel See Schedule A, Frame See Schedule A, or for which a copy thereof is attached.

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

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

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

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

/Michael S. Hynek/	September 23, 2019
Signature	Date
Michael S. Hynek	Manager of General Access, LLC which is GP of General Access I, Ltd., GP of Applicant
Printed or Typed Name	Title or Registration No.

SCHEDULE A

Docket No.:	**000189-0028-101**	**Conf. No.:**	**5591**
Application No.:	**09/948,059**	**Patent No.:**	**7,230,931**

Total Assignments: 3

Application #: 09948059 Filing Dt: 09/05/2001 Patent #: 7230931 Issue Dt: 06/12/2007

PCT #: NONE Intl Reg #: Publication #: US20020136170 Pub Dt: 09/26/2002

Inventor: Paul F. Struhsaker

Title: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION

Assignment: 1

Reel/Frame: 012467 / 0944 Received: 01/18/2002 Recorded: 01/10/2002 Mailed: 03/12/2002 Pages: 3

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: STRUHSAKER, PAUL F. Exec Dt: 12/07/2001

Assignee: RAZE TECHNOLOGIES, INC.
2540 EAST PLANO PARKWAY, SUITE 188
PLANO, TEXAS 75074

Assignment: 2

Reel/Frame: 012449 / 0730 Received: 01/15/2002 Recorded: 01/10/2002 Mailed: 03/06/2002 Pages: 8

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: RAZE TECHNOLOGIES, INC. Exec Dt: 12/20/2001

Assignee: ACCESS SOLUTIONS, LTD.
17519 MUIRFIELD
DALLAS, TEXAS 75287

Assignment:

Reel/Frame: 050326 / 0971 **Received:** 09/10/2019 **Recorded:** 09/10/2019 **Mailed:** 09/11/2019 **Pages:** 8

Conveyance: CHANGE OF NAME (SEE DOCUMENT FOR DETAILS).

Assignor: ACCESS SOLUTIONS, LTD. **Exec Dt:** 08/15/2011

Assignee: GENERAL ACCESS SOLUTIONS, LTD.
3400 WELBORN ST., #216
DALLAS, TEXAS 75219

Electronic Acknowledgement Receipt

EFS ID:	37262485
Application Number:	09948059
International Application Number:	
Confirmation Number:	5591
Title of Invention:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
First Named Inventor/Applicant Name:	Paul F. Struhsaker
Customer Number:	70763
Filer:	Kevin Augustine Rieffel/Tracy Chu
Filer Authorized By:	Kevin Augustine Rieffel
Attorney Docket Number:	9030101.147-US1
Receipt Date:	25-SEP-2019
Filing Date:	05-SEP-2001
Time Stamp:	11:31:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	000189-0028-101_POA.pdf	1888945 2da7d790703918fb0e3475bee774f9ea2c7f4a01	no	2

Warnings:

PETITIONER VERIZON
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P. 469

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	000189-0028-101_Stmt_373b.pdf	833467 2ba0c845791af269005282ddd9a4dc470d1874a9	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	2722412	

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

SPRINT SPECTRUM L.P.,
Appellant

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Appellee

2019-1855

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-01889.

Decided: May 13, 2020

BRIAN DAVID SCHMALZBACH, McGuireWoods LLP, Richmond, VA, for appellant. Also represented by DAVID EVAN FINKELSON.

GLEN E. SUMMERS, Bartlit Beck Herman Palenchar & Scott LLP, Denver, CO, for appellee. Also represented by JOHN HUGHES, NOSSON KNOBLOCH, DANIEL TAYLOR.

Before CHEN, LINN, and STOLL, *Circuit Judges.*

STOLL, *Circuit Judge.*

Sprint Spectrum L.P. appeals the final written decision of the Patent Trial and Appeal Board declining to hold certain claims of U.S. Patent No. 7,230,931 unpatentable on anticipation and obviousness grounds. Sprint specifically challenges the Board's construction of a claim term that appears in most of the challenged claims. Sprint also challenges the Board's determinations relating to the scope of Sprint's reply and the scope and content of the asserted prior art. Because we agree that the Board erred in construing the claim term at issue, we vacate the Board's decision as to the applicable claims and remand for consideration of certain grounds under the proper claim construction. We affirm the Board's decision in all other respects.

