Title: ANTENNA PACKAGING AND MOUNTING ASSEMBLIES AND METHOD

Abstract: A plural-antenna, microwave radio antenna assembly for a point-to-multi-point communications network. Multiple antennas on printed circuit boards (PCB) are carried by a mounting plate, enclosed by a radome and individually operatively connected to a protected microwave radio by antenna feed connectors. The protected microwave radio and antenna assembly are separately supported by an interface plate to facilitate replacement of the radio without disturbing the orientation of the antennas. The circuitry associated with the individual radios of the protected radio may be accessed by opening hinged panels on opposite sides of the protected radio and the protected radio is provided with means for holding it in place during mounting. Methods are also disclosed.
BACKGROUND OF THE INVENTION

The present invention generally relates to a point-to-multi-point microwave communications network having plural antennas and protected radios. More specifically, the invention relates to a lightweight, compact, plural-antenna, protected microwave radio assembly with two antennas enclosed in a single radome, two transceivers within a single housing, with means to hold the radio in place during installation, and with plural, hinged panels providing access to the circuitry of the individual radios.

Communications networks with protected radios and multiple antennas are well known. Point-to-multi-point microwave radios often have requirements for two operationally unconnected antennas, one antenna transmitting and receiving in the service of a node in the system, and the other in a stand-by mode.

In known systems, the antennas for different radios are separately housed in individual enclosures or radomes. Where the antennas are flat antennas, each antenna assembly generally consists of a printed circuit board enclosed between a mounting plate and a radome. Such antenna assemblies may require a complex mounting arrangement which increases the labor and cost of the assembly. In addition, antennas are usually positioned in areas that are directly exposed to the elements and often difficult to reach and the use of multiple radomes requires effecting multiple weather-tight seals.

The size and weight of known plural antenna assemblies is also a problem due to the location thereof in service in places which are limited in size and often on elevated towers. In addition, the use of multiple antenna assemblies generally creates a cluttered look unacceptable in many locations.
In one aspect, it is an object of the present invention to obviate many of the problems associated with known plural antenna assemblies and to provide a novel lightweight, compact, plural-antenna assembly for a point-to-multipoint, microwave communications network.

It is another object of the present invention to provide a novel plural antenna system with a simplified mounting arrangement having reduced space requirements and reduced weight thus facilitating the installation and maintenance of the system.

It is still another object of the present invention to provide a novel plural antenna system which combines multiple antennas in a single radome reducing the sealing requirements and providing a more aesthetically pleasing and less cluttered appearance.

Protected radio assemblies are well known in which two transceivers are operatively connected in an active/standby relationship so that communication is not interrupted in the event of the failure of the active transceiver. Because such radio transceivers are generally encased in a single housing, removal and repair of one of the transceivers requires the removal of the entire radio assembly, and thus the interruption of communication, in the event the failure of the active transceiver forces the stand-by transceiver into operation in an unprotected mode.

It is also customary to mount the antennas directly to protected radio assemblies thus requiring the reorientation of the entire radio and antenna assembly as a unit each time repairs to the protected radio are required.

The installation of radios is often difficult and hazardous because of the size and weight of protected radio assemblies and the requirement to support such assembly while
it is being secured to the supporting structure. In addition, maintenance of known protected radio assemblies is often difficult because access to the assembly requires maintenance personnel to secure the protected radio assembly access panel while the maintenance is performed, often high above a building roof. The distraction of the access panel presents a hazard.

In another aspect, it is an object of the present invention to obviate many of the problems associated with the mounting of known protected radio assemblies and to provide a novel protected radio assembly and method of mounting in a point-to-multipoint, microwave communications network.

It is another object of the present invention to provide a novel protected radio which is mounted independently of the mounting of the antennas associated therewith so that the protected radio may be removed and replaced as a unit without disturbing the orientation in space of the plural antennas, thus facilitating the installation and maintenance of the system by reducing the size and weight of the assembly that must be thus handled at the site of the antenna.

It is still another object of the present invention to provide a novel protected radio assembly in which each of the individual transceivers may be readily accessed and repaired or replaced without disturbing the operation of the other transceiver and disrupting communications.

It is still yet another object of the present invention to provide a novel method of mounting a plural-antenna protected radio assembly by providing a safer and less labor-intensive process.
It is a further object of the present invention to provide a novel hinge for mounting a protected radio assembly.

