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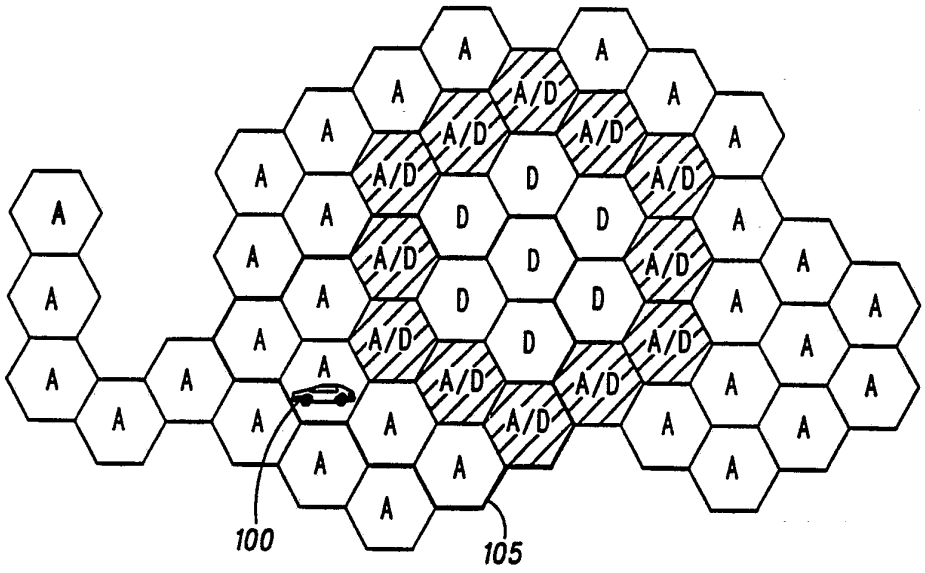

(57) Abstract

A communication system transfers communication from one communication domain (analog) (105) to another, unlike communication domain (digital). The communication system uses a transition cell having both analog and digital coverage areas overlapping in a 1:1 RF footprint. The transition cell is partitioned into sectors, each sector marked with either an analog or digital domain indication. When a subscriber unit (100) enters the transition cell from one domain, an inter-cell handoff into the transition cell within the same domain is performed. When the subscriber unit enters a sector having an opposite domain indication, an intra-cell handoff is performed. If the subscriber unit (100) then moves out of the transition cell, an inter-cell handoff into the new domain is performed.

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COMMUNICATION TRANSFER BETWEEN UNLIKE COMMUNICATION DOMAINS

Field of the Invention

This invention relates generally to communications systems, and more particularly to maintenance of communication within unlike communication domains.

Background of the Invention

As digital cellular radiotelephone technology matures, it becomes ever more necessary to combine digital and analog coverage areas in cellular radiotelephone communication domains. Subscriber units developed to accommodate both digital and analog modulation techniques, i.e., dual-mode subscriber units, will require handoff of communication between the digital communication domains and analog communication domains, and vice versa.

Problems occur, however, when the handoff between digital and analog domain is attempted, primarily at the boundary between the analog and digital coverage areas. When a dual-mode subscriber unit is operating in the digital domain, a potential analog target cell base-station cannot measure the subscriber units signal strength due to incompatibility. The same is true when the subscriber unit is operating in an analog cell; the digital base-stations cannot measure the subscriber units signal strength. Consequently, potential target base-stations in the other domain cannot measure the subscriber

units signal strength and thus cannot be included in a viable target candidate by a controlling switch.

One potential solution to the problem may be to provide digital scanning equipment at border analog cells and analog scanning equipment at border digital cells to provide the required scanning functions in the adjacent domains. The corresponding scanning equipment would have the capability to monitor the signal strength of the mobile to which it is in the same domain, and provide information back to a controlling switch for handoff purposes. However, the use of scanning equipment as opposed to voice-type base-station equipment increases the cost and complexity of the overall system while reducing the versatility and throughput of the system.