BACKGROUND

I

The '931 patent is directed to a wireless data communication system that selectively and dynamically directs bandwidth to specific subscribers within a service area. The disclosed system applies a known technique called time division duplexing (TDD), which uses a single frequency for bidirectional communication by designating separate and distinct periods of time for the transmittal and receipt of data. TDD systems may employ "frames" to structure the transmittal of downlink data and receipt of uplink data over a short period of time (e.g., 2 milliseconds).

The improvement disclosed in the '931 patent relates to these TDD frames. Specifically, the '931 patent discloses sending a broadcast signal to all subscribers within a service area at the start of each frame, followed by a series of directed signals or "beams" sent to and received from selected subscribers over the remainder of each frame. The broadcast signal at the start of each frame includes

instructions that assign the forthcoming beams to the selected subscribers. Through this approach, the downlink and uplink bandwidth of each frame can be dynamically allocated to various subscribers in a nonuniform fashion, thereby improving performance as compared to other ways of allocating bandwidth, such as "equal duration round robin polling" or "dynamic weighted polling . . . based on the throughput per cell." '931 patent col. 28 ll. 44–50.

Claims 2, 11, and 20 and the claims that depend from them are at issue on appeal. Claim 2, which depends from claim 1, is illustrative:

> 1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:
>
> transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry
>
> transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and
>
> subsequently transmits, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices

> within one of said sectors using one of said directed scanning beam signals.
>
> 2. The transceiver as set forth in claim 1 wherein said broadcast beam signal further comprises a first beam map containing *scanning beam information usable by said wireless access devices to detect said directed scanning beam signals.*

Id. at col. 30 ll. 31–57 (emphasis added to disputed claim limitation). Dependent claims 28 and 29 are also at issue on appeal, but do not depend from claims 2, 11, or 20. Claim 28 is illustrative:

> 28. The transceiver as set forth in claim 1 wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.

Id. at col. 33 ll. 4–9.

II

In July 2017, Sprint petitioned for inter partes review of claims 1–29 of the '931 patent. The Board instituted trial of the challenged claims on five grounds of unpatentability.[1] The instituted grounds included anticipation of certain claims by Vornefeld[2] and various obviousness

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[1] The Board initially declined to institute trial for claims 2, 11, and 20, but added those claims to the proceedings following *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018).

[2] Ulrich Vornefeld, et al., *SDMA Techniques for Wireless ATM*, IEEE COMMC'NS MAGAZINE, Nov. 1999, at 52.

combinations of Vornefeld, Ahy,[3] Andersson,[4] and Newman.[5] During the proceedings, patent owner General Access Solutions (GAS) conceded the unpatentability of independent claims 1, 10, and 19, thereby shifting the focus of the Board's unpatentability analysis to claims 2, 11, and 20. Following oral argument, the Board authorized supplemental briefing on the construction of the term "beam map" as recited in claims 2, 11, and 20.

Beyond accepting GAS's surrender of claims 1, 10, and 19, the Board declined to hold any of the other challenged claims unpatentable in its final written decision. *See Sprint Spectrum L.P. v. Gen. Access Sols., Ltd.*, No. IPR2017-01889, 2019 WL 1096544, at *13 (P.T.A.B. Mar. 7, 2019) (*Decision*). Applying the broadest reasonable interpretation standard, the Board first construed the term "a first beam map" as "scheduling information for one or more beams." *Id.* at *5. The Board then construed the phrase "a first beam map containing scanning beam information usable by said wireless access devices to detect said directed scanning beam signals," recited in claims 2, 11, and 20,[6] as "scheduling information for one or more beams

---

[3] U.S. Patent No. 7,366,133. We recognize, as the Board did, that the first named inventor's surname is Majidi-Ahy. We use the shorthand "Ahy" for consistency with the Board's decision.

[4] U.S. Patent No. 6,470,177.

[5] U.S. Patent No. 5,684,491.

[6] The language of claim 20 varies slightly from claims 2 and 11, reciting "a first beam map containing scanning beam information usable by said wireless access devices to *receive* said *first* directed scanning beam signal." '931 patent col. 32 ll. 35–39 (emphases added). Neither the Board nor the parties identified any effect of this slight variation, so we do not analyze claim 20 separately for the purpose of our review.

that provides data indicating which scanning beam is used at which time." *Id.* at *4–6. The Board held that the asserted prior art did not disclose the "scanning beam information" limitation of claims 2, 11, and 20 under its construction. *See id.* at *8–9, *11–13. In analyzing these claims, the Board declined to consider certain argument and evidence presented in Sprint's reply. *Id.* at *12 n.6. The Board separately found that the asserted prior art did not disclose the limitations of claims 28 and 29. *Id.* at *10, *13.