These and many other objects and advantages of the present invention will be readily apparent to one skilled in the art to which the invention pertains from a perusal of the claims, the appended drawings, and the following detailed description of the preferred embodiments.
BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded pictorial view of one embodiment of the present invention showing the combination of plural antennas into a single radome.

Figure 2 is an exploded pictorial view of a portion of the embodiment of Figure 1 from the front side thereof showing the connection of the interface plate and the protected microwave radio.

Figure 3 is a pictorial view of the assembled portion of the embodiment of Figure 2 from the rear side thereof showing the method of mounting.

Figure 4 is a pictorial view of the embodiment of Figure 3 illustrating the independent accessibility of the individual transceivers of the protected radios.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings where like numerals represent like components, the plural-antenna radio assembly 10 includes a generally planar mounting plate 12 having plural holes 20 extending therethrough. A printed circuit board (PCB) 14 is carried by the mounting plate 12 and contains plural operatively unconnected antennas 16 thereon, each of the antennas 16 having an antenna feed connector 18 operatively connected thereto. Each of the antenna feed connectors 18 extends rearwardly through the PCB 14, through one of the mounting plate holes 20, and an antenna feed channel 22 in the interface plate 24 so that each antenna feed connector 18 may be operatively connected to one of the transceivers in the protected microwave radio assembly 26. The PCB 14 is enclosed by the radome 28 which is sealed in a suitable conventional manner to the
mounting plate 12, with the mounting plate 12 providing mechanical support for the PCB 14 and the radome 28.

With continued reference to Figures 1 and 2, the protected radio assembly 26 is also supported by the interface plate 24 so that the protected radio assembly may be removed as a unit from the interface plate 24 without disturbing the mounting of the antennas to the interface plate and the orientation of the antennas in space. In an alternative embodiment, the protected radio assembly 26 is fixedly mounted to a pole mount and the antenna assembly is supported by the interface plate 24, which is supported by the central section 32.

Note that the interface plate 24 includes a central O-ring 30 on the rear side thereof and a peripheral O-ring 34 on the front side thereof that completely surround the antenna feed connectors 18 as they traverse the interface plate 24 to prevent water, dirt and other contaminants from entering into the assembly 26.

Note also in Figure 3 that the protected radio assembly may be positioned as a single unit adjacent the interface plate 24 with the hinges 42 overlying the hinges 44. The lift-off mating of the hinges provides support for the protected radio in the desired location adjacent the interface plate while the radio is being secured thereto, e.g. by conventional threaded fasteners inserted through the holes 45 in the interface plate 24 into the housing 32. In the preferred embodiment, the hinges are universal in that the same hinge may be used as the top or bottom hinge on either side of the radio housing and on either side of the interface plate.
In a preferred embodiment, the central section 32 of the radio housing is provided with panels 48 on opposite sides thereof to facilitate independent access to the two transceivers contained therein. Each access panel 48 may be opened to expose one of the transceivers for repair and/or replacement without interrupting the operation of the other one of the transceivers, all without disturbing the orientation of the antennas in space.

Note that the individual transceivers may be mounted within the enclosure and exposed by the opening of the panel. However, all or part of the individual transceivers may be carried by the panel on the internal side thereof so that opening the panel moves the circuitry away from the protected radio enclosure to provide easier access to the circuitry.

In a preferred embodiment, portions of each transceiver are carried within the housing and portions on the panel to facilitate access. It is desirable that the significant heat generating components be mounted on the panel in a heat transmitting relationship thereto so as to take advantage of the heat dispensing fins on the outside of the panel. Where the failure incurs in the portion of the circuit contained in the panel, the panel and the circuitry may be removed and replaced as a unit simply by lifting it off of the hinges on the interface plate.

Each of the panels 48 are provided with vertically spaced apart access panel hinges 42 that mate with interface plate hinges 44 on the interface plate 24. The mating of the hinges holds the protected radio in the desired position against the interface plate and thus facilitates the mounting of the radio to the interface plate. This hinge
configuration also facilitates the swinging of the panels 48 as shown in Figure 4 once the fasteners in the panels 48 are removed from the housing 32.

For example, conventional threaded fasteners 54 may be used to seal the panels 48 to the housing 32, and may be removed from one side of the housing 32. This completely frees the panels 48 from the housing 32 without requiring that the panels be secured during repair operations, i.e. the panels 48 remain attached to the interface plate by the hinges and can swing open to provide access to the interior of the housing and the interior of the panel. Note that the interface plate 24 contains grooves 52 adjacent the hinges into which a portion of the forward portion of the panel hinges may swing as the panel is opened.