Thus, a need exists for a communication system which controls the transfer of communication of a dual-mode subscriber unit between digital and analog communication domains without requiring dedicated scan receivers.

Summary of the Invention

A communication system transfers communication between unlike communication domains. The communication system communicates to a subscriber unit in a first communication domain and transfers communication of the subscriber unit from the first communication domain to a second communication domain when a subscriber unit enters the second communication domain.

Brief Description of the Drawings

FIG. 1 generally depicts a cellular topology which may beneficially employ the present invention.

FIG. 2 generally depicts transition cells which perform communication transfer between unlike communication domains in accordance with the invention

Detailed Description of a Preferred Embodiment

FIG. 1 generally depicts a typical cellular topology which could accommodate communication transfer between unlike communication domains (i.e., digital and analog) in accordance with the invention. The cells of FIG. 1 are depicted having an "A" for Analog only cells, "A/D" for analog and digital composite transition cells, and a "D" representing a digital-only cell. In the preferred embodiment, the transition cell would be two 60° sector/sector cells; one analog cell and one digital cell overlaying each other with a 1:1 RF footprint. Each sector of each transition cell is assigned either an analog domain indication (I_A) or a digital domain indication (I_D), depending on the domain of the adjacent cell. The domain indications I_A, I_D are used as flags to signal base-stations within transition cells when a domain transfer is required.

FIG. 2 depicts a sub-section 105 of FIG. 1 having analog and digital base-stations connected to a switch 220 in accordance with the invention. In the preferred embodiment, all the cells shown in FIG. 2 as well as the cells shown in FIG. 1 are connected to a switch. In addition, more than one switch can be implemented in a particular coverage area; the number of switches are typically dependant on the number of subscribers within the particular coverage area. Continuing, the switch 220

can be an EMX switch available from Motorola, Inc. and described in Motorola Instruction Manual No. 68P81054E59 published by Motorola Service Publications, Schaumburg, IL. The analog base-stations 200-204 shown may employ transmitters and receivers of the type described in Motorola Instruction Manual No. 68P81058E32-A published by Motorola Service Publications, Schaumburg, IL., in 1989. All analog cells "A" and transition cells "A/D" of FIG. 1 employ analog base-stations, although only several are shown for clarity in FIG. 2. The digital base-stations 210-212 shown could be of the type used in digital cellular systems such as, inter alia, the United States Digital Cellular System (USDC) defined in EIA/TIA, Project Number 2215 titled "Dual-Mode Mobile Station - Base-station Compatibility Standard" dated December 1989 and the Japan Digital Cellular Standard (JDC) defined by the Research and Development Center for Radio Systems in Japan (RCR), dated January 1991. Both of these digital systems use mobile assisted handoff (MAHO) to aid inter-cell handoff in the digital-only cells "D" and intra-cell digital handoff in the transition cells "A/D". As with the analog cells, all the digital cells "D" and transition cells "A/D" of FIG. 1 employ digital base-stations, although only several are shown for clarity in FIG. 2. Still another digital system which could be implemented in accordance with the invention is a code-division multiple access (CDMA) digital system.

If a dual-mode subscriber unit 100 (i.e., a subscriber unit having both analog and digital communication capability) is travelling throughout analog-only cells "A", analog-only handoff techniques are employed. Referring to FIG. 2, the subscriber unit 100 is communicating to analog base-station 200 in analog cell A_{200}. If the subscriber unit 100 enters transition cell $A/D_{202/212}$, the subscriber unit 100 will undergo an inter-cell handoff from analog base-station 200 of cell A_{200} to analog base-