Sprint challenges these determinations on appeal. We have jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

I

Sprint first challenges the Board's construction of the "scanning beam information" limitation in claims 2, 11, and 20. We review de novo the Board's ultimate claim construction and any supporting determinations based on intrinsic evidence. *Personalized Media Commc'ns, LLC v. Apple Inc.*, 952 F.3d 1336, 1339 (Fed. Cir. 2020) (citing *Knowles Elecs. LLC v. Cirrus Logic, Inc.*, 883 F.3d 1358, 1361–62 (Fed. Cir. 2018)). We review any subsidiary factual findings involving extrinsic evidence for substantial evidence. *Id.*

The broadest reasonable interpretation standard applies to this IPR proceeding.[7] "Under a broadest

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[7] Per recent regulation, the Board applies the *Phillips* claim construction standard to IPR petitions filed on or after November 13, 2018. *See Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (codified at 37 C.F.R. § 42.100(b)). Because Sprint filed its IPR petition before

reasonable interpretation, words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification and prosecution history." *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016) (citing *Straight Path IP Grp., Inc. v. Sipnet EU S.R.O.*, 806 F.3d 1356, 1362 (Fed. Cir. 2015)). "While the broadest reasonable interpretation standard is broad, it does not give the Board an unfettered license to interpret the words in a claim without regard for the full claim language and the written description." *Id.* (first citing *In re Suitco Surface, Inc.*, 603 F.3d 1255, 1260 (Fed. Cir. 2010); then citing *In re Abbott Diabetes Care, Inc.*, 696 F.3d 1142, 1148–50 (Fed. Cir. 2012)). Indeed, the broadest reasonable interpretation must take into account "the context of the *entire* patent." *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1374 (Fed. Cir. 2019) (emphasis added) (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc)).

The Board interpreted the claim term "scanning beam information usable by said wireless access devices to detect said directed scanning beam signals" as "data indicating which scanning beam is used at which time."[8] *Decision*, 2019 WL 1096544, at *5–6. For the following reasons, we agree with Sprint that the Board's construction is not the broadest reasonable interpretation in view of the context of the entire '931 patent.

To start, the Board's construction is narrower than the plain claim language, which merely requires that the

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November 13, 2018, we apply the broadest reasonable interpretation standard.

[8] We focus on the "scanning beam information" portion of the claim because the construction of the "first beam map" portion of the claim is not in dispute. In construing "first beam map," the Board adopted Sprint's proffered construction. *Decision*, 2019 WL 1096544, at *5.

scanning beam information can be used "to detect" directed scanning beam signals. Moreover, claims 4 and 5, which depend from claim 3, which in turn depends from claim 2, recite examples of the "scanning beam information" of claim 2 that would fall outside of the Board's narrow construction. "Under the doctrine of claim differentiation, dependent claims are presumed to be of narrower scope than the independent claims from which they depend." *AK Steel Corp. v. Sollac & Ugine*, 344 F.3d 1234, 1242 (Fed. Cir. 2003) (first citing *RF Del., Inc. v. Pac. Keystone Techs., Inc.*, 326 F.3d 1255, 1264 (Fed. Cir. 2003); then citing 35 U.S.C. § 112, ¶ 4 (2000)). The Board's construction would require the dependent claims to broaden "said scanning beam information" rather than narrow it. Claim 4, in particular, recites "wherein said scanning beam information identifies at least one modulation format," while claim 5 recites "wherein said scanning beam information identifies at least one forward error correction code level." '931 patent col. 30 l. 62 – col. 31 l. 2. The reference to "said" scanning beam information means that the particular "scanning beam information" identified in claim 2—i.e., "usable by said wireless access devices to detect said directed scanning beam signals"—must further "identif[y] at least one modulation format" (claim 4) or "identif[y] at least one forward error correction code level" (claim 5). The "modulation format" and "forward error correction code level" for a directed scanning beam do not identify "which scanning beam is used at which time"—yet they are types of information that can be used to *detect* a directed signal, which is all that the plain language of claim 2 requires. While we acknowledge that dependent claims are "only an aid to interpretation and are not conclusive," *Regents of Univ. of Cal. v. Dakocytomation Cal., Inc.*, 517 F.3d 1364, 1375 (Fed. Cir. 2008) (quoting *N. Am. Vaccine, Inc. v. Am. Cyanamid Co.*, 7 F.3d 1571, 1577 (Fed. Cir. 1993)), the incompatibility of these dependent claims counsels against adopting the Board's narrowing construction—especially

here, where the broadest reasonable interpretation standard applies.

