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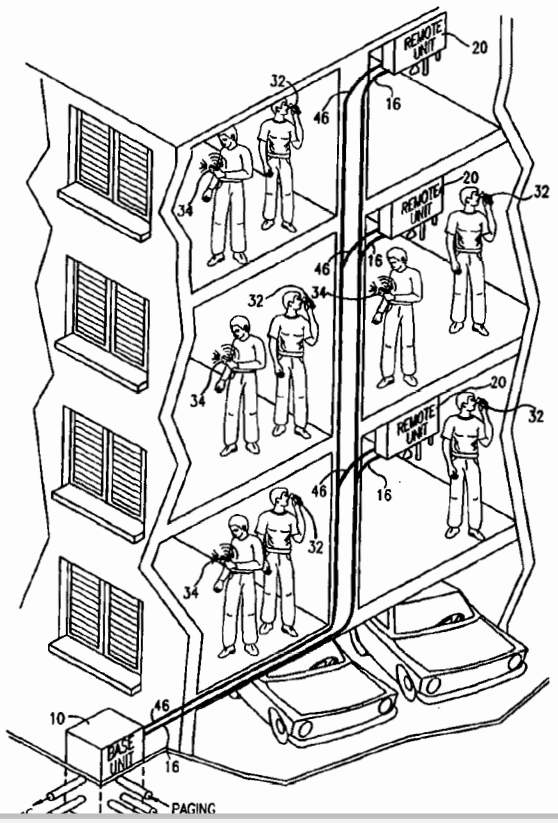
(54) Title: WIRELESS COMMUNICATIONS STATION AND SYSTEM

(57) Abstract

A wireless communications station comprising a base unit including a communications interface for communicating with plural wireless communications networks, a received communications combiner for combining received communications signals received from the plural wireless communications networks into a single radio frequency output, a transmit communications splitter for splitting previously combined transmit communications signals to be transmitted to the plural wireless communications networks into plural radio frequency outputs, at least one fiberoptic transmitter receiving the single radio frequency output and providing a corresponding optical output, and at least one fiberoptic receiver receiving an optical input and providing an RF output containing previously combined transmit communications signals, a plurality of remote units, each including plural antennas for communicating with communicators along plural wireless communications networks, a received communications splitter for splitting previously combined received communications signals from the base unit and supplying them to the plural antennas, a transmit communications combiner for combining transmit communications signals from the plural antennas into a combined radio frequency output, a fiberoptic transmitter receiving the combined radio frequency output and providing a corresponding optical output, and a fiberoptic receiver receiving an optical input and providing an RF output to the received communications splitter containing previously received transmit communications signals, a first optical fiber connecting each fiberoptic transmitter of the base unit with a corresponding fiberoptic receiver in a corresponding remote unit, and a second optical fiber connecting each fiberoptic transmitter of a remote unit with a corresponding fiberoptic receiver in the base unit.



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WIRELESS COMMUNICATIONS STATION AND SYSTEM

FIELD OF THE INVENTION

The present invention relates to communications systems generally and more particularly to wireless communications systems employing optical fibers.

BACKGROUND OF THE INVENTION

Cellular radio was conceived to provide high capacity mobile communications without requiring large amounts of spectrum. The original concept as proposed by AT&T, involves the use of a frequency band within a region known as a cell and reusing the same frequency band in other adjacent cells with manageable interference between cells.

The capacity of a cellular radio network increases as the number of cells increases with decreasing cell size. The small cells are known as microcells. Optical fibers have been used to feed the RF signal to microcells. Optical fiber can be run inside buildings, train stations, malls, etc. to improve coverage in a wireless communications system.

United States Patent 5,457,357 describes a number of details of a fiber optic microcellular radio system.

Present day wireless communications systems may be divided into a number of groups. These include cellular telephone networks, cordless telephones, wide area data networks, wireless local area networks, paging/messaging and satellite mobile systems. Each wireless communications system has its own frequency band and modulation scheme as well as its own geographic location in which the system is deployed. Some of these systems may become obsolete while others may evolve into future personal communication systems. Nevertheless, it appears that two or more wireless systems will commonly be found in any location.

Conventionally, each wireless communications system has its own network for improved coverage in buildings and other shadowed areas. A building which requires improved coverage for more than one wireless service must be "wired" separately for each service.

SUMMARY OF THE INVENTION

The present invention seeks to provide an improved distributed antenna network for microcells. The present invention further seeks to provide a single optical fiber network which is used simultaneously for a number of wireless communications systems.

There is thus provided in accordance with a preferred embodiment of the present invention a wireless communications station comprising:

a base unit including:

a communications interface for communicating with plural wireless communications networks;

a received communications combiner for combining received communications signals received from the plural wireless communications networks into a single radio frequency output;

a transmit communications splitter for splitting previously combined transmit communications signals to be transmitted to the plural wireless communications networks into plural radio frequency outputs;

at least one fiberoptic transmitter receiving the single radio frequency output and providing a corresponding optical output; and

at least one fiberoptic receiver receiving an optical input and providing an RF output containing previously combined transmit communications signals;

a plurality of remote units, each including:

plural antennas for communicating with communicators along plural wireless communications networks;

a received communications splitter for splitting previously combined received communications signals from the base unit and supplying them to the plural antennas;

a transmit communications combiner for combining transmit communications signals from the plural antennas into a combined radio frequency output;

a fiberoptic transmitter receiving the combined radio frequency output and providing a corresponding optical output; and

a fiberoptic receiver receiving an optical input and providing an RF output to the received communications splitter containing previously received transmit communications signals;

a first optical fiber connecting each fiberoptic transmitter of the base unit with a corresponding fiberoptic receiver in a corresponding remote unit; and

a second optical fiber connecting each fiberoptic transmitter of a remote unit with a corresponding fiberoptic receiver in the base unit.

Preferably each remote unit also comprises a diplexer or other isolation apparatus interposed between each of the plural antennas and the combiner and the splitter, so as to enable simultaneous two way communications via each antenna at different frequencies for transmission and reception.

Preferably the plural wireless communications networks include at least two communications networks selected from the group consisting of cellular telephone networks, cordless telephones, wide area data networks, wireless local area networks, personal communications systems, personal communications networks, paging/messaging networks and satellite mobile systems.

In accordance with a preferred embodiment of the present invention, a low frequency control signal is multiplexed by the communications interface onto the fiber network for providing loop back alarm status of each remote unit and to provide control signals thereto, which control amplifier gain thereof.

In accordance with a preferred embodiment of the present invention, the plural antennas include at last one swivel mounted directional antenna whose direction may be adjusted on site.

Preferably, the base unit also includes tuning circuitry which permits dynamic tuning and transmission/reception balance of cell size of each of the remote units.

The base unit may also include a network management interface which allows monitoring of the operational status of a base unit and the remote units connected thereto.

Preferably, the fiberoptic transmitter employs a vertical cavity surface emitting laser or an edge emitting laser coupled to a single or multi mode fiber. The edge emitting laser may be a distributed feedback laser integrated with an optical isolator.

There is additionally provided in accordance with a preferred embodiment of the present invention a microcellular telecommunications system employing a fiber network including optical fibers which may be single or multi mode and optical transmitters for transmitting signals along the optical fibers, the optical transmitters comprising a vertical cavity surface emitting laser.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a simplified pictorial illustration of part of a wireless communications station, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 is a simplified block diagram illustration of circuitry employed in the apparatus of Fig. 1;

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