From the foregoing, it may be seen that the interface plate 24 functions to provide independent structural support for the protected microwave radio assembly 26 and the antenna assembly. The interface plate 24 also provides an antenna feed channel 22 through which the antenna feed connectors 18 traverse the interface plate 24 and operatively connect to transceivers within the protected microwave radio 26. Additionally, the interface plate 24 protects the antennas and the protected radio assembly 26 from the elements.

The panels may be removed from the housing of the protected radio to provide access to the transceivers contained therein without having to secure the panels. Further, the location of the individual transceivers on the internal surface of the panels facilitates access to the transceivers in many installations and easy replacement.
While preferred embodiments of the present invention have been described, it is to be understood that the embodiments described are illustrative only and the scope of the invention is to be defined solely by the appended claims when accorded a full range of equivalence, many variations and modifications naturally occurring to those of skill in the art from a perusal hereof.
WHAT IS CLAIMED IS:

1. A lightweight, compact, plural-antenna, radio antenna assembly for a point-to-multi-point, protected microwave communications network comprising:
   a generally planar mounting plate having plural holes extending therethrough;
   at least one printed circuit board (PCB) carried by said mounting plate on the front side thereof, said PCB having plural, operatively unconnected antennas printed thereon with each of said antennas having an antenna feed connector operatively connected thereto and extending rearwardly through the PCB and one of said plural holes in said mounting plate; and
   a radome sealably mounted to said mounting plate to enclose said PCB;
   thereby to provide a lightweight, compact antenna assembly for a plural-antenna, protected microwave point-to-multi-point communications network.

2. A plural-antenna, protected microwave radio for a point-to-multi-point communications network, comprising:
   a generally planar interface plate;
   a plural-transceiver, microwave radio assembly fixedly attached on the rear side of said interface plate; and
   a lightweight, compact antenna assembly carried on the front side of said interface plate, said antenna assembly having two independent antennas in one radome.

3. The radio of Claim 2 wherein said antenna assembly includes:
   a generally planar mounting plate having plural holes extending therethrough,
a printed circuit board (PCB) carried by said mounting plate on the front side thereof,
said PCB having plural, operatively unconnected antennas printed thereon with each of said antennas having an antenna feed connector operatively connected thereto and extending rearwardly through the PCB and one of said plural holes in said mounting plate; and
a radome sealably mounted to said mounting plate to thereby enclose said PCB.
4. The radio of Claim 2 wherein said protected radio assembly comprises:
an enclosure for two microwave radios, said enclosure having an access aperture on opposite lateral sides thereof each for obtaining access to one of said two radios within said enclosure
an access panel configured to close each of the apertures in said enclosure and each having plural vertically spaced apart hinges adjacent one end thereof;
a first plurality of fasteners for removably securing each of said access panels to said enclosure in a closed position with respect to one of said apertures to thereby deny access to a radio within said enclosure; and
a second plurality of fasteners for removably securing one end of said enclosure to said interface plate in a predetermined position with respect thereto with the hinges of each of said access panels in a mating operable relationship with the hinges of said interface plate when said access panels are in said closed position,
whereby each of said access panels remain hingedly connected to said interface plate after the removal of said first fastener means so that each of said access panels may
be (a) pivoted away from said closed position to provide access to a radio within said enclosure and (b) pivoted into said closed position to deny access to a radio within said enclosure,

and whereby each of said access panels may be opened to expose one of the radios for repair and/or replacement without interrupting the operation of the other one of the protected radios, all without disturbing the orientation of the antennas in space.

5. A protected radio assembly comprising:

two mutually unconnected antennas in a single radome; and

two mutually unconnected transceivers in a single housing, each of said transceivers being operably connected to one of said antennas.

6. In a plural-antenna, protected microwave point-to-multi-point communications network, the improvement comprising the enclosure of plural flat antennas in a single radome.

7. In a plural-antenna, protected microwave point-to-multi-point communications network, the improvement comprising the enclosure of plural operably unconnected transceivers in a single housing.

8. A method of mounting to antennas and two transceivers to form a protected radio comprising the steps of:

(a) mounting two operably unconnected flat antennas in a single radome;

(b) mounting two operably unconnected transceivers in a single housing; and

(c) operably connecting each of the transceivers to one of the antennas.