The specification of the '931 patent similarly counsels against the Board's narrowing construction. The Board reasoned that the specification "consistently describes" the beam map as indicating "which scanning beam is used at which time." *Decision*, 2019 WL 1096544, at *6 (citing '931 patent col. 29 ll. 34–36, col. 29 ll. 51–55, col. 29 l. 66 – col. 30 l. 2). The three passages cited by the Board describe only a single embodiment, however, illustrated by Figure 14. As we have explained, the scope of an invention may only be properly limited to the preferred embodiment "if the patentee uses words that manifest a clear intention to restrict the scope of the claims to that embodiment." *Info-Hold, Inc. v. Applied Media Techs. Corp.*, 783 F.3d 1262, 1267 (Fed. Cir. 2015) (citing *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004)).

The Board identified no manifestation of a clear intention to restrict the scope of the claims to the embodiment illustrated by Figure 14. In support of its construction, the Board relied heavily on a sentence in the specification that states:

> The Broadcast Beam Maps provide data indicating which scanning beam (or beams) are used at which time (measured in symbols or other baud-oriented time unit) for the frame.

'931 patent col. 29 ll. 34–36. This sentence is not definitional and should not be read into the broader claim language that the patent applicant chose to use in claims 2, 11, and 20, particularly under the broadest reasonable interpretation standard. This sentence is also within the description of Figure 14, which the specification describes as just "one embodiment of the present invention." *Id.* at col. 29 ll. 3–5. And the same section of the specification also states that beam maps more broadly "comprise . . . information that defines scanning beams that cover the

sector." *Id.* at col. 29 ll. 51–53. Elsewhere, the specification expressly states that its figures and embodiments "are by way of illustration only and should not be construed in any way to limit the scope of the invention." *Id.* at col. 11 ll. 47–51. At bottom, there is no clear manifestation (nor did the Board identify one) that would allow the Board to limit the broad words "scanning beam information usable by said wireless access devices to detect said scanning beam signals" to an embodiment that provides "data indicating which scanning beam is used at which time."

The Summary of the Invention section repeats the limitations of the various dependent claims. *See id.* at col. 9 ll. 35–52. It states that in "one embodiment," the "scanning beam information [is] usable by the at least one wireless access device to detect the [at] least one directed scanning beam," and in "another embodiment" the "scanning beam information identifies a downlink time slot." *Id.* at col. 9 ll. 35–44. In "still another embodiment," the "scanning beam information identifies at least one modulation format associated with the at least one directed scanning beam," and in "yet another embodiment," the "scanning beam information identifies at least one forward error correction code level associated with the at least one directed scanning beam." *Id.* at col. 9 ll. 45–52. All of these different options for the "scanning beam information" support an interpretation broader than the Board's construction, given the interrelationship of claims 2–5.

In addressing this section of the specification, the Board relied on the specification's use of the phrase "another embodiment" to reason that the "downlink time slot" of claim 3 "is different than the information usable to detect directed scanning beam signals" recited in claim 2. *Decision*, 2019 WL 1096544, at *6 (citing '931 patent col. 9 ll. 35–44). That reasoning does not withstand scrutiny. While the Summary of the Invention does characterize each additional piece of information as "another embodiment" or similar, the specification does not describe these

embodiments as separate and distinct, or mutually exclusive. Nor does it preclude a broad interpretation of claim 2's "scanning beam information." As explained above, the structure of the corresponding dependent claims indicates that the types of information recited in claims 3, 4, and 5 are examples of "*said* scanning beam information"—i.e., the *same* scanning beam information recited in claim 2 that is "usable . . . to detect said directed scanning beam signals."