station 202 of cell $A/D_{202/212}$ via the switch 220 using conventional analog handoff techniques. As long as the subscriber unit 100 is assigned to an analog channel in a sector having an analog domain indication I_A, the subscriber unit 100 will maintain communication with analog base-station 202. When the subscriber unit 100 assigned to an analog channel moves into a sector of transition cell $A/D_{202/212}$ having a digital domain indication I_D, analog base-station 202 will attempt an intra-cell handoff to a digital channel in the same sector. The analog base-station 202 will send a handoff request (HOR) to the switch 220, at which time the switch 220 will request the digital base-station 210 to make a signal strength measurement of the subscriber unit 100 in the same sector. If the signal strength is adequate, the subscriber unit 100 is handed off to an available digital channel used by digital base-station 210. If the subscriber unit 210 now moves into the digital-only cells "D", typical digital handoff techniques are employed to perform inter-cell digital handoffs. The procedure for communication transfer between the two domains is reversed when the subscriber unit 100 travels from the digital domain to the analog domain.

In an alternate embodiment, a method for transitioning between domains without using sector information is also envisioned. A subscriber unit 100 would use normal analog or digital handoffs to be handed off into a transition cell A/D. Once in the transition cell, the subscriber unit 100 would use normal intra-cell handoffs to move between sectors; an intra-cell handoff between domains would not be performed as long as an inter-cell handoff is required. When a inter-cell handoff is required, the base-station (analog or digital) in communication with the subscriber unit 100 would request a signal quality value measurement (a signal strength measurement in the preferred embodiment) from all target cells in the domain the subscriber unit 100 was in. In the preferred embodiment, a target cell in

the same domain is a neighboring cell in the same domain. If no target cells are acceptable, the switch 220 would report this back to the base-station in communication with the subscriber 100. At this point, an intra-cell handoff would be initiated to change domains. The base-station in the new domain now in communication with the subscriber 100 would attempt to perform an inter-cell handoff into a cell of the new domain.

With this inventive technique, a single transition cell can support bi-directional transitions from one domain without providing scan receivers as potential target cells in the other domain. The invention eliminates the need for dedicated scanning receivers on the border of the domains, thus increasing system versatility and throughput.

What I claim is:

Claims

1. A communication system which transfers communication between unlike communication domains, the communication system comprising:

means for communicating to a subscriber unit in a first communication domain; and

means for transferring communication of said subscriber unit from said first communication domain to a second communication domain when said subscriber unit enters said second communication domain.

2. The communication system of claim 1 wherein either of said first and second communication domains further comprise one of either an analog communication domain and a digital communication domain.

3. The communication system of claim 1 wherein one of said first and second communication domains further comprise one of either a time-division multiple access (TDMA) communication system and a code-division multiple access (CDMA) communication system.

4. A communication system which transfers communication between unlike communication domains, the unlike communication domains coupled together via a common interface, the communication system comprising:

means for communicating to a subscriber unit in a first communication domain in a first coverage area;

means for maintaining communication to said subscriber unit on said first communication domain as said subscriber unit enters a second coverage area; and

means for transferring communication of said subscriber unit, via the common interface, from said first communication domain to a second communication domain within said second coverage area when said subscriber unit enters said second communication domain.

5. A communication system which transfers communication between unlike communication domains, the unlike communication domains coupled together via a common interface, the communication system comprising:

means for communicating to a subscriber unit in a first communication domain in a first coverage area;

means for maintaining communication to said subscriber unit on said first communication domain as said subscriber unit enters a second coverage area;

means for requesting a plurality of target cells, via the common interface, to measure a signal quality value of said subscriber unit; and

means for transferring communication of said subscriber unit, via the common interface, from said first communication domain to a second communication domain within said second coverage area when said measured signal quality values are below a predetermined signal quality threshold.

6. The communication system of claim 5 wherein said second coverage area is a composite of at least said first communication domain and said second communication domain.

7. The communication system of claim 5 wherein said signal quality value is a signal strength value.

8. A method of communication transfer between unlike communication domains, the method comprising the steps of:

communicating to a subscriber unit in a first communication domain; and

transferring communication of said subscriber unit from said first communication domain to a second communication domain when said subscriber unit enters said second communication domain.