Finally, the specification expressly contemplates an embodiment where "only one beam is active" for a given frame. '931 patent col. 28 ll. 61–63. The Board's construction for "first beam map" likewise requires providing "scheduling information for *one* or more beams." *Decision*, 2019 WL 1096544, at *5 (emphasis added). The broadest reasonable construction of the "scanning beam information" limitation, then, should accommodate an embodiment where only one beam is active for the duration of a frame. *See GE Lighting Sols., LLC v. AgiLight, Inc.*, 750 F.3d 1304, 1311 (Fed. Cir. 2014) ("[W]here claims can reasonably [be] interpreted to include a specific embodiment, it is incorrect to construe the claims to exclude that embodiment, absent probative evidence on the contrary." (second alteration in original) (quoting *Oatey Co. v. IPS Corp.*, 514 F.3d 1271, 1277 (Fed. Cir. 2008))). The Board's construction is thus too narrow because it requires identifying "which scanning beam is used *at which time*" for each frame—a superfluous requirement for an embodiment where only one beam is active for each frame.

We conclude that the Board erred in its overly narrow construction of the "scanning beam information" limitations in claims 2, 11, and 20. Absent any lexicography or manifestation of clear intent to limit the scope of "scanning beam information" to any particular embodiment, the plain language must control. Accordingly, the recited "scanning beam information" must be broad enough to include *any* information that is "usable by said wireless access devices

to detect said directed scanning beam signals." *E.g.*, '931 patent col. 30 ll. 55–57. Certainly, that can include "data indicating which scanning beam is used at which time," as recited in the Board's construction. But the broadest reasonable interpretation of "scanning beam information" is not limited to that kind of data, nor must it include that kind of data. Consistent with the claims and specification, it could instead include the identification of "a downlink time slot," a "modulation format," a "forward error correction code level," or any other kind of "information usable by said wireless access devices to detect said directed scanning beam signals" as recited in the claim. *See id.* at col. 9 ll. 35–52, col. 30 l. 53 – col. 31 l. 2.

Because the Board did not apply the broadest reasonable interpretation of "scanning beam information," we vacate its unpatentability determinations as to claims 2, 11, and 20 and the claims that depend therefrom. We remand to the Board for an analysis of the unpatentability grounds under the proper construction.

II

Next, Sprint challenges the Board's refusal to consider its reply arguments regarding the disclosure of the asserted Ahy prior art. In the final written decision, the Board objected to Sprint's identification of Ahy's "antenna selection parameter" as disclosing the limitations of claims 2, 11, and 20. The Board explained that Sprint's arguments were "new assertions because they raise[d] a new issue and exceed[ed] the scope of a proper reply." *Decision*, 2019 WL 1096544, at *12 n.6 (first citing 37 C.F.R. § 42.23(b); then citing Office Practice Trial Guide, 77 Fed. Reg. 48,765, 48,767 (Aug. 14, 2012)). Sprint insists that its reply arguments "simply expanded upon [the arguments in its petition] in response to a claim construction argument raised by GAS in its Response." Appellant's Br. 43.

We conclude that Sprint's scope of reply challenge is rendered moot by the Board's separate determination that Sprint failed to sufficiently establish a reason to combine the prior art references at issue: Newman and Ahy. *See Decision*, 2019 WL 1096544, at *13. Whether there is a reason to combine is a factual determination that we review for substantial evidence. *Rambus Inc. v. Rea*, 731 F.3d 1248, 1251–52 (Fed. Cir. 2013). The Board's finding is supported by substantial evidence because a reasonable factfinder could find no reason to combine based on the limited argument and evidence presented by Sprint. The portion of Sprint's petition addressing claim 2 merely refers back to an earlier analysis for claim element 1[a], as does the supporting expert declaration. We agree with the Board that Sprint's reason to combine analysis for claim element 1[a]—a different claim limitation covering different subject matter—is "insufficient to explain why one of ordinary skill would have incorporated Ahy's disclosure of [certain parameters relevant to claim 2] into Newman." *Decision*, 2019 WL 1096544, at *13. Sprint complains that the Board overlooked certain pages of its petition, but the pages that Sprint identifies on appeal—which address claim element 1[c]—are not the pages that Sprint identified to the Board. We can hardly fault the Board for focusing on the pages that Sprint actually referenced in its petition.

Even if the Board had considered Sprint's reply arguments and evidence, nothing in the excluded portion of Sprint's reply addresses the reason to combine Newman and Ahy. Thus, the Board's finding of no reason to combine precludes a finding of obviousness regardless of whether Sprint's reply arguments were proper. Accordingly, we affirm the Board's finding of no reason to combine and hold Sprint's scope of reply challenge moot.

III

Finally, Sprint challenges the Board's separate determination as to claims 28 and 29 of the '931 patent. Sprint does not dispute the Board's interpretation of claims 28 and 29, focusing instead on the Board's reading of the Vornefeld prior art reference. Specifically, Sprint insists that the only reasonable understanding of Vornefeld's Figure 3 is that it discloses a single frame covering a fixed unit of time. The Board rejected Sprint's view, finding instead that Figure 3 of Vornefeld discloses *multiple* spatially separated frames that are simultaneously transmitted in parallel—not a *single* frame with "second downlink data traffic," as required by claims 28 and 29.

We review the Board's findings regarding the scope and content of the prior art for substantial evidence. *Rambus*, 731 F.3d at 1251–52. "If two 'inconsistent conclusions may reasonably be drawn from the evidence in record, [the PTAB]'s decision to favor one conclusion over the other is the epitome of a decision that must be sustained upon review for substantial evidence.'" *Elbit Sys. of Am., LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1356 (Fed. Cir. 2018) (alteration in original) (quoting *In re Cree, Inc.*, 818 F.3d 694, 701 (Fed. Cir. 2016)). When presented with the figure and accompanying discussion in Vornefeld, a reasonable factfinder could conclude, as the Board did, that the depicted transmissions comprise separate frames transmitted in parallel. Figure 3 identifies two axes: a time domain and a spatial domain. The depiction of components in parallel in the spatial domain could illustrate to an ordinarily skilled artisan that multiple frames are sent simultaneously to different locations in three-dimensional space. Indeed, the Board observed that the text accompanying Figure 3 describes "*concurrent* transmission of [medium access control protocol data units] in the spatial domain." *Decision*, 2019 WL 1096544, at *10 (emphasis added) (citing J.A. 1003). In the context of Figure 3, Vornefeld also discusses a "[s]*imultaneous* downlink

transmission" that "enables the base station to *send different information to several locations* in the same time and frequency slot." J.A. 1004 (emphases added). Vornefeld additionally discusses "[c]*oncurrent* transmission of [mobile terminals] in one slot" if "spatial filtering" is performed. *Id.* (emphasis added). These disclosures support the Board's interpretation of Figure 3 as one in which the parallel lines represent spatially separated frames sent simultaneously—not components of one large frame, as Sprint proposes.

Because the Board's understanding of Figure 3 of Vornefeld is reasonable in view of these disclosures, it is supported by substantial evidence. We therefore affirm the Board's determination as to claims 28 and 29.

CONCLUSION

We have considered the parties' remaining arguments, and we do not find them persuasive. For the foregoing reasons, we vacate the Board's final written decision with regard to claims 2–9, 11–18, and 20–27 of the '931 patent and remand for further proceedings consistent with this opinion.[9] We affirm the Board's decision in all other respects.

AFFIRMED-IN-PART, VACATED-IN-PART, AND REMANDED

COSTS

No costs.

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[9] Because we affirm the Board's finding of no reason to combine Newman and Ahy, on remand the Board need not address the asserted combination of Newman, Ahy, and Andersson (Ground V) notwithstanding our vacatur and remand on the claim construction issue.

United States Court of Appeals for the Federal Circuit

SPRINT SPECTRUM L.P.,
Appellant

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Appellee

2019-1855

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-01889.

JUDGMENT

THIS CAUSE having been considered, it is

ORDERED AND ADJUDGED:

AFFIRMED-IN-PART, VACATED-IN-PART, AND REMANDED

ENTERED BY ORDER OF THE COURT

May 13, 2020

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court

United States Court of Appeals for the Federal Circuit

SPRINT SPECTRUM L.P.,
Appellant

v.

GENERAL ACCESS SOLUTIONS, LTD.,
Appellee

2019-1855

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-01889.

MANDATE

In accordance with the judgment of this Court, entered May 13, 2020, and pursuant to Rule 41 of the Federal Rules of Appellate Procedure, the formal mandate is hereby issued.

FOR THE COURT

June 19, 2020

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/948,059	09/05/2001	Paul F. Struhsaker	9030101.147-US1

CONFIRMATION NO. 5591

POA ACCEPTANCE LETTER

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Date Mailed: 03/10/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/25/2019.