9. A method of communication transfer between unlike communication domains, the unlike communication domains coupled together via a common interface, the method comprising the steps of:

communicating to a subscriber unit in a first communication domain in a first coverage area;

maintaining communication to said subscriber unit on said first communication domain as said subscriber unit enters a second coverage area; and

transferring communication of said subscriber unit, via the common interface, from said first communication domain to a second communication domain within said second coverage area when said subscriber unit enters said second communication domain.

10. A method of communication transfer between unlike communication domains, the unlike communication domains coupled together via a common interface, the method comprising the steps of:

communicating to a subscriber unit in a first communication domain in a first coverage area;

maintaining communication to said subscriber unit on said first communication domain as said subscriber unit enters a second coverage area;

requesting a plurality of target cells, via the common interface, to measure a signal quality value of said subscriber unit; and

transferring communication of said subscriber unit, via the common interface, from said first communication domain to a second communication domain within said second coverage area when said measured signal quality values are below a predetermined signal quality threshold.

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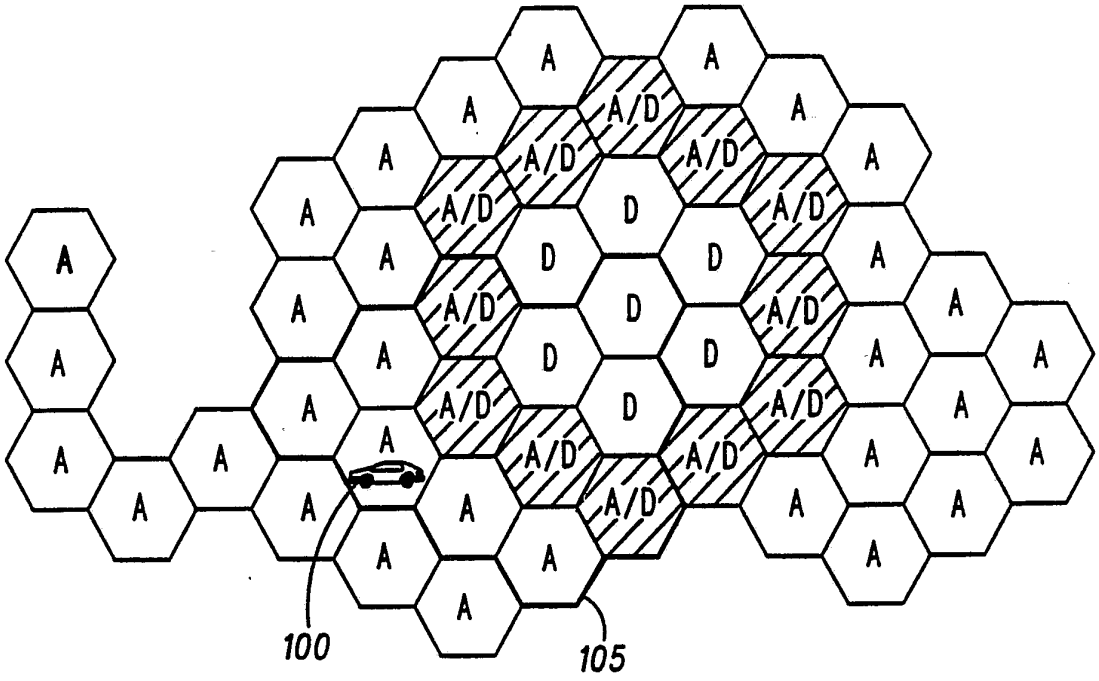
A
A/D
D
100
105