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

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

/dtdinh/

PETITIONER VERIZON
EX. 1012
P. 488

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/948,059	09/05/2001	Paul F. Struhsaker	9030101.147-US1

CONFIRMATION NO. 5591

POWER OF ATTORNEY NOTICE

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Date Mailed: 03/10/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/25/2019.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

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

/dtdinh/

PETITIONER VERIZON
EX. 1012
P. 489

PATENTS
000189-0028-101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

Patentees	:	Paul F. Struhsaker		
Patent No.	:	7,230,931		
Issued	:	June 12, 2007		
Application No.	:	09/948,059	Confirmation No.:	5591
Filed	:	September 5, 2001		
For	:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION		

New York, New York 10004
May 5, 2021

Mail Stop PETITION
Hon. Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

PETITION UNDER 37 C.F.R. § 1.182
FOR DUPLICATE ORIGINAL PATENT

Sir:

Patentees and assignee hereby petition under 37 C.F.R. § 1.182 for issuance of a duplicate original ribbon copy of the above-identified patent.

1. The above-identified patent was issued on June 12, 2007. However, the original ribbon copy appears to have been lost or misplaced soon thereafter, as follows:

2. The assignee, the undersigned's client, reports that it does not have the original ribbon copy or any record of ever having received the original ribbon copy. Prior counsel has been contacted and has provided no indication that it has the original ribbon copy or any record of ever having received the original ribbon copy. The undersigned's law firm has no record of ever having received the original ribbon copy.

3. The undersigned was appointed as counsel on or about September 25, 2019 with the filing of a Power of Attorney Document. It is the practice of the undersigned's

law firm to store documents, including original patents, received via mail from the U.S. Patent and Trademark Office. Only upon request, it is the practice of the undersigned's law firm's to include a cover letter whenever forwarding an original patent to a client. It is further a practice of the law firm to keep an image copy of the signed cover letter in the law firm's electronic files. No such records exist.

4. The undersigned has contacted prior counsel who represented the assignee on or around June 12, 2007, the day the above-identified patent was issued. No indication was provided by prior counsel that they have the original ribbon copy or any record of ever having received the original ribbon copy

5. From the foregoing, it may be concluded that either the original ribbon copy of the above-identified patent was sent to the assignee and lost or misplaced by the assignee, or the original ribbon copy of the above-identified patent was never sent to the assignee and was lost or misplaced by prior counsel.

Therefore, patentees and assignee respectfully request that the Patent and Trademark Office issue a duplicate original patent. $420.00, in payment of the fee set forth in 37 C.F.R. § 1.17(f), is being paid during electronic submission of this Petition. The Director is hereby authorized to charge any additional fee that may be due, or to credit any overpayment, in connection with this Petition, to Deposit Account No. 06-1075, from which the undersigned is authorized to draw.

Prompt consideration and grant of this petition are respectfully requested.

Dated: May 5, 2021

Respectfully submitted,

By: /Kevin A. Rieffel/
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PETITIONER VERIZON
EX. 1012
P. 491

Electronic Patent Application Fee Transmittal

Application Number:	09948059
Filing Date:	05-Sep-2001
Title of Invention:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
First Named Inventor/Applicant Name:	Paul F. Struhsaker
Filer:	Kevin Augustine Rieffel/Romina Gallo
Attorney Docket Number:	000189-0028-101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
PETITION FEE- 37 CFR 1.17(F) (GROUP I)	1462	1	420	420
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**420**

Electronic Acknowledgement Receipt

EFS ID:	42643492
Application Number:	09948059
International Application Number:	
Confirmation Number:	5591
Title of Invention:	WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION
First Named Inventor/Applicant Name:	Paul F. Struhsaker
Customer Number:	164543
Filer:	Kevin Augustine Rieffel/Romina Gallo
Filer Authorized By:	Kevin Augustine Rieffel
Attorney Docket Number:	000189-0028-101
Receipt Date:	05-MAY-2021
Filing Date:	05-SEP-2001
Time Stamp:	14:27:51
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$420
RAM confirmation Number	E202155E28200581
Deposit Account	061075
Authorized User	Romina Gallo

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition for review by the Office of Petitions	000189-0028-101-Petition.pdf	122545 b554800134fb4cff0d45ab713681727a09f04bcd	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	31129 148c13c29677f8a71065102f1600fd288e1e403a	no	2
Warnings:					
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		Total Files Size (in bytes):	153674		

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

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

New International Application Filed with the USPTO as a Receiving Office

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

United States Patent and Trademark Office

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Sale Adjustment Accounting Date:09/13/2021

Effective Date	Sale Accounting Date	Sale Item Reference Number
05/05/2021	09/13/2021	09948059

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20219CB29261837	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$420.00	DA

United States Patent and Trademark Office

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Refund Accounting Date:09/13/2021

Effective Date	Sale Item Reference Number	Refund Total
05/05/2021	09948059	$420.00

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method	Account Number
I20219CB29261837	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$420.00	DA	061075

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/948,059	09/05/2001	Paul F. Struhsaker	000189-0028-101	5591

164543 7590 09/15/2021

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EXAMINER	
AHMED, SALMAN	

ART UNIT	PAPER NUMBER
2616	

NOTIFICATION DATE	DELIVERY MODE
09/15/2021	ELECTRONIC

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

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

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

DocketRequests@hglaw.com
HGPatentDocket@hglaw.com
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UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Patent No. 7,230,931
Issue Date: June 12, 2007
Application No. 09/948,059
Filing or 371(c) Date: September 5, 2001
Attorney Docket No. 000189-0028-101
For: WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TSS FROMES AND METHOD OF OPERATION

DECISION ON PETITION

This is a decision on the petition under 37 CFR 1.182, filed May 5, 2021, requesting issuance of a duplicate Letters Patent for the above-identified patent.

The petition is **GRANTED**.

The Office of Data Management is directed to issue the duplicate Letters Patent.

As authorized, the $420 fee for the petition under 37 CFR 1.182 has been assessed to petitioner's deposit account.

A copy of this decision is being faxed to the Office of Data Management for issuance of the duplicate Letters Patent.

Telephone inquiries concerning this decision should be directed to undersigned at (571) 272-1642. All other inquiries regarding the issuance of the duplicate Letters Patent should be directed to Rochaun Hardwick in the Office of Data Management at (571) 272-4200.

/April M. Wise/
April M. Wise
Paralegal Specialist, Office of Petitions

cc: Rochaun Hardwick, Randolph Square, 9th Floor, A24 (Fax No. (571) 270-9958)

NOTE: This order is nonprecedential.

United States Court of Appeals for the Federal Circuit

GENERAL ACCESS SOLUTIONS, LTD.,
Appellant

v.

SPRINT SPECTRUM LLC,
fka Sprint Spectrum L.P.,
Appellee

2021-1824

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-01889.

ON MOTION

ORDER

Upon consideration of General Access Solutions, Ltd.'s motion to voluntarily dismiss this appeal pursuant to Federal Rule of Appellate Procedure 42(b),

IT IS ORDERED THAT:

(1) The motion is granted to the extent that the appeal is withdrawn.

(2) Each party shall bear its own costs.

FOR THE COURT

October 27, 2021
Date

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court

s29

ISSUED AS A MANDATE: October 27, 2021

(12) **INTER PARTES REVIEW CERTIFICATE** (2499th)
United States Patent
Struhsaker

(10) **Number: US 7,230,931 K1**
(45) **Certificate Issued: Nov. 15, 2021**

(54) **WIRELESS ACCESS SYSTEM USING SELECTIVELY ADAPTABLE BEAM FORMING IN TDD FRAMES AND METHOD OF OPERATION**

(75) Inventor: **Paul F. Struhsaker**

(73) Assignee: **GENERAL ACCESS SOLUTIONS, LTD.**

Trial Number:

IPR2017-01889 filed Jul. 28, 2017

Inter Partes Review Certificate for:

Patent No.: **7,230,931**
Issued: **Jun. 12, 2007**
Appl. No.: **09/948,059**
Filed: **Sep. 5, 2001**

The results of IPR2017-01889 are reflected in this inter partes review certificate under 35 U.S.C. 318(b).

INTER PARTES REVIEW CERTIFICATE
U.S. Patent 7,230,931 K1
Trial No. IPR2017-01889
Certificate Issued Nov. 15, 2021

AS A RESULT OF THE INTER PARTES REVIEW PROCEEDING, IT HAS BEEN DETERMINED THAT:

Claims **28-29** are found patentable.

Claims **1-27** are cancelled.

* * * * *

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-394	10/10/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
General Access Solutions, LTD.	Verizon Communications, Inc., et al

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,230,931	6/12/2007	General Access Solutions, LTD.
2	9,426,794	8/23/2016	General Access Solutions, LTD.
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**