FIG.1

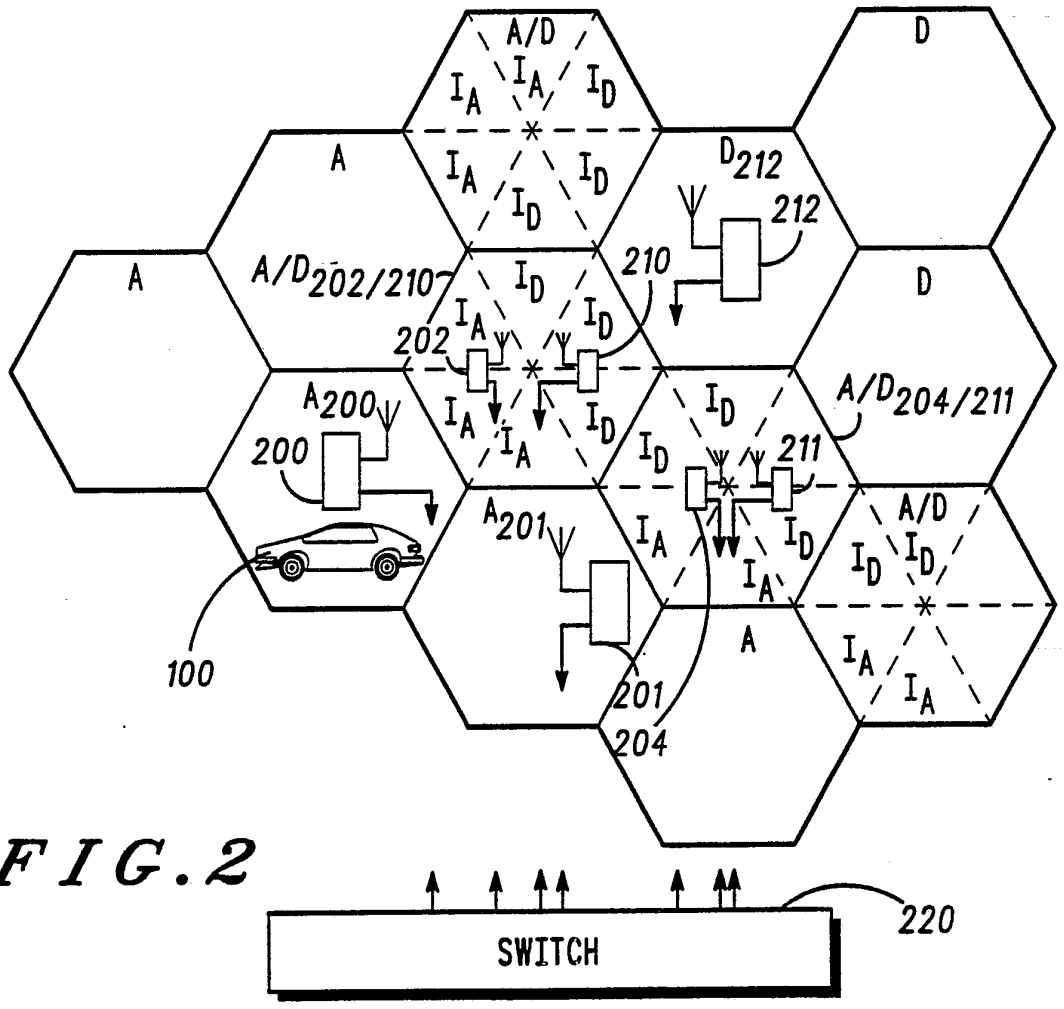
A/D
D
A
D212
212
A/D202/210
210
202
A200
200
A/D204/211
211
A201
201
204
100
SWITCH
220

FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/06997

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 11/00
US CL :379/60
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)

U.S. : 319/59,455/33.1,33.2

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

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

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US,A, 4,989,230 (GILIG ET AL) 29 JANUARY 1991 See abstract; col. 7, lines 22-44	1,2,4-10 3
Y	US,A, 4,748,655 (THROWER ET AL) 31 MAY 1988 See col. 4, lines 19-22.	3
A,P	US,A, 5,119,397 (DAHLIN ET AL) 02 JUNE 1992 See abstract	1-10
A	US,A, 4,799,253 (STERN ET AL) 17 JANUARY 1989 See fig.1	1-10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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